

The Danish Wadden Sea as Breeding Ground and Crossroad for Birds



Colophone

Title:	The Danish Wadden Sea as Breeding Ground and Crossroad for Birds
Author:	Lars Maltha Rasmussen
Photos:	Lars Maltha Rasmussen, John Larsen and Poul Reib
Front page photo:	Pied Avocets. Jens Christian Kjærgård
Layout:	Tine Stampe
Printed by:	SvendborgTryk
Publisher:	BirdLife Denmark. Dansk Ornitologisk Forening
URL:	www.dof.dk/publikationer
Published:	July 2008
Referees:	John Frikke, Michael Borch Grell, Thomas Vikstrøm.
English rewriting:	Joy Klein
Financial support:	Vogelbescherming Netherlands, Carlsen-Langes Legatstiftelse.
Should be cited as:	Rasmussen, L. M. 2007: The Danish Wadden Sea as Breeding Ground and Crossroad for Birds. Dansk Ornitologisk Forening, BirdLife Denmark. <i>(Med dansk resumé: Det danske vadehav som yngleområde og knudepunkt for fugle).</i>
ISBN nr.	87-90310-51-9

The Danish Wadden Sea as Breeding Ground and Crossroad for Birds

DOF rapport 1

July 2008



Index

1. Summary	7	Common Eider (<i>Somateria mollissima</i>).....	40
2. Dansk Resumé.....	9	Common Scoter (<i>Melanitta nigra</i>).....	41
3. Introduction	11	Other diving ducks.....	42
Objective and methodology	12	Peregrine Falcon (<i>Falco peregrinus</i>).....	43
4. The Danish Wadden Sea.....	13	Montagu's Harrier (<i>Circus pygargus</i>).....	43
Danish Wadden Sea landscapes	13	Hen Harrier (<i>Circus cyaneus</i>).....	44
Conservation of key habitats.....	13	Marsh Harrier (<i>Circus aeruginosus</i>).....	44
National and international regulations.....	14	Eurasian Oystercatcher (<i>Haematopus ostralegus</i>).....	44
The Trilateral Wadden Sea Plan	17	Pied Avocet (<i>Recurvirostra avosetta</i>).....	44
5. Management and threats.....	19	Great Ringed Plover (<i>Charadrius hiaticula</i>)	45
Primary production.....	19	Kentish Plover (<i>Charadrius alexandrinus</i>).....	46
Disturbances from recreational activities.....	19	Eurasian Golden Plover (<i>Pluvialis apricaria</i>).....	46
Disturbance from military training activities	20	Grey Plover (<i>Pluvialis squatarola</i>).....	47
Hunting.....	20	Northern Lapwing (<i>Vanellus vanellus</i>).....	47
Commercial use of biological resources.....	24	Red Knot (<i>Calidris canutus</i>).....	47
Area management	28	Sanderling (<i>Calidris alba</i>).....	48
Wind energy production and power lines.....	30	Curlew Sandpiper (<i>Calidris ferruginea</i>).....	48
Predation	31	Dunlin (<i>Calidris alpina</i>).....	48
Alien invasive species (AIS).....	32	Black-tailed Godwit (<i>Limosa limosa</i>)	49
Climate change.....	33	Bar-tailed Godwit (<i>Limosa lapponica</i>).....	50
6. Ranking conservation issues for the Danish Wadden Sea.....	34	Whimbrel (<i>Numenius phaeopus</i>)	50
7. Species accounts.....	35	Eurasian Curlew (<i>Numenius arquata</i>)	50
Divers and Grebes (<i>Gavia spp. & Podiceps spp.</i>).....	35	Common Redshank (<i>Tringa totanus</i>)	50
Great Cormorant (<i>Phalacrocorax carbo</i>)	35	Common Black-headed Gull (<i>Larus ridibundus</i>).....	51
Eurasian Spoonbill (<i>Platalea leucorodia</i>)	36	Common Gull (<i>Larus canus</i>).....	52
Dark-bellied Brent Goose (<i>Branta bernicla bernicla</i>).....	36	Lesser Black-backed Gull (<i>Larus fuscus</i>).....	52
Light-bellied Brent Goose (<i>Branta bernicla hrota</i>)	37	Herring Gull (<i>Larus argentatus</i>)	52
Barnacle Goose (<i>Branta leucopsis</i>).....	38	Gull-billed Tern (<i>Gelochelidon nilotica</i>).....	53
Common Shelduck (<i>Tadorna tadorna</i>).....	39	Sandwich Tern (<i>Sterna sandwicensis</i>).....	54
Eurasian Wigeon (<i>Anas penelope</i>).....	39	Common Tern (<i>Sterna hirundo</i>).....	55
		Arctic Tern (<i>Sterna paradisaea</i>)	55
		Little Tern (<i>Sterna albifrons</i>).....	55
		Black Tern (<i>Chlidonias niger</i>).....	56
		Short-eared Owl (<i>Asio flammeus</i>).....	56
		9. References and Webpages.....	57

*Section of a flock of Golden Plovers counting 20,000 individuals in total on Rømø Nørreland in april during the spring migration.
Photo: Lars Maltha Rasmussen.*



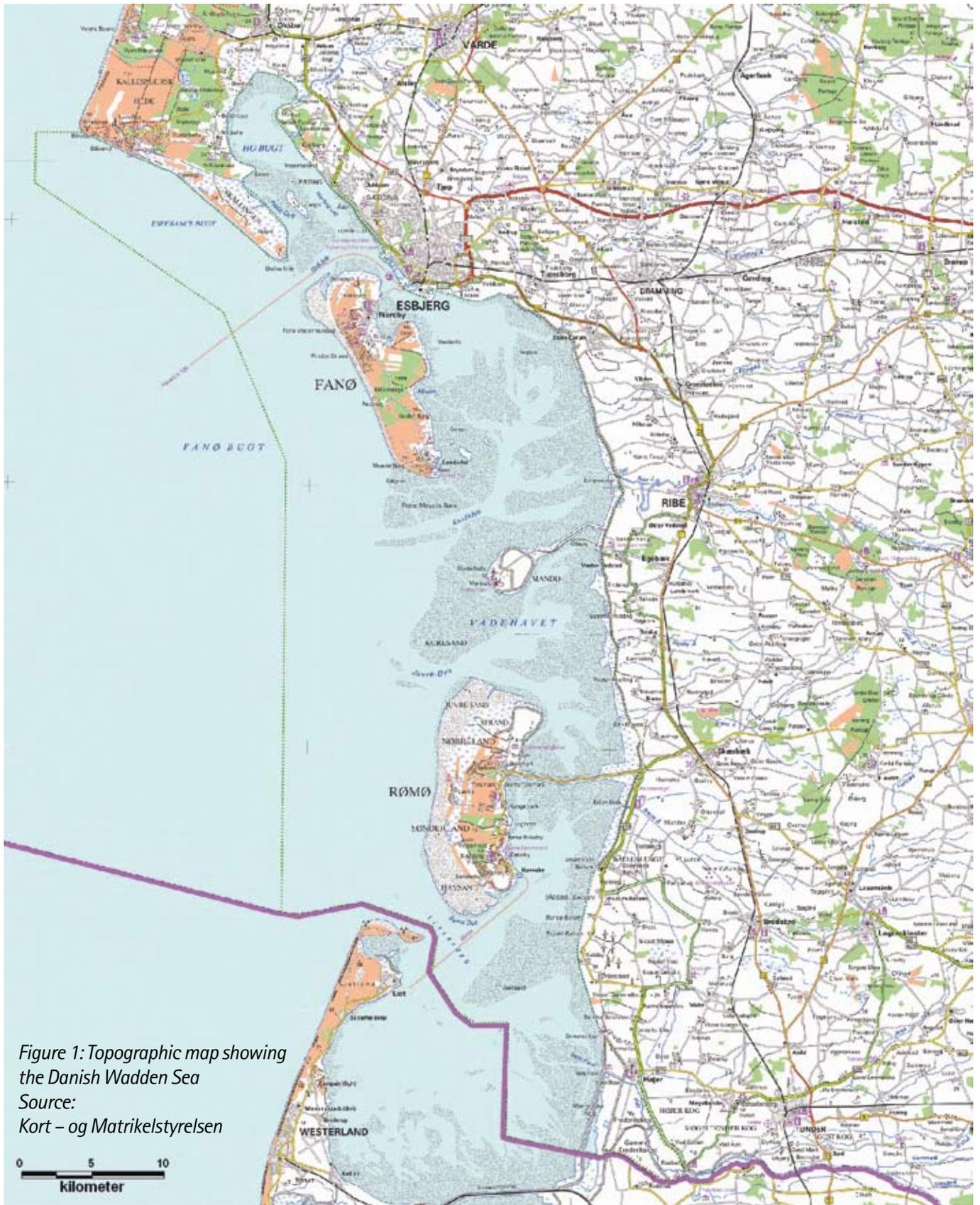


Figure 1: Topographic map showing the Danish Wadden Sea
 Source:
 Kort- og Matrikelstyrelsen

1. Summary

Trilateral efforts carried out since 1991 in monitoring birds and a number of additional parameters in the Wadden Sea have provided important information on trends and the overall importance of the area for birds. About half of the 34 monitored migratory bird populations in the international Wadden Sea have decreased significantly in number since 1991. In addition, some of the breeding birds for which the Wadden Sea is internationally important have declined in numbers due to changes in the Wadden Sea environment. Present knowledge based on research indicates that these negative trends are probably mainly the result of developments within the Wadden Sea, rather than elsewhere along the flyway.

Scientific studies on the entire Wadden Sea ecosystem as well as on the breeding and migratory bird populations that depend on this unique ecosystem indicate a multitude of negative impacts on nature caused by anthropogenic activities: disturbance, habitat change, coastal protection, farming activity, pollution, global warming, over-fishing, hunting etc. Considering the significant conservation value of the Wadden Sea, the many threats call for immediate action. When aiming at a better protection of the Wadden Sea as a shared ecosystem the following Danish issues should have high priority:

- Almost all areas in the polders included in the co-operation area are increasingly subject to intensive farming. These polders can be improved as habitats for breeding and migrating birds with targeted management.
- Salt marshes as well as freshwater and brackish meadows in the protection area can be significantly improved as habitats for breeding and migrating birds if management is targeted to improve these habitats.
- There is a need to improve the ecological links between the marine and terrestrial environments by restoring a more natural tidal influence on river mouths, restoring wetlands and extensifying farming practices.
- Hunting is one of the most direct and disturbing human factors influencing the habitat use and the distribution of waterbirds in large parts of the Danish Wadden Sea: on water as well as on land. Hunting should be regulated so that it has only an insignificant influence on the habitat use and the distribution of birds in the Wadden

Sea area. There is a need to create more hunting-free areas, especially in polders.

- The impact on natural ecosystems and the disturbance of internationally important concentrations of sea ducks caused by shrimp fishery in the outer parts of the Danish Wadden Sea need to be thoroughly studied, and fishery management should respect the precautionary principle.
- Numbers of breeding birds and especially colony-breeding species are under extreme pressure from increasing numbers of predators. All parts of the Danish Wadden Sea including most islands are affected, since dams and dikes provide easy access for mammalian predators. The negative effect on the reproduction of breeding birds caused by predation, especially by Red Foxes, should be reduced.
- Disturbance of breeding Kentish Plover and Little Tern by intense tourism is still an important issue. Measures to protect breeding birds on Rømø have not been adapted to habitat changes.

Birds are good indicators of changes in the Wadden Sea ecosystem, because they are numerous and relatively easy to monitor. Nevertheless, threats to bird populations are often recognized too late to take the necessary action, since documentation of trends in bird numbers alone does not explain the changes. Research is increasingly important to fill gaps in the knowledge needed for a competent management of the Wadden Sea.



Herring Gull colony with pulli on Langli. Photo: Lars Maltha Rasmussen.

2. Dansk Resumé

Siden 1991 har det trilaterale samarbejde om overvågning af Vadehavet skaffet vigtige oplysninger om områdets betydning for og udviklingen i fuglebestande. Halvdelen af de 34 bestande af trækfugle der er overvåget i det internationale Vadehav, er gået betydeligt tilbage siden 1991. En række ynglefugle, hvis forekomst i Vadehavet har international betydning, er også gået tilbage i antal på grund af ændringer i vadehavsmiljøet. Ud fra vores nuværende viden baseret på forskning skyldes den negative udvikling snarere miljøet i selve Vadehavet end andre steder på fuglenes trækveje.

Resultatet af videnskabelige studier i både Vadehavets økosystem, trækfugles og ynglefugles økologi giver grundlag for at pege på mange af de negative effekter som især skyldes menneskelig aktivitet: Forstyrrelser, ændringer i miljøet, kystbeskyttelse, landbrug, forurening, global opvarmning, overfiskning, jagt osv. I betragtning af Vadehavets enestående naturbeskyttelsesmæssige betydning, bør der handles nu. Med en målsætning om en bedre beskyttelse af Vadehavet som et samlet økosystem bør følgende danske problemer prioriteres:

- Forvaltningen af strandenge, brakke og ferske enge i det trilaterale beskyttelsesområde kan ved en målrettet indsats forbedres betydeligt til gavn for såvel ynglende som rastende fugle.
- Landbrugsdriften intensiveres til stadighed i størstedelen af de arealer i baglandet som er omfattet af det trilaterale samarbejdsområde. Disse arealer kan også forvaltes målrettet til større gavn for såvel ynglende som rastende fugle.
- Der er behov for at forbedre den økologiske forbindelse og overgangen mellem hav og land ved at genskabe et mere naturligt miljø i åernes nedre løb og udløb til Vadehavet ved naturgenopretning af vådområder og ekstensivering af landbruget.
- Jagt er en af de menneskelige aktiviteter der har den største påvirkning af fuglenes fordeling og udnyttelse af naturressourcerne i store dele af Vadehavet, på land såvel som på vandet. Jagten bør reguleres, så den får en ubetydelig effekt på fuglenes fordeling. Dette kan opnås bl.a. ved oprettelsen af flere jagtfrie områder i baglandet.

- Rejefiskeriets indflydelse på Vadehavets økosystem bør undersøges nøjere og bør tilrettelægges under iagttagelse af forsigtighedsprincippet.
- Jordrugende fugle og især fuglekolonier er meget pressede af et stigende antal rovpattedyr. Pga. anlæggelsen af diger og dæmninger kan alle områder i den danske del af Vadehavet, også øerne, nås af rovpattedyr. Den negative effekt på ynglefuglene, som især skyldes forekomsten af ræv, bør reduceres.

Fugle er generelt talrige og relativt lette at overvåge og er derfor gode at anvende som indikatorer på ændringer i miljøet. Til trods herfor erkendes ændringer i fuglefaunaen ofte for sent til at handle, når man ikke kender baggrunden for ændringerne. Derfor skal overvågningen følges op af forskning for at sikre en ansvarlig forvaltning af Vadehavet. De tre vadehavslande Holland, Tyskland og Danmark har mange af de samme problemer som kun kan løses i fællesskab.



Ribe sluice with lock chamber. Photo: Lars Maltha Rasmussen.



Pacific Oyster (Crassostrea gigas) stranded on an intertidal mudflat. Photo: Lars Maltha Rasmussen.

3. Introduction

The Danish Wadden Sea with its shallow waters, mudflats, barrier islands, salt marshes and polders is the single most important Danish habitat and is designated as a Natura 2000 area according to EU directives. Being internationally important for both migratory and breeding birds, the Wadden Sea is a crucial link on the East Atlantic flyway, where large numbers of birds stop over to refuel for long intercontinental migratory flights between wintering areas in West Africa and the Arctic breeding grounds between Northern Canada and Siberia. The Wadden Sea offers the birds possibilities to feed, roost and breed. An important element of this ecosystem is high densities of shellfish and other invertebrates that are accessible to birds due to the tidal influence of the sea. The abundance of shellfish, especially, provides favourable conditions for highly specialized bird species unique to this ecosystem. Geese and ducks feed on sea-grass beds, in salt marshes, meadows and farmland. Gulls, terns, mergansers, Eurasian Spoonbills and Great Cormorants all prey upon the abundant invertebrates and fish. Bivalves and sea-grass beds play an important role in the sediment cycles of the Wadden Sea and form diverse communities that offer a predictable food source for many bird species. Birds roost in meadows, salt marshes and on sandbanks during high tide.

However, a number of human activities threaten the natural values of the Wadden Sea. Shrimp fisheries disturb and probably result in a large by-catch of non-target species. Military activities and increasing mass tourism in the Wadden Sea disturb the birds. Spatial developments, such as the construction of wind farms, extension of holiday house areas and the extension of industrial harbours, reduce the area available for birds.

In this report, 'the Danish Wadden Sea' refers to the entire Danish area covered by Natura 2000 regulations, also known as the trilateral cooperation area. The Wadden Sea is subdivided into the following main areas: the inner Wadden Sea (i.e. between the mainland and the islands); the outer Wadden Sea (i.e. west of the islands but east of the basis line); the islands; the salt marsh and the polders.

The Danish part of the Wadden Sea covers approx. 200,000 hectares making up the northernmost 10% of the international Wadden Sea which comprises deeps, gullies, tidal flats, salt marshes, barrier islands with dunes and mainland polders. The total size of land area surveyed for breeding birds in the Danish Wadden Sea is 43,684 ha

or about 28% of the total trilateral land area (Koffijberg et al. 2006). Three large barrier islands, Fanø, Mandø and Rømø, fringe the Danish Wadden Sea. Compared with the Wadden Sea in the neighbouring German state, Schleswig-Holstein, the Danish part is characterized by comparatively less tidal amplitude and a smaller distance from the mainland to the sandy beaches on the west side of the barrier islands. In the south, along the Danish-German border, there is more than 35 km from the 'gest' (glacial deposits) across the polders and the mudflats to the North Sea coast off Rømø and Sylt. In the north, all the Wadden Sea landscapes are found within a range of only 6 km.

The Danish Wadden Sea is comparatively little influenced by fresh water compared to the rest of the Wadden Sea, and only small areas are influenced by brackish conditions. The sea west of the islands is rather shallow and, in general, depths below 20 meters are found 25 km from the coast.

The largest island, Rømø (approx. 80 km²), has a uniquely broad sandy beach covering 30 km² in total, one of the broadest in north-western Europe. Large parts of this beach and the beach on Fanø are intensively used for tourism and sports, and cars are allowed to drive in most places. At the same time, they are important as a breeding site for specialized birds such as Little Tern and Kentish Plover. A 9 km long dam with a two-lane road was built between 1939-1948 to connect Rømø with the mainland.

Because the German island of Sylt was connected to the mainland by a dam completed in 1927, the Lister Dyb tidal basin is now enclosed, being connected to the North Sea only by the Lister Dyb between the two islands.

The island of Mandø was originally two islands until a sea dike was finished in 1937. Subsequently, a low dam intended for coastal protection east of the island was extended as a causeway across to the mainland in 1974. The causeway is regularly flooded at average high tides and is only accessible to private vehicles at low tide.

Fanø is connected to the mainland by a ferry. With 3,100 inhabitants, this island forms a separate municipality. Fanø holds major and important parts of the natural saltmarshes and dune landscapes in the Danish Wadden Sea.

The northernmost island, Langli (approx. 70 ha), is now uninhabited and very important as a breeding ground for more than 60% of all colony-breeding birds in the Danish Wadden Sea.

The town of Esbjerg has the only large industrial concentration located in the Danish Wadden Sea area. With around 80,000 inhabitants, this town has an important offshore industry supplying the North Sea oil and gas industry as well as a turnover of containers for import and export.

Climatic conditions in this northernmost part of the Wadden Sea are on average colder than in the south-western part. In January, average temperatures are just above zero, and freezing conditions on the mudflats occur in most winters.

In general, heavy industry and coastal protection measures dominate the Danish part of the Wadden Sea comparatively less than in most other parts of the Wadden Sea.

This report is produced on behalf of the Danish BirdLife partner, the Danish Ornithological Society (DOF), and was made possible only by financial contribution from Vogelbescherming Nederland. The proposals and suggestions in this report do not necessarily express the official policy of DOF.

Objective and methods

This report is the Danish contribution to a shared BirdLife vision for a modern conservation strategy for the Wadden Sea as an internationally important ecosystem. The aim of the report is to summarize the most recent Danish scientific research about the avifauna, the threats and the conservation status. The Danish report is going to be combined with similar Dutch and German reports as a basis for a joint conservation strategy.

A large number of scientific studies have been carried out in the international Wadden Sea. These are both fundamental long-term studies and short-term practical studies to map the effect of changes and interventions. Migratory and breeding shorebird populations are monitored on an intergovernment trilateral basis. These studies serve the following purposes:

- Monitoring changes in bird numbers
- Monitoring habitat use and food choice
- Explaining the trends observed

In this report focus is on the most characteristic waterbirds, especially highlighting their international importance.

The table of contents corresponds to the Dutch report by Reneerkens et al. (2007) but some additional issues are

also addressed. The present report does not have the status of a scientific paper, and not every claim is supported by a reference to the original source. The report does not give a complete overview of all scientific papers on the different subjects, but it should be possible to find sufficient references for the reader to retrieve the sources of most statements in this report. For assistance in finding relevant references, I thank Per Sand Kristensen, Karsten Laursen and Vadehavscentret.

Concerning scientific contents and language, the following persons contributed with invaluable comments and corrections: John Frikke, Statens Miljøcenter Ribe, Michael Borch Grell, BirdLife Denmark, Hans Meltofte, BirdLife Denmark, Thomas Vikstrøm, BirdLife Denmark and Joy Klein, BirdLife Denmark.

4. The Danish Wadden Sea

Danish Wadden Sea landscapes

The Danish Wadden Sea landscape is the result of glacial processes during the Saale and Weichselian ice ages, followed by erosion and deposition, man-made reclamations, etc. The average tidal amplitude varies from 1m at nip tide to 2.1m at spring tide. The first human settlements date back approx. 3,000 years. In the mid-1500s, the first sea dike was built in the southern part of the Danish Wadden Sea. The barrier islands are new geological features dating back only about 5,000 years. Human settlements on the islands date back to around 1,200 years. The peninsula of Skallingen is only about 400 years old (Sønderjyllands Amt & Ribe Amt 2005).

New dikes have been successively constructed up until recent times, and the majority of the mainland salt marshes have been reclaimed. The largest complex of polders is the more than 10,000 ha large Tøndermarsken where the river Vidå is bordered by river dikes to control flooding. About 3,700 ha are protected as a nature reserve with meadow-bird management (Rasmussen & Laursen 2000). On the islands, and especially on Skallingen, in Ho Bugt and around the river Varde Å, large undiked areas remain. Varde Å is the only river in the Danish Wadden Sea having a natural brackish estuary not controlled by dikes and sluices. The river water moves backwards about 8 km at flood. The island of Jordsand in the Lister Dyb tidal basin is the only Danish hallig, formerly a much larger low-lying marsh island with a number of farms. This island has literally disappeared due to erosion and is reduced to a small sandspit that is often flooded completely at high tide. A contrasting development is found south-east of Fanø where the sandbanks of Keldsand and Fuglsand have developed several hundred hectares of salt-marsh vegetation since the early 1990s.

Conservation of key habitats

The responsibility for the management of the Danish part of the Wadden Sea has recently changed in line with the general Danish administration reform. Since January 1st 2007, 'Statens Miljøcenter Ribe' has been responsible for designing the management plans, and two local municipalities, Esbjerg and Tønder, are responsible for carrying out the management. The Danish part of the Wadden Sea is planned to be designated as a national park but, so far, there is no coherency in its management. A process initiated by the Ministry of Environment to fulfil the aims of the European Birds, Habitat and Water Frame Directives (Miljøministeriet 2007) should be given special at-

tention by the nature protection organizations. Ideas and proposals for the coming efforts were invited in autumn 2007.

The land use planning of the Danish Wadden Sea is covered by a number of Danish laws¹, and EU Directives and international agreements have been signed for the Danish Wadden Sea (Skov- & Naturstyrelsen 2004b):

- The Trilateral Wadden Sea Plan (Stade, 22 October 1997).
- The Esbjerg Declaration (31 October 2001).
- Executive order on Nature Conservation and a Wildlife Reserve in the Wadden Sea. (Bekendtgørelse nr. 135 af 17. februar 1998, "Vadehavsbekendtgørelsen." Later revised: the present version is executive order no. 867 of 21/06/2007.)
- Regional planning (nr. 15 til Regionplan 1997-2008 for Sønderjyllands Amt og nr. 24 til Regionplan 2008 for Ribe Amt).

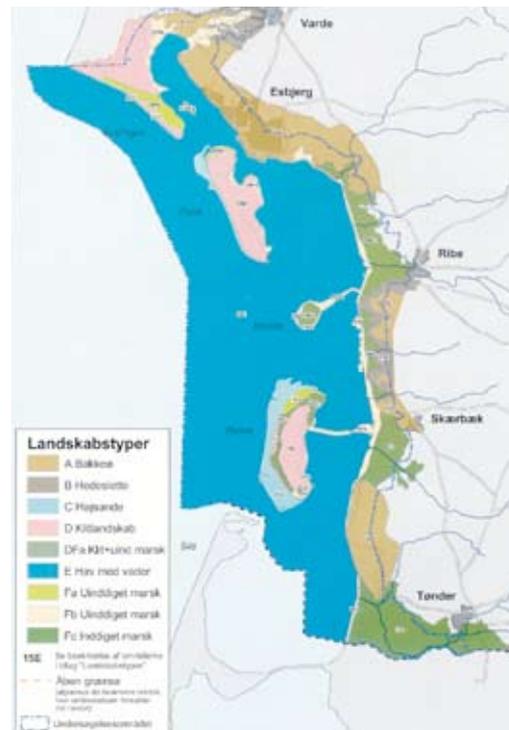


Figure 2: Types of landscapes in the Danish Wadden Sea. A: Glacial deposits from the Saale ice age; B: Alluvial plains; C: Sandbanks (not all mapped); D: Dunes; DFa: Dunes and undiked salt marshes; E: Sea and intertidal flats; Fa: Natural salt marsh; Fb: Man-made salt marsh; Fc: Polders.

Source: Counties of Ribe and Sønderjylland with support from The Danish Outdoor Council and The Forest and Nature Agency 2005.

National and international regulations

The Danish part of the Wadden Sea comprises a number of Natura 2000 areas. Two of the marine areas including salt marshes are designated as EU Special Areas of Conservation (SPA), and 10 marine areas including polders on the mainland are designated as Special Protection Areas for birds according to the EC Wild Birds Directive. The habitats that form the basis of designation of the Wadden Sea as two Special Areas of Conservation² are listed in Table 2, and the similar list of relevant species can be found in Table 3. The list of SPAs is found in Table 4 and the list of relevant bird species in Table 5. The Danish government has initiated a planning procedure that will ultimately lead to the establishment of management plans for each of the Danish Natura 2000 areas by 2009.

On the Danish national level, the regulations concerning the nature and game reserve have until now represented the most strict regulations concerning birds in the Wadden Sea area outside the dikes. The regulation concerning wildlife was drawn up in 1979 and regulations on the nature reserve in 1982. Both sets of regulations were merged in 1999 to form a combined nature and game reserve regulation. These acts regulate amongst others hunting and access to the area.

Table 1: List of key habitats that form the basis of the designation of Special Areas of Conservation No. 78, the Danish Wadden Sea including the rivers Ribe Å, Tved Å and Varde Å west of Varde, and No. 90, Vidå with tributaries, Lake Rudbøl and Magisterkøgen according to Directive 92/43/EEC.

Code	Key habitats
1110	Sandbanks, which are slightly covered with salt water all the time
1130	Estuaries
1140	Mudflats and sand flats not covered by seawater at low tide
1150 *	Coastal lagoons
1310	Salicornia and other annuals colonizing mud and sand
1330	Atlantic salt meadows (<i>Glauco-Puccinellietalia maritima</i>)
2110	Embryonic shifting dunes
2120	Dunes with <i>Euphorbia terracina</i>
2130 *	Fixed coastal dunes with herbaceous vegetation (grey dunes)
2140 *	Decalcified fixed dunes with <i>Empetrum nigrum</i>
2170	Dunes with <i>Salix repens ssp. argentea</i>
2180	Wooded dunes of Atlantic, Continental and Boreal region
2190	Humid dune slacks
3150	Natural eutrophic lakes with Magnopotamion or Hydrocharition-type vegetation
3260	Watercourses of plane to mountain levels with the <i>Ranunculus fluitantis</i> and Callitriche-Batrachion-vegetation.
4010	Northern Atlantic heaths with <i>Erica tetralix</i>
6210	Semi-natural dry grasslands and scrubland faces on calcareous substrates (Festuco-Brometalia) (important orchis sites)
6230 *	Pseudo-steppe with grasses and annuals of the Thero-Brachopodietea
6410	Molinia meadows on calcareous, peaty or clayey-silt-laden soils (<i>Molinion caeruleae</i>)
7230	Alkaline Fens
91D0 *	Bog woodland

* priority habitat types⁵





Harbour Seals and one Grey Seal hauling out on Galgedyb south of Fanø with a Cormorant in the background. Photo: Lars Maltha Rasmussen.

Table 2: List of key species designated for the Danish Wadden Sea area according to Directive 92/43/EEC Annex II: Animal and plant species of community interest whose conservation requires the designation of special areas of conservation.

Key species of animals			
Code	Species	Latin	Danish
1095	Sea Lamprey	<i>Petromyzon marinus</i>	Havlampret
1096	Brook Lamprey	<i>Lampetra planeri</i>	Bæklampret
1099	River Lamprey	<i>Lampetra fluviatilis</i>	Flodlampret
1103	Twaite Shad	<i>Alosa fallax</i>	Stavsild
1106	Salmon	<i>Salmo salar</i> (only in fresh water)	Laks (kun i ferskvand)
1113 *	Houting	<i>Coregonus oxyrinchus</i>	*Snæbel
1145	Weatherfish	<i>Misgurnus fossilis</i>	Dyndsmerling
1351	Harbour Porpoise	<i>Phocoena phocoena</i>	Marsvin
1355	Otter	<i>Lutra lutra</i>	Odder
1364	Grey Seal	<i>Halichoerus grypus</i>	Gråsæl
1365	Common Seal	<i>Phoca vitulina</i>	Spættet sæl

* priority species⁸

Table 3: Special Protection Areas (SPAs) in the Danish Wadden Sea⁹

No	Natura 2000	Name	Area	Year
F49	DK00AX049	Engarealer ved Ho Bugt	2711	1994
F51	DK00AX051	Ribe Holme og enge med Kongeåens udløb	6701	1994
F52	DK00AX052	Mandø	854	1994
F53	DK00AX053	Fanø	4439	1994
F55	DK00AX055	Skallingen og Langli	2367	1994
F57	DK00AY057	Vadehavet	115671	1994
F60	DK009X060	Vidåen, Tøndermarsken og Saltvandssøen	6498	1994
F65	DK009X065	Rømø	6964	1994
F67	DK009X067	Ballum og Husum Enge og Kamper Strandenge	4287	1994
F113	DK00VA347	Sydlig Nordsø	246296	2004

Table 4: Key bird species for which the Danish Wadden Sea SPA's are designated according to the EU Directive on the conservation of wild birds (79/409/EEC)

Species on Annex I	Exceeding 1%-level	Breeding	Migratory	Criterion
SPA 49 Engarealer at Ho Bugt				
Montagu's Harrier		B		F1
Hen Harrier		B		F1
Corncrake		B		F1
Avocet				F2, F4
Bluethroat		B		F1
SPA 51 Ribe Holme & Enge, Kongeåens udløb				
Bittern		B		F3
White Stork		B		F1
Marsh Harrier		B		F3
Montagu's Harrier		B		F1
Hen Harrier		B		F1
Spotted Crake		B		F1
Corncrake		B		F1
Avocet		B		F1
Golden Plover				F2, F4
Ruff		B		F1
Short-eared Owl		B		F1
Bluethroat		B		F1
	Pinkfooted Gose			F4
SPA 52 Mandø				
Marsh Harrier		B		F1
Avocet		B		F3
Ruff		B		F1
Gull-billed Tern		B		F1
Common Tern		B		F1
Arctic Tern		B		F5
Short-eared Owl		B		F5
	Dark-bellied Brent Goose			
SPA 53 Fanø				
Bittern		B		F1
Marsh Harrier		B		F3
Hen Harrier		B		F1
Avocet		B		F3
Kentish Plover		B		F1
Dunlin		B		F3
Gull-billed Tern		B		F1
Arctic Tern		B		F1
Little Tern		B		F1

	Light-bellied Brent Goose			F4
SPA 55 Skallingen & Langli				
Avocet		B		F1
Gull-billed Tern		B		F1
Sandwich Tern		B		F1
Common Tern		B		F3
Arctic Tern		B		F1
Little Tern		B		F1
	Dark-bellied Brent Goose			F5
	Wigeon			F5
SPA 57 Vadehavet				
Barnacle Goose				F2, F4
Avocet		B		F1,F2, F4
Kentish Plover		B		F1,F2
Golden Plover				F2, F4
Dunlin		B		F1,F2, F4
Bar-tailed Godwit				F2, F4
Little Gull				F2, F5
Gull-billed Tern		B		F1
Sandwich Tern		B		F1
Common Tern		B		F1
Arctic Tern		B		F1
Little Tern		B		F1
	Dark-bellied Brent Goose			F4
	Light-bellied Brent Goose			F4
	Shelduck			F4
	Wigeon			F4
	Teal			F4
	Pintail			F4
	Shoveler			F4
	Eider			F4
	Common Scoter			F4,F7
	Grey Plover			F4
	Oystercatcher			F4
	Curlew			F4
	Redshank			F4
	Greenshank			F4
	Red Knot			F4
	Sanderling			F4
SPA 113 Sydlige Nordsø				
Red-throated Diver				F2, F7
Black-throated Diver				F2, F7
Little Gull				F4

- B: Breeding species*
- M: Migratory species, exceeding 1% of flyway population*
- Mn: Migratory species, nationally important numbers*
- F1: Species on Annex I, regularly breeding, with at least 1% of national numbers*
- F2: Species on Annex I and regularly in area part of year with at least 1% of flyway population (M), or rare species (Mn) with more than 1% of Danish numbers, where Danish areas are important to their conservation*
- F3: The species have a relatively small but significant occurrence*
- F4: Migratory species, exceeding 1% of flyway population*
- F5: Species regularly with important numbers in areas holding more than 20,000 water birds (except gulls)*
- F7: Species having a relatively small but important occurrence in the area, which contributes significantly to the survival of the species in critical periods of the life cycle (severe winters, moulting period, on migration etc.)*

The Trilateral Wadden Sea Plan

The Trilateral Wadden Sea Plan¹⁰ covers the cooperation area, within which there is distinguished between protection areas and conservation areas. The conservation area is similar to the Danish Wadden Sea nature and game reserve. This area includes subtidal and intertidal areas and salt marshes in front of the dikes. The undiked salt marsh and the brackish marshes at Varde Å including the polders behind the dikes form part of the protection area¹¹. The ecotargets for the conservation area are aimed at improving natural dynamics and increasing undisturbed areas and favourable conditions for animals and birds. Specific targets concerning bird populations in the Wadden Sea are formulated in the Wadden Sea Plan as follows:

Favourable conditions for breeding and migratory birds:

- Favourable food availability *
- Natural breeding success *
- Sufficiently large undisturbed roosting and
- Moulting areas
- Natural flight distances

*mainly relevant for breeding birds

Concerning the protection area, targets do not consider natural dynamics, but allow conventional farming, wind energy, etc.

During the past 30 years, conservation efforts in the Wadden Sea area have focused on the conservation area, which

primarily comprises marine areas and salt marshes. There is an intimate ecological connection between the marine areas throughout the entire Wadden Sea and across the country borders. However, the ecological links between the marine systems and the terrestrial systems are weak because of the radical changes caused by the large-scale coastal protection works. The links are still important for birds, but their protection is very weak. Originally, the distinctive marine habitats and terrestrial habitats were ecologically linked and formed a coherent gradient of landscapes. However, the building of sea dikes and the regulation of watercourses with dikes and sluices have to a large extent caused fragmentation of the Wadden Sea nature area and broken the ecological links between the marine and terrestrial habitats. Controlling both salt water and fresh water flooding has improved conditions for developing low-lying areas for settlements, urban and industrial purposes as well as for intensive farming.



Drainage of marshland in Ballum Enge despite its status as a SPA.
Photo: Lars Maltha Rasmussen.

The Cooperation area

Intensification of farming has had a significant impact in the cooperation area, both on the islands and in polders on the mainland. The intensification also affects the marine habitats by producing a surplus of nutrients. Many species of birds make use of the transition zone between land and sea, consisting of the salt marsh, rivers and polders at different times of the year. Here, traditional farming practices with hay cutting and grazing animals have almost ceased. Large areas of permanent grassland in the polders have now been turned into arable land or are used for intensive cultivation of grass with the aid of fertilizers.

In Tøndermarsken, grasslands were turned into arable land with a speed of 5% annually as early as 1978¹². This development was stopped for an area of approx. 2,000 ha when a law was passed in the Danish Parliament in 1986 to protect it. However, this deterioration of the environment persists in all other polder areas in the Danish Wadden Sea. Temporarily flooded polder habitats have almost disappeared.

Intensification of farming has led to conflicts between farming interests and nature protection interests, especially with regard to birds. One of these conflicts is a management problem caused by increasing numbers of geese and a change of crops and farming practices more vulnerable to goose grazing¹³. Despite these conflicts, more intensive farming practices may have caused increased biomass production on a local scale, thus resulting in improved food conditions for a number of migrating birds. Geese, especially, have benefited from new and more nutritious crops on farmland instead of natural food resources.

For breeding meadow-birds, intensification has had an overall negative impact on numbers and reproductive output. Hence, meadow-birds in polders within the Wadden Sea area have declined in numbers¹⁴. Dunlin and Ruff have become nearly extinct as breeding birds in the southern Wadden Sea, but the Danish Wadden Sea area still holds a few pairs.

Until now, there has been no regulation of spatial use, and no regulation of hunting activities in polder SPAs to comply with the objectives of the EC Birds Directive. The protection objectives set in the Wadden Sea Plan for the cooperation area are much less ambitious than for the conservation area. For some areas, the IUCN Category V could be applied (see Table 6). For the conservation area, the protection level meets the IUCN management categories II-IV. Hardly any areas can achieve category I (wilderness

area), since no strictly protected areas are of a sufficient size. Until now, construction of wind turbines, roads and hotels has not been planned in these areas. However, construction of roads and hotels has been planned near Ribe and on Rømø.

Table 5: IUCN Management Categories¹⁵

Category I	Strict nature Reserve/Wilderness Area
Category II	National Park
Category III	National Monument
Category IV	Habitat/Species management Area
Category V	Protected Landscape/Seascape
Category VI	Managed Resource Protected Area

The Danish Wadden Sea has been one of seven Danish pilot projects aiming at establishing the first Danish national parks. The establishment of a national park administration could ideally form the basis for a better coordination of the different sets of planning initiatives in the Wadden Sea (Niras 2007).

An important aim to strengthen nature management in the Wadden Sea area could be achieved by allowing the dynamic ecological systems to develop by restoring ecological links between the marine and terrestrial habitats in the full ecological spectrum.

1. Note concerning regulations in force for the Wadden Sea: (Notat om gældende regler for Vadehavet) http://www.snsn.dk/Lindet/Nationalpark/Materiale/vadehavet_regler.pdf
2. Council Directive 92/43: <http://europa.eu/scadplus/leg/en/lvb/128076.htm>
3. Basis of designation (udpegningsgrundlag) http://www2.skovognatur.dk/natura2000/habitat/oplysninger/udpegningsgrundlag/udpegningsliste51_100.htm
4. Map of Area No 78: <http://www.skovognatur.dk/NR/rdonlyres/511293D6-1C59-4FCE-A0E4-2A3474-F53A90/0/hab78.pdf>
5. <http://web.uct.ac.za/depts/pbl/jgibson/iczm/legis/ec/hab-an1.htm>
6. Basis of designation (udpegningsgrundlag) http://www2.skovognatur.dk/natura2000/habitat/oplysninger/udpegningsgrundlag/udpegningsliste51_100.htm
7. Map of SAC No 90: <http://www.skovognatur.dk/NR/rdonlyres/511293D6-1C59-4FCE-A0E4-2A3474F53A90/0/hab78.pdf>
8. "" priority habitat types http://ec.europa.eu/environment/nature/nature_conservation/eu_enlargement/2004/habitats/annexii_en.pdf
9. The Wadden Sea Plan: <http://cwss.www.de/management/Plan.htm>
10. The Wadden Sea Plan: <http://cwss.www.de/management/Plan.html>
11. Beskyttelse og benyttelse af de ydre koge i Tøndermarsken, (Protection and use of outer polders in Tøndermarsken) <http://www.snsn.dk/NATUR/netpub/toendermarsk/Kap2.htm>
12. Beskyttelse og benyttelse af de ydre koge i Tøndermarsken, (Protection and use of outer polders in Tøndermarsken) <http://www.snsn.dk/NATUR/netpub/toendermarsk/Kap2.htm>
13. Madsen, J. G. Cracknell & T. Fox (eds.) 1999: Goose Populations of the Western Palaearctic. Wetlands International Publication No. 48.
14. Rasmussen, L.M., B. Hälterlein, B. J. Koks, P. Potel and P. Südbeck 2000: Breeding birds in the Wadden Sea in 1996 Results of a total survey in 1996 and of numbers of colonial breeding species 1991-1996. Wadden Sea Secretariat.
15. IUCN guidelines for protected area management categories http://www.unep-wcmc.org/protected_areas/categories/eng/index.html

5. Management and threats

Primary production

The primary production in the Danish parts of the Wadden Sea is affected by nutrients from both the North Sea and the local outflow of fresh water into the Wadden Sea, and through air pollution. Despite tremendous improvements in pollution control, especially from urban areas since the 1970s, the entire Danish Wadden Sea is still affected by a number of pollutants. Nutrient levels of N and P have been markedly reduced since the 1970s, but are still a factor 3-5 above the natural level before industrialization, hence having a significant impact on the Wadden Sea ecosystem. The most important sources of nutrients entering the Wadden Sea are farmland and other sources through freshwater streams (Skov- & Naturstyrelsen 2007c).

Large sea-grass beds currently occur on the lee side of Rømø and Fanø and between Jordsand Flak and Koldby. Both *Zostera* species are present. An aerial survey in the northern Lister Dyb and in the Juvre Dyb tidal area ascertained that sea-grass beds covered 430 ha.

Locally, sea-grass beds are of a significant size contributing to the feeding possibilities of especially Brent Geese (*Branta bernicla* sp.) and Eurasian Wigeon (*Anas penelope*). Most important are the areas at Koldby Leje on the mainland coast in the Lister Dyb tidal basin, and on the lee side east of the islands, especially Fanø. The biomass of sea-grass varies considerably on an annual basis, and as in other parts of Danish seas, the present sea-grass biomass is only a fragment compared with the situation before the sea-grass disease in the 1930s.

Gaps in knowledge about primary production

- What are the reasons for the slow recovery of sea-grass beds in the Wadden Sea?
- What measures can be made to improve the recovery of sea-grass beds?

Potential conservation actions concerning primary production

- Reduction of the input of nutrients to the Wadden Sea from rivers and streams by restoration of natural watercourses and by further reducing the loss of nutrients from farmland would strengthen the vitality of sea-grass when growing at average salinities.

Disturbances from recreational activities

Increasing tourism, especially on the islands of Rømø and Fanø, can potentially affect the distribution and the reproductive output of breeding birds as well as the vegetation. In general, the existing knowledge about the carrying capacity of the natural areas is insufficient (Ballegaard 1994).

Only few studies of the effects of disturbance have been carried out in the Danish Wadden Sea. One study showed that people going for a walk on sandy beaches and in salt marshes in front of dikes have a negative impact on the number of waterbirds using these areas (Laursen et al. 1997). In addition, leisure boats have an effect on moulting Common Eiders (*Somateria mollissima*) during the summer months. On high-tide roosts, human disturbance may reduce the bird numbers significantly. Some species like Eurasian Curlew (*Numenius arquata*) and large flocks of geese and Eurasian Wigeon (*Anas penelope*) have a considerable flight distance when disturbed by humans. Birds may to some extent become used to human disturbance depending on the character and frequency of the disturbance. Flight distance and the time spent in the air or being alert after a disturbance increase when different sources of disturbance act together, for example raptors or aircraft in combination with human disturbance (Laursen & Rasmussen 2002).

The west coasts of the islands of Rømø and Fanø are intensely used for recreation. There is a conflict between the present level of recreation and breeding birds such as Kentish Plover and Little Tern on the sandy beaches: the breeding birds being adversely affected by recreation resulting in reduced numbers and breeding success. On Rømø, some small areas have been closed to the public during the breeding season to protect colonies of these birds. However, the breeding sites usually shift from season to season due to changes in beach morphology and vegetation development. It is therefore questionable if present management practices are sufficient to protect the populations. Bird colonies are often established and incubation is in progress, when the level of human disturbance suddenly increases because of events like holidays or warm and sunny weather with large numbers of people on the beaches. In addition, straying dogs seem to be a frequent problem for the birds breeding on the beaches.

The major high-tide roosts in the Wadden Sea were investigated by Koffijberg et al. (2003) to give a status of the protection regimes and potential sources of human distur-

bances for each site. This study showed that the level of human disturbance is one of the most important factors determining numbers of birds on high-tide roosts. Recreational activities are the most frequent source of disturbance. 36% of all roosts in the Danish Wadden Sea are subject to some kind of recreational pressure when considering only moderate to heavy recreational pressure. Birds tend to avoid roosts visited by many people in the summer holiday season, when recreational activities peak in July and August however tending to expand into spring and autumn. As a result, potential conflicts between waterbirds at high-tide roosts and recreational activities are expected to increase in the future.

See following chapter on hunting for further evaluation of this aspect.

Disturbance from military training activities

Military training activities may cause disturbance at high-tide roosts in the Wadden Sea (Koffijberg 2003). In the Danish Wadden Sea, there is a more than 2,000 ha large military training area and shooting range in the northernmost part of Rømø, on which there are bombing targets for low-flying jet fighters.

To reduce the risk of bird strikes, the northern part of the salt marshes on Rømø is left ungrazed, so as to make the area less attractive to birds (Skov- & Naturstyrelsen 2002). It is possible that this management reduces the presence of geese. The effect on the breeding birds is, however, minimal.

Although the effects of the disturbance of the birds and other effects have not been studied, there is no doubt that these activities in the military training area have serious negative effects on the breeding and staging birds using this area. The actual bombing area forms only a small percentage of the total area, but training activities seem to have increased over the last few years. Training is especially intense in May and August, at times when large concentrations of migrating birds are passing the northern Wadden Sea and could potentially use the area for foraging and as a high-tide roost.

Data on the number of destroyed nests are not available, and registrations of the breeding bird populations in the area before 1991 were accidentally lost. Seals and geese use the area to some extent, but there are no qualified data on the habituation of the wildlife to the training activities.

Gaps in knowledge about disturbance

- What are the impacts of recreational activities on distribution and breeding success of breeding birds in the

Wadden Sea, especially Little Tern (*Sterna albifrons*) and Kentish Plover (*Charadrius alexandrinus*)?

- Is it possible to minimize the conflict between the military uses of the areas potentially important for birds, or is it possible to find alternatives for the military activities?
- How should recreational activities be managed to reduce conflicts?

Potential conservation actions concerning disturbance

- In order to reduce the disturbance of birds on high-tide roosts, a spatial and temporal zoning of recreational activities should be further developed.
- Visitor information could be systematically improved.
- Empirical experiences could be gathered from managing and studying high-tide roosts.
- The minimum flying height of 1500 feet over the Wadden Sea seems to be violated quite often. Control of this regulation should be reinforced.

Hunting

The first hunting-free reserve in the Danish Wadden Sea was established in Albuebugten, Fanø, in 1896. Parts of the Danish Wadden Sea in Albuebugten and around Jordsand were declared game reserves in 1936 (Skov- & Naturstyrelsen 2007b). The entire Danish Wadden Sea outside the dikes was declared a game reserve in 1979 and a few additional hunting regulations were introduced. Hunting is now regulated by a revised notification from 2006 (BEK nr. 1326 af 20/11/2006). The general rule is that hunting migratory birds is forbidden within the conservation area, but with a considerable number of exceptions in areas of salt marshes, along the mainland coast and on Mandø and Rømø. Since the mid-1990s, hunting has only been allowed in narrow strips along the major part of the coast on privately owned land. Hunting is also allowed from anchored vessels and by wading in the Wadden Sea west of a so-called "shrimp line" between the islands from October 1st to January 31st. In compensation, hunting has been forbidden in state-owned areas on Skallingen, Fanø, Mandø and Rømø.

The shooting free area does not include the SPAs in polders together with salt marshes and meadows in Ho Bugt and meadows on Fanø and Rømø. Here hunting is generally allowed, with the exception of publicly owned clay pits along the dike.

At present, the open season for dabbling ducks and geese is from September 1st to December 31st, and hunting activities peak during October and November.

Hunting affects natural flight distances and increases the disturbing impact of other human activities (Salvig et al. 1994, Laursen & Salvig 1997). A study of hunting in the Ballum area in 1983–86 describes the hunting in the Danish Wadden Sea in detail (Frikke & Laursen 1994a). This description is still valid for the pattern of hunting in the Danish Wadden Sea. Intensive hunting activity takes place at dawn and particularly at dusk, when ducks and geese move between feeding grounds in the polders and safe roosting sites in the Wadden Sea. In the polders and meadows, hunting takes place in areas where birds roost and/or feed. On average, 40 hunters were present in the area each evening, and many more were present on the first day of the open season. When storm surges flood the salt marshes and the high-tide roosts that the birds normally use, they have great difficulties finding acceptable roosts because of hunting in the polders behind the dike. In these situations, there were more than one hundred hunters in the area, mainly sitting near the dike, but also spread in the hinterland. When the foreland is flooded, a similar situation arises in all other areas in the Danish Wadden Sea except in Margrethe Kog and Skallingen/Langli, where large hunting-free areas are not flooded in storms. Massive disturbance caused by hunting in these situations may result in considerable numbers of birds abandoning the Danish Wadden Sea completely.

It was a general finding in the study at Ballum that a significant part of all hunting activities took place after the closing of legal hunting 1 or 1½ hours after sunset, which was also found by Meltofte (1978). In addition, protected species were often shot.

In a study by Madsen (1988) it was found that hunting was a significant disturbing factor, and that ducks, especially Eurasian Wigeon, left the study area before the food resources had been fully exploited. On arrival at the Wadden Sea in autumn, Eurasian Wigeon feed on sea-grass on mudflats. When this food resource is depleted, they feed on seeds on the salt marshes. But in many places, utilization of the salt marshes is negatively affected by hunting (Laursen & Frikke 1994 a & b). These studies indicated that hunting prevents dabbling duck from exploiting the best habitats in autumn and recommended that the following management could improve conditions for waterfowl in the SPAs:

- Permanent grassland should no longer be changed into arable land.
- Hunting should be managed to ensure an ecological connection between the Wadden Sea and the polder areas.

- Better organization of hunters to prevent illegal and intensive hunting.
- Hunting-free core areas behind the dikes of a size that will allow birds to feed and roost undisturbed.
- Hunting-free corridors that allow passage for water-birds from the Wadden Sea to the polders.

Frikke & Laursen (1994b) recommended reducing the negative effect of intensive hunting by pointing out nine areas where hunting should be managed with hunting-free corridors connecting to hunting-free areas in the polders to provide favourable roosting and feeding conditions for birds in storm situations.

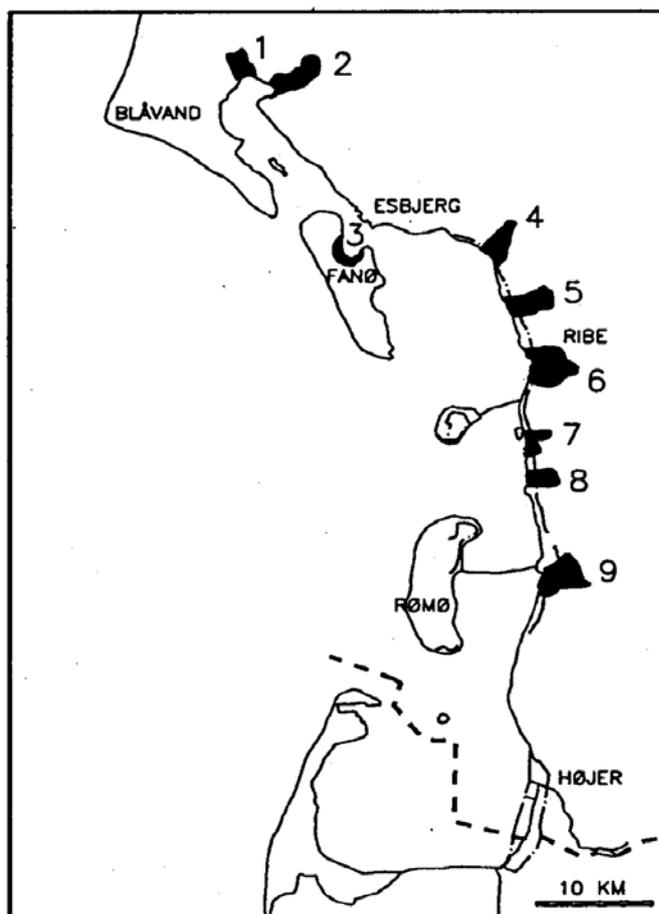


Figure 3: Map of proposed hunting-free areas in the polders to reduce the negative effect of intensive hunting by providing favourable roosting and feeding conditions for birds in storm situations. Numbers in the map refer to named areas. Source: Frikke & Laursen 1994b.

In a study on the effects of hunting in the approx. 4,000 hectare large SPA, Tøndermarsken, east of Margrethe Kog, it was concluded that hunting was the main reason

why this area had a low quality for foraging and resting waterbirds in the hunting season (Rasmussen 1998 & 1999). In Margrethe Kog, including a 800 ha large hunting-free area, the number of bird days per hectare in the open season was 10 times higher for Barnacle Goose (*Branta leucopsis*) than in the adjacent areas of Tøndermarsken despite the fact that this species does not have a hunting season. A game reserve in Tøndermarsken that only regulated hunting in September had, however, no effect on the number of waterbirds using the area, since waterfowl do not depend on inland foraging in early autumn. Because of the heavy use by the growing number of geese in Margrethe Kog, local food resources became a limiting factor for the number of geese. It was concluded that livestock and grazing birds were competing for the same food resources (Rasmussen 1999). This analysis proposed the following management to improve conditions for the grazing birds such as geese and Eurasian Wigeon in the area:

- Feeding possibilities in the hunting-free core area, where food resources were a limiting factor, could be improved by discontinuing livestock grazing at an earlier date and not having winter grazing.
- Reduction in human disturbance by stopping grazing early and by restricting access to the protected area could enhance the use of areas near roads.
- Establishment of hunting-free areas covering at least 150 ha on permanent grassland to give access to more food resources and roosting possibilities within the bird protection area. Ideally, these areas should include parts of the river Vidå to improve the attraction of the area, especially for Eurasian Wigeon that prefer to feed at the water's edge.
- Feeding and roosting conditions in the area can be improved by keeping a high water table in ditches and channels all year round. Additionally, temporary flooding with fresh water of low-lying permanent grassland in hunting-free areas would attract not only ducks and geese, but also waders.

None of these measures have been introduced in the management of the SPAs in the polders in Tøndermarsken or elsewhere in the Danish Wadden Sea. On the contrary, the game reserve in Tøndermarsken was closed down in 1999 and no other restrictions were made to improve conditions for the migratory birds in the area.

Experiences from a network of hunting-free game reserves that was established in the period 1994–1999 in Denmark outside the Wadden Sea support the positive

effect which could be achieved from hunting-free areas (Clausen et al. 2001). In total, 31 new reserves were established and another 7 were enlarged. The effects of this network were found to result in

- A considerable increase in the number of staging dabbling ducks and geese
- An increase in number especially of the quarry species that are most susceptible to disturbance from hunting activities, and
- An increase in species diversity.



Drainage of former salt marsh in Havneby Kog (SPA) in order to turn the area into a golf course. Photo: Lars Maltha Rasmussen.

One of the effects of the reserves was an increase in the hunting bag around the hunting-free zones, to the benefit of hunters, at the same time as the birds gained better staging possibilities.

At the Trilateral Ministerial Conference in Esbjerg in 1991 it was decided that hunting migratory species should end progressively. This decision was, however, amended in the State Declaration in 1997 to the effect that "hunting of migratory species has been, or will be, progressively phased out in the Conservation Area, or in an ecologically and quantitatively corresponding area in the Wadden Sea Area" (Common Wadden Sea Secretariat 1997). The 'conservation area' was adjusted to include not only mudflats and salt marshes on the mainland coast, but also state-owned land in Margrethe Kog and on Skallingen. The 'cooperation area' includes the conservation area as well as the majority of the polder areas in the Danish Wadden Sea area, which are designated as SPAs.

An increase in numbers of wintering Eurasian Curlews in the international Wadden Sea from 160,000 to more

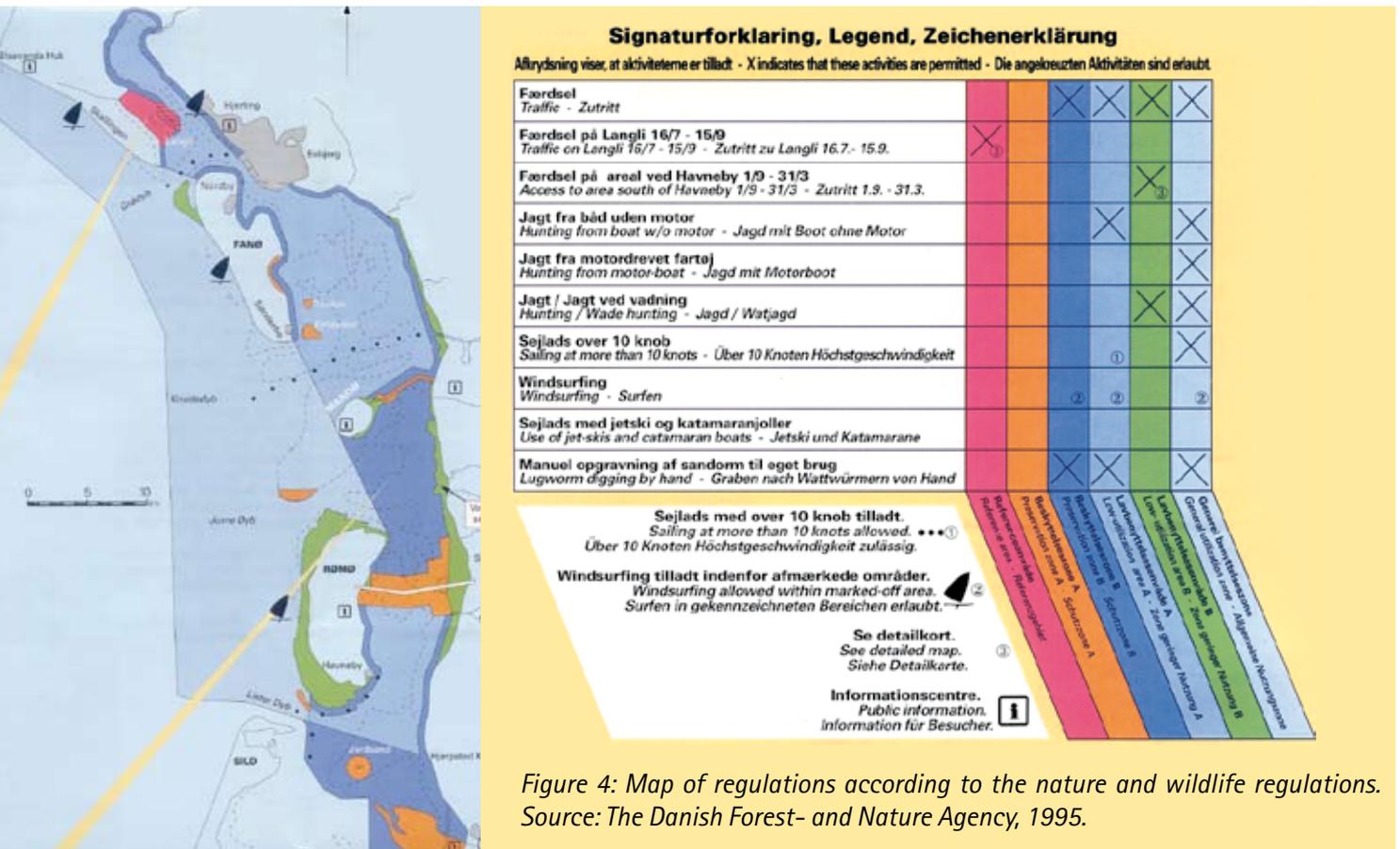


Figure 4: Map of regulations according to the nature and wildlife regulations. Source: The Danish Forest- and Nature Agency, 1995.

than 250,000 individuals in 1995 (Blew & Südbek 2005) could be explained by the hunting protection of the species in 1982 and in 1994 in Denmark (Laursen 2005a). Eurasian Curlew is one of the species with the greatest flight distance, and use of the high-tide roosts and night roosts largely depends on the degree of protection against disturbance (Rasmussen 2001). Protecting large areas in the Danish Wadden Sea from hunting in 1992 and a total ban on hunting this species in 1994 had an effect on the geographical distribution of Eurasian Curlews, and the numbers increased by a factor 3-4 both in autumn and in winter, equalling densities in Schleswig-Holstein, where the species has been protected for a long time.

Laursen and Frikke (2006) concluded that the birds in the Danish Wadden Sea game reserve (i.e. the conservation area) have been managed in a sustainable way during 1992-2000. It was found that staging populations of five quarry species, Common Eider, Mallard (*Anas platyrhynchos*), Northern Pintail (*Anas acuta*), Eurasian Wigeon and Common Teal (*Anas crecca*) in the Danish Wadden Sea were either stable or correlated with negative factors out-

side the Wadden Sea. Nevertheless, Koffijberg et al. (2003) found that moderate to heavy hunting pressure was affecting waterbirds on 33% of the high-tide roosts in the Danish Wadden Sea. Since hunting is known to increase flight distances considerably, the high hunting pressure in the Danish cooperation area probably has a considerable indirect negative effect on use of the high-tide roosts by increasing flight distances in relation to the presence of other, non-hunting human beings and similarly by reducing feeding possibilities within the conservation area.

It can be concluded that there is room for improvement in the management of hunting in the conservation area and in the adjacent SPAs. Hence, it is remarkable that intensive hunting is still allowed in the SPAs behind the dikes, and that hunting is not regulated in any of the nine areas proposed as hunting-free corridors and areas behind the dikes (Frikke & Laursen 1994b). Furthermore, a comprehensive assessment of the impact of human activities on waterfowl in the Wadden Sea (Laursen et al. 1997) recommended that polders behind the dikes should be included in future management of the Danish Wadden

Sea, especially in order to improve conditions for quarry species such as Mallard and Teal.

It is evident that larger numbers of several species, with or without a hunting season, could be present in the Danish Wadden Sea during the hunting season. Despite an apparently sustainable hunting management in the conservation area, it is rather questionable if the present management in fact does comply with the clear statement in the State Declaration, that "hunting in ecologically and quantitatively corresponding area in the Wadden Sea Area" should be phased out in the Danish Wadden Sea. So far, there are no hunting regulations on privately owned land. It seems that those areas which should compensate for the cessation of hunting in several sites inside the conservation area were selected for administrative reasons rather than on the basis of biological criteria. Hence, Laursen et al. (1997) found that numbers of waterbirds increased considerably more in reserves that were designated on the basis of biological criteria to fulfil the requirements of the waterbirds than in reserves selected for administrative reasons, i.e. mainly because they were publicly owned.

In the intertidal areas west of the islands, hunting from motorboats was found to have the most direct and disturbing effect on the distribution of Common Eiders (Salvig et al. 1994).

Gaps in knowledge about hunting

- How does hunting in the Danish Wadden Sea affect flight distances of species that are hunted as well as protected species?



Greylag Geese shot in Tøndermarsken on September 1st, the first day in the hunting season. Photo: Lars Maltha Rasmussen.

- Which areas outside the present conservation area, but inside the cooperation area in the polders and on saltmarshes have potentially the most important ecological links to the Danish Wadden Sea?
- What will be the effect of the establishment of large hunting-free areas in the polders and meadows in the cooperation area with regard to the number of birds, the species diversity and the turnover rate of birds within the conservation area and the cooperation area, respectively? This could be studied by a full-scale experiment.
- How does hunting in the outer Danish Wadden Sea affect the condition and the number of Common Eiders using the Wadden Sea?
- In which hunting-free core areas other than Tøndermarsken are food resources a limiting factor due to grazing of livestock?

Potential conservation actions concerning hunting

- Establishment of hunting-free areas of at least 250 ha on permanent grassland to give access to more food resources and roosting possibilities within the bird protection area. Ideally, these areas should include parts of the rivers to improve the attraction of the areas especially for Eurasian Wigeon, which prefers to feed at the water's edge.
- Improvement of the feeding possibilities in the hunting-free core areas, where food resources are a limiting factor, by discontinuing livestock grazing at an early date and not having winter grazing.
- Hunting from motorboats in the protection area to be stopped.
- Hunting of the species for which the SPAs are designated to be stopped.

Commercial use of biological resources

Blue Mussel (*Mytilus edulis*)

Until 1983, only two boats, mainly operating in the Lister Dyb tidal basin south of Rømø, carried out Blue Mussel fishery in the Danish Wadden Sea. Catches were usually below 2,000 tons/year (Munch-Petersen & Kristensen 1987) (Figure 5). Following low catches in the Netherlands, a large number of Dutch and Danish fishing boats exploited the Blue Mussel biomass in the Danish Wadden Sea in 1984 and 1985, increasing the landed amount to about 30,000 tons in 1985 (Kristensen et al. 2005). Consequently, the Blue Mussel biomass collapsed in 1987 due to over-fishing, and this was followed by a

large decrease in observed numbers of Common Eiders in the Danish Wadden Sea.

Since 1986, quotas have been set annually on mussel fishery. To determine annual quotas, the biomass of Blue Mussels has been monitored annually since 1986 in the Danish Wadden Sea (Figure 6). Based on average bird days in the period 1988–1999 quotas are calculated to ensure that mussel-feeding birds can harvest a minimum of 50% of the annual production of Blue Mussels or at least 10,334 tons/year, equalling 13 million bird days. Since the annual production is about 50 % of the total biomass this must be at least 41,336 to provide food for the birds. This is a minimum figure since this calculation does not reflect that birds depend on a fragment of the actual size classes only. The calculation of the consumed amounts of Blue Mussels is based on an average for all mussel-eating species (Kristensen & Laursen in prep.). Mussels are most important for Common Eider making up about 60 % of the food intake, 17 % for Oystercatcher and 5 % for Herring Gull. However, Common Eider depends almost exclusively on subtidal musselbeds, in contrast to the other mussel eating species.

In 1990, the number of licences was cut from 40 to 5, and 48% of the Danish Wadden Sea was completely closed to mussel fishery. In contrast to Germany and the Netherlands, culture banks are not allowed in the Danish Wadden Sea. Since 1990, annual quotas have varied between 2,000 and 10,000 tons. Before 1990, the only area without commercial mussel fishing was in the no-use-area in Ho Bo Dyb between Skallingen and Langli covering approx. 1% of the Danish Wadden Sea.

Despite the regulations, the Blue Mussel biomass has diminished dramatically. On average, annual landings have been 6% of the total estimated biomass, and they have never exceeded 10%. Since 2001, the Blue Mussel biomass has decreased to only about 10% of the average level in the period 1986–2004 (Kristensen et al. 2005). This biomass is lower than the calculated 10,334 tons that the birds need. In recent years, the quotas for the Blue Mussel fishery have been very low or set to zero because of this very low biomass. Sheiffarth & Frank (2005) found a negative correlation between mussel landings and the consumption by Common Eider and Eurasian Oystercatcher for the entire Wadden Sea, which could indicate an existing conflict between fisheries and birds. Fishing intensity in the Danish Wadden Sea was in the lower end compared to Schleswig-Holstein and the Netherlands and the relation between

mussel landings and the consumption by Common Eider and Eurasian Oystercatcher was not found for the Danish Wadden Sea alone (Figure 5).

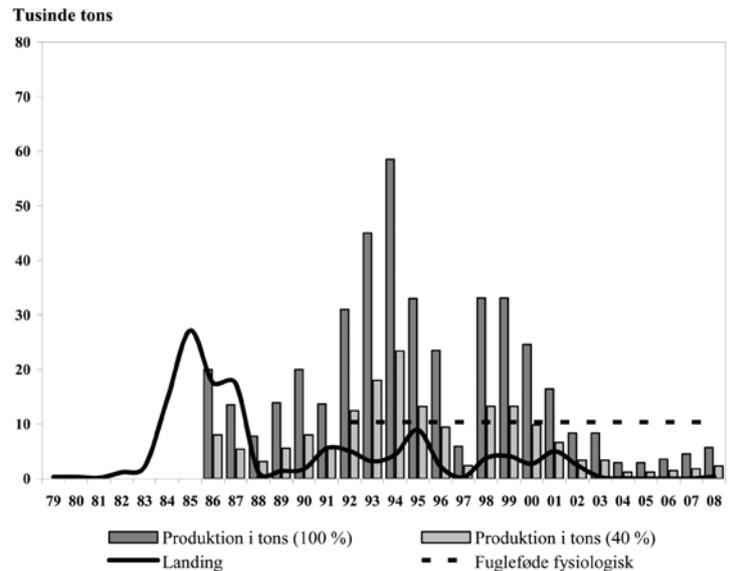


Figure 5: Annual landings of Blue Mussels (solid bars) in the Danish Wadden Sea 1979–2008. Dark bars: 100% production, light bars: 40% production, solid line: landings, dashed line: annual food consumption for birds. Source: Kristensen & Pihl (2006). Recent additions through correspondence with the author.

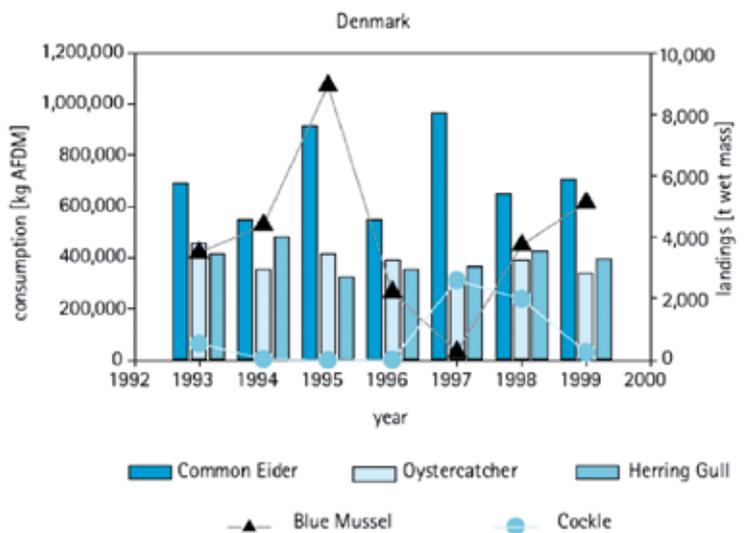


Figure 6: Consumption by major shellfish-eating birds and landings of mussels and cockles in the Danish Wadden Sea 1993–1999. Source: Scheiffarth & Frank 2005

Surf Clam (*Spisula solida*)

Since 1992, fishery for Surf Clams has taken place mainly on Horns Rev but also on Røde Klit Sand west of Rømø. Annual landings varied between 19,000 tons in 1992 and 2002 and no landings in the years between 1995 and 2000 (Jensen et al. 2003). The fishery ceased between 1995 and 2000 because the fishable stocks collapsed at water depths lower than 10 m. Fishing was resumed in 2002 in deeper waters, where a large part of the fishery takes place outside the Danish national 12 mile zone.

Surf Clam is the preferred food item for Common Scoters, that occur in internationally important numbers in the western, outer part of the Danish Wadden Sea.

Shellfish fishing affects the Common Scoter, and *Spisula* fishing can potentially threaten the feeding grounds of this species. Along the Dutch Wadden Sea coast, there has been a moratorium on commercial clam fishing since 1999 because of low stocks of the bivalve (Netherlands Environmental Assessment Agency 2007).

Brown Shrimp (*Crangon crangon*)

Brown Shrimp is a key species in the Wadden Sea ecosystem as an important prey for fish and birds. Brown Shrimps make annual movements between the Wadden Sea and adjacent shallow parts of the North Sea. The Wadden Sea itself is very important as a nursery area for the Brown Shrimp.

Danish fisheries for Brown Shrimp were initiated in the 1960s on an experimental basis. At the end of the 1970s, up to 30 vessels participated in Brown Shrimp fisheries (Kristensen & Hedegaard 2002). Brown Shrimp is fished along the North Sea coast of Denmark from the Danish/German border to Thyborøn in the north. German and Dutch calculations on the Brown Shrimp stocks indicate a biomass in the southern North Sea of between 10,000 and 70,000 tons. Landings of Brown Shrimp by Dutch and Ger-

man fleets are the largest in the EU, followed by Denmark. In 2006, 28 Danish vessels were fishing for Brown Shrimp, and a large number of German vessels (43) and Dutch vessels (73), too, fished shrimps in Danish waters and landed the catches in Danish harbours (ICES 2006). Until recent years, mainly Danish trawlers caught Brown Shrimps in the Danish Wadden Sea, but landings by foreign trawlers have increased and have outnumbered the Danish catch since 2005. Compared to average landings in 1992, Danish trawlers increased landings in 2003 by 41% and foreign trawlers by 71%, with a further strong increase in 2006 (ICES 2006). In 2005, the total Danish landings of Brown Shrimp by Danish and foreign trawlers were 8,748 tons. In 2005, total landings in Germany and the Netherlands were 16,485 tons and 16,142 tons, respectively. British landings are less than 1,000 tons/year. From 1990 to 2005, the total amount of Brown Shrimp landings from the North Sea increased from 12,000 tons to 37,000 tons (ICES 2006). Fishery effort has been rather constant on a high level in the Netherlands, but has increased in Germany and Denmark. A large part of this shrimp fishery is carried out in the western part of the Danish Wadden Sea.

Shrimp fisheries do not only affect the shrimp stock, but beam trawling also has a negative impact on the other benthic fauna. Discard has a negative impact on North Sea flat fish species, as well as on shrimps and other bottom living invertebrates. Undersized shrimps and small fishes thrown over board is largely killed or predated. Discards have most likely a strong effect on bird populations and the ecosystem of the Wadden Sea (Walther & Becker 1997). Especially Lesser Black-backed Gull (*Larus fuscus*) has increased in numbers and spread dramatically in the Wadden Sea, and in the last decades also in the Danish part, and there might be connections to increased shrimp fishery (Koffijberg et al. 2006).



Blue Mussels. Photo: Lars Maltha Rasmussen.



Beam trawler for shrimp fishing leaving the harbour in Havneby, Rømø. Photo: Lars Maltha Rasmussen.



Golden Plovers and Starlings with grazing sheep on Mandø. Photo: Lars Maltha Rasmussen.

In recognition of the impact, beam trawlers have been required to fit a selection grid or sieve net to the trawl since 2003, according to EU regulations. Similar restrictions have been in force in Denmark for a longer time (Kristensen & Hedegaard 2002).

Since 1977, beam trawling has not been allowed east of a so-called "shrimp line" in the Danish Wadden Sea. This restriction prevents a negative impact on the benthic fauna in the inner part of the Danish Wadden Sea, but no Danish research has investigated the impact on the benthic fauna in the open zone, which is protected under both the EC Birds and EU Habitat Directives. According to these directives, shrimp fishery should only be authorized when sufficient and unambiguous proof that it has a negligible effect on the ecosystem has been documented. It is not possible to find documentation that the shrimp fishery in the outer parts of the Danish Wadden Sea does in fact comply with this precautionary principle.

A major bottleneck in ensuring a sustainable shrimp

fishery is the almost complete lack of data and knowledge about precise operations of the fleet and the effects of the fisheries on the stock of Brown Shrimp and the marine ecosystem as a whole (ICES 2006). Hence, more knowledge about the impact on the ecosystem is required.

A substantial part of the fishing takes place at a time when the fishing area sustains internationally important moulting concentrations of Common Scoter and Common Eider. The large number of boats is a potential factor of disturbance to the moulting birds in a period when they are very susceptible to disturbance. This problem needs special attention.

Gaps in knowledge about Blue Mussels, Surf Clam and shrimps

- What is the relative importance of littoral and sub-littoral banks as food for Blue Mussel eating birds? How large a part of the Blue Mussel biomass is actually available as food for birds?



Pied Avocets over the artificial Salt Water Lagoon on Margrethe Kog with windmills in the background. Photo: Poul Reib.

What are the direct and indirect impacts of commercial mussel fishing on the benthic fauna, fish stocks and seabirds?

- How large should marine protected areas in the Wadden Sea area be, and where should they be located to protect biodiversity and enhance surrounding fisheries?
- What is a sustainable fishery for Surf Clam and shrimps, considering the precautionary principle that seabird populations should not be negatively affected?
- Almost complete lack of data and knowledge about precise operations of the shrimp fishing fleet (cf. above).
- How important is disturbance caused by Brown Shrimp and Surf Clam fishing for roosting and moulting sea ducks?

Conservation actions concerning Blue Mussels, Surf Clam and shrimps

- The future quotas and licenses for Blue Mussel, Surf Clam and shrimp fishery should be revised to comply with the precautionary principle following the ruling of the European Court of Justice on the interpretation of the Habitats Directive saying that an activity may only be authorised in an SPA when it is certain it will not affect the environment.
- Control with shrimp landings and fishery efforts should be improved.
- Effective measures to reduce bycatch should be implemented for shrimp fishery to be permitted.

Area management

Change in farming intensity and practice is having an ever-increasing impact on breeding bird numbers and success

in a variety of habitats in the Danish Wadden Sea area. Where grazing has ceased on poor soils, especially on the islands, habitats have changed by becoming overgrown with higher vegetation. Habitats have also been altered by the establishment of spruce and pine plantations and the building of holiday bungalows. There are only scattered data on the status and trends of birds breeding in the dune habitats on the islands. Important breeding birds in these habitats are Eurasian Curlew, Short-eared Owl and Northern Wheatear.

In richer soils, especially in the polders, farming has been intensified considerably (Gram et al. 1990, Falk et al. 1991, Rasmussen & Laursen 2000). Irrigation systems covering considerable parts of the polders have been abandoned, and most areas with permanent grassland have been drained and turned into arable land with high-yielding crops. Increasing farming intensity has caused several species of meadow-birds to decline in numbers and distribution (Rasmussen et al. 2000, Laursen 2005b). Management of meadow-birds has been studied intensively since the beginning of the 1980s (Thorup 2003), and a national action plan for threatened meadow-birds should achieve and maintain a favourable conservation status for species and habitats in the Natura 2000 sites (Asbirk og Pitter 2005). Of the 25 most important meadow-bird sites in Denmark, 12 are concentrated in the Wadden Sea area.

Despite a stable number of grazed sites (Bio/consult 2002), grazing intensity has increased over the last 10-15 years, and now most salt marshes in the Danish Wadden Sea are grazed (Ribe Amt, unpublished data in letter). There is no coherent management of the Danish Wadden Sea salt marshes according to the trilateral policies. Regulation of stocking rates was carried out in two restricted areas (Rømø Dam and Mandø) only after complaints about overgrazing by a local nature protection society.

So far, no initiatives in the area management have been taken as a follow-up on the Trilateral Wadden Sea Plan. A large and expensive scheme in the Varde Å river valley and Ho Bugt area, 'Operation Engsnarre' (Operation Corncrake), based on EU subsidies to reduce farming intensity, has had only little success in managing the area in favour of meadow birds, especially when considering the expense.

This situation is in contrast to salt marsh management in Germany. With the establishment of national parks in the German Wadden Sea and the implementation of trilateral policies aiming at natural salt marshes, an increasing part of the salt marshes has become dominated by a natural morphology and vegetation development (Koffijberg et al. 2005). Grazing was actively stopped on approx. 50% of the salt marshes, and grazing intensity has been reduced in most other parts. These large-scale changes have benefited many breeding birds that favour higher vegetation, while some species, like Pied Avocet and Northern Lapwing, experienced local declines. Higher vegetation has changed conditions for feeding geese especially. Although the geese redistributed over the area, the maximum numbers and the duration of staging have not changed since livestock grazing was reduced.

Of the three mainly herbivore bird species in the Wadden Sea, Dark-bellied Brent Goose and Eurasian Wigeon are decreasing, while Barnacle Goose is increasing in numbers. Limited food resources do not seem to be the main factor causing these trends. Concerning the redistribution of the geese, salt marsh management and the availability of alternative feeding sites have been an issue of discussion. A debate exists as to whether salt marshes should be managed in such a way that they can support maximum numbers of geese in order to reduce feeding in agricultural areas.

Although today's coastal protection works are less dominant in the Danish part of the Wadden Sea compared to most other parts of the Wadden Sea, they have totally altered the habitats and natural environment. The construction of sluices and sea dikes along the major part of the mainland coast and on Rømø and Mandø has weakened the ecological links between the marine systems and the terrestrial systems. In the past, intensive coastal works were carried out to gain land. This approach has changed in accordance with the Wadden Sea Plan since the Stade Declaration was adopted in 1997 and, ideally, coastal protection should allow natural processes to take place, taking into account that the safety of the inhabitants is essential.

In many salt marshes where safety is not an issue, active land aggregation has stopped. One example is that brushwood groynes along the Rømø Dam and on the foreland further than 400 m from dikes are no longer maintained.

However, a massive land aggregation is still in process along the low causeway between Mandø and the mainland. It should be discussed if this activity is in agreement with agreed trilateral policy, which states that "infrastructural works which are necessary for the supply of the islands shall be carried out in a way that the environmental impact on the Wadden Sea is kept to a minimum and permanent, or long lasting, impacts are avoided".

Along the river Vidå, riparian works in terms of dams along the river arms have significantly changed the hydrology and habitats since these measures were initiated at the end of the 1920s. Despite the alterations of the river system, this was the only river where the Houting (*Coregonus oxyrinchus*) survived. Recently, a project that aims at restoring flooded areas has been granted by the EU Life programme. Along the river Kongeå, there are increasing problems in maintenance of the river, because increasing incidents with high water levels are conflicting with farming interests in the area.

Despite the lack of successful restoration projects in the Danish Wadden Sea, the management of the clay pit ponds at Sneum Å (Sneum Engsø) has been very positive. This clay pit, which provided the necessary raw materials for a reinforcement of the sea dike, was managed to the benefit of breeding and roosting birds with breeding islands and hunting restrictions.

Gaps in knowledge about area management

- What are the long-term consequences of improving and maintaining the causeway between Mandø and the mainland coast on hydrological conditions and sedimentation in the tidal areas around the island?
- What is the effect of increasing salinity in salt marshes because of increasing water levels and frequency of storms?
- What can be learned from the studies on the German changes in grazing levels, and how can the objectives of the Wadden Sea Plan be achieved?
- What are the effects of the EU subsidies on the habitat quality for breeding meadow-birds as well as for migratory birds such as ducks, geese and swans?
- What are the practical experiences in managing meadow-bird habitats and restoring grazed habitats on good and poor soil?

Conservation actions concerning area management

- Specifically for Denmark, objectives and management plans need to be developed and executed for salt marsh areas and polders.
- Restoration projects for the lower parts of the rivers should be developed and executed.
- Restoration projects for the polders and marshlands should be developed and executed.
- Management of all clay pits could be improved based on the Sneum Engso model.
- Coordination of the approach in salt marsh management across national borders.
- Implementation of action plans for meadow-birds in the bird protection areas.

Wind energy production and power lines

In the Danish Wadden Sea, the majority of the polders behind the dikes were designated as SPAs following the borders of the already designated Ramsar Site. In Denmark, planning of the open landscape has followed the principle that wind turbines were not allowed in SPAs. Following this policy, the Danish Wadden Sea landscape is largely free from these technical structures, and it seems unlikely that this approach will change in the near future.

Wind farms in low-lying areas just south of Esbjerg, however are placed within such a short distance from the protection area, that they could potentially have an effect on birds' utilization of the adjacent areas (Koffijberg et al. 2003).

In the future, wind farms established in Denmark will be mainly sea-based. It has recently been decided to enlarge the huge wind farm west of Blåvandshuk, just outside the Wadden Sea protection area and the North Sea SPA no. 113.

Between the Wadden Sea conservation area and the open sea SPA no. 113 to the west, there is a distance of between 15 and 20 km (Figure 7). This area could therefore be a possible future location for a sea-based wind farm. From the outline of this SPA (Skov- & Naturstyrelsen 2004), it seems that depths between 20 and 30 m define the eastern border of this area, but there is no articulate argumentation for this specific demarcation. It should be noted that the conservation area in Schleswig-Holstein, west of the islands of Sylt and Amrum, just south of the Danish-German border, has been extended westward to a position corresponding approximately to the eastern border of the Danish SPA no. 113. At present, it seems that different sets of criteria are used on either side of the border to define protected areas,

and that there is a lack of coordination concerning the protected areas in the North Sea.

When considering land-based constructions, the transport of electricity through high voltage power lines is an issue that evokes increasing public attention: mainly due to landscape effects but also due to health concerns. In the Danish Wadden Sea, two large power lines cut across from the mainland to the islands of Rømø and Fanø. The power line to Rømø is placed on the Rømø Dam. Registration of road kills along the Rømø Dam (Sønderjyllands Amt unpubl. data) shows that Red Foxes regularly patrol the dam, probably in search of birds killed by the power line. A previous study showed that a large number of birds were killed, but numbers were difficult to quantify (Gylstorff 1979). The power line to Fanø is carried by large tension towers and crosses an open area of tidal flats and open water. It is very difficult to study the effects of these. Considering the very large number of waterfowl roosting and moving through the areas, these power lines are probably the most inappropriately placed power lines in Denmark.

Modern power cables have reduced the price difference between solutions using overhead conductors and underground cables. The same precautionary principle that applies for wind turbines in the conservation area should be applied to the existing power lines. This approach is also called for in the State Declaration, with the objective to "conserve, restore and develop elements that contribute to the character or identity of the landscape."

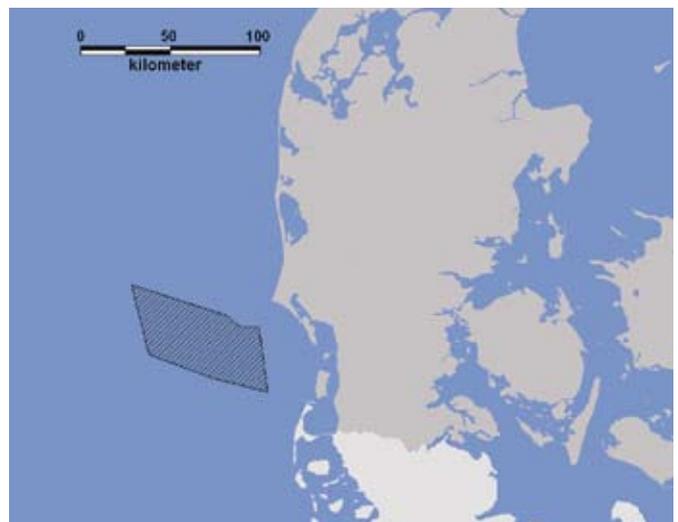


Figure 7: The Danish SPA no. 113 in the southern North Sea covers 2463 km² and target species are Red-throated Diver (*Gavia stellata*) and Little Gull (*Larus minutus*).

Source: Kort- og Matrikelstyrelsen

Conservation actions concerning wind turbines

- Effort should be made to coordinate the designations of the protected areas in the North Sea on both sides of the national borders between Denmark and Germany.
- Overhead conductors crossing the conservation area with high densities of birds e.g. from mainland to Rømø and Fanø should be changed to underground cables within a limited time horizon.



*Fox swims to shore on Langli during the severe winter of 1987.
Photo: Lars Maltha Rasmussen.*

Predation

Predation on nests and young is a growing problem for breeding birds in the Danish Wadden Sea area. Increasing numbers of Red Foxes in the area has had a devastating effect on breeding birds, because foxes have access to all parts of the area. Following campaigns in the period 1964–1984 to eliminate Foxes in southern Jutland to fight rabies, density of foxes increased at least tenfold in a few years (T. Asferg pers. comm.) and foxes colonized polders and salt marshes (Rasmussen 1999). Hence, all colony-breeding species have declined in numbers and have disappeared from a large number of sites. The result is that colony breeders are very restricted in number and distribution compared to the German and Dutch parts of the Wadden Sea. The only exception to this negative trend is the island of Langli, where about 70% of all colony breeders in the Danish Wadden Sea are found on approx. 70 ha. Foxes reach the island across the mudflats almost every winter, but in recent years, more effort has been

devoted to removing foxes from the island, also outside the normal hunting season, to the benefit of the breeding colonies there.

Predation by foxes seems to have reached a level where many territorial breeding species are also negatively affected, both on the islands and on the mainland (Fischer, K. pers. comm., Clausen et al. 2007). The present distribution and high numbers of foxes are mainly a result of a much reduced persecution of foxes combined with construction of dams and coastal protection works, creating better access to former colonies. Flooding control in polders increases the alternative food resources for predators in terms of mice. Fox dens are often found in man-made structures such as ditches, dikes, etc. On Fanø, foxes were probably released in the 1940s (Fischer, K. pers. comm.), and the population density of foxes on that island is particularly high due to a large number of wild rabbits that are also a result of introduction. Before that time, Fanø housed some of the largest colonies of gulls and terns in Denmark. Colony breeders are no longer present on Fanø. Foxes also reach the outlying sandbanks of Keldsand and Fuglsand where colonies of Arctic Tern, Pied Avocet and Common Eider were found in the 1990s.

These conditions should be counteracted by a management strategy aimed at reducing numbers of foxes to a level allowing natural numbers and breeding success for colony breeders to be restored in accordance with the Wadden Sea Plan.

In addition, avian predation – for example by Crows – is on the rise, following an increase in the number of bushes, small trees and new hedges in the former completely open landscapes. This habitat change is a result of several factors, of which some of the most important are drainage, cessation of grazing, increased use of fertilizer and natural succession.

Gaps in knowledge about predation

- When does predation happen?
- How is it possible to reduce the numbers of predators on Fanø, Mandø, Rømø and the mainland?

Conservation actions concerning predation

- Management plans for the marshes and polders should aim at keeping the areas free of bushes and trees and to remove these from large coherent areas designated for meadow-birds.
- Targeted removal of ground predators from islands and other important breeding areas such as clay pits.

Alien invasive species (AIS)

Next after habitat destruction, the spread of alien invasive species (AIS) is recognized as one of the greatest threats to ecosystems around the world (Reaser et al. 2001). Especially in marine ecosystems, the introduction of new species is generally an irreversible process that can have unpredictable and detrimental effects. AIS can change the species composition of an ecosystem by changing the way nutrients are cycled through the system or directly by competing for resources or space (IUCN 2007).

Several of the most conspicuous species settle on Blue Mussel beds, the most obvious species being the Pacific Oyster (*Crassostrea gigas*) (de Vlas et al. 2005). Pacific Oyster was introduced to the Danish Wadden Sea on culture plots in the 1980s (Skov- & Naturstyrelsen 2007a). It was assumed that the species was not able to reproduce at temperatures below 27°C. Sporadic occurrence of the Pacific Oyster in some parts of the Wadden Sea has been recorded for more than 20 years, but a rapid increase in the entire area has been documented only during the last 5 years (Common Wadden Sea Secretariat 2007). In the Danish Wadden Sea, Pacific Oyster biomass has been estimated at a total of 3,300 tons in 2006 (Kristensen & Pihl 2006). Pacific Oyster forms dense reefs with up to 1,000/m² and a biomass of 30–50 kg live wet weight. The Pacific Oyster has almost no natural predators in the Wadden Sea. Predation of small individuals by Eurasian Oystercatcher (*Haematopus ostralegus*) and Herring Gull (*Larus argentatus*) have been observed, but without apparent effect on the oyster's population growth. Most bird species seem to be able to adapt to the appearance of oyster reefs, because they feed mainly on the associated fauna, such as worms and shore crabs. Birds with food preference for Blue Mussels, such as Common Eider and Eurasian Oystercatcher, are not able to use larger oysters as a food resource.



Since the Pacific Oyster only settles on hard substrates, it is feared that they will completely take over many Blue Mussel banks. The question is whether native Blue Mussel beds will disappear from the Wadden Sea or if three types of beds (Blue Mussel beds, Pacific Oyster reefs and mixed beds) will evolve instead cannot be answered at present.

Nehls & Büttger (2007) concluded that there are no management options available, since it will not be possible to remove the Pacific Oyster from the Wadden Sea. Consequently, Pacific Oysters will be a permanent element of the Wadden Sea ecosystem. The spread of the Pacific Oyster in the Wadden Sea must be regarded as the consequence of a careless introduction of an alien species to a sensitive and protected ecosystem and possibly as the largest ecological problem of the Wadden Sea in recent times (J. Frikke, pers. comm.). This underlines the fact that the introduction of alien species in an ecosystem has to be avoided by all possible means. At the moment, the Danish Ministry of Food, Agriculture and Fisheries is examining the possibilities of exploiting the Pacific Oyster for consumption, claiming that the objective is to remove this AIS from the Wadden Sea. At the moment of writing, the Ministry of Environment has not licensed this fishery, because the negative impact on the infauna due to the effect of harvesting the oysters has not been assessed.

Another alien invasive species is the American Razor Clam that inhabits sandy bottoms in the intertidal areas in the inner Wadden Sea and also in subtidal areas in the outer Wadden Sea. This is a long and soft-shelled mussel, and in contrast to the Pacific Oyster, the Razor Clams (*Ensis spp.*) are eaten to a large extent by Common Eiders. This clam seems to replace Blue Mussels as the most important prey in parts of the Danish Wadden Sea at least for some periods (T. Jensen pers. comm.). In addition, Common Scoter has been observed eating Razor Clams (B. Jakobsen pers. comm.).

The ability of Common Cordgrass (*Spartina anglica*) to detain and store large amounts of sediment has involved that the species has been planted out among other sites in the Wadden Sea in connection with land reclamation. Unfortunately, some negative effects have shown to follow the establishment and spreading of the species, among others:

- Change of habitat types and thereby especially a threat against wetlands, salt marsh and intertidal flats
- Loss of valuable habitat for migrating birds, especially waders
- Ousting of indigenous plant species and thus a loss of biodiversity

Eggs from Mallard predated by Crow on Mandø. Photo: Lars Maltha Rasmussen.

- Loss of habitat for fish fry living in shallow water (Skov- og Naturstyrelsen 2007a)
- Also Japanese Rose (*Rosa rugosa*) and Swiss Mountain Pine (*Pinus mugo*) are substantial threats in relation to overgrowing of bird sites and other habitats (J. Frikke, pers. comm.).

Gaps in knowledge about AIS

- To what extent does Razor Clam (and other AIS) play a role as a food resource for shell-eating birds?
- What is the trade-off between the negative impact of oyster fisheries and the possibilities of reducing this element in the Wadden Sea fauna?

Potential conservation actions concerning AIS

- All AIS should be recorded in the Wadden Sea and number/biomass and distribution should be carefully monitored.
- Basic knowledge on all AIS found in the Wadden Sea needs to be collected and a review of possible effects and counteractions should be drafted.
- All possible efforts should be made to avoid future release of AIS whether deliberately or by accident.

Climate change

The effects of climate change are extensively discussed by Reneerkens et al. (2007) and they will probably be generally valid for the entire Wadden Sea. The following additional questions address these serious changes:

- Will the sedimentation in the Wadden Sea follow the rapidly increasing water level – as argued by some geologists – so that only minor habitat changes will follow?
- Which habitats and species are most at risk of disappearing from the Wadden Sea because of climate change?
- What measures could increase the resilience of habitats and species in the Wadden Sea to cope with climate change and sea level rise?
- What actions are required to recreate the full range of coastal landscapes in the Wadden Sea habitats and species distributions to compensate for their loss because of climate change and sea level rise?
- Where can sea-walls be pulled back to allow salt-marshes to re-establish themselves to replace those that will be lost?

*Razor Clams (Ensis directus) washed ashore on Rømø Beach.
Photo: Lars Maltha Rasmussen.*



6. Ranking conservation issues for the Danish Wadden Sea

Based upon the issues discussed in the chapter on management and threats and the species account, the following national conservation issues are proposed as the most important to be addressed when aiming for a better protection of the Danish Wadden Sea. The issues are not listed in order of importance.

- Salt marshes and brackish meadows in the protection area can be considerably improved as a habitat for breeding and migrating birds by targeting management according to the Wadden Sea Plan, especially by grazing management.
- Similarly, polders and brackish or freshwater meadows in the cooperation area that are increasingly subject to intensive farming can be improved as a habitat for breeding and migrating birds with targeted management and appropriate farming practices to reverse the intensification.
- There is a need to improve the ecological links between the marine and terrestrial environments by restoring a more natural tidal influence on estuaries, restoring wetlands, extensification of farming practices and establishment of hunting-free areas, especially in polders.
- Hunting is one of the most disturbing human factors influencing the habitat use and the distribution of waterbirds in polders, salt marshes and in the outer parts of the Danish Wadden Sea causing highly increased flight distances and thereby increasing the effects of other human disturbances. A full-scale experiment studying the effects of the establishment of large hunting-free areas in a polder on the number of birds and species diversity turn-over rate is a priority.
- The impact on natural ecosystems caused by shrimp fishery in the outer parts of the Danish Wadden Sea needs to be thoroughly studied, and management of this fishery should respect the precautionary principle.
- The negative effect on the reproduction of breeding birds in the Wadden Sea due to increasing numbers of ground predators, especially Foxes, should be reduced.
- Power lines across the tidal flats to Fanø and Rømø are constantly killing large numbers of birds. Considering the very large number of waterfowl roosting and moving through the areas, these power lines are probably the most inappropriately placed power lines in Denmark. Due to the precautionary principle, these power lines should be changed to underground cables within a limited time horizon.



Tourists on sandflat near Mandø Ebbevej in the Danish Wadden Sea.
Photo: Lars Maltha Rasmussen.

7. Species account

In this chapter, trends and changes in the numbers of breeding and migrating birds focus on the last 15 years of trilateral governmental cooperation in monitoring birds in the Wadden Sea. When relevant, reference is made to the numbers of migratory birds registered before that period, according to Meltofte et al. (1994). The red list status for all bird species in the international Wadden Sea is given by Rasmussen et al. (1996).

Divers and Grebes (*Gavia spp.* & *Podiceps spp.*)

Migratory

Red-throated Diver (*Gavia stellata*), Black-throated Diver (*Gavia arctica*) and Great Northern Diver (*Gavia immer*) are all wintering in the Wadden Sea east of the islands – the latter though being quite scarce. However, the shallow waters west of the islands hold internationally important numbers of divers. Hence, SPA no. 113 “Southern North Sea” has been designated on the basis of the occurrence of Red-throated and Black-throated Divers.

The divers spend the winter in the southern North Sea off the Wadden Sea in numbers up to 36,000 individuals (Laursen & Essink 2005). 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 of the North Sea off the Wadden Sea (Laursen & Frikke 1987). About 7% of the divers occurred inside, and 93% outside the Wadden Sea Cooperation Area.

Great-crested Grebe (*Podiceps cristatus*) occurs in the Wadden Sea in small and insignificant numbers outside the breeding season.

Gaps in knowledge about divers

- Very little information is available on the numbers as well as on spatial seasonal distribution of divers in SPA no. 113. Nothing is known about the divers' prey selection. There is at present no monitoring of the divers in the area.

Great Cormorant (*Phalacrocorax carbo*)

Migratory, breeding

Great Cormorants have only recently tried to establish colonies in the Danish Wadden Sea. On the island of Jordsand, there were unsuccessful breeding attempts in 1994 and 1995 (Rasmussen et al. 2000). Illegal egg collection probably contributed to these breeding failures and breeding attempts have not been observed on Jordsand since 1995. The sea is eroding the island, and it is now reduced to a small sandbank with limited possibilities for Great Cormorants.

In Magisterkog, which is a polder dominated by reedbeds and a few willow bushes at the Danish–German border, one pair of Great Cormorants made a breeding attempt in 2001.

On Langli, the most important site for colony breeders in the Danish Wadden Sea, a new colony of Great Cormorants was established in 2003. Annual breeding attempts resulted in between 15 and 22 nests. According to a national management plan for Great Cormorants (Miljøministeriet 2002), establishment of new colonies is undesirable. Breeding success was prohibited by the Forest and Nature Agency by spraying the eggs to kill the embryos. Consequently, the Wadden Sea is the only part of Denmark where Great Cormorants have not until now successfully established colonies. This management conflicts with the objectives of the Wadden Sea Plan that aims at providing natural and favourable breeding conditions for all species, including Great Cormorant.

The total population of breeding Great Cormorant in Denmark increased from only 300 pairs in 1971 to a maximum of more than 42,481 pairs in 2000. Since 1997, the large annual increase in numbers has stopped, and the total Danish population has fluctuated between 36,682 and 42,481 pairs (Eskildsen 2006). Hence, the increase in numbers of breeding Great Cormorants that took place in the rest of Denmark was not permitted in the Danish Wadden Sea. The population control, usually by spraying the eggs, was mainly done in colonies in West Jutland and on the Wadden Sea island of Langli (Eskildsen l.c.). The control measures have contributed to a recent decrease in total numbers in Denmark and especially in the western parts of the country (Bregnballe 2006).

The total number of staging Great Cormorants in the international Wadden Sea has increased since the 1980s (Blew & Südbeck 2005), and numbers have increased in all months. This situation also applies for the Danish Wadden Sea. The number of Great Cormorants feeding in the Danish Wadden Sea by far outnumbers

the breeding birds. Great Cormorants peak in July and August with more than 3,000 individuals.

The present management of the Great Cormorants in the Danish Wadden Sea is not based on information about their diet.

Gaps in knowledge about Great Cormorant

- What is the diet composition of Great Cormorants in the Danish Wadden Sea?
- To what extent do the increasing numbers of Great Cormorant influence the fish stocks of migratory species such as Salmon (*Salmo salar*) and Houting (*Coregonus oxyrinchus*), as well as the young of Plaice (*Pleuronectes platessa*), Sole (*Solea solea*) and other fish species depending on the Wadden Sea as a "kindergarten"?
- How can the conflicting management objectives between the Trilateral Wadden Sea Cooperation and the national Danish management plan be solved?

Potential conservation actions for Great Cormorant

- Permit the establishment of some breeding colonies of Great Cormorants in the Danish Wadden Sea to fulfil the Wadden Sea Plan targets: favourable conditions for breeding birds and a natural breeding success. This action can be immediately realized by allowing Great Cormorants to breed undisturbed on Langli, which is a "protected" reserve for birds.

Eurasian Spoonbill (*Platalea leucorodia*) Migratory, breeding

After almost 30 years of absence, a Danish colony of Eurasian Spoonbill was established in 1996 on an island in the Limfjord, about 180 km north-east of the Danish Wadden Sea. In 2002, another colony was established in Ringkøbing Fjord just 40 km north of the Wadden Sea (Skriver 2004). Only 40 km south of the Danish Wadden Sea, a colony of Eurasian Spoonbills on Hallig Oland was established in recent years. Sightings of Eurasian Spoonbills in the Danish Wadden Sea have increased in accordance with the increasing numbers of northerly breeding birds. Therefore, it was not surprising that a group of eight adult birds was seen on Langli for the first time on May 18th 2007, when copulation was also observed. Two pairs laid eggs, but on June 27th the nests were flooded by an extreme high tide and breeding was unsuccessful (pers. obs.). This is probably the first colony of this species in the Danish Wadden Sea. There seem to

be optimal feeding conditions in the surroundings of Langli, especially at Skallingen, a peninsula with many natural gullies, and in Ho Bugt, a large bay with extensive soft mudflats. It is quite possible that Eurasian Spoonbills will try to establish a colony here in coming years.

Although Langli is part of a scientific reserve with restricted public access, the new colony is exposed to human disturbance, since no warden is living on the island. The establishment and success of a new colony of Eurasian Spoonbills could be threatened by an increasing number of visits, especially by boats, in spite of the ban on access during the breeding season.

At present, there are no other sites in the Danish Wadden Sea where foxes are absent. Areas like Sneum Engsø, Lakolk Sø on Rømø and islands in Margrethe Kog are potential future breeding sites, providing they are kept free of foxes.

Potential conservation actions for Eurasian Spoonbill

- Manage potential breeding sites on islands to remove or minimize the occurrence of Red Foxes and human disturbance.

Dark-bellied Brent Goose (*Branta bernicla bernicla*) Migratory

The Brent Goose occurs in two distinct populations in the Danish Wadden Sea: the nominate race of the Brent Goose, the Dark-bellied Brent Goose, and the Spitsbergen population of the Light-bellied Brent Goose.

The Dark-bellied Brent Goose is widespread in Denmark on migration from the end of September to the end of May. The Danish Wadden Sea holds the most important spring staging sites for this species in Denmark, accounting for approx. 75% of the goose days (Madsen et al. 1990, Ebbsing et al. 1999). The Dark-bellied Brent Geese migrate rapidly through the Danish Wadden Sea in autumn, to winter south of the area (Blew & Südbeck 2005, Koffijberg & Günther 2005). In mild winters, a maximum of 1,600 birds may be found in the Danish Wadden Sea, but all leave in cold winters. As in the other parts of the Wadden Sea, numbers peak during spring migration.

During autumn migration, the Dark-bellied Brent Geese forage primarily in the tidal zone, the southern part of the Wadden Sea being the most important Danish staging area. Madsen (1988) showed that the numbers of both Brent Geese and Eurasian Wigeon were dependent on the quantity of food. There was an inter-specific competition for the food resources between Eurasian Wigeon and

Dark-bellied Brent Goose. Hunting in the studied feeding areas prevented the birds from making optimal use of the food resources and caused them to leave for the southern wintering areas early and before depletion of accessible intertidal food resources.

With up to 24,000 individuals, the numbers of Dark-bellied Brent Geese in the Danish Wadden Sea in spring are much lower than in the German holligen in Schleswig-Holstein (Blew & Südbeck 2005). Overall, spring numbers have declined since the mid-1990s, and the decline has mainly taken place in the salt marshes on the mainland coast. In contrast, numbers have been stable on Langli and have increased on Mandø. A rather similar development has taken place in the Wadden Sea in Schleswig-Holstein and the Netherlands.

In spring, the Dark-bellied Brent Goose gradually shift to forage on salt marsh. Since 1985, increasing numbers of Dark-bellied Brent Geese have been feeding on permanent, non-saline and often fertilized pastures, especially in the polders on Mandø (Madsen et al. 1990, pers. obs.). Madsen et al. (1990) showed that only on Langli did grazing intensity of the Dark-bellied Brent Goose reach a level (approx. 1,000 goose days per hectare) where food resources limited their number.

The displacement towards the islands coincides with a dramatic increase in numbers of Barnacle Geese (*Branta leucopsis*). Barnacle Geese occur almost entirely on the mainland, but in spring 2006 and 2007, Barnacle Geese by far outnumbered Dark-bellied Brent Geese on Mandø, which is the most important spring staging site in the Danish Wadden Sea for this species. Maximum numbers on Mandø in spring 2007 were 3,000 and 13,000 for Brent and Barnacle Geese, respectively. These increases in numbers of geese have led to complaints about crop damage by local farmers. Increasing numbers of Barnacle Geese and their much later departure in spring may lead to interspecific competition with Brent Geese, forcing Brent Geese to move to less optimal feeding areas. Madsen et al. (1990) found that food resources were not a limiting factor up to 1990, but in the same period numbers of feeding geese did not increase in correspondence with increasing flyway numbers. They found that disturbance could play a role, but did not find any conclusive answers.

Gaps in knowledge about Dark-bellied Brent Goose

- How are spring feeding conditions changing for Dark-bellied Brent Geese, with increasing numbers of Barnacle Geese and a shift from mainland sites towards islands?

- Do the two species compete for the same food resources or does grazing of Barnacle Geese facilitate grazing of Brent Geese?
- Do spring feeding possibilities affect breeding fitness?
- How can conflicts with farmers be mitigated?
- Does overgrazing of forelands force Brent Geese to forage in the polders?

Potential conservation actions for Dark-bellied Brent Goose

- Identify key feeding sites for Dark-bellied Brent Goose and manage these to prevent human disturbance in the period March to May, when feeding before migration to the arctic breeding grounds is essential.
- Manage present key feeding sites and potential feeding sites, especially in polders, in such a way as to avoid conflict between the interests of farmers and geese.
- Establish management for the co-existence of farmers and geese through balanced management schemes, especially in agricultural feeding areas adjacent to salt marshes. This would also be beneficial to the target of natural flight distances (see chapter on disturbances).

Light-bellied Brent Goose (*Branta bernicla hrota*) Migratory

The "Danish" population of Light-bellied Brent Goose breeds in Spitsbergen, north-east Greenland and Franz Josef Land. Outside the breeding season, Light-bellied Brent Geese occur regularly in smaller numbers in the northern part of the Danish Wadden Sea from Ho Bugt to the northern Juvre Dyb tidal basin, and especially east of the islands of Fanø and Mandø (Clausen et al. 1999). In very cold winters, a large percentage of the birds leave the northern parts of Denmark to winter on Lindisfarne, eastern England, but also in the Wadden Sea, both in Denmark and especially in the Netherlands.

A population increase followed full protection from hunting in Denmark in 1972. Since the mid-1980s there has been a major shift in winter distribution. It is believed that before the 1970s, the entire population of Light-Bellied Brent Goose arrived in the Wadden Sea directly from the breeding grounds in Spitsbergen as early as late August. Since the mid-1980s, numbers of Light-bellied Brent Geese in the Wadden Sea have decreased, whilst numbers have increased elsewhere in the western and northern parts of Denmark. The possible cause for this recent decline in the Wadden Sea appears to be deple-



Shelduck probably killed and eaten by a Peregrine Falcon at Langli.
Photo: Lars Maltha Rasmussen.

tion of sea-grass (Clausen & Fischer 1994). At present, the hunting restrictions in force seem to be sufficient to protect the Light-bellied Brent Goose.

Gaps in knowledge about Light-bellied Brent Goose

- Since the occurrence of this subspecies in the Danish part of the Wadden Sea is linked to the availability of sea-grass, it is essential to know more about the reasons for the changes in sea-grass biomass and about the annual variation of sea-grass in the Wadden Sea.

Potential conservation actions for Light-bellied Brent Goose

- Possibilities for improving conditions for the Light-bellied Brent Goose in the Wadden Sea depend on measures to increase the biomass of sea-grass.

Barnacle Goose (*Branta leucopsis*)

Migratory, breeding

The Danish Wadden Sea is an important staging area for the Russian-Baltic population of Barnacle Goose (*Branta leucopsis*) that use the Wadden Sea in spring and autumn as a

staging area. Smaller numbers stay during winter. Since the early 1900s, a considerable increase in the flyway population caused the Barnacle Goose to expand from the German to the Danish Wadden Sea and further up the Danish west coast (Blew & Südbeck 2005). Until 2000, maximum numbers were below 30,000 individuals for the Danish Wadden Sea, but since then this number has often been exceeded in each of the largest sites: Margrethe Kog, Ballum Enge and Ribemarsken. In April 2007, a total of more than 100,000 were counted simultaneously in Margrethe Kog and Ballum Enge.

With the increase in numbers, Barnacle Geese have delayed their spring departure from the Wadden Sea, now leaving about 4-6 weeks later than in the mid-1990s. The peak of spring-staging birds has shifted from the end of March to the end of April or early May.

A majority of the geese feed on salt marshes, but just after arrival in September/October and in spring prior to departure in May many birds also feed on semi-natural grassland in Margrethe Kog and in other polders. Barnacle Geese favour feeding sites along the mainland coast in contrast to Brent Geese. In spring 2007, more than 10,000 individuals occurred on the islands of Mandø. As discussed in the chapter on Dark-bellied Brent Goose, this very large number of Barnacle Geese may have lead to competition between the two species.

Because of the increasing numbers and the extended staging period, complaints from farmers about crop damage have increased in recent years.

Barnacle Geese have expanded their breeding range dramatically. Since the mid-1980s, a Baltic breeding population centered on the island of Gotland has built up. The breeding range has even expanded into the Wadden Sea. During recent years, several breeding attempts may have taken place in Margrethe Kog, and in 2007 the first nest of a Barnacle Goose was found on the island of Langli. The breeding attempt was not successful, as the nest was flooded in June.

Gaps in knowledge about Barnacle Goose

- To what extent do Barnacle Goose and Dark-bellied Brent Goose compete for food?
- Do limitations in food availability trigger a shift from mainland sites towards island sites?
- How does grazing of livestock facilitate or compete with grazing of Barnacle Geese?

Potential conservation actions for Barnacle Goose

- Manage present key feeding sites and potential feeding sites, especially in polders, in such a way as to avoid conflict between the interests of farmers and geese.

Common Shelduck (*Tadorna tadorna*)

Migratory, breeding

With more than 350 pairs, the Wadden Sea area is one of the main strongholds for the Danish breeding population of this species. There is, however, considerable uncertainty about the actual number of breeding pairs and trends are very uncertain. Numbers might be considerably higher.

Increasing numbers of Common Shelduck are moulting as early as June in the Danish Wadden Sea, where more than 10,000 are found. It has been discussed if increasing disturbance in the most important moulting grounds in the German parts of the Wadden Sea is the main reason for this change in distribution (Blew & Südbeck 2005). In addition, wintering numbers in the Danish part of the Wadden Sea have been increasing over the past years as in other parts of the Wadden Sea.

Gaps in knowledge about Shelduck

- What are the reasons for increasing numbers of moulting Shelduck in the Danish Wadden Sea?
- Where are the most important moulting and wintering areas and the potential disturbances of Shelduck from increasing recreational activities?

Eurasian Wigeon (*Anas penelope*)

Migratory, breeding

On arrival at the Wadden Sea in September, Eurasian Wigeon mainly feed on sea-grass beds together with Brent Geese. When this food source is quickly depleted, they feed on salt marshes where seeds of many plants ripen. Numbers of Eurasian Wigeon peak in the Danish Wadden Sea in September–November with a peak number of 36,700 counted on October 1st, 2006 (DOFbasen), and as food resources on the salt marsh become scarcer, the birds move on to feed inland in polders, preferably on improved grassland (see Figure 8). In autumn, a large number of the Eurasian Wigeons move inland at night to feed (Meltotte et al. 1994).

Eurasian Wigeon are very susceptible to disturbance (Koffijberg et al. 2003). In winter, their herbivorous diet necessitates them to feed up to 20 hours daily, and they require relatively undisturbed areas with near by bodies of water to feel safe. Disturbance, and especially hunting, will prevent the birds from using an area. Hunting in the Danish Wadden Sea probably reduces numbers of Eurasian Wigeon significantly, especially along the mainland coast where they are heavily hunted (Laursen 1985).

Since 1997, as a response to new hunting-free areas in parts of the salt marsh, numbers of Eurasian Wigeon have increased along the Danish mainland coast, but in late autumn, when they prefer feeding on grassland, hunting in the polders does not allow the birds to stay. Only in Margrethe Kog, where hunting is prohibited, do birds concentrate in freshwater areas late in autumn and in winter. Compared to Schleswig-Holstein, numbers of wintering Eurasian Wigeons are still relatively low (see also chapter on hunting page 21).

In the years 2002–2005 a few pairs of Eurasian Wigeon were observed at the island of Mandø under circumstances indicating breeding (DOFbasen, N. Knudsen, pers. comm.).

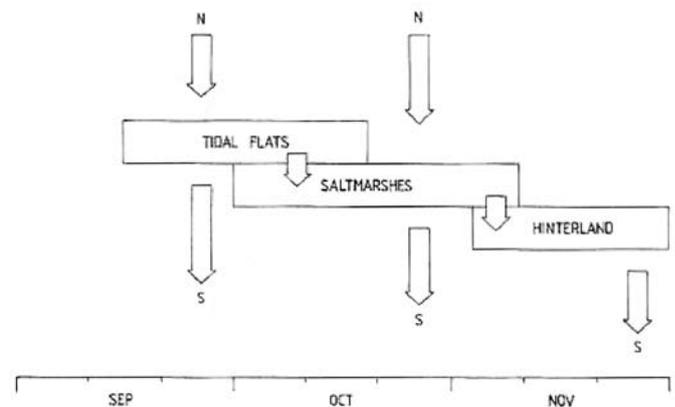


Figure 8: A generalized outline of movements between habitats for Eurasian Wigeon during the autumn season in the Danish Wadden Sea. Source: Madsen 1988.

Gaps in knowledge about Eurasian Wigeon

- Does hunting cause the number of wintering Wigeon in the Danish Wadden Sea to be much below the carrying capacity of the habitats, as an effect of disturbance?
- How large should hunting-free areas in the polders be to allow significant numbers of Eurasian Wigeon to feed and roost there in autumn and winter?

Potential conservation actions for Eurasian Wigeon

- Identify key feeding sites for Eurasian Wigeon on the mainland (covering both mudflats, saltmarshes and wet inland grasslands) and manage these in such a way as to prevent human disturbance in autumn and winter and to avoid future conflict between the interests of farmers and Eurasian Wigeons.

Common Eider (*Somateria mollissima*)

Migratory, breeding

Common Eiders wintering in Denmark and the Danish Wadden Sea breed in Sweden, Finland, other Baltic countries and Denmark (Noer 1991). The birds move between the North Sea, the Kattegat and the Baltic Sea directly across Jutland. Larger numbers arrive at the Danish Wadden Sea in early November and usually peak in January. The majority of Common Eiders leave the Danish Wadden Sea in late February or early March (Meltofte et al. 1994). There are also significant post breeding moult concentrations in July and August in the Danish Wadden Sea. A maximum of 20,000 was counted in August 1983, but since 1992 numbers have decreased and now do not exceed 7,000. In the Danish Wadden Sea, the Lister Dyb tidal basin is the most important moulting area (Koffijberg et al. 2003)

Aerial mid-winter surveys in the Danish Wadden Sea recorded approx. 50,000 Common Eiders from 1965 to 1973 (Joensen 1974). When the fishery for Blue Mussels collapsed in The Netherlands in 1983, large numbers of Dutch and Danish fishing boats exploited the Blue Mussel stocks in the Danish Wadden Sea instead, leading to over-fishing of the stocks in 1987. Immediately, this had a very serious impact on the numbers of Common Eiders in the Danish Wadden Sea (Laursen & Frikke 1987). Since 2001, the biomass of Blue Mussels has decreased further to only about 10% of the average level in the period 1986–2004 (Kristensen et al. 2005), and numbers of Common Eiders have declined further.

Since the middle of the 1990s, Common Eider populations wintering in the Danish waters have halved from approx. 800,000 in 1990 to only 370,000 in winter 2000 (Desholm et al. 2003). Laursen & Frikke (2006) found, however, that despite the overall population decline, Common Eider numbers in the Danish Wadden Sea were stable from 1980 to 2000, but that the distribution within the Danish Wadden Sea changed considerably. In 1992, hunting from motorboats was banned between the mainland coast and the islands, and since then Common Eider numbers have been correlated with the Blue Mussel biomass and distribution, suggesting that before 1991 Common Eiders were displaced by hunting from motorboats. It further indicates that food is a limiting factor and could explain large fluctuations in numbers in the northern part of the Danish Wadden Sea. Hunting may still displace Common Eiders from important sources of food west of the islands, where sea duck hunting from motorboats is still allowed. In addition, Laursen et al. (1997) found a negative relationship

between the number of moulting Common Eiders and the number of boats at sea.

Common Eiders have compensated for lower food stocks in the Dutch Wadden Sea to some extent by feeding on less profitable *Spisula* banks in the adjacent coastal zone of the North Sea (Kats 2007). This is probably true also for Common Eiders in the Danish Wadden Sea, where Common Shore Crab (*Carcinus maenas*) and American Razor Clam (*Ensis americanus*) have also periodically been found to be of major importance as food (T. Jensen, pers. comm.).

Common Eiders breed in the Danish Wadden Sea in colonies on the islands of Mandø and Langli. Small groups or single pairs breed on Fanø and Rømø together with very few on the mainland. Monitoring of breeding Common Eider on Mandø, the most important site, is irregular and methods have changed, which hampers the trend analyses for the Danish Wadden Sea. Based on adult males on and near the island, a maximum of 682 pairs was counted on Mandø in 1999. On Langli, numbers increased from 10–20 pairs in the early 1990s to 130–196 in 1997–2004 due to protection of the breeding birds on the island. Historical data for breeding Common Eiders before the 1960s are largely lacking. It is assumed that numbers of breeding Common Eiders have declined considerably on Rømø and Fanø after the 1940s when Red Foxes reached the islands.

Gaps in knowledge about Common Eider

- Annual and methodologically consistent counts are needed to clarify how the breeding population of Common Eiders is developing in the most important colony on Mandø.
- What is the reproductive output of Common Eider breeding in the Danish Wadden Sea in terms of fledged young?
- How important is feeding on other food resources than the Blue Mussel?
- How does hunting of Common Eider in the Danish Wadden Sea affect the Wadden Sea breeding population?
- How does hunting in the outer Danish Wadden Sea affect feeding possibilities and numbers of wintering Common Eiders?
- What is the effect of the present fishery for Blue Mussels on numbers of wintering and breeding Common Eiders?
- Does current fishery for shrimps or *Spisula* have an impact on numbers and distribution of Common Eiders?



Redshanks near high tide resting area north of Kongeåslusen. Photo: Lars Maltha Rasmussen.

Potential conservation actions for Common Eider

- Creation of breeding sites free of Red Foxes on the large islands of Rømø and especially on Fanø could improve conditions for breeding Common Eiders considerably.
- Common Eider hunting within the conservation area of the Danish Wadden Sea to be stopped.
- The risk of oil spills from the North Sea oil industry and from vessels, especially during disasters, to be reduced.
- Reductions in the Blue Mussel fishery.

Common Scoter (*Melanitta nigra*)

Migratory

Danish seas hold the largest known concentrations of Common Scoter. The largest concentrations are found in the Kattegat and west of the Wadden Sea islands. West of the Danish Wadden Sea coast, up to 200,000 Common Scoters can be found (Laursen & Frikke 1987), and numbers here are of outstanding international importance (Sheiffart & Frank 2005). The moulting area west of the Danish Wadden Sea is the most important in the international Wadden Sea and probably the most important for this species (Figure 9 & 10). As early as June, very large

numbers arrive to moult flight feathers, and peak numbers are found in October. The moulting period is long and lasts until October, with adult males moulting first, followed by adult females and juveniles. The majority of the scoters are found at depths between 2 and 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% west of the Wadden Sea.

Common Scoters are dispersed in large, more or less dense flocks at some distance from the coast. Counting of these flocks from land is not possible (Blew & Südbeck 2005). Only special counts from an aeroplane cover this species well (Petersen 2004). Numbers of Common Scoters are often underestimated because of these difficulties. Common Scoters feed on mussels, primarily Surf Clam (*Spisula subtruncata* or *S. solida*) but Razor Clam is also taken (Mardik et al. 2007). According to other sources, Razor Clam may be the most important prey for Common Scoter (H. Skov, pers. comm.).

The importance of the Wadden Sea for moulting Common Scoters decreases from Denmark over Germany to the Netherlands. In the northern part of the Wadden Sea, an extensive area has water depths below 10 m.

Common Scoters are especially sensitive to disturbances from, for example, shipping, low-flying aircraft and oil

dumps (Blew et al 2005). Construction of marine wind farms within the 12 mile zone can potentially reduce the areas available to moulting Common Scoters (Koffijberg et al. 2005, Petersen 2004) and there is no knowledge about the collision risk. Common Scoter is also very sensitive to oil spill, and this is probably one of the most important mortality factors.



Figure 9: Moulting distribution of Common Shelduck, Common Scoter and Common Eider. Size of circles is proportional to the importance of the moulting site for each species. Source: Koffijberg et al. 2005.

Gaps in knowledge about Common Scoter

- What is the effect of the present fishery for Surf Clam (*Spisula*) and shrimp on numbers of moulting and wintering Common Scoter?

Potential conservation actions for Common Scoter

- The risk of oil spills from the North Sea oil industry and from vessels, especially during disasters, to be reduced.
- A proper management of *Spisula* fishery needs to be developed to ensure compliance with the target of having favourable food availability especially for the Common Scoter.
- Establishment of zones with no shrimp fishing, especially during the very sensible moulting period.

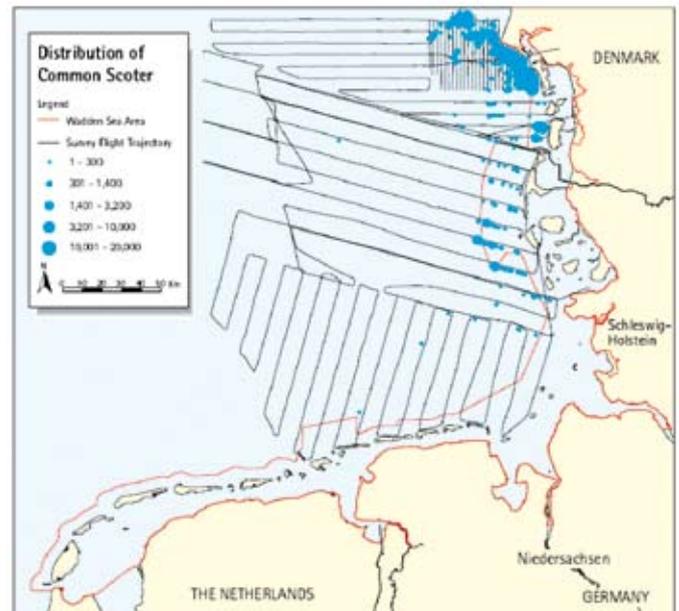


Figure 10: Geographical distribution of Common Scoter in the SE North Sea off the Wadden Sea, March 2002. Black lines: flight routes. Red line: Trilateral Cooperation Area. Data: MINOS (Germany), National Environmental Research Institute and Elsam Engineering A/S (Denmark). Source: Laursen & Essink 2004.

Other diving ducks

Smew (*Mergellus albellus*) occurs in very small numbers in the river mouths in the Wadden Sea. The three species of diving duck Common Goldeneye (*Bucephala clangula*), Red-breasted Merganser (*Mergus serrator*) and Goosander (*Mergus merganser*) occur regularly in small numbers in the Danish Wadden Sea. In cold winters, numbers increase, as more birds wintering in the inner Danish waters move to the Wadden Sea. It seems that larger numbers of these species occur west of the islands than inside the Wadden Sea. There is no information on the diet of these species of diving ducks from the Danish part of the Wadden Sea. Red-breasted Merganser is probably an annual breeder in the Danish Wadden Sea numbering less than 10 pairs.

Greater Scaup (*Aythya marila*) winters regularly in quite small numbers behind the islands in the Danish Wadden Sea. In Ho Bugt, a group of less than 100 birds is found annually. Greater Scaup might be far more common west of the islands in the North Sea, where they can be difficult to detect far from land and mixed in much larger flocks of Common Scoter (*Melanitta nigra*).



Newly hatched Lapwing pullus. Photo: Lars Maltha Rasmussen.

Peregrine Falcon (*Falco peregrinus*) **Migratory, breeding**

The Peregrine Falcon disappeared completely as a breeding bird in Denmark in 1972. Before then, the species was a rare breeder with less than 10 pairs. However, since 2002, pairs have bred with success in the eastern part of the country.

In recent years, Peregrine Falcons have bred in metal towers and on the ground on sandbanks in the Wadden Sea of Schleswig-Holstein. A few years ago, a pair of Peregrine Falcon started building a nest at a sand bank in the Danish Wadden Sea, but the pair did not succeed in breeding (K. Fischer & N. Knudsen, pers. comm.). Thus, there is no historical evidence of breeding in the Danish Wadden Sea, but with the spreading of breeding pairs and increasing numbers present throughout the year it is to be expected that Peregrines will breed in the Danish Wadden Sea area in the near future. In 2007, an artificial nesting box was put up on a power plant in Esbjerg.

Increasing numbers of Peregrines are seen in the Danish Wadden Sea, and it is estimated that up to 20 individuals can be present at the same time. Peregrine Falcons often hunt on high-tide roosts and presence of raptors, especially Peregrine Falcon, was found to be the most important disturbing factor on a high-tide roost (Laursen & Rasmussen 2002).

Gaps in knowledge about Peregrine Falcon

- What limits the resettlement of the Wadden Sea area by breeding Peregrine Falcon?

Montagu's Harrier (*Circus pygargus*) **Breeding**

Montagu's Harrier is a ground-breeding raptor of open landscapes. The species is on the annex I of the European Birds Directive. The Wadden Sea area with polders is the most important Danish breeding area of this species. In 2006, 66% of the Danish pairs were breeding within the SPAs in the Wadden Sea area.

Numbers of Montagu's Harrier have decreased from about 40–50 pairs around 1975 to 25 pairs in 2007 (Rasmussen 2007a.). As in most parts of Western Europe, Montagu's Harriers breeding in Denmark have substituted nesting in natural habitats by nesting in farmland crops. Degradation of farmland habitat and loss of clutches due to farming activities are believed to be the key factors responsible for the decrease in numbers. Only constant annual efforts in locating nests in farmland have prevented a larger decrease in numbers.

There is substantial knowledge about which measures should be taken around the nesting place to improve conditions for breeding success (Rasmussen 2006). However,

specific knowledge and practical experience in increasing farmland habitat quality is lacking from Denmark. Dutch experiences show that protection of the nesting sites combined with improvement of farmland habitats on a landscape scale is necessary to turn the negative trend (Koks & Visser 2002).

Gaps in knowledge about Montagu's Harrier

- Where is the bottleneck for this long distance migrant? Mortality on migration and in winter, or reproductive output on the breeding grounds?

Potential conservation actions for Montagu's Harrier

- International cooperation on the protection of the species.
- Ongoing protection of nest sites – at least till the population is stable and growing.
- Improvement of farmland habitat.
- Increasing public awareness of the special protection needs of this species.

Hen Harrier (*Circus cyaneus*)

Migratory, Breeding

During the 1990s, the Hen Harrier spread as a breeding bird from the south-western Wadden Sea islands to Denmark, where the first breeding attempt was made in 1996. Breeding occurred regularly at two sites until 2001. Since then, the Hen Harrier has not bred in the Danish Wadden Sea area. Montagu's Harrier stopped breeding on the same sites at the same time. The reason is thought to be predation and human disturbance (Rasmussen 2003).

Small numbers of hen harriers regularly feeds in the polder areas and on the islands during the winter, as well as during spring and autumn migration.

Marsh Harrier (*Circus aeruginosus*)

Breeding

Marsh Harriers are not monitored in the Danish Wadden Sea. Despite the fact that the Marsh Harrier is listed on annex I of the EU Bird Directive, there are no reliable estimations of this species.

Eurasian Oystercatcher (*Haematopus ostralegus*)

Migratory, breeding

Eurasian Oystercatcher is a very characteristic breeding bird in the Danish Wadden Sea. The number of breeding

Eurasian Oystercatcher has decreased from 2,938 pairs in 1996 to 2,318 pairs in 2006 (Thorup 2007). This development is parallel to the rest of the Wadden Sea.

Large numbers pass through on migration and winter here as well. Only in cold winters numbers are low in the Danish Wadden Sea. Maximum numbers were up to 60,000 in September 1981 (Meltofte et al. 1994), but not over 44,000 from 1992-2000 (Blew & Südbeck 2005). These numbers qualify Eurasian Oystercatcher to be the second most numerous wader species, only outnumbered by Dunlin. Laursen & Frikke (2006) found that the trend for Eurasian Oystercatchers roosting in the Danish Wadden Sea had increased slightly in the period 1980-2000, and this was negatively correlated with the general Wadden Sea trend but positively correlated with the Blue Mussel biomass. The trend since 2000 has not yet been analyzed.

Gaps in knowledge about Eurasian Oystercatcher

- What are the reasons for the decline in breeding numbers in the Danish Wadden Sea?
- What is the breeding success for Eurasian Oystercatchers in the Danish Wadden Sea?
- What kind of salt marsh management will improve conditions for breeding Eurasian Oystercatcher?
- What is the recent trend for migrating Eurasian Oystercatchers in the Danish Wadden Sea?

Pied Avocet (*Recurvirostra avosetta*)

Migratory, breeding

The Danish Wadden Sea is by far the most important breeding and moulting site for Pied Avocets in Denmark. Numbers of breeding Pied Avocets in the Wadden Sea area peaked around 1991 with 1,133 pairs (Fleet et al. 1994, Thorup 2005). In 2006, the breeding number was reduced to 573 pairs. The largest colony in Margrethe Kog had very poor breeding success. The preferred feeding habitats are along the mainland coast and, here, colonies decreased or disappeared. On Langli, Mandø and Rømø, where predators are less numerous, numbers have increased, but this could not compensate for the loss of breeding sites on the mainland. It is assumed that predation by increasing numbers of Red Foxes plays an important role, but increased incidents of flooding in the breeding season also seems to be important.

In July-August around 7500 avocets uses the Danish Wadden Sea as a moulting area (Meltofte 1993), peak numbers recorded from land in 2005 being around 8000



Pied Avocets. Photo: Lars Maltha Rasmussen.

(DOFbasen). They are nearly all concentrated at the Rømø Dam while Ho Bugt formerly was an important moulting area too. In the Danish Wadden Sea as a whole the highest number of staging avocets ever recorded is 11.300 estimated by aerial survey 1980-91 (Meltofte 1993). A few thousand birds stay in the Danish Wadden Sea during September and October, and the last few birds leave the area during the first half of November. Occasionally single individuals winter in Denmark. Spring counts rarely exceeds the size of the local breeding population. The autumn trend has been negative in accordance with the rest of the Wadden Sea.

Gaps in knowledge about Pied Avocet

- What is the breeding success of the Pied Avocets in the Danish Wadden Sea and how does human disturbance and increasing flooding events affect breeding success?

Potential conservation actions for Pied Avocet

- It is possible to improve breeding conditions for Pied Avocets by creating more breeding islands free of predators in clay pit ponds.
- Existing breeding islands where vegetation has grown too high should be managed in favour of breeding Pied Avocets.
- Reduction of the overall level of predators, especially Red Foxes, will favour breeding Pied Avocets.

Great Ringed Plover (*Charadrius hiaticula*) Migratory, breeding

In 2006, only 122 pairs of breeding Great Ringed Plovers were found in the Danish Wadden Sea. This is only half the number found in 2001 and 44% of the number in 1996. Numbers declined in most places, and breeding pairs in farmland behind the dikes had almost completely vanished. The breeding population belonging to the subspecies *hiaticula* has shown a negative trend for a number of years, not only in the Wadden Sea (Koffijberg et al. 2006). The negative trend has been attributed to disturbances, especially on important breeding sites on the sandy beaches, but the recent decline is mainly in rather undisturbed habitats.

On migration through the Danish Wadden Sea, Great Ringed Plover peak in May and August with approx. 2,000. The majority are probably the northern subspecies *tundrae*.

Gaps in knowledge about Great Ringed Plover

- What are the reasons for the decline in the breeding numbers in the Wadden Sea?
- Is the recent negative trend an effect of breeding conditions in the Wadden Sea or the conditions outside?

Kentish Plover (*Charadrius alexandrinus*)

Breeding

The Kentish Plover is a rare breeding bird in the Wadden Sea area. The breeding sites in the Danish Wadden Sea are the only ones left in Denmark, in contrast to a couple of decades ago when some breeding pairs were also found on several other coastal sites, especially along the west coast of Denmark. Breeding numbers in the Wadden Sea area were low at the beginning of the 1990s, but peaked in 2000 with 105 pairs. This was most likely a result of displacement of breeding pairs from Schleswig-Holstein, where vegetation in newly embanked areas developed in disfavour of breeding Kentish Plovers (Rasmussen et al. 2000). In 2006, numbers decreased to only 47 Danish breeding pairs.

By far the most important breeding sites are found in areas on the broad beaches on Rømø and Fanø, but the population on Fanø has almost disappeared. Predation by Red Foxes is the main reason for this, despite some protection efforts with fencing in of nests. On the beaches of Rømø, flooding and disturbance are recorded as negative factors.

Gaps in knowledge about Kentish Plover

- What is the breeding success of Kentish Plovers in the Danish Wadden Sea area?
- What can be done to reduce predation on Kentish Plovers on Fanø?
- Are the negative trend and the restricted distribution an effect of breeding conditions in the Wadden Sea or conditions outside?

Potential conservation actions for Kentish Plover

- Fencing in and monitoring of important breeding areas for Kentish Plover.

Eurasian Golden Plover (*Pluvialis apricaria*)

Migratory

Denmark is a key area for moulting and migrating Eurasian Golden Plovers. During autumn, the NW European *P. a. altifrons* population from northern Scandinavia and western Russia mixes with the much smaller population of *P. a. apricaria* which breeds in southern Scandinavia, the Baltic States, Germany and Denmark. These two flyway populations form a 'Continental group' that migrates through Denmark and the Wadden Sea. In August, adult Eurasian Golden Plovers arrive from breeding grounds and

complete their moult in the western parts of Denmark including the Wadden Sea area. In August 1996, 13,700 Eurasian Golden Plovers were recorded in the Danish part of the Wadden Sea including the polders. Juveniles start arriving in September, and during October and November large numbers of Eurasian Golden Plovers migrate through Denmark and stay until the first night frosts occur (Meltøfte 1993). Numbers in the Danish Wadden Sea peak in November.

On an internationally coordinated count in October 2003 the Danish Wadden Sea and polders held large concentrations, and 81,000 were counted here (Rasmussen 2007b). Of these, only 4,400 were actually counted in the saline parts of the Danish Wadden Sea including the salt marsh areas outside the dikes. The rest was concentrated in very large flocks in the polders. Regularly, 50,000 Golden Plovers are found in the Danish Wadden Sea with the largest concentration on two sites: Tøndermarsken and Ballum Enge. Trend estimates for the Wadden Sea during 1992-2002 indicate a fluctuating but slightly decreasing, not significant trend for peak months (Blew & Südbeck 2005).

Although the most important feeding areas are on grassland, feeding on mudflats occurs regularly in the Danish Wadden Sea. It is not known if feeding on mudflats has increased in the past years as observed in other parts of the Wadden Sea (Krüger 2004), but feeding on mudflats seems to be essential for the relatively small number of wintering Eurasian Golden Plovers in the Danish Wadden Sea.

Since the beginning of the 1980s, numbers of autumn moulting and staging Eurasian Golden Plovers have increased by 177% in Denmark as a whole. The large increase has occurred only outside the Danish Wadden Sea. The increase in numbers in the rest of Denmark is thought to reflect an overall population increase combined with a general ban on hunting in 1982 and the establishment of a large number of hunting-free areas in Denmark during the 1990s. Hunting has been banned in approx. 50% of the salt marsh areas in the Danish Wadden Sea, but in the more important inland areas, disturbance by hunting activities has not changed over the past decades, which can explain why the large increase did not affect the Danish Wadden Sea.

Gaps in knowledge about Eurasian Golden Plover

- To what extent does hunting affect numbers of Eurasian Golden Plovers on autumn migration in the Danish Wadden Sea and the polders?



Bar-tailed Godwit. Photo: John Larsen.

Grey Plover (*Pluvialis squatarola*) Migratory

The Grey Plover is a long-distance migrant with breeding grounds on the arctic tundra. The species is to a high degree dependent on the Wadden Sea during migration and wintering. Up to 40% of the flyway population of an estimated 250,000 individuals can be present in the Wadden Sea. The Danish Wadden Sea holds comparatively few Grey Plovers, with a maximum of 5,000 in August 1994. Recently coordinated spring counts provided a peak number of 6,000 Grey Plovers 29 May 2005 (DOFbasen). Numbers of Grey Plovers in the international Wadden Sea increased during the 1980s, but have decreased substantially during the 1990s, except in the Danish Wadden Sea.

Gaps in knowledge about Grey Plover

- What are the reasons for the substantial decrease during the last 15 years in the Wadden Sea?

Northern Lapwing (*Vanellus vanellus*) Migratory, breeding

The Northern Lapwing is an important member of the meadow-bird community. Breeding Northern Lapwings often make up half of all breeding waders in meadows. It is the first wader to nest in spring, and many other species of meadow-birds profit from its aggressive anti-predator behaviour. Northern Lapwings are still widespread and

common in many places, and the Danish Wadden Sea including the polders held 2,656 breeding pairs in 2001 (Rasmussen 2003). On one hand, the breeding population within the Danish Wadden Sea is fluctuating, but stable. On the other hand, key sites with large and dense populations, e.g. Tøndermarsken, have shown steep declines within the last decade (Rasmussen & Laursen 2000). Despite still being a relatively numerous breeding species, Northern Lapwings suffer from intensification of agricultural practice, e.g. earlier mowing, increasing livestock density, increasing use of fertilizer and cultivation of permanent meadows into arable land etc. Once large populations of breeding Northern Lapwing have crashed, it has proved very difficult to increase populations. Many adverse factors influence breeding numbers and success. An intensive research programme on breeding Northern Lapwing in Tøndermarsken is studying the effects of ongoing restoration management (Clausen et al. 2007). Northern Lapwing is probably the most intensively studied breeding wader species in Western Europe, and substantial knowledge exists about how to manage meadows in favour of this species.

Northern Lapwing migrates inland and only a small fraction is counted in the Danish Wadden Sea. Between 30,000 and 40,000 Northern Lapwing are found regularly, with the largest concentrations in the polders in Ballum Enge and Tøndermarsken.

Gaps in knowledge about Northern Lapwing

- Except for recent research in Tøndermarsken, there are no monitoring data on breeding success. What is the reproductive output in different habitats?
- What are the reasons for fluctuations in numbers of breeding pairs and breeding success in different habitats?
- Potential conservation actions for Northern Lapwing
- Management plans need to be developed for almost all areas within the Natura 2000 areas.

Red Knot (*Calidris canutus*) Migratory

Two populations of Red Knot visit the Danish Wadden Sea. *Calidris c. canutus* breeds in Siberia and *C. c. islandica* breeds in Canada and Greenland and spends the winter mainly in the Wadden Sea, Britain and Ireland. Both subspecies of Red Knot occur in the Danish Wadden Sea, but the relative importance of the Danish Wadden Sea for the two subspecies is not well known.

The Wadden Sea in Schleswig-Holstein is comparatively much more important for Red Knots, usually holding 10 times as many Red Knots throughout the year compared with the Danish Wadden Sea. There is no clear trend for the Danish Wadden Sea between 1980 and 2000 and the numbers of Red Knot vary considerably within different parts of the Danish Wadden Sea (Laursen & Frikke 2006). On internationally coordinated counts, maximum numbers of Red Knots were found in May 1995 with approx. 20,000 Red Knots in the Danish Wadden Sea. However, in Margrethe Kog and on Keldsand (south-east of Fanø) there have been several records of 20,000 – 30,000 Red Knots, especially since 2002. Record numbers of 106,000 Red Knots were counted on May 1st 2007 on Jordsand and Koresand (DOFbasen) and 90,000 Red Knots were counted on May 3rd 2002 on Keldsand. In recent years, increasing numbers of Red Knots have been observed in Ho Bugt in the northernmost part of the Danish Wadden Sea. The maximum here was 7,200–8,000 summering birds around July 1st 2005.

Gaps in knowledge about Red Knot

- Red Knots have not been studied intensively in the Danish Wadden Sea, and basic knowledge about the species is still lacking.
- What are the reasons for the relatively low but increasing importance of the Danish Wadden Sea for Red Knots compared to other parts?
- What is the reason for the large fluctuation in numbers?

Sanderling (*Calidris alba*)

Migratory

The largest numbers of Sanderling in the Danish Wadden Sea can be seen on the North Sea beaches of the islands and on uninhabited sandbanks. Numbers peak in late May or in the first days of June, when Sanderlings fuel up before leaving the Wadden Sea to head directly for their breeding grounds in the High Arctic. Only special counts in late May targeted at this species will provide reliable data on peak numbers. While coordinated trilateral counts produced a maximum of 7,796 Sanderlings on May 6th 1995, there was a record count of 5,118 Sanderlings on Fanø alone on May 14th 2002. Both dates were about 14 days before spring migration peaks.

Although the majority of Sanderlings move through the Wadden Sea, the species winters in considerable numbers. The Sanderling is the only wintering wader species that shows

no difference in numbers between cold and mild winters.

Gaps in knowledge about Sanderling

- The breeding origin of the Sanderlings moving through and wintering in the Wadden Sea is not known.

Curlew Sandpiper (*Calidris ferruginea*)

Migratory

The Curlew Sandpiper is attracted to brackish mudflats with high concentrations of few invertebrate species. This habitat is rare in the Danish Wadden Sea, where rivers are small and where sluices control the water level in estuaries, so that Curlew Sandpipers only occur in small numbers. Occasionally, total numbers may reach more than 100 individuals on autumn migration, and peak numbers were recorded in Margrethe Kog at the end of August 1999 with 395.

Dunlin (*Calidris alpina*)

Migratory, breeding

Dunlin are by far the most numerous waterbird in the Wadden Sea. Some of the largest concentrations in the international Wadden Sea are found in the Danish part (Meltofte et al. 1994), e.g. in Margrethe Kog (maximum 75,000 but regularly 60,000) as well as on Mandø and Fanø. The highest total in the Danish Wadden Sea was about 400,000 Dunlins counted in September 1981 and 1990 and in August 1996 (Meltofte et al. 1994). Monitoring data show a permanent, slight decrease since 1992 (Blew et al., 2005, Laursen & Frikke 2006). Thus, on September 1st, 2007, only 81,000 Dunlins were counted in the Danish Wadden Sea (DOFbasen).

Dunlins of the subspecies *schinzii* breeding from Iceland through the British Isles to the Baltic Sea area, Denmark and the Wadden Sea area are defined as a specific bio-geographic population showing distinct morphology, moulting patterns and migratory routes. This population is in steep decline, and its red list status is endangered or critical within all parts of the distribution. Red list status in the Wadden Sea is critical (Rasmussen et al. 1996).

Formerly, the Dunlin was a breeding bird in all parts of the Wadden Sea. This breeding population has decreased over several decades, and breeding Dunlins are now confined to the Danish part of the Wadden Sea. But even here, numbers have been steadily decreasing, e.g. from 39 pairs in 1996 to less than 20 pairs in 2006 (Thorup 2007). Only two breeding sites on Rømø regularly hold more than a few pairs.

On Fanø, the last breeding pair was found in 2003. In the last 10 years, the number of breeding pairs has been monitored annually, but there are no data on breeding success, and the reason for the decline remains unknown. Nevertheless, it is evident that changes in management of the meadows are the main reason for this decline (Asbirk & Pitter 2005). Without an immediate and dedicated effort to change this trend, the last breeding pair of Dunlin on Rømø will be found in 2014 and Dunlin will be extinct as a breeding bird in the Wadden Sea.

Gaps in knowledge about Dunlin

- How inbred is the Dunlin population of the Wadden Sea?
- What is the fledging success of breeding Dunlin on Rømø?
- Where are these birds wintering?
- Where are the breeding grounds of the Dunlins migrating through the Danish Wadden Sea?

Potential conservation actions for Dunlin

- Urgent action is needed, but it may still be possible to turn the negative trend for the breeding Dunlins in the Wadden Sea. However, without proper management, breeding Dunlin in the Wadden Sea will soon be history. This is the last call to make a coherent management plan for breeding Dunlin in the Wadden Sea!
- The management plan should involve not only the sites where Dunlins are still breeding, but also former and potential breeding sites used within the last decade.
- Grazing and hay cutting should be managed optimally for breeding Dunlins.
- Restoration of natural hydrology is an essential factor in the management of breeding sites for meadow-birds.
- Predator levels should be kept low at important sites for meadow-birds.
- The official 'Action Plan for Threatened Meadow Birds' (Asbirk & Pitter 2005) should be implemented with greater speed.

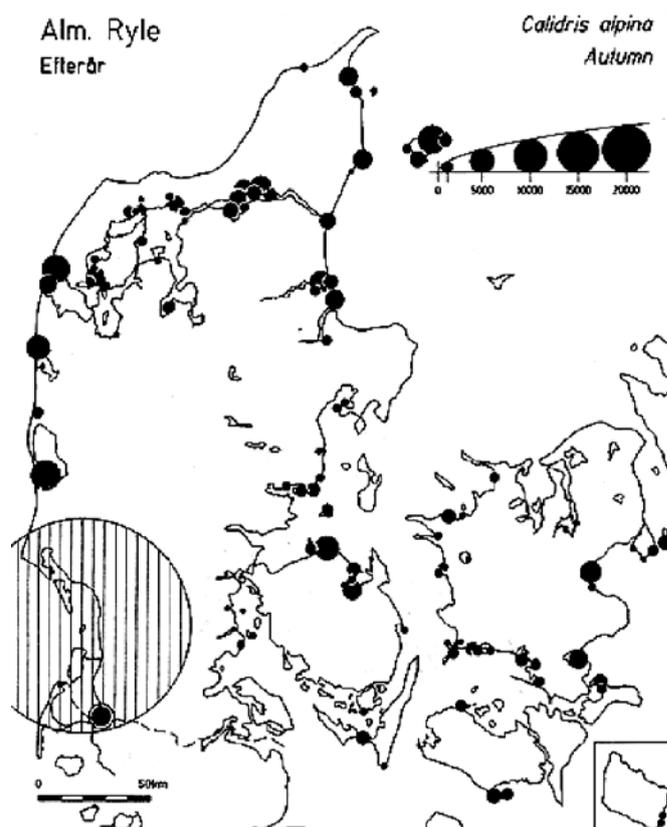


Figure 11: Autumn maximum numbers of Dunlin compared to other Danish sites. Source: Meltofte 1993.

Black-tailed Godwit (*Limosa limosa*) Migratory, Breeding

Black-tailed Godwit breeds in damp permanent grassland on Rømø, Mandø and in Tøndermarsken. Small numbers still breed in Ballum Enge and Ribemarsken. The breeding numbers in the Danish Wadden Sea make up about 15% of the total Danish breeding numbers (Thorup 2004b). The most important breeding numbers are found in Niedersachsen and the Netherlands, basically in the mainland polders outside the Wadden Sea area.

In Denmark, the Wadden Sea breeding numbers peaked around 1980 and since then have declined by 24% (Thorup 2004a). Especially in mainland polders, numbers decreased dramatically, and many breeding sites in the polders, from Tøndermarsken in the south to Esbjerg and Varde Å in the north, have disappeared correspondingly. In contrast, numbers have increased on Mandø (Larsen 2005b). It is believed, that the main reason for this decline is intensification of agricultural practises. Black-tailed Godwit is included as a target species in the national Danish 'Action Plan for Threatened Meadow Birds' (Asbirk & Pitter 2005).

Black-tailed Godwit is a migrant and many birds winter inland in rice fields in Africa south of the Sahara. Numbers of Black-tailed Godwit have increased in areas with a good meadow-bird management, despite the general negative trend. This indicates that the population size of this species is mainly controlled by factors at the breeding sites. Overall numbers have been declining on a European scale leading to a designation of Black-tailed Godwit as a globally near-threatened species in the recently revised IUCN Global Red List for birds.

Post-breeding concentrations of up to 200–300 birds occur regularly in Margrethe Kog and at the Rømø Dam (DOFbasen), but on spring migration numbers of staging Black-tailed Godwits rarely exceeds 100 whereas the largest concentrations have been recorded in the Ho Bay.

Potential conservation actions for Black-tailed Godwit

- The official Danish 'Action Plan for Threatened Meadow Birds' (Asbirk & Pitter 2005) should be implemented with greater speed.

Bar-tailed Godwit (*Limosa lapponica*)

Migratory, breeding

Two subspecies of Bar-tailed Godwit migrate through Denmark, and birds can be found in all seasons in the Danish Wadden Sea (Meltøfte et al. 1994). The timing of the migration is similar to the rest of the Wadden Sea. Those wintering in the Wadden Sea are presumed to breed in northernmost Europe, while the African winterers probably breed in northern Siberia east to the Taimyr Peninsula.

The numbers peak in the first half of May, when a maximum of 65,000 has been counted in 1995. 41,000 birds counted on May 21st, 2006, were believed to be of the ssp. *taymyrensis* (DOFbasen). As in other parts of the Wadden Sea, Bar-tailed Godwit feed on grassland in May just before departing for the breeding grounds.

Wintering numbers are dependent on the severity of the winter. In cold winters, almost all Bar-tailed Godwits leave the Danish Wadden Sea (Blew & Südbeck 2005).

Despite an overall negative trend in the international Wadden Sea since 1992 (Blew & Südbeck 2005), the trend in the Danish Wadden Sea showed a moderate increase in spring and stable numbers during summer and autumn (Laursen & Frikke 2006).

Sheiffart et al. (2002) showed that the two subspecies of Bar-tailed Godwit in the Lister Dyb tidal basin (including the southern parts of the Danish Wadden Sea) use dif-

ferent parts of the Wadden Sea. The Siberian *taymyrensis* stops over on the mainland coast in May, while the North European *lapponica* is mainly found on the islands. It is not known if this difference in site use is also valid for other parts of the Wadden Sea.

Whimbrel (*Numenius phaeopus*)

Migratory

Whimbrels migrate through the Wadden Sea in rather small numbers, and the Danish Wadden Sea is less important compared to the southern Wadden Sea. On trilateral counts, a maximum of 650 Whimbrels was recorded in May 1988 and 238 Whimbrels in August 1996 (Meltøfte et al. 1994, Blew & Südbeck 2005).

Eurasian Curlew (*Numenius arquata*)

Migratory, breeding

Despite that numbers of breeding pairs have declined significantly, Eurasian Curlew is still a typical breeding species in the dunes of Fanø and Rømø. Much higher numbers are breeding in the western Wadden Sea, and the trend here is stable.

Numbers of Eurasian Curlew wintering in the Danish Wadden Sea have increased significantly since the early 1990s (Rasmussen 2001). Peak numbers were recorded in April 2000 with a total of 9,000 Curlews and on March 10th, 2004, with a total of 8,900 (DOFbasen). On the sandbanks of Keldsand and Trinden east of southern Fanø, peak numbers have regularly exceeded 4,000 since 2000. Following this increase Curlews are roosting in significant numbers on an increasing number of sites. For a further discussion on this increase, see the chapter on hunting.

Gaps in knowledge about Eurasian Curlew

- What are the main reasons for the decline in breeding numbers of the Curlew on the Danish breeding grounds in the Wadden Sea?

Common Redshank (*Tringa totanus*)

Migratory, breeding

The Danish Wadden Sea is the most important area in Denmark for breeding Common Redshank. The species prefers to breed in salt marsh with higher vegetation where the nest is concealed. This species is one of the more difficult on which to obtain precise breeding data, but the methods used seem to provide reliable trends. The num-



Cattle grazing on salt marsh on an unprotected coastline near Ho in Ho Bugt. Photo: Lars Maltha Rasmussen.

bers in the Danish Wadden Sea have been fluctuating but decreasing since 2001 (Thorup 2007). The decrease was mainly found in the polders except Tøndermarsken, but also in areas on the islands with dense populations. Many studies have confirmed the hypothesis that ungrazed salt marshes are preferred to intensively grazed salt marshes. Data suggest that population dynamics might be a result of source-sink relations.

Spring migration numbers recorded in the Danish part of the Wadden Sea are up to 4,300 (medio April to medio May), while 10,300 birds have been recorded during autumn migration peaking in the middle of August (Meltofte et al. 1994). A record count of 14,000 redshanks were obtained 31 July 2005 (DOFbasen). A few thousand redshanks of the icelandic race (*T.t. robusta*) usually winters in the northern part of the Danish Wadden Sea (Meltofte 1993).

Gaps in knowledge about Common Redshank

- What are the actual breeding numbers in areas with high densities?
- What is the breeding success in different habitats?

Potential conservation actions for Common Redshank

- Reduce overgrazing by sheep and cattle in salt marsh areas. Salt marshes and brackish meadows in the pro-

tection area can be improved as a habitat for breeding Common Redshanks when management is targeted to improve these habitats.

- Salt marshes and brackish meadows in the protection area can be improved as breeding habitat for Common Redshanks with a targeted management.

Common Black-headed Gull (*Larus ridibundus*) Migratory, breeding

As in the rest of the Wadden Sea countries, Common Black-headed Gulls formerly bred in much larger numbers inland, but during the past century, they have tended to use marine food sources in a more opportunistic way. Many inland colonies have disappeared, and in the Danish Wadden Sea a few larger, coastal sites are now the most important breeding sites.

Like other colony breeders, Common Black-headed Gulls are very susceptible to predation by mammalian predators, and breeding numbers in the Danish Wadden Sea are comparatively smaller than in the rest of the Wadden Sea due to lack of predator-free breeding sites. Furthermore, larger species of gulls can restrict breeding success, when they breed close in the same areas. Numbers of breeding pairs in the Danish Wadden Sea in the period 1996 to

2006 have fluctuated between 5,500 and 13,500 pairs, but with no clear trend. Breeding colonies of Common Black-headed Gulls are very important to several other breeding species that prefer to breed in or near these colonies, especially Gull-billed Terns and Sandwich Terns.

Common Black-headed Gull is found in high numbers in spring and especially in late summer, when numbers peak in August. In August 1996, 51,000 Common Black-headed Gulls were counted in the Danish Wadden Sea.

Potential conservation actions for Common Black-headed Gull

- It is possible to improve breeding conditions for Common Black-headed Gulls by creating more breeding islands free of predators in clay pit ponds.

Common Gull (*Larus canus*)

Migratory, breeding

The most important colony of breeding Common Gulls is found on Langli with 77% of the total of 1,600 pairs breeding in 2006 in the Danish Wadden Sea. The population increased in the 1990s until a maximum was reached in 2003 with 3,020 pairs in the Danish Wadden Sea. Since 2003 numbers on Langli have decreased, and breeding success has been very low. On Mandø, where about 300 breeding pairs were found, breeding success is not known, but it seems to be very low. Numbers of breeding sites are very restricted in the Danish Wadden Sea because Red Foxes can access most areas.

Common Gull occur in large numbers in the Danish Wadden Sea and numbers peak during autumn and



King Ragworm (Neanthes virens), related to Sandworm (Arenicola marina) and Mud Snails (Hydrobia spp). The worm swarms in March/April and is an important food source to for example Herring Gulls right before the egg-laying season begins. Photo: Lars Maltha Rasmussen.

mid-winter. Record numbers are from January 1992 with 45,000 individuals.

Potential conservation actions for Common Gull

- It is possible to improve breeding conditions for Common Gulls by reducing predator levels on the islands.

Lesser Black-backed Gull (*Larus fuscus*)

Migratory, Breeding

The Lesser Black-backed Gull did not breed in the Danish Wadden Sea until 1996 when the first pairs settled on Langli. The number of breeding pairs here increased to more than 1,000 in 2007 together with about 100 pairs on Mandø. It is most likely that this increase was favoured by the very large and expanding colonies in the western Wadden Sea, but the observation in the Langli colony in 2007 of an adult Lesser Black-backed Gull ringed as a chick in southern Norway suggests that the situation is more complex. The breeding success in the Langli colony is very high, and could support a further increase in breeding numbers.

Migrating Lesser Black-backed Gulls are regularly staging in the Danish Wadden Sea in small numbers rarely exceeding 100 birds. They often occur at sites with breeding Black-headed Gulls such as Sneum Engsø. Occasionally a few are wintering here.

Gaps in knowledge about Lesser Black-backed Gull

- What is the reason for the expansion of Lesser Black-backed Gull in the Danish Wadden Sea?

Herring Gull (*Larus argentatus*)

Migratory, breeding

Numbers of breeding Herring Gulls in the Danish Wadden Sea have been growing steadily over the past 30 years, especially in the most important colony on Langli. Here, the reproductive output has been sufficient due to very good protection measures and removal of Red Foxes. Apart from Langli, only Mandø supports significant numbers of breeding Herring Gulls, with 784 pairs in 2006. This increase is in contrast to the trend in the rest of the Wadden Sea, despite the fact that open rubbish dumps were all closed in Denmark in the last decade (Koffijberg et al. 2006). Rubbish dumps were an important source of food, allowing especially first year gulls to better survive the first winter. The positive trend is due almost exclusively to developments in the single large colony on Langli. The



Sandwich Tern colony in a salt marsh on Langli. Photo: Lars Maltha Rasmussen.

expansion of Lesser Black-backed Gulls on Langli may in a few years lead to competition between the two species. It is known from other parts of the Wadden Sea that Lesser Black-backed Gulls often dominate Herring Gulls in mixed colonies.

In the Danish part of the Wadden Sea, very large numbers of Herring Gull concentrate on the west coast of Fanø in mid-winter. Here they benefit from a large biomass of stranded bivalves and other invertebrates. Peak numbers may exceed 35,000 Herring Gulls (December 2006) and peak numbers for the Danish Wadden Sea are 50,000 in January 1998.

Potential conservation actions for Herring Gull

- It is possible to improve breeding conditions for Herring Gulls by reducing predator levels on the islands.

Gull-billed Tern (*Gelochelidon nilotica*) Breeding

The Gull-billed Tern is a rare breeding bird in north-western Europe with an isolated breeding population in the Wadden Sea. In the 20th century the species bred at many

sites in the western parts of Denmark, but they had all disappeared by the end of the century (Rasmussen & Fischer 1997). Gull-billed Tern has probably not bred with success in Denmark since 1996 and is now an irregular breeding bird in the Danish Wadden Sea. The Danish data indicate that the decline is caused by negative conditions on the breeding ground. Predation, flooding, trampling by cattle etc. are important reasons for the lack of breeding success.

The centre of the Wadden Sea distribution has moved southward to around the Elbe river mouth. On this background, it seems too late to prevent this species from going extinct as a Danish breeding bird. Hence, extra efforts should be made to monitor and secure the German breeding population.

Potential conservation actions for Gull-billed Tern

- Gull-billed Tern usually settle in colonies of Common and Black-headed Gull and occasionally in colonies of Avocets or Common Tern. Improving conditions for colony-breeding species in the Danish Wadden Sea could enhance the chances of attracting breeding Gull-billed Terns once again.

Sandwich Tern (*Sterna sandwicensis*)

Migratory, breeding

There are no available data indicating the presence of breeding Sandwich Tern in the Danish Wadden Sea before regular monitoring of breeding birds from the mid-1980s. Then there were a few, but unsuccessful, breeding attempts on the northern tip of Rømø. In recent years, Sandwich Terns have only been breeding on Langli, where a colony was established in 1992. This colony was successfully producing young in 1994 (Rasmussen 2003), and the colony grew to 1,529 pairs in 1999. Thereafter numbers declined, and the colony disappeared completely in 2003 due to the presence on the island of Red Fox that may have reached Langli across the mudflats or on the ice in winter. After removal of the foxes from Langli, 1,190 pairs of Sandwich Terns bred again in 2004. In the following years, foxes were not regularly present on Langli in the breeding season (April - September). In 2007, the Forestry and Nature Agency managing Langli has intensified efforts to remove foxes by constructing artificial fox dens, where foxes can be exterminated more easily. Annual campaigns to remove foxes from the island in late winter are undertaken, and permission to hunt foxes outside the regular hunting season is provided when necessary.

In 2006, Langli was home to the only Sandwich Tern colony on the Danish North Sea coast, and 3,300 breeding pairs bred successfully. This colony was the largest in Denmark with 54% of the national population (Christensen 2006). In an international Wadden Sea context, the Langli colony was one of the five most important in 2006, holding approx. 17% of the breeding pairs.

There are long distances between the important breeding colonies of Sandwich Tern. The two most important breeding colonies in the western part of Jutland disappeared when foxes gained access to the islands in 2003 and 2005, respectively (J.O. Christensen in letter, Gregersen 2006). In the Kattegat, the most important colony on the Hirschholmene islets (260 km north-east of Langli) decreased in numbers in 2006 compared to previous years (K.T. Petersen pers. com.). The Sandwich Tern colony on the German island of Trischen has disappeared in recent years, and these distant breeding sites are probable sources of the large influx of birds on Langli. Now, the nearest breeding colony is at Norderoog in Schleswig-Holstein. Despite annual fluctuations at the individual sites, the overall breeding number in the Wadden Sea has been stable or slightly increasing since 1992 (Koffijberg et al. 2006). This also indicates that movements between colonies within the Wadden Sea and

breeding colonies in the inner Danish waters take place (Rasmussen et al. 2000, Gregersen 2006).

Food preference has not been investigated for Sandwich Terns breeding in the Danish Wadden Sea, but it is assumed that Sandeel (*Ammodytes sp.*) play a vital role as a food resource. Lesser Sandeel (*Ammodytes marinus*) is by far the most common of these species, and the total catch in the North Sea amounted to 800,000 tons annually in the 1990s, making it the single most important fish species caught in the North Sea (Rindorf 2001). In the North Sea east of the Firth of Forth in Scotland, fishery in a large area was banned for precautionary reasons in 2000, when colonies of seabirds, especially Kittiwake (*Rissa tridactyla*) had suffered low breeding success in years with large catches of Sandeel (Rindorf et al. 2000). There is some evidence that differences in the timing of peak Sandeel availability influence the reproductive output of the Scottish colonies of Kittiwake and Guillemot (*Uria aalge*) causing a low breeding success when Sandeel availability peaks early in the season.

In July and August, the sandbank of Langli Flak in Grådyb just west of Esbjerg is regularly a major post-breeding roosting site for Sandwich Terns, independent of the breeding numbers at Langli. Maximum numbers may reach more than 8,000. The birds roosting here feed in the Danish Wadden Sea and in the North Sea west of Blåvandshuk and Fanø (Meltøfte 1987).

Gaps in knowledge about Sandwich Tern

- Basic understanding of the food consumption of Sandwich Terns breeding in the Danish Wadden Sea is lacking. Which species of fish are important, and what is the timing of their occurrence?
- To what extent do Sandwich Terns move between different colonies in Denmark and the Wadden Sea?
- Does fishery in the North Sea have an impact on food availability for Sandwich Tern?

Potential conservation actions for Sandwich Tern

- Gregersen (2006) suggests that larger species of gulls (Herring, Lesser and Greater Black-backed Gull) should actively be removed from within 300 m from breeding colonies of Sandwich Tern to avoid predation.
- To avoid or reduce predation, Langli as well as potential and former breeding sites in the Danish Wadden Sea should be managed to prevent foxes from gaining access during the breeding season of the coastal birds.

Common Tern (*Sterna hirundo*) Migratory, breeding

Despite its English name, the Common Tern is not common as a breeding bird in the Danish Wadden Sea. The breeding number has been declining since the mid-1990s with a maximum of 215 pairs in 1996. Breeding is now restricted to a few scattered colonies on islets in clay pits, and the most important colony on the island of Mandø, formerly holding 143 pairs, consisted of only 6 pairs in 2007.

On autumn migration, Common Tern concentrate at Blåvandshuk, where up to 6,000 are regularly counted in late July and August. For night roosting they gather on Langli Flak. The record number is 14,000 from July 1994. In addition, on Peter Meyers Sand south of Fanø more than 5,000 Common Terns have been recorded in August.

Gaps in knowledge about Common Tern

- What is the reason for the declining number of breeding Common Tern in the Danish Wadden Sea?

Arctic Tern (*Sterna paradisaea*) Migratory, breeding

Numbers of breeding Arctic Terns in the Danish Wadden Sea have decreased slightly from a maximum of almost 1,200 pairs in 1997 to 827 in 2006 (Thorup 2007). Breeding success has failed almost completely several times

within the last few years, when a number of floods occurred in the breeding season. Breeding success is only monitored at a couple of sites but, generally, the success seems to be very low in most years.

Arctic Terns regularly occur on spring and autumn migration but they have never been systematically monitored.

Little Tern (*Sterna albifrons*) Breeding

Little Tern has a stronghold in the Danish part of the Wadden Sea, which supports around 30% of the Danish breeding pairs. In the period 1998 to 2002, numbers were stable at a high level with 243–279 breeding pairs, but numbers dropped to only 97 pairs in 2006 (Thorup 2007). The most important breeding sites were on the exposed beaches on Rømø and Fanø, and on the harbour precincts at Esbjerg. The stable situation after 1996 was probably mainly due to improved protection measures on the beaches, where important breeding sites on Rømø were closed to the public during the breeding season. In recent years, vegetation coverage on the beaches has increased significantly, and Little Terns are no longer attracted to the closed areas, but have started breeding outside them. However, the protection measures have not been adapted to this development. As a result, breeding sites are often exposed to disturbance and straying dogs. In the same period, breeding success has been affected several times by flooding during



Sheep and Dark-bellied Brent Geese Grazing on salt marsh on Mandø.
Photo: Lars Maltha Rasmussen.

the breeding season. The breeding site on Esbjerg Harbour, well protected against predation and disturbance, was recently altered, and is consequently no longer suitable for Little Tern.

Gaps in knowledge about Little Tern

- Does increasing flooding in the breeding season affect breeding success?
- What is the effect of protection measures?

Potential conservation actions for Little Tern

- Protection measures on the beaches of Rømø and Fanø should be closely monitored and annually revised to fit the needs of the breeding Little Terns. These dynamic habitats change appearance after winter storms and, due to changes in vegetation coverage, different areas will be suitable for breeding each year.
- Close monitoring and guarding of the nesting areas are necessary to ensure that the protection measures actually work as intended.

Black Tern (*Chlidonias niger*)

Breeding

One of the few remaining Danish breeding sites for Black Tern is in Tøndermarsken in the Danish Wadden Sea area. In the 1980s, this area was the most important Danish site for the species, with up to 70 pairs breeding in small colonies in ponds in the pastures. After a project to restore the traditional irrigation system of 270 km of channels, the number of breeding Black Terns increased. However, the populations collapsed totally in 1998, when all breeding pairs left the area, some moving to new sites on the German side of the border. The collapse seems to be connected with the collapse in the breeding population of Northern Lapwing in the core Black Tern breeding area. When Northern Lapwings were more or less absent in late May to early June because of low numbers and very low breeding success, the small colonies of Black Terns lost the ability to defend themselves against airborne predators (Rasmussen 1999). A nature restoration project in the inner part of the nature protection area of Tøndermarsken provided a new breeding site, that housed between 13 and 24 pairs from 2002 to 2006.

The possible re-establishment of the Black Tern as a breeding bird in Tøndermarsken is probably dependent on the success of the meadow-bird management. Numbers of breeding Northern Lapwings are still low compared to numbers and densities in the 1980s.



Oyster Catcher. Photo: Lars Maltha Rasmussen.

Gaps in knowledge about Black Tern

- Where is mortality a bottleneck for the population? Is it on the breeding grounds, along the migration route or in wintering areas?

Potential conservation actions for Black Tern

- Establishing floating nest sites in areas rich in food but poor in nesting sites has proved successful in many places. A similar approach could increase nesting possibilities in Margrethe Kog and Ny Frederikskog where meadow-bird communities are intact, but where breeding sites at present are lacking.

Short-eared Owl (*Asio flammeus*)

Migratory, Breeding

In the last decade, numbers of breeding Short-eared Owls have decreased. At intervals of several years, up to 40 breeding pairs occurred in many sites in the western part of Denmark. In years with few breeding pairs, the island of Mandø has been one of the stable sites, holding annually 2-4 pairs. Breeding has occasionally failed because of predation by Red Fox and cats (Knudsen 2006). In recent years, Short-eared Owls have settled in set-aside fields in the polders on the mainland. Breeding success of these pairs is usually not monitored (Thorup 2007).

A few Short-eared Owls spend the winter in the Danish Wadden Sea, and these birds are mainly occurring in the polders and on the larger islands. This species is also regularly seen during spring and autumn migration.

Gaps in knowledge about Short-eared Owl

- How important are set-aside fields for breeding Short-eared Owls?

References and Webpages

- Asbirk, S. & E. Pitter (eds.) 2005: Handlingsplan for truede engfugle. Skov- & Naturstyrelsen
- Ballegaard, T. 1994: Natur og turisme. Program til belysning af turismen og dens påvirkning af naturen på vadehavsøerne. Pilotprojekt Rømø. Faglig rapport fra DMU nr. 114.
- Bio/Consult 2002: Strandenge i Ribe Amt. Status 2000. Ribe Amt.
- Blew, J. & P. Südbeck (eds.) 2005: Migratory Water birds in the Wadden Sea 1980–2000. Wadden Sea Ecosystem, No. 20. Common Wadden Sea Secretariat. Wilhelmshaven.
- Bregnballe, T. 2006: Oliering giver færre skarver. Nyhedsbrev. Samarbejdsprojekt om skarvregulering og fiskebestande i de vestjyske fjorde 3: 4–6.
- Bønløkke, J., J.J. Madsen, K. Thorup, K.T. Pedersen, M. Bjerrum & C. Rahbek 2007: Trækfugleatlas. The Danish Bird Migration Atlas. Københavns Universitet.
- Clausen, P. & K. Fischer 1994: Lysbuget Knortegås (*Branta bernicla hrota*): Forekomst og økologi i Vadehavet. Dansk Orn. Foren. Tidsskr. 88: 9–22.
- Clausen, P., J. Madsen, S.M. Percival, G.Q.A. Anderson, K. Koffijberg, F. Mehlum & D. Vangeluwe 1999: Light-bellied Brent Goose, *Branta bernicla hrota*: Svalbard. In: Madsen, J., G. Cracknell & A.D. Fox (eds.): Goose Populations of the Western Palearctic. A review of status and distribution. Wetlands International Pub. No. 48.
- Clausen, P., E. Bøgebjerg, H.E. Jørgensen, J.P. Hounissen & I.K. Petersen 2001: Jagt- og forstyrrelsesfri kerneområder for vandfugle: Status 1999. Arbejdsrapport fra DMU nr. 146.



Sandwich Terns and tourists on Rømø Beach. Photo: Lars Maltha Rasmussen.

Clausen, P., J. Kahlert, J.P. Hounisen, K. Olsen, E. Bøgebjerg & J.P. Kjeldsen 2007: Tøndermarskens ynglefugle 2005–2006. Naturovervågning. Danmarks Miljøundersøgelser. Arbejdsrapport fra DMU nr. 238.

Common Wadden Sea Secretariat 1997: The Stade Declaration. Web site visited 1.7.2007: <http://www.waddensea-secretariat.org/tgc/MD-Stade.html>

Common Wadden Sea Secretariat 2007: Conclusions and Recommendations from the Trilateral Workshop on Pacific Oyster Invasion in the Wadden Sea. Web site visited 18.9.2008: <http://www.waddensea-secretariat.org/news/symposia/oyster2007/oyster2007.html>

Christensen, J.O. 2006: Splitterne *Sterna sandvicensis*. In: Nyegaard, T. & M.B. Grell: Truede og sjældne ynglefugle i Danmark 2005. Dansk Orn. Foren. Tidsskr. 100: 69–70.

de Vlas, J., B. Brinkman, C. Buschbaum, N. Dankers, M. Herlyn, P.S. Kristensen, G. Millat, G. Nehls, V. Ruth, J. Steenbergen, & A. Wehrman, 2005: Subtidal blue mussel beds. In: Essink, K., C. Dettmann, H. Farke, K. Laursen, G. Lüerssen, H. Marencic & W. Wiesinga (eds.): Wadden Sea quality status report 2004. Common Wadden Sea Secretariat 8.5.2: 211–218. Wilhelms-haven.

Desholm, M., T.K. Christensen, G. Scheiffarth, M. Hario, Å. Andersson, B. Ens, C.J. Camphuysen, L. Nilsson, C.M. Waltho, S.-H. Lorentsen, A. Kuresoo, R.K.H. Kats, D.M. Fleet & A.D. Fox 2006: Status of the Baltic/Wadden Sea population of the Common Eider *Somateria m. mollissima*. In: Kats, R.: Common Eiders (*Somateria mollissima*) in The Netherlands: The rise and the fall of breeding and wintering populations on relation to the stocks of the shellfish. Thesis at Rijksuniversiteit Groningen. Web site: <http://irs.ub.rug.nl/ppn/301030170>



Red Knots from Siberia on autumn migration through the Danish Wadden Sea. Red Knots from Greenland and Canada winter here. Photo: Lars Maltha Rasmussen.

- DOFbasen. Internet-based bird observation database of DOF/ BirdLife Denmark, www.dofbasen.dk
- Ebbinge, B.S., C. Berrevoets, P. Clausen, B. Ganther, K. Günther, K. Koffijberg, R. Hahéo, M. Rowcliffe, A.K.M. St. Joseph, P. Südbeck & E.E. Syroechovsky Jr. 1999: Dark-bellied Brent Goose (*Branta bernicla bernicla*). In: Madsen, J., G. Cracknell & A.D. Fox (eds.): Goose Populations of the Western Palearctic. A review of status and distribution. Wetlands International Pub. No. 48.
- Eskildsen, J. 2006: Skarver 2006. Arbejdsrapport fra DMU nr. 233.
- Falk, K., H. Nøhr, K. Bendix & H. Hagge 1991: Arealanvendelsen og fuglelivet i Ballum Enge. Ornithol. Unpubl. report.
- Fleet, D.M., J. Frikke, P. Südbeck & R.L. Vogel 1994: Breeding Birds in the Wadden Sea 1991. Wadden Sea Ecosystem No. 1, CWSS & TMAG, Wilhelmshaven.
- Frikke, J. & K. Laursen 1994a: Jagt i Ballumområdet. Faglig rapport nr. 104. DMU.
- Frikke, J. & K. Laursen 1994b: Forlandsjagt i Vadehavet. Med analyse af betydningen for andefugle. Faglig rapport nr. 102. DMU.
- Gram, I., H. Meltofte, & L.M. Rasmussen 1990: Fuglene i Tøndermarsken 1978-1988. Miljøministeriet.
- Gregersen, J. 2006: Ynglebestanden af splitterne i Danmark 1993-2005: med bemærkninger om historisk udvikling, trusler og anbefalinger til en forvaltning af bestanden. Dansk Orn. Foren. Tidsskr. 100: 88-96.
- Gylstorff, N.-H. 1979: Fugles kollisioner med elledninger. M.Sc. thesis, University of Århus.
- ICES 2006: Report of the Working Group on Crangon fisheries and Life History. (WGCRAN) Hune, The Netherlands. ICES CM 2006/LRC: 10.
- IUCN 2007: GIPS. The global Invasive Species Programme. Web site visited 28.8.2007: <http://www.gisp.org/index.asp>
- Jensen, H., P.S. Kristensen & E. Hoffman 2003: Sandeel and clams (*Spisula* sp.) in the wind turbine park at Horns Reef. Report to TechWise. Danish Institute for Fisheries Research, Department of Marine Fisheries, Charlottenlund. Web site: <http://www.hornsrev.dk/Miljoeforhold/miljoerapporter/Tobis%20og%20spisula%20rapport-%208%20april%2003.pdf>
- Knudsen, N. 2006. Mosehornugle *Asio flammeus*. In: Nyegaard, T. & M.B. Grell: Truede og sjældne ynglefugle i Danmark 2005. Dansk Orn. Foren. Tidsskr. 100: 71-72.
- Koffijberg, K. & K. Günther 2005: Recent population Dynamics and Habitat Use of Barnacle Geese and Dark-bellied Brent Geese in the Wadden Sea. In: Blew, J. & P. Südbeck (eds.): Migratory Waterbirds in the Wadden Sea 1980-2000. Wadden Sea Ecosystem No. 20. Common Wadden Sea Secretariat, Wilhelmshaven.
- Koffijberg, K., J. Blew, K. Eskildsen, K. Günther, B. Koks, K. Laursen, L.M. Rasmussen, P. Potel & P. Südbeck 2003: High tide roosts in the Wadden Sea: A review of bird distribution, protection regimes and potential sources of anthropogenic disturbance. Wadden Sea Ecosystem No. 16. Common Wadden Sea Secretariat, Wilhelmshaven.
- Koffijberg, K., L. Dijkzen, B. Hälterlein, K. Laursen, P. Potel, P. Südbeck 2005: Breeding Birds. In: Essink, K., C. Dettmann, H. Farke, K. Laursen, G. Lürßen, H. Marencic, W. Wiersinga (eds.): Wadden Sea Quality Status Report 2000. Wadden Sea Ecosystem No. 19.
- Koffijberg, K., L. Dijkzen, B. Hälterlein, K. Laursen, P. Potel & P. Südbeck 2006: Breeding Birds in the Wadden Sea in 2001. Results of the total survey in 2001 and trends in numbers between 1991-2001. Wadden Sea Ecosystem No. 22. Common Wadden Sea Secretariat, Wilhelmshaven.
- Koks, B. & E. Visser 2002: Montagu's Harriers (*Circus pygargus*) in the Netherlands: Does nest protection prevent extinction? Ornithol. Anz. 41: 159-166.
- Kristensen, P.S., N.J. Pihl & R. Borgstrøm 2005: Blåmuslingebestanden i det danske Vadehav 2004. Danmarks Fiskeriundersøgelser.
- Kristensen, P.S. & R. Borgstrøm 2006: The Danish Wadden Sea: Fishery of mussels (*Mytilus edulis* L.) in a wildlife reserve? In: Laursen, K. (ed.): Monitoring and assessment in the Wadden Sea: Proceedings from the 11th Scientific Wadden Sea Symposium, Esbjerg, Denmark, 4-8 April 2005. Technical

- Report No. 573, National Environmental Research Institute, Department of Wildlife Ecology and Biodiversity: 113-122.
- Kristensen, P.S. & A. Hedegaard 2001: Hesterejer (*Crangon crangon*) – køns- og størrelsesfordelinger i danske fangster og landinger fra Nordsøen 2000. DFU-rapport 90-01. Danmarks Fiskeriundersøgelser.
- Kristensen, P.S. & K. Laursen 2006: The common mussel (*Mytilus edulis* L.) in the Danish Wadden Sea; biomass, distribution, fishery and importance as food for different bird species. In: Laursen, K. (ed.). Monitoring and Assessment in the Wadden Sea. Proceedings from the 11. Scientific Wadden Sea Symposium, Esbjerg, Denmark 4-8 April 2005. Faglig rapport fra DMU nr. 573. Web site visited 18.9.2008: www2.dmu.dk/1_viden/2_Publikationer/3_fagrapporter/rapporter/FR573_Proceeding_Part_3.pdf
- Kristensen, P.S. & N.J. Pihl 2006: Blåmuslinge- og stillehavsøstersbestanden i det danske Vadehav 2006. Danmarks Fiskeriundersøgelser.
- Krüger, T. 2004: Wegzugbestand des Goldregenpfeifers *Pluvialis apricaria* in Niedersachsen: Ergebnisse einer landesweiten Synchronzählung am 11./12. Oktober 2003. Vogelschutz-warte im Niedersächsischen 36: 35-52.
- Laursen, K. 1985: Jagt på vandfugle i Vadehavet samt det øvrige Syddjylland. Danske Vildtundersøgelser 39. Vildtbiologisk Station, Kalø.
- Laursen, K. 2005a: Curlews in the Wadden Sea – Effects of Shooting Protection in Denmark. In: Blew, J. & P. Südbeck (eds.): Migratory Waterbirds in the Wadden Sea 1980-2000. Wadden Sea Ecosystem No. 20. Common Wadden Sea Secretariat, Wilhelmshaven.
- Laursen, K. 2005b: Forekomst af yngle- og trækfugle i seks EF-fuglebeskyttelsesområder i Vadehavets marsk. Arbejdsrapport fra DMU nr. 219.
- Laursen, K. & K. Essink 2005: Offshore area. In: Essink K., C. Dettmann, H. Farke, K. Laursen, G. Lüerßen, H. Marencic & W. Wiersinga: Wadden Sea Quality Status Report 2004. Wadden Sea Ecosystem No. 19.
- Laursen, K. & J. Frikke 1987: Winter counts of seabirds off the southwest coast of Denmark. Dansk Orn. Foren. Tidsskr. 81: 167-172.
- Laursen, K. & J. Frikke 1994: Hunting in Saltmarshes in the Danish Wadden Sea. Ophelia Suppl. 6: 339-342.
- Laursen, K. & J. Frikke 2006: Assessment of sustainable management of staging waterbirds in the Danish Wadden Sea. Wildfowl 56: 152-171.
- Laursen, K. & L.M. Rasmussen 2002: Menneskelig færdsels effekt på rastende vandfugle i Saltvandssøen. Faglig rapport fra DMU, nr. 395.
- Laursen, K., J. Salvig & J. Frikke 1997: Vandfugle i relation til menneskelig aktivitet i Vadehavet 1980-1995 med en vurdering af reservatbestemmelser. Danmarks Miljøundersøgelser. Faglig rapport fra DMU, nr. 187.
- Madsen, J. 1988: Autumn Feeding Ecology of Herbivorous Wildfowl in the Danish Wadden Sea, and Impact of Food Supplies and Shooting on Movements. Comm. No. 217 from Vildtbiologisk Station.
- Madsen, J., J. Frikke & K. Laursen 1990: Forekomst og habitatvalg hos Mørkbuget Knortegås (*Branta bernicla bernicla*) i Danmark, og specielt Vadehavet. Danske Vildtundersøgelser 45.
- Mardik F.L., P.C. Spannenburg, H.J.P. Verdaat, K. Romke & R. Kats 2007: Identification and size estimation of *Spisula subtruncata* and *Ensis americanus* from shell fragments in stomachs and faeces of Common Eiders *Somateria mollissima* and Common Scoters *Melanitta nigra*. In: Kats, R.: Common Eiders (*Somateria mollissima*) in The Netherlands: The rise and the fall of breeding and wintering populations on relation to the stocks of the shellfish Thesis at Rijksuniversiteit Groningen. Web site: <http://irs.uibn.rug.nl/ppn/301030170>
- Meltofte, H. 1978: Skudeffektivitet ved intensiv kystfuglejagt i Danmark. En pilotundersøgelse. Dansk Orn. Foren. Tids-skr. 72: 217-221.
- Meltofte, H. 1987: Forekomsten af måger og terner på Blåvandshuk 1963-1977. Dansk Orn. Foren. Tidsskr. 81: 137-166.
- Meltofte, H. 1993: Vadefugletrækket gennem Danmark. Dansk Orn. Foren. Tidsskr. 87: 1-180.
- Meltofte, H., J. Blew, J. Frikke, H-U. Rösner & C.J. Smit 1994: Numbers and distribution of waterbirds in the Wadden Sea.

Results and evaluation of 36 simultaneous counts in the Dutch-German-Danish Wadden Sea 1980-91. IWRB Publication 34/ Wader Study Group Bull. 74, special issue.

Miljøministeriet 2007: Kom med ideer til, hvordan vi får renere vand og bedre natur. Miljøcenter Ribe.

Miljøministeriet 2002: Forvaltningsplan for skarv (*Phalacrocorax carbo*) i Danmark. Miljøministeriet, Skov- og Naturstyrelsen. Web site 24.4.2007: <http://www.sns.dk/natur/skarv/skarvforvaltningsplan.pdf>

Munch-Petersen, S. & K.S. Kristensen 1987: Assessment of the stocks of Mussels in the Danish Wadden Sea. ICES K 13, ICES Shellfish Committee.

Nehls, G. & H. Büttger 2007: Spread of the Pacific Oyster (*Crasostrea gigas*) in the Wadden Sea. Causes and consequences of a successful invasion. CWSS. Report. Web site visited 18.9.2008: <http://www.waddensea-secretariat.org/news/symposia/oyster2007/Pacific-oyster-report-April-2007.pdf>



Montagu's Harrier. Photo: Lars Maltha Rasmussen.

Netherlands Environmental Assessment Agency 2007. Web site visited 25.07.2007: <http://www.mnp.nl/mnc/i-en-1248.html>.

Niras 2005: Erhvervs- og velfærdsøkonomisk analyse af Nationalpark Vadehavet. Visioner, scenarier og økonomiske analyser. Juli 2005. Web site visited 22.8.2007: <http://www.sns.dk/lindet/nationalpark/PDF/okonomi/Erhvervs%20og%20velfaerdsokonomisk%20analyse.pdf>

Pedersen, I.K., I. Clausager & T.K. Christensen 2003: Bird numbers and distribution in the Horns Rev offshore wind farm area. Report for Elsam Engineering A/S by NERI, Rønde.

Petersen, I.K. 2004: Bird numbers and distributions in the Horns Rev offshore wind farm area. Annual status report, 2004. NERI.

Rasmussen, L.M. 1998: Jagt og rastende vandfugle 1994-1997. Tøndermarskens Ydre Koge. Arbejdsrapport fra DMU nr. 77.

Rasmussen, L.M. 1999: Analyse af udvikling for ynglende og rastende fugle 1979-99. Tøndermarsken. Arbejdsrapport fra DMU nr. 113.

Rasmussen, L.M. 2001: Springflodstællinger af fugle i Vadehavet 1995-1999 – rastende stor regnspøve. In: Laursen, K. (ed.): Overvågning af fugle, sæler og planter 1999-2000, med resultater fra feltstationerne. Faglig rapport fra DMU nr. 350: 76-84.

Rasmussen, L.M. 2003: Ynglefugle i Vadehavet 2001. Arbejdsrapport fra DMU nr. 178.

Rasmussen, L.M. 2006: Hedehøg i Sydvestjylland ynglesæsonen 2006 – arbejdsrapport fra Projekt Hedehøg. Dansk Ornitologisk Forening.

Rasmussen, L.M. 2007a: Hedehøg i Sydvestjylland ynglesæsonen 2007 – arbejdsrapport fra Projekt Hedehøg. Dansk Ornitologisk Forening.

Rasmussen, L.M. 2007b: Koordineret optælling af Hjejler (*Pluvialis apricaria*) i Danmark i oktober 2003. Dansk Orn. Foren. Tidsskr. 101: 15-23.

Rasmussen, L.M. & K. Fischer 1997: The breeding population of Gull-billed Terns (*Gelochelidon nilotica*) in Denmark 1976-1996. Dansk Orn. Foren. Tidsskr. 91: 101-109.

Rasmussen, L.M. & S. Gillings 2007: Results of a coordinated count of European Golden Plover (*Pluvialis apricaria*) in Northern Europe, October 2003. Wader Study Group Bulletin. Wader Study Group Bull. 114: 60–64.

Rasmussen, L.M. & K. Laursen 2000: Fugle i Tøndermarsken - bestandsudvikling og landbrug. TEMA-rapport, DMU 35/2000.

Rasmussen, L.M., O.G.N. Andersen, J. Frikke, K. Laursen, J. Salvig, D.M. Fleet, B. Hälterlein, H. Heckenroth, T. Merck, H.-U. Rösner, P. Südbeck, W.J. Wolff & J.B.M. Thissen 1996: Red List of birds of the Wadden Sea area. Helgoland Marine Research 50, Supplement 1: 113–128.

Rasmussen, L.M., D.M. Fleet, B. Hälterlein, B.J. Koks, P. Potel & P. Südbeck 2000: Breeding Birds in the Wadden Sea in 1996. Results of a total survey in 1996 and numbers of



Sheep grazing on the Rømø Dam. Photo: Lars Maltha Rasmussen.

- colony breeding species between 1991 and 1996. Wadden Sea Ecosystem No 10. Common Wadden Sea Secretariat, Wilhelmshaven.
- Reaser, J.K., L.E. Neville, H.E. Svart (eds.) 2001: Management of invasive alien species: Forging Cooperation in the Baltic/Nordic Region. Workshop report and final recommendations. Danish Forest and Nature Agency.
- Reneerkens, J., T. Piersma & S. Bernard 2007: The Wadden Sea as a crossroad of migration routes for birds – Literary study into the opportunities and threats for shorebirds in an international perspective. Royal Netherlands Institute for Sea Research.
- Rindorf, A. 2001: Tobis, tobisfiskeri og havfugle. Fisk & Hav 53: 2–10.
- Rindorf, A., S. Wanless, M.P. Harris 2000: Effects of changes in sandeel availability on the reproductive output of seabirds. Marine Ecology Progress Series 202: 241–252.
- Salvig, J.C., K. Laursen & J. Frikke 1994: Surveys of Human Activities and their Effects on Numbers and Distributions of Waterfowl in the Danish Wadden Sea. In: Frederiksen, M. & Dahl (eds.): Birds and their Ecology in the Wadden Sea. Proceedings of the 8th International Scientific Wadden Sea Symposium, Esbjerg 1993. Ophelia, Supplement 6: 333–337.
- Scheiffarth, G. & D. Frank 2005: What can we learn from current monitoring programs? A case study on shellfish eating birds in the European Wadden Sea. In: Blew, J. & P. Südbeck (eds.): Migratory Water Birds in the Wadden Sea 1980 – 2000. Wadden Sea Ecosystem No. 20, Common Wadden Sea Secretariat, Wilhelmshaven.
- Skov- & Naturstyrelsen 2002: Rømø Skydeområde. Drifts- og plejeplan 2002–2017. Web site visited 18.9.2008: www.sns.dk/udgivelser/2002/roemoedrft/default.htm
- Skov- & Naturstyrelsen 2004a: Høring om Forslag til udpejning af et nyt fuglebeskyttelsesområde 113, Sydlige Nordsø. Web site visited 10.7.2007.
- http://www.sns.dk/natura2000/fuglebeskyttelse/sydlige_nordso/
- Skov- & Naturstyrelsen 2004b: Notat om regler gældende for Vadehavet. Upubliceret Notat.
- Skov- & Naturstyrelsen 2007a: Invasive arter. Web page visited 23.4.2007: www.skovognatur.dk/Natur/invasivearter
- Skov- & Naturstyrelsen 2007b: Vadehavsplanens betydning i fremtiden. Web page visited 1.7.2007: www2.skovognatur.dk/netpub/Vadehavet/vadehavsplanens_betydning.html
- Skov- & Naturstyrelsen 2007c: Vand- og naturplaner. Vadehavet. Web page visited 25.8.2007: www.vandognatur.dk/Emner/Naturplaner/Naturomraader/89_vadehavet.htm
- Skriver, J. 2004: Skestork. In: Grell, M.B., H. Heldbjerg, B. Rasmussen, M. Stabell, J. Tofft & T. Vikstrøm. Truede og sjældne ynglefugle i Danmark. Dansk Orn. Foren. Tidsskr. 98: 45–100
- Sønderjyllands Amt og Ribe Amt 2005: Landskab i vadehavsområdet – analyse af landskabskarakteren. Web page visited 18.9.2008: www2.sns.dk/lindet/nationalpark/PDF/landskab/Landskab%20BILAG%20til%20web.pdf
- Thorup, O. 2003: Truede engfugle – status for bestande og forvaltning i Danmark. Dansk Ornitologisk Forening.
- Thorup, O. 2004a: Ynglefugle i Vadehavet 2004. NERI, Kalø. Unpubl. report.
- Thorup, O. 2004b: Status of populations and management of Dunlin *Calidris alpina*, Ruff *Philomachus pugnax* and Black-tailed Godwit *Limosa limosa* in Denmark. Dansk Orn. Foren. Tidsskr. 98: 7–20.
- Thorup, O. 2005: Breeding Avocets in Denmark. – Wader Study Group Bull. 107: 72–74.
- Thorup, O. 2007: Ynglefugle i Vadehavet 2006. Unpubl. report.
- Walther, U. & P. Becker 1997: Occurrence and consumption of seabirds scavenging on shrimp trawler discards in the Wadden Sea. J. Marine Sci. 54: 684–694.



The Wadden Sea is probably the most important Danish nature conservation site in an international perspective. For hundreds of thousands of migratory birds and many other species – like for instance the harbour seal – the Danish Wadden Sea forms an extremely rich ecosystem. But this ecosystem is at present time under severe pressure.

This report by Dansk Ornitologisk Forening – BirdLife Denmark summarises the present conservation status of the Danish Wadden Sea emphasising the rich bird life. Birds are good indicators of changes in the Wadden Sea ecosystem, because they are numerous, they are found in all habitats and they are relatively easy to monitor.

Furthermore, the report identifies a number of serious threats to The Wadden Sea, ranging from mis-management of marsh areas behind the dikes (especially Tøndermarsken), lack of natural dynamics, disturbances by tourism and hunting, over-fishery (of shrimps and mussels), predation by introduced foxes and American mink to environmental impacts caused by climate change (flooding, storms, erosion, migratory "mis-match" etc.)

Denmark, Germany and the Netherlands share common challenges in The Wadden Sea. Therefore, the three countries' national BirdLife partners – Naturschutzbund Deutschland, Vogelbescherming Netherlands and Dansk Ornitologisk Forening have joined to establish a shared BirdLife vision for a modern conservation strategy for the Wadden Sea as a crucial flyway ecosystem crossing the national borders. This report forms the Danish technical contribution to the science based joint conservation strategy.

Montagu's Harrier. Photo: Lars Maltha Rasmussen.

