Migratory Waterbirds in the Wadden Sea 1987– 2008

WADDEN SEA ECOSYSTEM No. 30 - 2010

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Trend, Phenology, Distribution and Climate Aspects

Colophon

Publishers
Common Wadden Sea Secretariat (CWSS), Wilhelmshaven, Germany;
Joint Monitoring Group of Migratory Birds in the Wadden Sea (JMMB).

Authors

Karsten Laursen,	Danmarks Miljøundersøgelser / NERI, Aarhus University, Grenåvej 12, DK 8410 Rønde;
Jan Blew,	BioConsult SH, Brinckmannstr. 31, D-25813 Husum;
Kai Eskildsen,	Nationalparkverwaltung Schleswig-Holsteinisches Wattenmeer, Schloßgarten 1, D - 25832 Tönning;
Klaus Günther,	Schutzstation Wattenmeer, NationalparkHaus Hafen Husum, Hafenstraße 3, D - 25813 Husum;
Bernd Hälterlein,	Nationalparkverwaltung Schleswig-Holsteinisches Wattenmeer, Schloßgarten 1, D - 25832 Tönning;
Romke Kleefstra,	SOVON Vogelonderzoek Nederland, Toernooiveld 1, NL-6503 GA Nijmegen;
Gerold Lüerßen,	Common Wadden Sea Secretariat, Virchowstr. 1, D - 26382 Wilhelmshaven;
Petra Potel,	Nationalparkverwaltung Niedersächsisches Wattenmeer, Virchowstr. 1, D - 26382 Wilhelmshaven;
Stefan Schrader,	Landesbetrieb für Küstenschutz, Nationalpark und Meeresschutz Schleswig-Holstein, Herzog-Adolf-Str. 1, D - 25813 Husum

Language support
Seabury Salmon

Cover photo
Bo Lassen Christiansen

Lay-out and technical editing
Common Wadden Sea Secretariat

Graphic support
Gerold Lüerßen

Print
L-Druck GmbH, Rastede

Paper
Revive Pure Natural Matt - 100% Recycling Paper

Number of copies
1,500

Published
2010

ISSN 0946-896X

This publication should be cited as:
Laursen, K., Blew, J., Eskildsen, K., Günther, K., Hälterlein, B., Kleefstra, R., Lüerßen, G., Potel, P., Schrader, S. 2010. Migratory Waterbirds in the Wadden Sea 1987- 2008. Wadden Sea Ecosystem No.30. Common Wadden Sea Secretariat, Joint Monitoring Group of Migratory Birds in the Wadden Sea, Wilhelmshaven, Germany.

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Common Wadden Sea Secretariat
Joint Monitoring Group of Migratory Birds in the Wadden Sea
In cooperation with
Aarhus University, National Environmental Research Institute,
Dept. of Wildlife Ecology and Biodiversity.
Naturstyrelsen Ribe, Danish Ministry of the Environment and
Bio Consult SH.

Contents

1. Introduction

The Wadden Sea is among the largest coastal wetlands in the world. It is a key area and the most important staging site along the East Atlantic Flyway for birds moving between breeding areas in the Arctic from Canada/Greenland in the west to Siberia in the east to wintering areas in West Europe, the Mediterranean and Africa. The Wadden Sea's shallow, tidal influenced waters, its extensive tidal flats and adjacent saltmarshes provide food for about 12 million waterbirds which stop to build up their fat reserves for their further migration, moulting during autumn or staging during winter. At least 52 populations of 41 migratory waterbirds use the Wadden Sea annually. Of these, the numbers of 44 populations of 34 species are large enough for the Wadden Sea to be considered as their most important stopover site during migration (Meltofte *et al.*, 1994, Blew *et al.*, 2005a).

The purpose of this report is two-fold, 1) to update the knowledge and numbers of the migratory birds for the QSR 2009 report. In that report, the species numbers are assessed in relation to targets in the Wadden Sea plan (Laursen *et al.*, 2009, Wadden Sea Plan, 1997); and 2) to provide the most recent information and data of the migratory birds in the Wadden Sea, including the species phenology, geographical distribution and numbers. In the present report these aspects are also analysed in relation to climate and regional aspects. Since the report published by Meltofte *et al.* (1994) species distribution has not been estimated; while in the interim period focus has been on population numbers and trends (Rösner *et al.*, 1994, Poot *et al.*, 1996) and new statistical methods have been introduced and results have been provided (Blew *et al.*, 2005a, Blew *et al.*, 2007).

The data presented in this report is a part of the Trilateral Monitoring and Assessment Program for the Wadden Sea gathered by the Joint Monitoring of Migratory Birds program. It consists of (a) at least 2-3 synchronous, complete, counts each year, and (b) bi-monthly counts during spring tide at 60 counting sites and (c) additional three counts for geese and aerial counts for Shelduck and Eider. The trilateral counts were initiated in 1980 and from 1987/1988 a solid counting scheme was established, which makes it possible to produce trends calculated not only from winter or autumn, but on year-round data. To do this, missing data are substituted by calculated numbers to fill in gaps in the counts. This paper presents results from 1987/1988-2007/2008, thus covering a period of 21 years.

The report is produced by the National Coordinating Group on the Joint Monitoring of Migratory Birds (JMMB) under the Trilateral Monitoring and Assessment Program. During the preparatory work of the report Bettina Reineking from the Wadden Sea Secretariat and Mark van Roomen from SOVON, The Netherlands, was part of the JMMB-group and they both gave valuable support and suggestions for the work. We all offer our sincere thanks for the time they spent in the group and their work on migratory birds.

Since the last migratory bird report (Blew *et al.*, 2007), the Dutch and German parts of the Wadden Sea Conservation Area were designated as a World Heritage Site by UNESCO in June 2009 (Common Wadden Sea Secretariat, 2008). This was a great step in formally recognizing the global importance of the Wadden Sea. Since this report covers the period up to the designation year, the result of these analyses can be considered as a baseline for future comparison of developments in the Wadden Sea.

Photo: Gundolf Reichert

2. Summaries

2.1 Summary

The Wadden Sea along the west coast of Denmark, Germany and The Netherlands holds the largest coherent tidal flat in the world. The size including the offshore area (to 15 m depth) is roughly 14.700 km^2, of which the intertidal flats make up a third of the area and the saltmarshes about 3 %. Due to nutrition inflow from the North Sea and the rivers, the Wadden Sea habitats provide a rich food source for birds all year around.

The Wadden Sea is the single most important staging, moulting and wintering area for waterbirds on the East Atlantic flyway. According to the 1% criterion of the Ramsar Convention, the Wadden Sea is of outstanding international importance as a staging, moulting and wintering area for at least 52 populations of 41 migratory waterbirds species that use the East Atlantic Flyway and originate from breeding populations from a large part of the northern hemisphere, from Canada/Greenland in the west, across Scandinavia to Siberia in the east. Numbers of 44 populations of 34 species are of a magnitude that makes the Wadden Sea indispensable to these species, either as a main staging site during migration, or as their primary wintering or moulting habitat; these are the species dealt with in this report.

During recent years the amount and quality of migratory bird data has increased considerably and data handling has been improved. The current 'Joint Monitoring of Migratory Birds' (JMMB) program, carried out in the framework of the 'Trilateral Monitoring and Assessment Program' (TMAP), consists of 2-3 internationally synchronous, complete counts every year and monthly or bi-monthly counts during spring tide at 688 counting sites.

Total numbers result in a maximum of approximately 6 million birds being present in the Wadden Sea at one time, not considering turn-over. Besides Great Cormorant and Spoonbill, those numbers add up to about 1.37 million ducks and geese, 3.46 million waders and 0.89 million gulls, all valid for the most recent bird years 1999/2000-2006/2007. Most species reach highest numbers during autumn migration. Numbers of waders are almost as high during spring, whereas ducks and geese overwinter in high numbers. Only gulls are numerous during summer.

Nearly the entire populations of the Dark-bellied Brent Goose *Branta b. bernicla* and of the Red Knot *Calidris canutus* use the Wadden Sea during the annual cycle. In addition, seven species are present with more than 50 % of their flyway population and a further 13 species with more than 10 %. In addition the coastal zone of the offshore area is used by high numbers of moulting Shelduck *Tadorna tadorna* and moulting and wintering Common Eider S*omateria mollissima*.

During the last decade, the JMMB-group had focused on estimating trends for the migratory birds in the Wadden Sea (Blew *et al*. 2005), revealing serious declines in some species numbers (Blew *et al*. 2007). In this report, beside the trend estimates, the JMMB-group focuses on geographical distribution and phenology of the migratory species in relation to the environmental and climatic dynamics in the Wadden Sea. More than 20 years of migratory bird monitoring offers excellent opportunities to look for changes during this period. Thus, analyses are performed for the geographical distributions and for the species phenology throughout the year, separately for the Northern and the South-Western Wadden Sea.

The aims of this report are:

1. Update of species trends
2. Analyses of changes in geographical distribution
3. Analyses of changes in phenology
4. Analyses of species numbers in relation to climate conditions

The trend analyses for 34 waterbird species in the Wadden Sea during the 21 year period from 1987 to 2008 show that

- numbers of 8 species had strong or moderate increases: Great Cormorant, Eurasian Spoonbill, Barnacle Goose, Northern Pintail, Common Ringed Plover, Sanderling, Curlew Sandpiper and Bar-tailed Godwit;
- 12 species had stable numbers: Dark-bellied Brent Goose, Eurasian Wigeon, Northern Shoveler, Grey Plover, Eurasian Lapwing, Red Knot, Dunlin, Eurasian Curlew, Common Redshank, Common Greenshank, Ruddy Turnstone and Common Gull;
- 14 species had decreasing numbers, mostly moderate: Common Shelduck, Common Teal, Mallard, Common Eider (after 1993), Eurasian Oystercatcher, Pied Avocet, Kentish Plover, European Golden Plover, Ruff, Whimbrel, Spotted Redshank, Black-headed Gull, Herring Gull and Great Black-backed Gull.

The assessment of the trend results reveals that species which show strong increases in the Wadden Sea also show increases in their flyway populations. Those species with moderate increases in the Wadden Sea are those wintering in tropical Africa and breeding in the Arctic. About half of the species with stable numbers in the Wadden Sea also have stable flyway numbers; all of these species have their breeding and wintering grounds in the Arctic/Europe and in tropical Africa/Europe. The species that decline in the Wadden Sea are dominated by species breeding in North, Central and Western Europe, and a large proportion of these species also spend the winter there. Thus, while the Arctic breeding species have done better in recent years, the species showing decreasing trends seem to be affected by conditions in NW Europe, and likely within the Wadden Sea. In relation to food, it seems obvious that species using garbage dumps such as Herring Gull and Great Black-backed Gull decrease in numbers as well as species feeding on mussels such as Common Eider and Oystercatcher (and partly Herring Gull).

Most species show a more or less uniform distribution throughout the Wadden Sea with high numbers in the Central and South-Western parts. Some species, such as the Spotted Redshank occur only at a few sites; others, such as the Shelduck moulting off the Elbe estuary, have local concentrations of high numbers during a period of the year. With regard to species distribution, changes between an early period 1987/88-1994/95 and a late period 1999/00-2006/07 are analysed. They show for example that Great Cormorant increases at all sites. In contrast, gull species decrease in all four parts of the Wadden Sea. All geese species and Shelduck increase in Niedersachsen but decrease in Schleswig-Holstein and seem to be stable in the Danish and The Netherlands areas. As for the dabbling ducks and waders, similar patterns are found: most of these species show stable numbers in The Netherlands and in the Danish parts, but several species decrease in Schleswig-Holstein and Niedersachsen. This geographical pattern has a striking similarity with the distribution of tidal amplitude in the Wadden Sea, which is higher in the central parts, but lower in the Danish and Dutch regions. For the species that feed on the tidal flats, we found a significant correlation between the height of the tidal amplitude in the sub-areas and the number of species that change in numbers between 1987/88-1994/95 and 1999/00-2006/07. In contrast to that, no significant correlation was found for those species feeding on the salt marshes. Consequently, these results bring a focus to the tidal dynamics in the Wadden Sea. The dynamics could be climate driven and we recommend that this should be studied in more detail in the future.

Most species show a reasonably constant pattern in their phenology over the years. In particular their arrival and departure times are stable. But when looked in more detail, several species have shown changes between the periods 1987/88-1994/95 and 1999/00-2006/07. While during autumn no clear changes in phenologies appear, during spring in the Northern and South-Western Wadden Sea the median date of a few species (1 in the Northern, 4 in the South-Western regions), show an earlier passage in the late compared to the early period, but several species (12 and 10) show a later passage through the Wadden Sea. Those showing a late passage through the Wadden Sea belong to both the North European and to the Arctic breeding species.

Climate conditions influence a number of biological processes. For the bird numbers in the Wadden Sea, we propose that winter conditions expressed by the North Atlantic Oscillation index (NAO) and the water temperature in the Wadden Sea in April have an influence on the species´ survival/distribution (winter climate) and reproductive success (water temperature in April). The results show that trends in 30 out of 34 species are significantly correlated with one or both of these climate variables, while trends in four species are not: Common Shelduck, Common Redshank, Ruddy Turnstone and Common Gull. Out of those two climate variables most species trends correlated with the April water temperature in the Wadden Sea. Moreover, species which show a positive correlation to April water temperature mainly have a positive trend in the Wadden Sea. In contrast, those species showing negative correlations with the April water temperature were dominated by species showing negative trends. While the direct causes of these results are not clear, it could indicate that those species taking advantage of warmer spring temperatures and thus better feeding conditions also arrive at the breeding grounds in a better body condition and thus have a higher reproductive success.

The results confirm impressively once more that the Wadden Sea is a highly important staging and wintering area for a large number of species and populations which belong to the East Atlantic Flyway. Changes had occurred during the last two decades that influence the species numbers, phenologies and geographical distributions. For at least some species, possible causes for declines may well be the physical, ecological and climatic conditions in the Wadden Sea. It is also acknowledged, that conditions outside the area are affecting numbers and trends of other species. We recommend continuing to study possible links between the conditions in the Wadden Sea and the breeding and wintering numbers of these bird species

Monitoring of the migratory birds in the Wadden Sea is a continuous process. Results are used to produce status reports like this one containing relevant and focussed information to assess the species' use of the Wadden Sea and the parameters that affect them. The most up to date information on the trends of the migratory species can be found on the Common Wadden Sea Secretariat's web site:

http://www.waddensea-secretariat.org/TMAP/Migratory_birds.html

2.2 Sammenfatning

Vadehavet, beliggende langs vest- og nordkysten af Danmark, Tyskland og Holland, udgør ét af verdens største sammenhængende tidevandsområder. Området, med tilgrænsende havområder ned til 15 m's dybde, udgør næsten 15.000 km^2. Heraf udgør de karakteristiske naturtyper som tidevandsflader mere end 30% og strandenge 3%. På grund af tilførsel af næringsstoffer fra Nordsøen og de mange større eller mindre vandløb, rummer Vadehavsområdet meget store føderessourcer, der året rundt er til rådighed for en lang række forskellige arter af fugle.

Vadehavet er i sin helhed det vigtigste område for vandfugle langs den Østatlantiske Trækrute. Sammenholdt med Ramsar-konventionens kriterier for vigtighed (1%-regelen), er Vadehavet af enestående betydning som raste-, fælde- og overvintringsområde for mindst 52 bestande af 42 trækkende vandfuglearter, som benytter den Østatlantiske Trækrute, der forbinder yngleområderne mod nord med overvintringsområderne mod syd. Arterne tilhører ynglebestande som kommer fra et område på den nordlige halvkugle, der strækker sig fra Canada/Grønland i vest over Skandinavien til Sibirien i øst. 44 bestande af 34 arter forekommer i så store mængder, at Vadehavet er deres vigtigste raste-, overvintrings- eller fældeområde. Det er disse arter, der behandles i denne rapport.

Gennem de seneste år er mængden og kvaliteten af data om trækfuglenes forekomst øget betydeligt, og bearbejdningen af data er som følge heraf forbedret. Det løbende 'Trilaterale Overvågningsprogram for Trækkende Vandfugle' (JMMB), der udføres inden for rammerne af det 'Trilaterale Overvågnings- og Evalueringsprogram' (TMAP), består af 2-3 årlige, synkrone og dækkende optællinger samt 'springtidstællinger', der udføres månedlig eller med 14 dages intervaller på 688 lokaliteter.

Det maksimale antal fugle, som opholder sig i Vadehavet på samme tid, er beregnet til ca. 6 millioner, men et større antal bruger området fordi individerne konstant afløser hinanden (turn over effekt). Foruden Skarv og Skestork kommer antallene op på ca. 1,37 mio. ænder og gæs, 3,46 mio. vadefugle og 0,89 mio. måger, alle opgjort i perioden 1999/2000 - 2006/2007. De fleste arter optræder med de største antal under efterårstrækket. Men for vadefugle er antallet omtrent ligeså stort om foråret, mens ænder og gæs kulminerer om vinteren. Kun måger er til stede i store tal om sommeren.

Omtrent hele bestanden af Mørkbuet knortegås *Branta b. bernicla* og Islandsk ryle *Calidris canutus* er afhængige af Vadehavet i deres årlige cyklus. Desuden er syv arter tilstede med mere end 50% af deres samlede bestande og yderligere 13 arter forekommer i antal, som udgør mere end 10% af bestandene. Dertil kommer, at kystzonen mod Nordsøen bruges af et stort antal fældende Gravænder *Tadorna tadorna* samt fældende og overvintrende Ederfugle *Somateria mollissima*.

Gennem de senere år har JMMB-gruppen haft fokus på beregning af arternes bestandsmæssige udvikling, de såkaldte "trends" for trækfugle i Vadehavet (Blew *et al.* 2005). Disse resultater afslører betydelige nedgange i antallene for nogle arter. Foruden arternes udvikling fokuserer denne rapport også på deres geografiske fordeling og forekomst gennem året, den såkaldte fænologi. Disse forhold undersøges i relation til arternes biologi og klimatiske ændringer i Vadehavet. Mere end 20 års overvågning af de trækkende vandfugle giver gode muligheder for at undersøge, om der er sket forandringer i løbet af perioden. Analyserne af arternes geografiske fordeling og deres forekomst er gennemført for henholdsvis den nordlige og sydvestlige del af Vadehavet.

Formålet med denne rapport er at:

1. Opdatere arternes bestandsmæssige udvikling (trends)
2. Analysere ændringer i arternes geografiske fordeling

3. Analysere ændringer i den årlige forekomst (fænologi)
4. Analysere arternes antal i relation til klimaændringer

Analysen af udviklingen for bestandene af 34 arter af trækkende vandfugle i Vadehavet gennem en periode på 21 år (1987 til 2008) viser,

- at antallene for 8 arter viser stærke eller moderate stigninger: Skarv, Skestork, Bramås, Spidsand, Stor præstekrave, Sandløber, Krumnæbbet ryle og Lille kobbersneppe.
- at 12 arter havde stabile antal: Mørkbuget knortegås, Pibeand, Skeand, Strandhjejle, Vibe, Islandsk ryle, Almindelig ryle, Stor regnspove, Rødben, Hvidklire, Stenvender og Strommåge.
- at 14 arter gik tilbage i antal, de fleste moderat: Gravand, Krikand, Gråand, Ederfugl (efter 1993), Strandskade, Klyde, Hvidbrystet præstekrave, Hjejle, Brushane, Lille regnspove, Sortklire, Hættemåge, Sølvmåge og Svartbag.

Vurdering af arternes udvikling viser, at de arter der udviser stærkt stigende antal i Vadehavet tilhører arter, hvis samlede bestande også er stigende. Arter med moderate fremgange i Vadehavet, er arter, som yngler i Arktis og overvintrer i tropisk Afrika. Omkring halvdelen af de arter, der har stabile antal i Vadehavet tilhører arter hvis samlede bestande også er stabile; alle disse arter yngler i Arktis/Europa og i overvintre i tropisk Afrika/Europa. Arter, der optræder med faldende antal i Vadehavet, domineres af arter som yngler i Nord-, Central- og Vesteuropa, og en stor del af arterne overvintrer også der.

Således viser vurderingen, at de arktisk ynglende arter har klaret sig godt i de senere år, mens de arter, der viser nedgange, er afhængige af forholdene i Nordvesteuropa og sandsynligvis også af forholdene i Vadehavet. I relation til føde, er det f.eks. også tydeligt, at arter, som søger føde på lossepladser eller i forbindelse med fiskeriaktiviteter (Sølvmåge og Svartbag), falder i antal lige som de arter, der æder blåmuslinger (Ederfugl og Strandskade, og delvist også Sølvmåge).

De fleste arter viser en ensartet geografisk fordeling med store antal i de centrale og sydvestlige dele af Vadehavet. Nogle arter som Sortklire forekommer kun i mindre antal og på få lokaliteter. En anden art som Gravand, der fælder i store antal vest for Elbens udmunding, har en forholdsvis lokal udbredelse, men forekommer i store antal i en kort periode. Arternes fordeling er undersøgt i en tidlig (1987/88 - 1994/95) og en sen periode (1999/2000 - 2006/07).

Resultaterne viser, at for eksempel Skarv er steget i antal i alle områder. I modsætning hertil er måge-arterne gået tilbage i antal i alle dele af Vadehavet. Alle gåse-arter samt Gravand er steget i antal i Nedersaksen, faldet i Slesvig-Holsten og er stabile i Danmark og Holland. For svømmeænder og vadefugle er der fundet et tilsvarende mønster: De fleste arter har stabile antal i Holland og Danmark, mens flere arter er faldet i antal i Slesvig-Holsten og Nedersaksen. Denne geografiske fordeling har en slående lighed med højden af tidevandets udsving fra ebbe til flod (amplitude) i Vadehavet, hvor amplituden er størst i de centrale dele (Slesvig-Holsten og Nedersaksen) og mindst mod nord (Danmark) og sydvest (Holland). For arterne som søger føde på tidevandsfladerne fandt vi en signifikant sammenhæng mellem størrelsen af tidevandsforskellen i delområderne og antallet af fuglearter, som viste signifikante ændringer i deres antal i samme delområder mellem perioderne 1987/88 - 1994/95 og 1999/2000 - 2006/07. I modsætning hertil blev der ikke fundet nogen signifikante ændringer i antallene for de arter, som søger føde på strandengene i de tilsvarende delområder. Hermed sættes der fokus på tidevandsdynamikken i Vadehavet. Denne dynamik kan være påvirket af klimaændringer, og det anbefales, at denne sammenhæng undersøges i fremtiden.

De fleste arter viser et nogenlunde stabil mønster i deres fænologi (den årlige forekomst) fra år til år. I særdeleshed er tidspunkterne for

Photo: Thorsten Krüger

deres ankomst til og afrejse fra Vadehavet stabile. Men undersøgt mere detaljeret, viser adskillige arter forandringer mellem perioderne 1987/88 - 1994/95 og 1999/2000 - 2006/07. Mens der ikke er klare tendenser om efteråret, viser flere arter ændringer i deres median-datoer om foråret i både den nordlige og sydlige del af Vadehavet. Således viser få arter (1 i den nordlige og 4 i den sydlige del) tidligere passage gennem Vadehavet i den sene sammenlignet med den tidlige periode. Men adskillige arter (12 og 10 i de to områder) viser en senere passage gennem Vadehavet. De arter der udviser en sen passage gennem Vadehavet om foråret, er arter, som yngler i både Nordeuropa og i Arktis.

Klimatiske forhold har indflydelse på adskillige biologiske processer. For antallet af fugle i Vadehavet antager vi, at forholdene om vinteren udtrykt ved det Nordatlantiske Oscillation Index (NAO) og vandtemperaturen i Vadehavet i april har betydning for arternes overlevelse, (vinterklima) og ungeproduktion (vandtemperatur i april). Analyserne viser, at udviklingen i antallene for 30 ud af 34 arter er signifikant korreleret med den ene eller begge disse klimaparametre, mens antallene for kun fire arter ikke viser nogen korrelation. Disse fire arter er: Gravand, Rødben, Stenvender og Stormmåge. Af de to klimaparametre er de fleste arter korreleret med vandtemperaturen i april. Desuden er de arter som er positivt korreleret med vandtemperaturen i april overvejende arter, hvis bestande øges i Vadehavet. I modsætning hertil er de arter, som er negativt korreleret med vandtemperaturen i april arter, som overvejende forekommer i faldende antal i Vadehavet. Selvom grundene til denne sammenhæng ikke er klare, kunne det indikere at de arter, som kan drage nytte af varme forår og mulighederne for at udnytte tidligt forekommende byttedyr, er bedre til at opbygge deres fedtdepoter. Dermed er de også i stand til at ankomme til ynglepladserne i en bedre kondition og opnå en god ynglesucces.

Resultaterne viser endnu engang at Vadehavet har en stor betydning som raste- og overvintringsområde for et stort antal arter og bestande, som tilhører den Østatlantiske Trækfuglekorridor. Ændringer, som har fundet sted gennem de sidste to årtier, har påvirket arternes antal, forekomst og geografisk fordeling. I det mindste for nogle arter er der givet forklaringer på mulige sammenhænge mellem de antalsmæssige ændringer og de fysiske, økologiske og klimatiske forhold i Vadehavet. Resultaterne viser desuden, at også forhold uden for Vadehavet påvirker arters antal og udvikling. Vi vil derfor anbefale, at samarbejdet udbygges mellem Vadehavet og landene som udgør arternes yngle- og overvintringsområder mod henholdsvis nord og syd.

Overvågning af trækkende fugle i Vadehavet er en kontinuerlig opgave. Resultaterne bruges bl.a. til at udarbejde statusrapporter som den foreliggende, der indeholder resultater og sammenstillinger, der er et vigtigt grundlag for at kunne vurdere arternes brug af Vadehavet og de mulige faktorer, der påvirker dem. Et sådant arbejde tager tid, og mens det står på, ændrer arternes antal sig. Derfor kan udredninger som denne forekomme at være historiske, men årsagerne til de beskrevne udviklingstendenser vil sandsynligvis stadig være gældende i lang tid fremover. For at kunne give læserne den nyeste udvikling, opdateres arternes udvikling løbende på Vadehavssekretariatets webside, hvor man kan få indblik i de nyeste resultater:

http://www.waddensea-secretariat.org/TMAP/Migratory_birds.html

2.3 Zusammenfassung

Das Wattenmeer entlang der Westküste von Dänemark, Deutschland und den Niederlanden ist das größte zusammenhängende Wattgebiet der Welt. Einschließlich des Offshore-Bereichs (bis zu einer Tiefe von 15 m) beträgt seine Größe etwa 14.700 km^2, ein Drittel davon sind Wattflächen, ungefähr 3 % sind Salzwiesen. Aufgrund des Nährstoffeintrages aus der Nordsee und den Flüssen weisen die Wattenmeerhabitate eine hohe Produktivität auf, die ganzjährig zu einem reichen Nahrungsangebot für Vögel führt.

Das Wattenmeer ist das bedeutendste Rast-, Mauser- und Überwinterungsgebiet für Wasser- und Watvögel auf dem Ostatlantischen Zugweg. Bezogen auf das 1% -Kriterium der Ramsar-Konvention ist das Wattenmeer von herausragender internationaler Bedeutung für mindestens 52 Populationen von 41 ziehenden Wat- und Wasservogelarten des ostatlantischen Zugwegs. Die Brutgebiete dieser Populationen erstrecken sich über einen großen Teil der nördlichen Hemisphäre und reichen von Kanada und Grönland im Westen über Skandinavien bis nach Sibirien im Osten. Für 44 Populationen von 34 Arten stellt das Wattenmeer einen unverzichtbaren und häufig den wichtigsten Trittstein während des Zugs und das Haupt-Überwinterungs- und Mausergebiet dar; diese Arten werden im vorliegenden Bericht behandelt.

Sowohl die Qualität und als auch die Quantität der Wasser- und Watvogeldaten haben in den letzen Jahren beträchtlich zugenommen und Datenhaltung und -auswertung wurde verbessert. Das laufende gemeinsame Monitoring-Programm („Joint Monitoring Program of Migratory Birds – JMMB"), welches im Rahmen des „Trilateral Monitoring and Assessment Program – TMAP" durchgeführt wird, umfasst in 688 Zählgebieten jährlich zwei bis drei internationale Synchronzählungen sowie Springtidenzählungen, welche in ausgewählten Gebieten ca. alle 15 Tage stattfinden.

Insgesamt sind (nach den Zählungen/ Ergebnissen) maximal etwa 6 Millionen Vögel gleichzeitig im Wattenmeer anwesend, wobei der „turnover" unberücksichtigt bleibt. Betrachtet man den Zeitraum 1999/ 2000 bis 2006/2007, so setzen sich diese Zahlen aus ca. 1, 37 Millionen Enten und Gänsen, 3,46 Millionen Watvögeln und 0,89 Millionen Möwen zusammen, dazu kommen noch Kormorane und Löffler. Die meisten Arten erreichen ihre Höchstbestände während des Herbstzuges, die Zahlen der Watvögel sind aber auch im Frühjahr ähnlich hoch, Gänse und Enten dagegen kommen im Winter in hohen Beständen vor, während Möwen auch im Sommer häufig sind.

Im Jahresverlauf nutzt praktisch die gesamte Population der Dunkelbäuchigen Ringelgans *Branta. b. bernicla* und des Knutts *Calidris canutus* das Wattenmeer. Zusätzlich sind sieben weitere Arten mit mehr als 50% und weitere 13 Arten mit mehr als 10% ihrer flyway-Population anwesend. Hohe Bestände der Brandgans *Tadorna tadorna* sowie der Eiderente *Somateria molissima* nutzen die angrenzende Küstenzone zur Mauser bzw. zur Mauser und Überwinterung.

Während der letzten Dekade hat sich die JMMB-Gruppe darauf konzentriert, Populations-Trends der Zugvögel im Wattenmeer zu berechnen, wobei in den Bestandszahlen einiger Arten erhebliche Abnahmen festgestellt wurden (Blew *et al.* 2005, 2007). In dem vorliegenden Bericht wird zusätzlich die geografische Verteilung und die Phänologie der Zugvogelarten betrachtet. Die mittlerweile über 20 Jahre zurückreichende Datenerfassung bietet eine hervorragende Gelegenheit, Änderungen innerhalb dieses Zeitraumes in Bezug zu Veränderungen der Umwelt und des Klimas im Wattenmeer zu setzen. So konnten Analysen der geografischen Verteilung für unterschiedliche Jahreszeiten und der Phänologien getrennt für das nördliche und das südwestliche Wattenmeer durchgeführt werden.

Die Ziele dieses Berichtes sind:

1. Aktualisierung der Populationstrends;
2. Analyse der Änderungen in der geografischen Verteilung
3. Analyse der Änderungen in den Phänologien
4. Analyse der Populationstrends in Bezug auf klimatische Bedingungen

Die Analyse der Trends von 34 Wat- und Wasservogelarten für die 21 Jahre von 1987 bis 2008 zeigt, dass:

- 8 Arten starke oder mäßige Zunahmen zeigen: Kormoran, Löffler, Weißwangengans, Spießente, Sandregenpfeifer, Sanderling, Sichelstrandläufer und Pfuhlschnepfe,
- 12 Arten stabile Bestände haben: Dunkelbäuchige Ringelgans, Pfeifente, Löffelente, Kiebitzregenpfeifer, Kiebitz, Knutt, Alpenstrandläufer, Großer Brachvogel, Rotschenkel, Grünschenkel, Steinwälzer, und Sturmmöwe,
- 14 Arten abnehmende Bestände haben: Brandente, Krickente, Stockente, Eiderente (nach 1993), Austernfischer, Säbelschnäbler, Seeregenpfeifer, Goldregenpfeifer, Kampfläufer, Regenbrachvogel, Dunkler Wasserläufer, Lachmöwe, Silbermöwe und Mantelmöwe.

Eine Aufschlüsselung der Trends zeigt, dass bei Arten, die starke Zunahmen im Wattenmeer aufweisen, auch die Flyway-Population zunimmt. Viele Arten, deren Bestände mäßige Zunahmen im Wattenmeer verzeichnen, überwintern im tropischen Afrika und brüten in der Arktis. Ungefähr die Hälfte der Arten, die mit stabilen Zahlen im Wattenmeer auftreten, weisen auch stabile Flyway-Bestände auf; die Brutgebiete dieser Arten liegen in der Arktis und in Europa, sie überwintern in Europa und im tropischen Afrika. Arten, deren Bestände im Wattenmeer abnehmen, gehören vor allem zu denen, die in Nord-, Zentral- und Westeuropa brüten und überwiegend auch dort überwintern. Während sich also die Bestände der arktischen Brutvögel erholt haben, scheinen die Arten mit abnehmenden Trends von Bedingungen in Nordwest-Europa beeinträchtigt zu sein, wahrscheinlich sogar von denen im Wattenmeer. Mit Blick auf die bevorzugte Nahrung der Arten zeigt sich, dass die Bestände von Silbermöwe und Mantelmöwe, die von offenen Mülldeponien profitierten, abnehmen, ebenso wie die Bestände von muschelfressenden Arten wie Eiderente, Austernfischer und teilweise Silbermöwe.

Die meisten Arten weisen eine mehr oder weniger gleichmäßige Verteilung im Wattenmeer auf, mit hohen Anzahlen in den zentralen und südwestlichen Bereichen. Einige Arten, wie der Dunkle Wasserläufer, treten nur in wenigen Gebieten auf, andere zeigen deutliche lokale Konzentrationen während eines Jahresabschnittes, wie die Brandgans, die im Elbe-Ästuar mausert. Im Hinblick auf die Artenverteilung wurden die Veränderungen zwischen einer frühen Periode 1987/88 – 1994/95 und einer späten Periode 1999/00-2006/07 analysiert. Dabei wurde deutlich, dass z. B. die Bestände des Kormorans überall zunehmen, während z. B. die Möwenbestände in allen vier Wattenmeer-Regionen abnehmen. Alle Gänsearten und die Brandgans nehmen in Niedersachsen zu und in Schleswig-Holstein ab, scheinen aber im dänischen und niederländischen Bereich stabile Bestände zu haben. Ähnliche Muster wurden für Gründelenten und Watvögel gefunden: Die meisten dieser Arten weisen stabile Trends im dänischen und niederländischen Wattenmeer auf, während viele dieser Arten im schleswig-holsteinischen und niedersächsischen Teil abnehmende Trends aufweisen. Dieses geografische Muster hat eine bemerkenswerte Ähnlichkeit mit der Gezeiten-Amplitude, welche im zentralen Bereich des Wattenmeers höher ist als in den dänischen und niederländischen Bereichen. Für Arten, die auf den Wattflächen nach Nahrung suchen, konnten wir eine signifikante Korrelation zwischen der Höhe der Gezeiten-Amplitude in den entsprechenden Regionen (sub-areas) und der Veränderung der Bestandszahlen zwischen 1987/88-1994/95 und 1999/00-2006/07 feststellen. Im Gegensatz dazu konnte für Arten, die auf den Salzwiesen nach Nahrung suchen, keine solche signifikante Korrelation gefunden werden. Diese Ergebnisse weisen auf Veränderungen in der Gezeiten-Dynamik im Wattenmeer hin, welche letztendlich von klimatischen Veränderungen verursacht sein können und es wird empfohlen, dieses zukünftig eingehender zu untersuchen.

Die meisten Arten zeigen über die Jahre ziemlich konstante Phänologieverläufe, insbesondere die Ankunfts- und Abflugzeiten sind im Wattenmeer gleich bleibend. Bei genauerer Betrachtung, zeigen jedoch etliche Arten Änderungen zwischen den verglichenen Perioden 1987/88-1994/95 und 1999/00-2006/07: Anhand des mittleren Durchzugsdatums (Median) konnte für das Frühjahr einerseits bei einigen Arten ein früherer Durchzug während des jüngsten Zeitraums (1999/00-2006/07) festgestellt werden (1 Art im nördlichen, 4 Arten im südwestlichen Wattenmeer); andererseits wurde bei 12 Arten im nördlichen und 10 Arten im südwestlichen Wattenmeer ein späterer Durchzug durch das Wattenmeer registriert. Arten, welche im Frühjahr später durch das Wattenmeer ziehen, gehören sowohl zu den nordeuropäischen als auch zu den arktischen Brutvögeln. Im Herbst wurden keine deutlichen Änderungen entdeckt .

Klimatische Bedingungen beeinflussen eine ganze Anzahl biologischer Prozesse. Wir gehen davon aus, dass die Anzahl der Vögel im Wattenmeer durch die Klimabedingungen im Winter beeinflusst werden, die sich durch den Nordatlantischen Oszillationsindex (NAO) und die Wassertemperatur im April beschreiben lassen: Die Wetterlage im Winter (NAO) wirkt sich auf das Überleben und die Verteilung der Vögel aus, die Wassertemperatur im Wattenmeer auf ihren Bruterfolg. Bei 30 der 34 untersuchten Arten sind die Trends signifikant mit einer oder beiden Variablen korreliert, Ausnahmen bilden die Arten Brandente, Rotschenkel, Steinwälzer und Sturmmöwe. Die Trends der meisten Arten sind mit der Wassertemperatur im April korreliert. Die Arten, deren Trend positiv mit der Wassertemperatur im April korreliert ist, sind überwiegend Arten, für die auch ein positiver Trend im Wattenmeer verzeichnet wird. Umgekehrt wird die Gruppe, deren Trends negativ mit der Wassertemperatur im April korreliert sind, von Arten dominiert, die einen negativen Trend im Wattenmeer aufweisen. Obwohl der direkte Zusammenhang nicht eindeutig ist, könnten die Ergebnisse darauf hinweisen, dass die Arten, die von den wärmeren Frühlingstemperaturen und damit besseren Nahrungsbedingungen im Wattenmeer profitieren, in einer besseren Kondition in den Brutgebieten ankommen und dadurch einen höheren Bruterfolg haben.

Die Ergebnisse bestätigen einmal mehr, dass das Wattenmeer eines der bedeutendsten Rast- und Überwinterungsgebiet für viele Arten und Populationen des Ostatlantischen Zugwegs ist. In den letzten zwei Dekaden traten Veränderungen auf, die sich auf die Bestandszahlen dieser Arten im Wattenmeer, ihre Phänologien und ihre geografische Verteilung ausgewirkt haben. Zumindest für einige Arten sind die Gründe für die Abnahme ihrer Bestände wahrscheinlich in physikalischen, ökologischen und klimatischen Bedingungen im Wattenmeer zu suchen. Dessen ungeachtet werden Anzahl und Trends einiger Arten aber sicher auch von Bedingungen außerhalb des Wattenmeeres beeinflusst und es wird empfohlen, die Zusammenarbeit zwischen dem Internationalen Wattenmeer und den Brut- und Überwinterungsgebieten dieser Arten weiter zu intensivieren.

Das Monitoring der Zugvögel im Wattenmeer ist ein kontinuierlicher Prozess. Die Ergebnisse werden genutzt, um Statusberichte wie den vorliegenden zu fertigen, und damit wichtige und komprimierte Informationen bereit zu stellen, um sowohl die Nutzung des Wattenmeeres durch Wat- und Wasservogelarten als auch die möglichen Wirkfaktoren zu bewerten. Die aktuellsten Informationen zu den Trends der Zugvogelarten werden regelmäßig auf der Homepage des Internationalen Wattenmeersekretariats veröffentlicht:

http://www.waddensea-secretariat.org/TMAP/Migratory_birds.html

2.4 Sammenvatting

De internationale Waddenzee, die zich langs de Noordzeekust van Denemarken, Duitsland en Nederland bevindt, is het grootste aaneengesloten getijdengebied van de wereld. Inclusief het buitengaats gebied (tot 15 m diepte) beslaat het ruwweg 14.700 km^2, waarvan een derde deel bestaat uit droogvallend wad en circa 3% uit kwelders. De toevoer van voedselrijk water vanuit de Noordzee en de rivieren zorgt ervoor dat de Waddenzee jaarrond een belangrijke bron van voedsel is voor tal van organismen.

Zo is de Waddenzee het belangrijkste doortrek-, rui- en overwinteringsgebied voor tal van watervogels in de Oost-Atlantische trekroute. Op basis van de gehanteerde 1%-normen van de Ramsar Conventie is de Waddenzee van groot internationaal belang voor tenminste 52 populaties van 41 migrerende watervogels langs de Oost-Atlantische trekroute. Deze zijn afkomstig uit broedpopulaties die zich ruim verspreiden over het noordelijk halfrond, van Canada en Groenland in het westen tot Scandinavië en Siberië in het oosten. Van 44 populaties van 34 soorten zijn de aantallen in de internationale Waddenzee dusdanig groot dat het gebied beschouwd moet worden als de belangrijkste tussenstop gedurende de trek of als primair overwinterings- en/of ruigebied. Deze soorten worden alle in dit rapport behandeld.

In de afgelopen jaren is zowel de kwantiteit als de kwaliteit van de monitoringgegevens van trekkende watervogels van de Waddenzee groter geworden. Het huidige 'Joint Monitoring of Migratory Birds' (JMMB) programma, dat wordt uitgevoerd in het kader van de 'Trilateral Monitoring and Assessment Program' (TMAP), bestaat uit 2-3 internationale, gebiedsdekkende simultaantellingen per jaar en zowel maandelijkse als tweemaandelijkse hoogwatertellingen in 688 telgebieden.

Alles bij elkaar opgeteld zijn er naar schatting maximaal 6 miljoen watervogels gelijktijdig aanwezig in de Waddenzee, de doorstroming van vogels buiten beschouwing gelaten. Naast Aalscholvers en Lepelaars gaat het in de periode 1999/2000-2006/2007 om 1.37 miljoen ganzen en eenden, 3.46 miljoen steltlopers en 0.89 miljoen meeuwen. Veel soorten pieken in aantal gedurende de najaarstrek. Steltlopers laten een bijna even sterke piek in het voorjaar zien, terwijl bij ganzen en eenden de aantallen in de wintermaanden het hoogst zijn. Alleen de meeuwen zijn ook in de zomer talrijk.

Bijna de complete populaties van de Rotgans *Branta b. bernicla* en Kanoet *Calidris canutus* maken jaarlijks gebruik van de internationale Waddenzee. Daarnaast maakt bij zeven soorten meer dan 50% en bij nog eens dertien andere soorten meer dan 10% van de flyway-populatie gebruik van de regio. Aanvullend is de kustzone van groot belang voor grote aantallen ruiende Bergeenden *Tadorna tadorna* en Eiders *Somateria mollissima*.

Het afgelopen decennium heeft de JMMB-groep zich geconcentreerd op trendberekeningen van trekkende watervogels in de Waddenzee (Blew *et al.* 2005), wat de afname van diverse soorten aan het licht bracht (Blew *et al.* 2007). In dit rapport richt de JMMB-groep zich, naast het presenteren van actuele trends, op de geografische verspreiding en de fenologie van veel soorten in relatie tot landschappelijke en klimatologische veranderingen in de Waddenzee. Monitoringreeksen van ruim twintig jaar bieden de mogelijkheid naar dergelijke ontwikkelingen te kijken. Analyses van de geografische verspreiding en de fenologie gedurende het jaar worden apart weergegeven voor het noordelijke en het zuidwestelijke deel van de internationale Waddenzee. Dit rapport geeft daarmee inzicht in:

1. Actuele trends van soorten
2. Veranderingen in geografische verspreiding
3. Veranderingen in fenologie
4. Aantallen van vogelsoorten in relatie tot klimatologische omstandigheden

De trendanalyses bij 34 soorten watervogels in de Waddenzee over de afgelopen 21 jaar (1987-2008) laten de volgende zaken zien:

- De aantallen van acht soorten namen matig tot sterk toe. Dit geldt voor Aalscholver, Lepelaar, Brandgans, Pijlstaart, Bontbekplevier, Drieteenstrandloper, Krombekstrandloper en de Rosse Grutto.

- Twaalf soorten waren stabiel in aantal: Rotgans, Smient, Slobeend, Zilverplevier, Kievit, Kanoet, Bonte Strandloper, Wulp, Tureluur, Groenpootruiter, Steenloper en Stormmeeuw.
- Veertien soorten lieten een overwegend matige afname zien: Bergeend, Wintertaling, Wilde Eend, Eider (na 1993), Scholekster, Kluut, Strandplevier, Goudplevier, Kemphaan, Regenwulp, Zwarte Ruiter, Kokmeeuw, Zilvermeeuw en Grote Mantelmeeuw.

Trends tonen aan dat soorten die in de Waddenzee sterk in aantal toenemen ook een toename in hun flyway-populatie laten zien. Soorten met een matige toename zijn overwegend soorten die in tropisch Afrika overwinteren. Van de helft van de soorten die stabiel in aantal zijn, zijn ook de flyway-aantallen stabiel te noemen; al deze soorten hebben hun broed- en overwinteringsgebied in respectievelijk het Arctisch gebied/Europa en Afrika/Europa. Soorten die in het internationale waddengebied in aantal afnemen zijn vooral soorten die broeden in Noord-, Midden- en West-Europa en een groot deel hiervan overwintert er ook. Terwijl de Arctische broedvogels het de laatste jaren beter doen, lijkt afname van enkele soorten samen te hangen met de omstandigheden in Noordwest-Europa en naar het zich laat aanzien in de Waddenzee in het bijzonder. Wanneer voedsel in ogenschouw wordt genomen betreft het soorten die deels op vuilnis kunnen foerageren, zoals Zilvermeeuwen en Grote Mantelmeeuwen, alsook soorten waarvoor mossels van groot belang zijn, zoals Eiders en Scholeksters (deels ook Zilvermeeuwen).

De verspreiding van veel soorten komt onderling behoorlijk overeen, met de grootste aantallen in het centrale en zuidelijke deel van de Waddenzee. Sommige soorten beperken zich tot enkele gebieden (zoals de Zwarte Ruiter), andere soorten concentreren zich zeer lokaal in een bepaalde periode van het jaar (zoals ruiconcentraties van Bergeenden). Met betrekking tot de verspreiding van soorten zijn de veranderingen in een vroegere periode (1987/88-1994/95) en een recente periode (1999/00-2006/07) tegen het licht gehouden. Dit laat onder andere zien dat Aalscholvers in alle vier waddenregio's toenemen, terwijl meeuwen er juist afnemen. Alle ganzensoorten nemen toe in Neder-Saksen, nemen af in Sleeswijk-Holstein en zijn stabiel in aantal in het Nederlandse en Deense deel van de Waddenzee. Grondeleenden en steltlopers laten overeenkomstige patronen zien. Veel van deze soorten zijn stabiel in het Nederlandse en Deense waddengebied, maar ze nemen sterk af in de Duitse regio's. Deze geografische variatie komt overeen met de getijde-amplitude die in het centrale deel van de Waddenzee veel sterker is dan in het noordelijke en zuidelijke deel. Voor de soorten die op het droogvallende wad foerageren vonden we een significante correlatie tussen de verandering van tij in de verschillende deelgebieden en het aantal soorten waarvan aantallen veranderden tussen 1987/88-1994/95 en 1999/00-2006/07. Daarentegen werd voor soorten die op kwelders foerageren geen significante correlatie gevonden. Dit vestigt de aandacht op de peildynamiek in de Waddenzee, dat beïnvloed lijkt te worden door klimaatveranderingen en het verdient aanbeveling hier nader onderzoek naar te doen.

De meeste soorten laten een redelijk constant

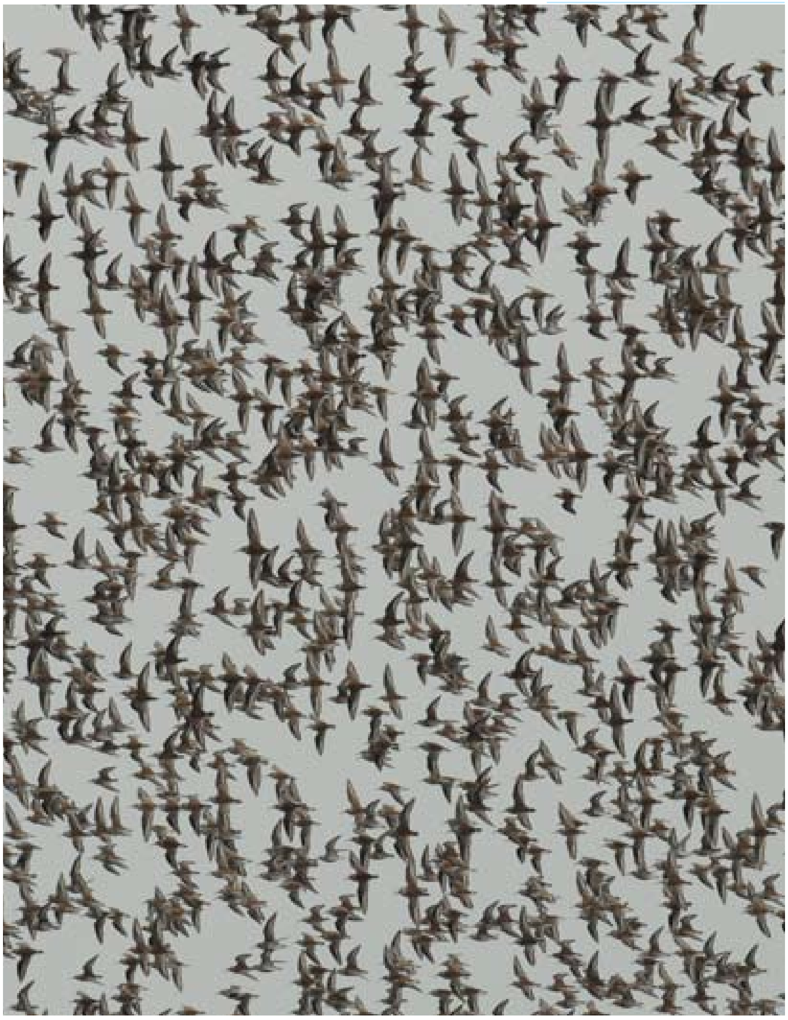


Photo: Gundolf Reichert

patroon zien in hun fenologie door de jaren heen, met name als het gaat om het tijdstip van aankomst in en vertrek uit de Waddenzee. Wanneer er echter meer in detail wordt gekeken, laten verschillende soorten veranderingen zien tussen de perioden 1987/88-1994/95 en 1999/00-2006/07. Terwijl in de najaarstrek geen duidelijke verschillen waarneembaar zijn, laat de mediane doortrekdatum voor een paar soorten (1 in het noordelijke deel en 4 in het zuidwestelijke deel van de Waddenzee) een vroegere voorjaarstrek zien in de recente periode, maar meer soorten (12 en 10) laten een verlate doortrek gedurende het voorjaar zien.. De soorten die later doortrekken behoren overwegend tot de Noord-Europese en Arctische broedvogels.

Klimaatveranderingen beïnvloeden een aantal biologische processen. Voor wat betreft de aantallen vogels in de Waddenzee stellen we in dit rapport vast dat de winteromstandigheden volgens de Noord-Atlantische Oscillatie index en de watertemperatuur in de Waddenzee in april van invloed zijn op de overleving en verspreiding van wadvogels (winterklimaat) en hun reproductiesucces (watertemperatuur in april). De resultaten laten zien dat de trends van 30 soorten, op een totaal van 34 soorten, significant correleren met één of beide klimaatvariabelen. Voor vier soorten is dit niet het geval, te weten Bergeend, Eider, Steenloper en Stormmeeuw. Van de twee klimaatvariabelen komen de meeste trends van soorten overeen met de temperatuur van het water in de Waddenzee in april. Sterker nog, van de soorten wiens trend een positief verband toont met deze veranderende watertemperatuur nemen de meeste soorten toe. Daarentegen gaat het bij soorten wiens trend een negatief verband vertoont met de watertemperatuur in april overwegend om soorten die in aantal afnemen. Hoewel de directe oorzaken hiervan onduidelijk zijn, lijkt het erop dat soorten die profijt trekken uit warmer voorjaarsweer, met vermoedelijk betere foerageeromstandigheden, in betere conditie in het broedgebied arriveren en een hogere reproductiesucces hebben.

De resultaten laten eens te meer zien dat de Waddenzee een doortrek- en overwinteringsgebied van groot belang is voor een groot aantal soorten en populaties die behoren tot de Oost-Atlantische vliegroute. In de twee afgelopen decennia hebben zich veranderingen voorgedaan die de aantallen van soorten, fenologie en geografische verspreiding beïnvloeden. Voor sommige soorten moet de afname gezocht worden in de landschappelijke, ecologische en klimatologische omstandigheden in de Waddenzee. Voor andere soorten moeten de oorzaken die aantallen en trends beïnvloeden buiten het gebied gezocht worden.

Monitoring van trekkende watervogels is een continu proces. De resultaten ervan worden ingezet voor rapporten als het onderhavige, met relevante en toegepaste informatie om het gebruik van de Waddenzee door tal van soorten toe te lichten, inclusief datgene wat hun aantallen en verspreiding beïnvloedt. Meer actuele informatie over de trends van al deze soorten zijn te vinden op de website van het Common Wadden Sea Secretariats:

http://www.waddensea-secretariat.org/TMAP/Migratory_birds.html

Photo: Jan Hunemann

3. Data and Methods

3.1 Implementation of the JMMB Program

Based on the process and discussions during data compilation for the report by Meltofte *et al.* (1994), the "Joint Monitoring Group of Migratory Birds in the Wadden Sea (JMMB)" was started in 1992. This group includes SOVON Vogelonderzoek Nederland in The Netherlands, the Staatliche Vogelschutzwarte at the Niedersächsischer Landesbetrieb für Wasserwirtschaft, Küsten- und Naturschutz (NLWKN – formerly Niedersächsisches Landesamt für Ökologie (NLÖ)) and the Nationalparkverwaltung Niedersächsisches Wattenmeer in Niedersachsen, the Schutzstation Wattenmeer" (formerly the WWF-Projektbüro Wattenmeer) and the Landesbetrieb für den Küstenschutz, Nationalpark und Meeresschutz Schleswig-Holstein (LKN – formerly Landesamt für den Nationalpark Schleswig-Holsteinisches Wattenmeer) in Schleswig-Holstein and the National Environmental Research Institute (NERI) in Denmark, and operates within the framework of the Trilateral Monitoring and Assessment Program (TMAP). The Common Wadden Sea Secretariat (CWSS) in Wilhelmshaven acts as the secretariat for the group.

The JMMB installed a Joint Monitoring Project on Migratory Birds in the Wadden Sea (Rösner, 1993). The objectives of this program are (Rösner *et al.*, 1994):

- *"to monitor changes in distribution and numbers of the populations of waterbirds within the Wadden Sea;*
- *to estimate total population sizes of bird species present in the Wadden Sea at any time;*
- *to reach proper estimates of the total numbers of birds using the Wadden Sea during a year;*
- *to supply data for the estimation of population sizes of species using the East Atlantic Flyway;*
- *to collect additional information which helps to explain the patterns found."*

A standardized set of migratory bird counts was agreed to supply the necessary amount and quality of data for meeting the objectives. The counting program consisted of:

- Yearly midwinter counts: Internationally coordinated synchronous counts of waterbirds in the entire Wadden Sea during one weekend. These counts continue the international counts carried out since 1980 and are also part of the worldwide survey of waterbirds as organized, compiled and analysed by Wetlands International.
- Yearly additional coordinated synchronous counts during one selected month per year. This data serves to supply additional data during times of the year other than January and thus during different migration periods. The counts should also – together with the January counts – help to calibrate the results from the spring tide counting sites.
- Spring tide counts in selected sites of the Wadden Sea. These counts aim to monitor trends of waterbird species using high-tide roosts. Each country selected representative sites for these spring tide counts.
- Complete counts of additional target species during their peak migration period in the Wadden Sea. On the trilateral level, these are goose counts in November, March and May and aerial counts of Common Eider in January; aerial counts of Common Shelduck during their moulting time in July and August so far only exist for Schleswig-Holstein, but an initiative has been taken to also implement these in the other regions.

This program has been carried out by all Wadden Sea countries since 1992; however, different national focuses lead to varying coverage for some of the topics.

3.2 Site selection and site aggregations

The Wadden Sea Area (Cooperation Area) covers some 14,700 km². This is, in general terms, the area seaward of the main dike (or, where the main dike is absent, the spring-high-tide-water line, and in the rivers, the brackish-water limit) up to 3 nautical miles from the baseline or the offshore boundaries of the Conservation Area (Essink *et al.*, 2005). However, more relevant for the migratory bird counts is the area of inter-tidal flats, because these are utilized for feeding. The total area of the inter-tidal flats, measured from the edge of the vegetation (or mean high water line in the case of sandbanks or sands) to the mean low water line, measures 4,534 km².

In Denmark, birds occurring in marsh land areas behind the sea walls are included in the counts except the distal parts of both the Varde Å valley and the Ribe Marsh. In Schleswig-Holstein, the recently embanked areas are also in-

Table 3.1
List of 29 sub-areas in the Wadden Sea and their names used. See Fig. 5.1 (p. 32) for a map of the sub-areas.

Coun-try	sub-area	area [km²]	name
DK	1	29	Langli-Ho Bugt
DK	2	109	Fanø-Sneum
DK	3	99	Mandø- Ribe
DK	4	58	Rømø-Ballum
DK	5	101	Jordsand-Margrethe Kog
SH	6	178	Sylt - Rickelsbüller Koog
SH	7	189	Amrum - Föhr - Festland
SH	8	180	Innere Halligen - Festland
SH	9	197	Äußere Halligen, Pellworm
SH	10	144	Husumer Bucht, Eiderstedt Nord
SH	11	176	Eiderstedt Süd - Eider - Büsum
SH	12	150	Trischen - Meldorfer Bucht
SH	13	175	Friedrichskoog - Brunsbüttel
SH	14	13	Unterelbe Schleswig-Holstein
LS		31	Unterelbe Niedersachsen
LS	15	391	Wurster Küste
LS	16	236	Mellum und Butjadinger Küste
LS	17	120	Jadebusen
LS	18	150	Friesische Inseln und Küste
LS	19	172	Mittlere Ostfriesische Inseln und Küste
LS	20	211	Leybucht und Inseln
LS	21	103	Westerems und Inseln
LS	22	33	Dollart Niedersachsen
NL		77	Dollard The Netherlands
NL	23	238	Rottum-Groningse Kust
NL	24	98	Schiermonnikoog
NL	25	276	Aemeland-Friese Kust oost
NL	26	141	Terschelling
NL	27	148	Griend-Friese Kust west
NL	28	230	Texel - Vlieland
NL	29	81	Balgzand-Wieringen
Total		4,534	

cluded either fully or with their wet areas only; waterbirds which were occasionally roosting in inland areas adjacent to the dike are included in the numbers of the respective counting site outside the dike. In The Netherlands, at the mainland of Friesland and Groningen, a strip of inland counting units bordering the sea barrier and in Noord-Holland the former island Wieringen (inland counting units) are included in the study area; the polders on the islands are also included in the counts. Based on these selections, a total of 688 bird count units exist in the Wadden Sea – 96 units in Denmark, 131 in Schleswig-Holstein, 152 in Niedersachsen and 309 in The Netherlands (Fig. 3.1). From these counting units, each country selected a set of spring tide counting sites, each consisting of one to 12 counting units (Table 3.2).

Table 3.2
Number of spring tide count sites (STC sites) and spring tide units in the four Wadden Sea parts, and the total number in the Wadden Sea.

Region	number of STC sites	number of STC units
DK	5	27
SH	39 (one shared with LS)	64
LS	10 (one shared with SH, one shared with NL)	51
NL	11 (one shared with LS)	21
Wadden Sea	63	163

The Wadden Sea is divided into 29 so-called “sub-areas”, each of which covers an ecological unit of tidal flats and their adjacent roosting sites (*i.e.* a number of counting units). For migratory waterbirds the mudflats are usually relevant as feeding sites, therefore a 'sub-area' consists of a mudflat with the adjacent parts of the tidal inlets (Meltofte *et al.*, 1994). Note that this concept is not equal to the 'tidal basins' used for other projects, as they consist of a tidal inlet with adjacent parts of the mudflats up to the water divide.

The sub-areas range in size from 29 to 391 km² and may aggregate 5 to 44 counting units. Two sub-areas, Nos. 14 and 22, are shared between two regions (Table 3.1).

3.3 Species selection

This report covers 34 waterbird species. Either the entire species or one or several of their biogeographical populations use the Wadden Sea as a staging, roosting, feeding or wintering area during one part of its yearly cycle. Species that only occur in low numbers or species for which counting results cannot be representative have been excluded from the analyses (for a more detailed explanation see Rösner *et al.*, 1994). The species selected represent a large variety of waterbird species with regards to breeding and wintering area, population size, and numbers occurring in the Wadden Sea as well as habitat and food preferences (Table 3.3).

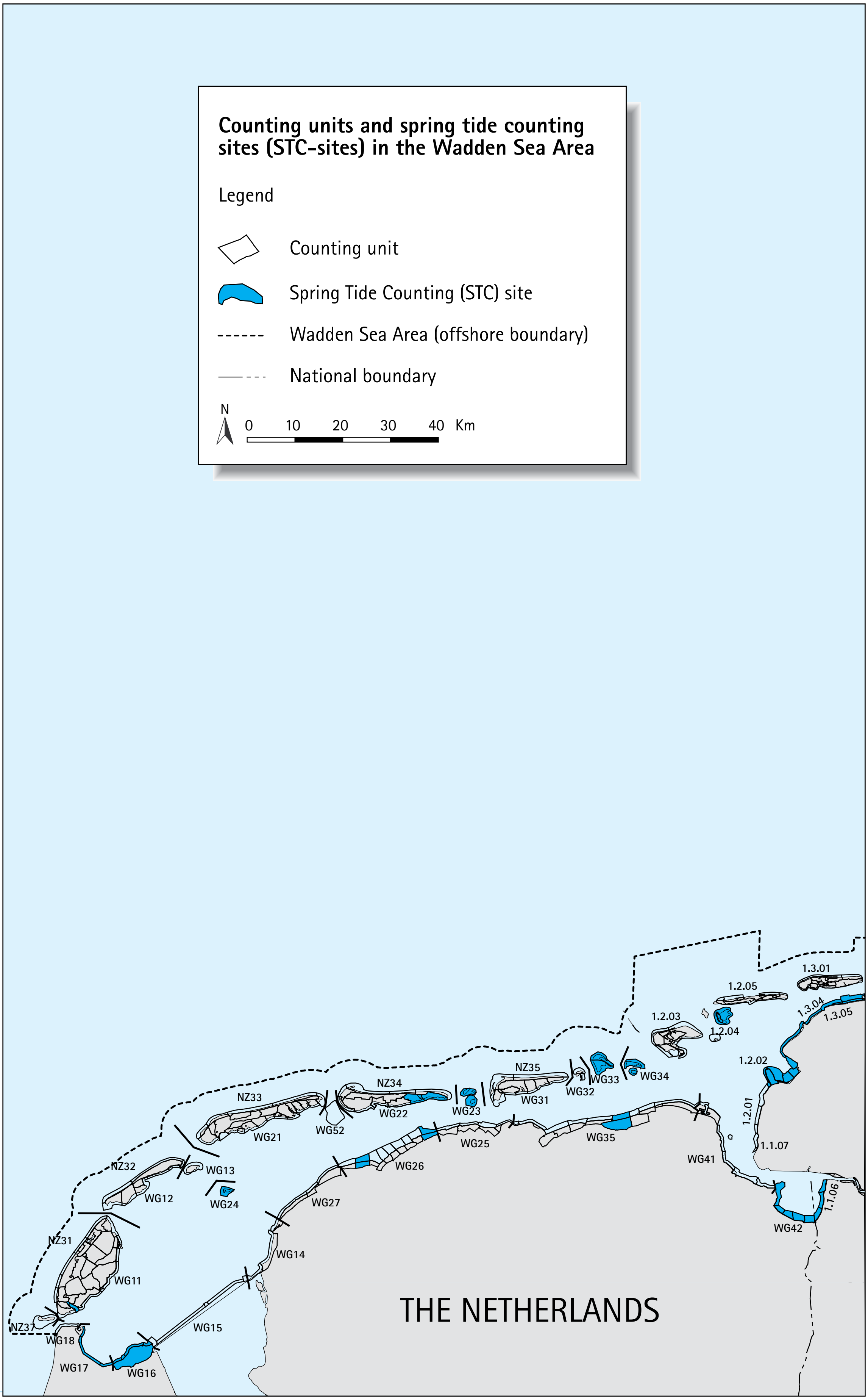
3.4 Fieldwork

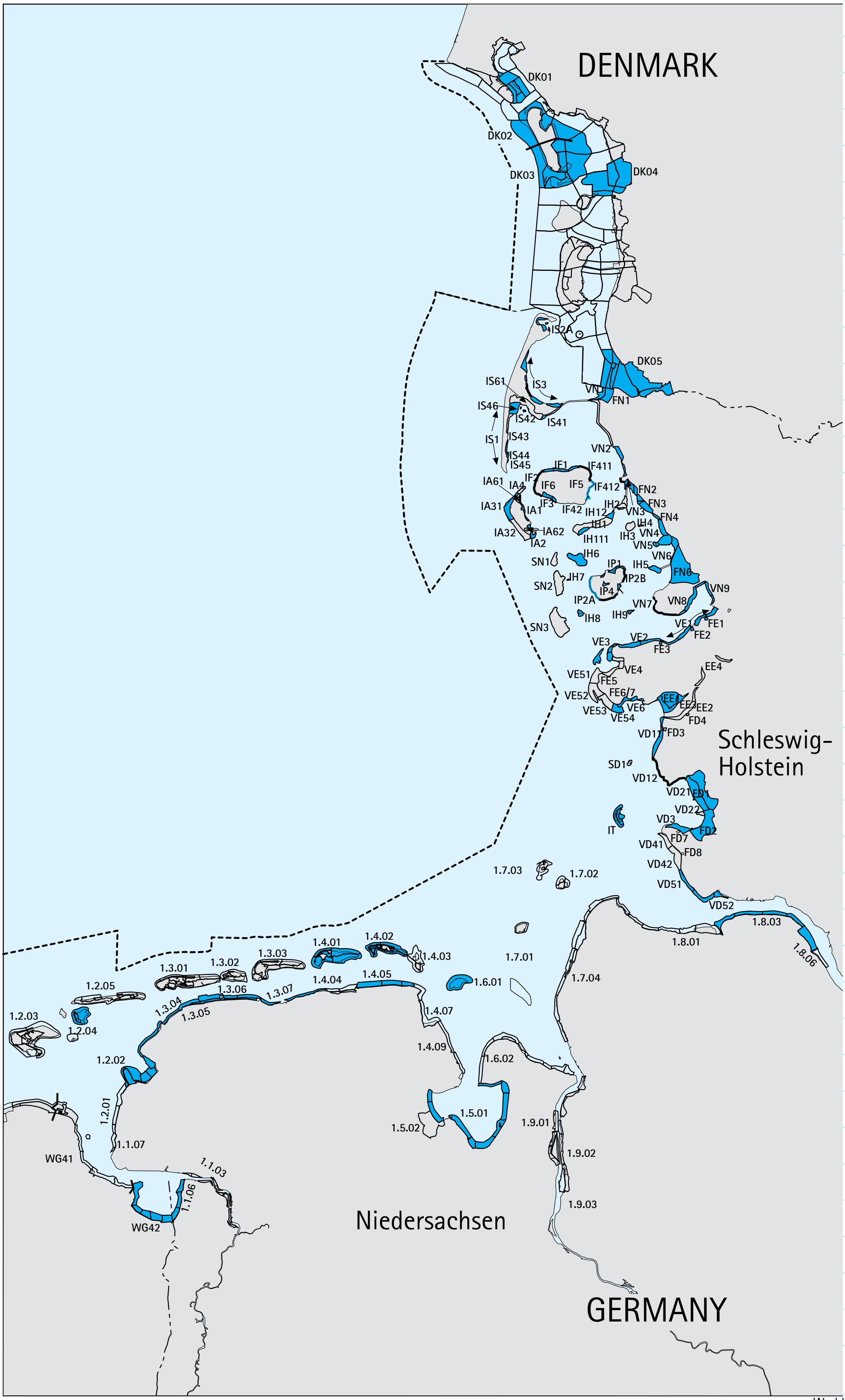
Counts of waterbirds in the Wadden Sea are carried out during daytime and at high tide, when most birds congregate at communal roosts along the shoreline and at islands together with remaining sand flats (Koffijberg *et al.*, 2003); sometimes, birds are also counted further inland, *e.g.* in polders. Counting dates are chosen around

Species	Fly-way trend	Breeding grounds	Wintering grounds	Trends in the Wadden Sea		Birds in the Wadden Sea		Feeding habitat	Food types
				20 years	10 years	Numbers	%		
Great Cormorant	+	West Europe	W. Eur./Med.	++	+	25,000	8	Deeps/offshore	Fish
Eurasian Spoonbill	+	Central Europe	Trop. Afr./Med.	++	++	1,800	12	Gullies/fresh w. ponds	Fish
Barnacle Goose	+	Arctic	W. Eur.	++	+	353,000	74	Saltmarsh	Grass
Dark-b. Brent Goose	-	Arctic	W. Eur.	0	+	200,000	94	Eelgrass b./saltmarsh	Eelgrass/grass
Common Shelduck	0	North, West Europe	W. Eur.	-	0	246,000	68	Mudflats	Crayfish/snails
Eurasian Wigeon	0	North Europe	W. Eur.	0	0	332,000	19	Eelgrass b./saltmarsh	Eelgrass/grass
Common Teal	+	Europe	Trop. Afr./Med.	-	+	43,000	10	Saltmarsh/polder	Seeds/grass
Mallard	0/-	Europe	W. Eur.	-	0	156,000	8	Saltmarsh/polder	Seeds/grass
Northern Pintail	0	North Europe	Trop. Afr./Med.	+	+	33,000	35	Saltmarsh/polder	Seeds/grass
Northern Shoveler	0	Central Europe	Trop. Afr./Med.	0	0	8,000	19	Saltmarsh/polder	Seeds/plankton
Common Eider	-	North Europe	W. Eur.	na	-	311,000	30	Mussel b./sandflats	B. mussels/cockles
Eurasian Oystercatcher	-	North Europe	W. Eur.	-	-	507,000	54	Mussel b./sandflats	B. mussels/cockles
Pied Avocet	0	Central Europe	Trop. Afr./Med.	-	-	39,000	41	Mudflats	Crayfish/worms
Common Ringed Plover	-	Arctic	Trop. Afr.	+	+	35,000	14	Sandflats/beaches	Crayfish/worms
Kentish Plover	+	Central Europe	Trop. Afr./Med.	-	-	700	1	Sandflats/beaches	Crayfish/worms
European Golden Plover	0	North Europe	Trop. Afr./Med.	-	-	120,000	14	Polder	Earthworms/insects
Grey Plover	-	Arctic	Trop. Afr./W. Eur.	+	+	149,000	53	Mixed flats	Worms
Northern Lapwing	0	Central Europe	W. Eur./Med.	0	0	117,000	6	Polder	Earthworms/insects
Red Knot	-	Arctic	Trop. Afr./W. Eur.	0	0	466,000	69	Mixed flats	Mussels
Sanderling	0/+	Arctic	Trop. Afr./W. Eur.	+	+	37,000	23	Beaches	Crayfish/worms
Curlew Sandpiper	++	Arctic	Trop. Afr.	+	+	14,000	2	Mudflats/fresh w. ponds	Crayfish/worms
Dunlin	0	Arctic	W. Eur./Med.	0	0	1,154,000	74	Mixed flats	Crayfish/worms
Ruff	-	Arctic	Trop. Afr.	--	--	5,000	1	Fresh w. ponds	Insects (?)
Bar-tailed Godwit	0/-	Arctic	Trop. Afr./W. Eur.	0	0	348,000	61	Mixed flats	Crayfish/worms
Whimbrel	0?	Arctic	Trop. Afr.	-	0	4,000	2	Polder	Beeries (?)/arthopods
Eurasian Curlew	-	North Europe	W. Eur.	0	0	324,000	68	Mudflats	Crayfish/worms
Spotted Redshank	0?	Arctic	Trop. Afr.	-	-	20,000	20	Mudflats/fresh w. ponds	Crayfish/worms/fish
Common Redshank	0?	Europe	Trop. Afr./W. Eur.	0	0	84,000	29	Mudflats/fresh w. ponds	Crayfish/worms
Common Greenshank	0	North Europe	Trop. Afr.	0	0	26,000	7	Mudflats	Crayfish/worms/fish
Ruddy Turnstone	-	Arctic	Trop. Afr./W. Eur.	0	+	11,000	8	Sandflats/construction	Crayfish
Black-headed Gull	-	Central Europe	W. Eur.	-	-	461,000	12	Mixed flats/polder	Crayfish/worms/fish
Common Gull	-	North Europe	W. Eur.	0	0	225,000	14	Mixed flats/polder	Crayfish/worms/fish
European Herring Gull	+	North Europe	W. Eur.	-	-	193,000	16	Mussel bed/offshore/dump	Mussel/Garbadge/wast
Great Black-backed Gull	+	North Europe	W. Eur.	-	-	13,000	3	Offshore/dumps	Garbadge/wast

Table 3.3
Overview of the 34 selected waterbird species showing breeding and wintering area, habitat and food preference, together with population size and numbers occurring in the Wadden Sea.

Figure 3.1
The Wadden Sea Area (Co-operation Area), including delimitations of all counting units and spring tide counting sites.




DENMARK
Schleswig-Holstein
Niedersachsen
GERMANY
DK01
DK02
DK03
DK04
DK05
IS2A
IS61
IS3
IS46
IS42
IS41
IS1
IS43
IS44
IS45
VN1
FN1
VN2
IF1
IF411
IF2
IF6
IF5
IF412
IA61
IA4
IA31
IA1
IF3
IF42
IA32
IA62
IA2
FN2
FN3
FN4
VN3
VN4
VN5
VN6
FN6
VN9
VN7
VN8
SN1
SN2
SN3
IH6
IH7
IH8
IH9
IP1
IP2A
IP2B
IP4
FE1
FE2
FE3
VE1
VE2
VE3
VE4
VE51
VE52
VE53
VE54
VE6
FE5
EE4
EE1
EE2
FD4
VD11
FD3
SD1
VD12
VD21
FD1
VD22
VD3
FD2
IT
FD7
VD41
FD8
VD42
VD51
VD52
1.7.03
1.7.02
1.7.01
1.7.04
1.8.01
1.8.03
1.8.06
1.4.01
1.4.02
1.4.03
1.4.04
1.4.05
1.4.07
1.4.09
1.6.01
1.6.02
1.5.01
1.5.02
1.9.01
1.9.02
1.9.03
1.3.01
1.3.02
1.3.03
1.3.04
1.3.05
1.3.06
1.3.07
1.2.01
1.2.02
1.2.03
1.2.04
1.2.05
1.1.03
1.1.06
1.1.07
WG41
WG42

spring tide, and usually fieldwork is concentrated during a narrow time window around a chosen counting date, preferably avoiding adverse observation conditions such as fog and heavy rain. Observers mostly operate from dykes or dunes, using high magnification (20-60x) telescopes to determine species and numbers. In larger salt marshes, trips to the shoreline are also made in order to obtain a better view of the roosting flocks. Small uninhabited islands and sands are counted from boats or are reached by foot during low tide; many of those are only counted from May to October, mostly due to safety reasons. Data is collected within small-scale counting units that can be covered by a single observer (or team of observers) during one high tide. In Denmark, part of the data presented here refers to aerial surveys. For this purpose, a standardized flight route is used, covering all parts of the Danish Wadden Sea, including open water (*e.g.* Laursen *et al.*, 1997). Aerial counts of Common Eider are carried out over the entire Wadden Sea but for Common Shelduck so far only in Schleswig-Holstein.

3.5 Classification of winters

Numbers and trends of migratory waterbirds in January are indispensable for international work and comparisons. However, with regard to the utilization of the Wadden Sea, winter trends are highly dependent on the actual weather.

Winter strength can be categorized. Using average daily temperature data and the number of 'ice days' (days with a maximum temperature below 0° C), (Fig. 3.2).

For birds, winter movements are initiated by very low temperatures (*e.g.* Ridgill and Fox, 1990). Within the time period considered in this report, the winters 1995/1996 and 1996/1997, are classified as cold. However, the cold spells in both winters occurred during different periods. Both winters started with very low temperatures during the last decade of December. In winter 1995/1996, the first frost period of 14 days forced many birds to leave the Wadden Sea, but during the following period of 11 days with milder temperatures, many of the birds that had remained in the Wadden Sea stayed over winter and others which had left returned to the area. The next period of 24 days with heavy frost started on 17 January 1996, but did not immediately affect the birds, so that during the synchronous count on 20 January 1996, many birds were still present. In winter 1996/97, the frost period starting during the last decade of December lasted for 24 days, until 13 January 1997. During that period the Wadden Sea turned into a frozen landscape and most birds left the region. Since the synchronous count took place during the last days of the frost period (9 January), fewer birds were recorded than in the winter before.

This demonstrates that it is not enough to record the parameters 'ice days' or 'lowest average temperature' during one winter to draw conclusions about the birds' likelihood to stay in the Wadden Sea. The chronological sequence of cold spells must also be taken into account.

For a more general description of winter climate the North Atlantic Oscillation index (NAO) is used. This index describes the weather condition in the northern hemisphere, and is estimated from sea water temperature and air pressure measured at a large number of weather stations (Hurrel *et al.*, 2003). For further description see chapter 4.8 about climate effects.

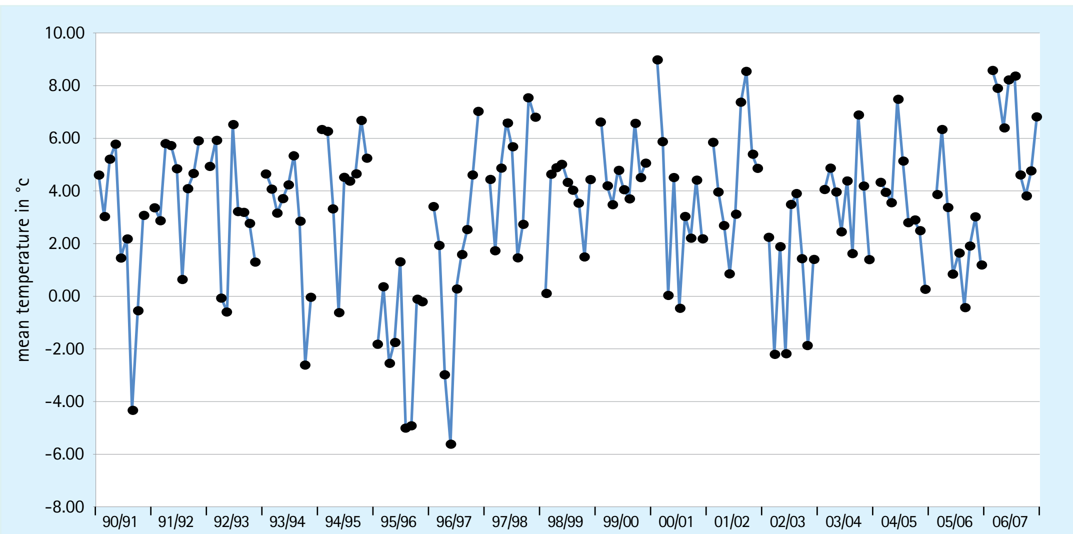


Figure 3.2
Average temperature on the island of Norderney (Germany) per decade during the months December, January and February 1992/1993-2006/2007 (data source: TMAP, data provided by DWD)

3.6 Data processing

3.6.1 Trends

During the last years, a routine has been established to update waterbird trends in the Wadden Sea (see JMMB 2008 – www.waddensea-secretariat.org). All data up to the latest seasons (July to June) are compiled and quality controlled for potential outliers, checked for the site list and for completeness of coverage. For each month the count closest to either the agreed synchronous counting date (international synchronous count in January and additional selected months per year, goose counts in March and May each year) or closest to the mid-month is selected. For goose counts performed each year in March and May, special international synchronous goose counts are performed; here, the particular counting dates have been used and the interval around the counting date has been shortened to +/- 2 days, accounting for the high mobility of these species to avoid overestimation. Naturally, compared to results from a calculation with +/- 8 days, the shortening of the interval led to more 'missing counts', to lower 'counted numbers', to higher 'imputed numbers' and thus to less significant trend estimates. However, overall results and patterns for the January counts and the goose counts in March and May did not change significantly.

If no count is available for a selected month /counting date for a site and a particular species, a '-1' is entered into the count results, thus marking a missing value.

A complete database for each season, month, counting unit and species is first processed by the UINDEX program (Bell, 1995). UINDEX estimates bird numbers for missing counts (imputing) taking into account site, year and month factors (Underhill and Prys-Jones, 1994). Sites are grouped in four regional strata representing the four different Wadden Sea 'regions'. For each bird species, the counted and imputed values for each month are added up to yearly averages for the respective 'bird-years', covering the period from July to June of the following year (Fig. 3.3).

TrendSpotter is applied to those yearly averages to calculate trends (Visser, 2004, Soldaat *et al*., 2007). This program uses the results expressed as 'yearly averages' to calculate so-called 'flexible trends'. These are particularly suitable for time series data with different periods of decreasing, stable or increasing trends (Visser, 2004; Soldaat *et al*., 2007). A trend line calculated by TrendSpotter is generally well comparable to a moving average or a smoothed trend line as calculated by a Generalized Additive Model (GAM) (*e.g.* Atkinson *et al*., 2006). TrendSpotter also calculates confidence intervals; differences between the trend level of the last year and each of the preceding years can be assessed (Soldaat *et al*., 2007). In this way trend estimates can be given for any period, as for example the last 10 years and the whole time period, as in the current analyses.

Trend estimates given within the text are used as categories (Fig. 3.4); to emphasize this, all trend estimates within the text are put in quotes (e.g. 'substantial increase').

In contrast, trend estimates of the flyway populations taken from Wetlands International (2006), given in five categories (sta = stable, dec = decreasing, inc = increasing, flu = fluctuating, exit = extinct), refer to the most recent refer-

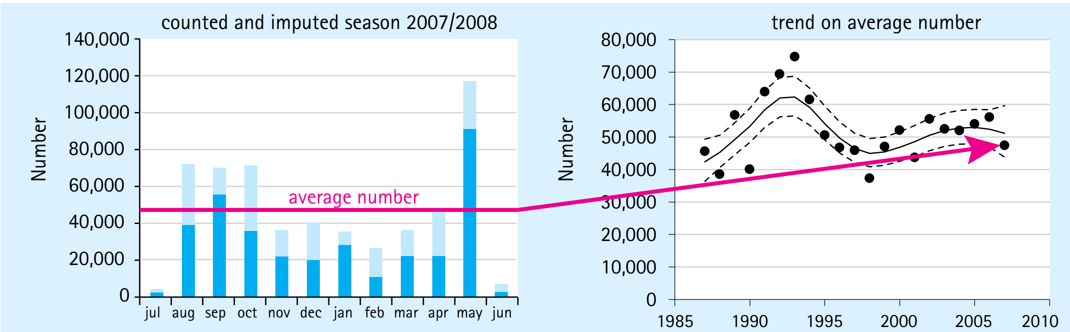


Figure 3.3
Example of the treatment of data for the trend analyses. First the seasonal pattern is constructed by using counted numbers and imputed numbers for each month for a certain species (left graph of the figure, dark blue is counted, light blue is imputed data). Then the average over all months is taken and this is the 'yearly estimate' to be used in the trend analyses (right graph). The trend line (solid line) and confidence limits (dotted lines) are calculated over all year estimates.

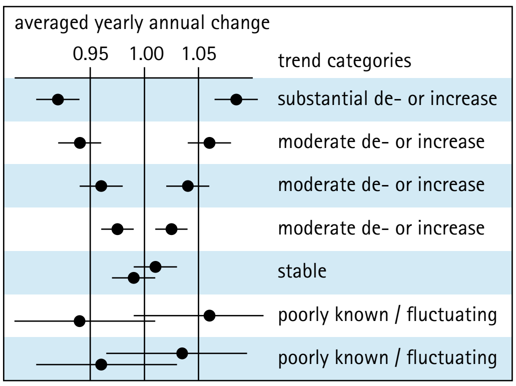


Figure 3.4
Trend classification used to express annual changes in waterbird numbers. Dots represent trend values, horizontal lines their 95% confidence limits.

ence. The time base for these trends is not standardized, nor is there a standard given regarding the magnitude of change before a population trend can be stated as increasing or decreasing (Wetlands International, 2006).

3.6.2 Distributions and maps

Presentation of distribution maps has two aims: 1) to show numbers and distributions during the early and the late period in the Wadden Sea's sub-areas, 2) to compare the early with the late period with regard to de- or increases per sub-area.

For this comparison, two seven-year periods have been selected, the early period from 1987/1988 to 1994/1995 and the late period from 1999/2000 to 2006/2007. We exclude the six periods between those two to make the differences as clear as possible

Data have been summarized for each of the 29 sub-areas in the Wadden Sea for each of the two periods (1987/1988 -1994/1995 and 1999/2000 to 2006/2007). For each sub-area the results from the UINDEX procedure, which is a dataset with the estimates (*i.e.* the sum of counted and imputed number) per species, site and month have been used. To calculate the numbers for the maps, the arithmetical means of the estimates of the considered seven bird-years of each period and all months of the species-specific season have been calculated. A comparison of the numbers in the early vs. the late period is based on a t-test (data log-transformed). Changes are considered to be statistical, significant when $P < 0.05$.

The data situation varies considerably for the different sub-areas with regard to overall numbers and with regard to imputed proportions. Data limitations exist:

- Some sub-areas have very low estimated numbers for some species during the considered time-periods and season; if any average numbers in either the early or late period results in an estimate with less than 100 individuals, data changes between the two periods are not calculated.
- Estimates per sub-area and season are based on a counted and an imputed proportion; if the imputed numbers in relation to the counted numbers exceed a proportion >= 70 %, the data are considered as "insufficient", and no changes have been calculated for these sub-areas because they are likely to be inaccurate.

Maps are shown for selected species and seasons, where seasons are defined per species (see Table 3.4).

3.6.3 Phenologies and figures

The presentation and analyses of phenologies serves two aims: 1) to show phenologies in the different Wadden Sea regions, 2) to compare the early with the late period with regard to phenology shape, arrival and departure times and median dates. Early (1987/1988 -1994/1995) and late (1999/2000 to 2006/2007) periods are the same as used for the distribution comparisons.

To estimate the phenology for each species, data from the spring-tide counting scheme have been used, because they are particularly valid for this type of analyses. No gap-filling has been applied, since spring-tide counting sites are especially well covered selected sites; while some gap-filling methods exist for these types of counts in Schleswig-Holstein, (K. Günther, pers. com.), they have not been applied for this report. For each counting unit the maximum count of each half-month was chosen. The arithmetical mean of those values over the seven bird-years (early and late period) resulted in one number per counting unit per half-month. Numbers were summarised for the Northern (Denmark and Schleswig-Holstein) and the Southern Wadden Sea (Niedersachsen and The Netherlands).

Results are expected to correctly represent the species phenology of the respective regions; however, numbers only represent a sub-sample, thus are lower and shall not be compared to maximum overall numbers (see below).

3.6.4 Maximum estimates

For further comparisons and to assess the quantity of a species staging in the Wadden Sea (*e.g.* in relation to its flyway population), maximum estimates are calculated per species and per migration season, separate for the early and late period as for the distribution and phenology. To calculate these, the synchronous or monthly counts are summarized per region (DK, SH, NDS, NL); to avoid outliers, the arithmetical mean of the three highest values within each season is calculated. These maximum estimates contain a counted and an imputed proportion. Estimates in which the proportion of the imputed number exceeds 50% were excluded from this calculation.

Euring	Species	breeding	autumn	winter	spring	moult
00720	Great Cormorant	4, 5, 6, 7	8, 9, 10	11, 12, 1	2, 3	
01440	Eurasian Spoonbill	5, 6	7, 8, 9, 10		3, 4	
01670	Barnacle Goose		9, 10, 11	12, 1, 2	3, 4, 5	
01680	Dark-bellied Brent Goose		9, 10, 11	12, 1, 2	3, 4, 5	
01730	Common Shelduck	4, 5, 6	9, 10, 11	12, 1	2, 3	7, 8
01790	Eurasian Wigeon		9, 10, 11	12, 1, 2	3, 4	
01840	Common Teal		9, 10, 11	12, 1, 2	3, 4	7, 8
01860	Mallard	5	9, 10, 11	12, 1	2, 3, 4	6, 7, 8
01890	Northern Pintail		9, 10, 11	12, 1, 2	3, 4	
01940	Northern Shoveler	5, 6	9, 10, 11	12, 1, 2	3, 4	7, 8
02060	Common Eider		9, 10, 11	12, 1, 2	3, 4	5, 6, 7, 8
04500	Eurasian Oystercatcher	5, 6, 7	8, 9, 10	11, 12, 1, 2	3, 4	
04560	Pied Avocet	5	8, 9, 10, 11		3, 4	6, 7
04700	Great Ringed Plover		7, 8, 9, 10		3, 4, 5	
04701	*C. h. hiaticula*	6, 7		11, 12, 1, 2	3, 4	
04702	*C. h. tundrae*		8, 9,		5	
04770	Kentish Plover	5, 6	7, 8, 9		3, 4	
04850	Eurasian Golden Plover		8, 9, 10, 11		3, 4	
04860	Grey Plover		8, 9, 10, 11	12, 1, 2	3, 4, 5	
04930	Northern Lapwing	4, 5, 6	7, 8, 9, 10, 11	12, 1	2, 3	
04960	Red Knot		7, 8, 9, 10	11, 12, 1, 2	3, 4, 5, 6	
04961	*C. c. canutus*		7, 8		5	
04962	*C. c. islandica*		9, 10	11, 12, 1, 2	3	
04970	Sanderling		7, 8, 9, 10	11, 12, 1, 2, 3	4, 5, 6	
05090	Curlew Sandpiper		7, 8, 9, 10		4, 5, 6	
05120	Dunlin		7, 8, 9, 10, 11	12, 1, 2	3, 4, 5	
05170	Ruff		7, 8, 9, 10		3, 4, 5	
05340	Bar-tailed Godwit		7, 8, 9, 10	11, 12, 1, 2	3, 4, 5, 6	
05342	*L. l. lapponica*		9, 10	11, 12, 1, 2	3, 4	
05341	*L. l. taymyrensis*		7, 8		5	
05380	Whimbrel		7, 8, 9		3, 4, 5	
05410	Eurasian Curlew	5, 6	7, 8, 9, 10, 11	12, 1, 2	3, 4	
05450	Spotted Redshank		7, 8, 9, 10, 11		4, 5	
05460	Common Redshank	5, 6	7, 8, 9, 10	11, 12, 1, 2	3, 4	
05461	*T. t. totanus*		7, 8		4, 5	
05462	*T. t. robusta*			10, 11, 12, 1, 2, 3		
05480	Common Greenshank		7, 8, 9, 10		4, 5	
05610	Ruddy Turnstone		7, 8, 9	10, 11, 12, 1	4, 5	
05611	A. interpres (Sibiria)		7, 8		5	
05612	A. interpres (Nearctic)		9, 10	11, 12, 1, 2	3, 4	
05820	Common Black-headed Gull	5, 6	7, 8, 9, 10	11, 12, 1, 2	3, 4	
05900	Common Gull	5, 6, 7	8, 9, 10	11, 12, 1, 2	3, 4	
05920	Herring Gull	5, 6	7, 8, 9, 10	11, 12, 1, 2	3, 4	
06000	Great Black-backed Gull	6, 7	8, 9, 10	11, 12, 1, 2	3, 4, 5	

Table 3.4
Species-specific seasons; the divisions are used in estimating the species distribution for the seasons (Wahl *et al.*, in prep.).

Table 3.5
The English and the scientific names of the 34 selected water bird species.

Euring-Code	English species name	Scientific species name
00720	Great Cormorant	*Phalacrocorax carbo*
01440	Eurasian Spoonbill	*Platalea leucorodia*
01670	Barnacle Goose	*Branta leucopsis*
01680	Dark-bellied Brent Goose	*Branta bernicla bernicla*
01730	Common Shelduck	*Tadorna tadorna*
01790	Eurasian Wigeon	*Anas penelope*
01840	Common Teal	*Anas crecca*
01860	Mallard	*Anas platyrhynchos*
01890	Northern Pintail	*Anas acuta*
01940	Northern Shoveler	*Anas clypeata*
02060	Common Eider	*Somateria mollissima*
04500	Eurasian Oystercatcher	*Haematopus ostralegus*
04560	Pied Avocet	*Recurvirostra avosetta*
04700	Great Ringed Plover	*Charadrius hiaticula*
04770	Kentish Plover	*Charadrius alexandrinus*
04850	Eurasian Golden Plover	*Pluvialis apricaria*
04860	Grey Plover	*Pluvialis squatarola*
04930	Northern Lapwing	*Vanellus vanellus*
04960	Red Knot	*Calidris canutus*
04970	Sanderling	*Calidris alba*
05090	Curlew Sandpiper	*Calidris ferruginea*
05120	Dunlin	*Calidris alpina*
05170	Ruff	*Philomachus pugnax*
05340	Bar-tailed Godwit	*Limosa lapponica*
05380	Whimbrel	*Numenius phaeopus*
05410	Eurasian Curlew	*Numenius arquata*
05450	Spotted Redshank	*Tringa erythropus*
05460	Common Redshank	*Tringa totanus*
05480	Common Greenshank	*Tringa nebularia*
05610	Ruddy Turnstone	*Arenaria interpres*
05820	Common Black-headed Gull	*Larus ridibundus*
05900	Common Gull	*Larus canus*
05920	Herring Gull	*Larus argentatus*
06000	Great Black-backed Gull	*Larus marinus*

3.7 Presentation of data

The complete English species names in Table 3.5 and the headings of the species accounts follow Wetlands International (2006). In the text, the more commonly used species names are used.

Numbers are given as rounded numbers; more than 1,000 rounded to the full 100, less than 1,000 to the full 10.

Flyway populations: The waterbird population estimates from Wetlands International (2006) have been used to obtain data for the flyway populations staging within or migrating through the Wadden Sea area. For each species and population, the sub-populations range is given either as the breeding or the non-breeding range. If more than one flyway population occurs in the Wadden Sea area, information for each of the populations is given (Wetlands International, 2002; Stroud *et al.*, 2004, Wahl *et al.*, 2007). In general, the application of the Ramsar Criterion 6 - "*...a wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of waterbirds...*" - is carried out such that the 1% threshold of the largest population is used for the assessment (Wetlands International 2002). This is true for migratory periods of spring and autumn when a separation of different populations during the counts or due to the migration behaviour is not possible. For species and populations of which the winter distribution is known, the criterion is only applied to the population wintering in the Wadden Sea area. Those species / populations are: *Calidris canutus islandica*, *Calidris a. alpina*, *Limosa l. lapponica*, *Tringa totanus robusta*, *Arenaria interpres* (breeding in Greenland, NE Canada). The species *Charadrius hiaticula*, *Pluvialis apricaria* and *Larus argentatus* may have separate populations in winter, but all can overwinter in the Wadden Sea and thus cannot be treated separately (see also Wahl *et al.* 2007).

The English and scientific names of the 34 selected water bird species are listed in Table 3.5.

3.8 Climate effects

Clearly, winter climate in the Wadden Sea can influence the number of birds present during winter (Bairlein and Exo, 2007). Thus, the hypothesis arises that climate can have a general influence on bird numbers recorded in the Wadden Sea. The annual bird numbers estimated for the Wadden Sea (composed by adding up monthly bird numbers for a year – see Fig. 3.3) are an excellent variable to test this hypothesis. Figures for Oystercatchers and Lapwings show that cold winters in West Europe can affect their survival (Catchpole *et al.* 1999; Alerstam 1982). They also reveal that a species such as Common Sandpiper *Tringa hypoleucos* which winters further south in the West Mediterranean to West Africa is influenced by climate on its winter grounds (although this species is not included in the Wadden Sea counts); precipitation, which is correlated with food abundance, particularly influences the survival of adults and the number of pairs that are able to establish territories during the following breeding season (Forchhammer *et al.* 1998; Pearce-Higgins *et al.* 2009; Figuerola 2007). Poor weather conditions may result in a smaller breeding population or fewer breeding successes (Davidson and Evans 1982). It is known that the Wadden Sea is an important feeding area during spring for several migratory species, and for several species it is an important stopover site during spring when birds build up their body reserves before flying to the breeding grounds (Zwarts, 1996). *E.g.* for the Common Sandpiper, feeding conditions in April are important for the breeding result (Pearce-Higgins *et al.* 2009). Thus conditions during winter and spring can influence the birds' survival and numbers.

To express the climate conditions over larger regions, the NAO index is often used (Hurrel *et al.*, 2003). It is calculated mainly from air pressure and water temperature in the Northern Atlantic and describes broadly the weather conditions in West Europe and North Africa. The NAO winter index, estimated on the basis of values from December-March, is especially suitable to describe winter climate, where high values express wet and mild winters and low values dry and cold winters in West Europe.

Thus if a species trend is positively correlated to the NAO index, this would indicate that this species increases with increasing NAO index, that the numbers increases with colder winters. If a species trend is negatively correlated to the NAO index, this indicates that the species decreases as the NAO index rises, so its numbers decrease with colder winters. Often these weather conditions in West Europe are opposite to those in South Europe and West Africa (Wang *et al.* 2005; Stige *et al.* 2006).

We assume that climate conditions during winter and spring have an impact on the numbers of migratory birds that pass through and stay in the Wadden Sea, and to express the climate conditions during these periods we have selected i) the NAO index for the winter months December-March (DJFM) and ii) the water temperature in April measured in Marsdiep in The Netherlands' Wadden Sea. The water temperature in April is closely correlated to both the temperature in March and May, and is therefore a good variable for the spring conditions. The two climate variables (NAO and water temperature) are not inter correlated (R2 = 0.047; P = 0.34, N = 21; linear correlation). Since most of the bird species breed in their second year (Cramp and Simons, 1977, 1983), we include both climate variable in year t and t-1 in the analyses.

The NAO winter index is shown in Fig. 3.5 together with the water temperature in the Marsdiep (Aken, 2001), The Netherlands, starting ten years before the study period to allow for comparison. The figure shows that the NAO winter index has increased up to and during the first two study years. Thereafter it has overall decreased, which indicates that the winter climate was mild and wet up to mid 1990s and thereafter became more cold and dry for some winters. The water temperature in Marsdiep had increased continuously during 1976-2008.

For the statistical analyses, we use Mixed Model with repeated effects and a co-variance structure that include an autoregressive variance function (Olsen and Schmidt, 2004). The total climate model includes: NAO(DJFM)t-1, NAO(DJFM)t, water temperature in the Wadden Sea in April, Wadden Sea (A)t-1 and Wadden Sea (A)t. The period we analyse is for t: 1988/89-2007/08 and period t-1: 1987/88-2006/07. The number of observations is N = 21 (for Eider N = 16), bird numbers are log transformed. In the Mixed Model, bird numbers (numbers that form the trend curves) present the dependent variable and the climate values the quantitative variables. When running the analyses, the primary model is used for all species, and for those species that do not show statistical, significant results (none of the variables show statistical significance of P <0.05) the model is modified by removing the variable showing the smallest correlation with the bird numbers until a statistical significant result is obtained and stopped when no variables became significant.

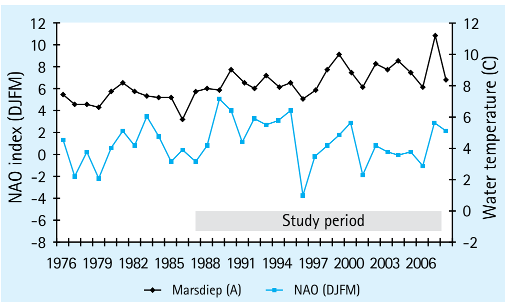


Figure 3.5
NAO winter index for December-March (DJFM)) and water temperature in April (A) in the Marsdiep in The Netherlands' Wadden Sea during 1976-2008 (Aken, 2001; Hurrel *et al.*, 2003).

Photo: Thorsten Krüger

4. Quality of Data

4.1. Coverage of main staging areas through site selection

The Wadden Sea Area – by definition – does not include inland counting units (except for the Danish part). Even though in some parts of the Wadden Sea some inland sites have been involved in the analyses for this report (see Chapter 3.2), some typical Wadden Sea species may not be adequately covered by the counts, since they fly inland during feeding times or high tide. This applies to one of the goose species (Barnacle Goose) and Curlews are also known to utilize inland pastures up to 15 km from the dike (Zwarts, 1996; Gloe, 1998, 1999) and thus are only partly covered. Golden Plover and Oystercatcher frequently remain inland during low tide. Gull species are also found either out on the sea or at harbours, garbage dumps and other inland areas, thus escaping counting efforts. Precise figures for the numbers of birds staying inland are sometimes unknown (except for geese) as these areas are not frequently monitored during the high tide counts.

4.2. Reliability of counted and estimated totals

Results of counted numbers are subject to counting errors of several sorts (Rappoldt *et al.*, 1985). However, for the vast majority of counts, it is believed that variations in both over- and underestimation are reasonably low. The proportion of imputed numbers within the estimated results, however, may give rise to some discussions. First of all, the imputed numbers are only 'temporary' parameters for the trend calculation by TRIM. For single counting units or very small regions, it would not be justifiable to show these numbers; for larger regions or – as is the case in this report – the combination of a high number of counting units to one entire region, the estimate of overall numbers is a reasonable approach integrating a large sum of counting units, of which each contains only a small amount of imputed numbers (Blew *et al.*, 2003).

However, some limitations apply:

- high and occasional occurring numbers of species during one month may result in unreasonable proportions of imputed numbers in other months,
- species which are difficult to count, either because they have a very short migration period (*e.g.* Sanderling, Curlew Sandpiper) or because they congregate in huge flocks at a few places (*e.g.* Knot) can result in erroneous estimates.

Conclusion: The numbers and the proportions of the individual international flyway populations are reliable results based on a cautiously calculated approach and thus present minimum estimates of each species or population; if an even better counting coverage could be achieved and turnover of individuals was considered, many estimates could in fact be higher. These results again demonstrate the outstanding importance of the Wadden Sea for migratory waterbirds.

5. Species Accounts

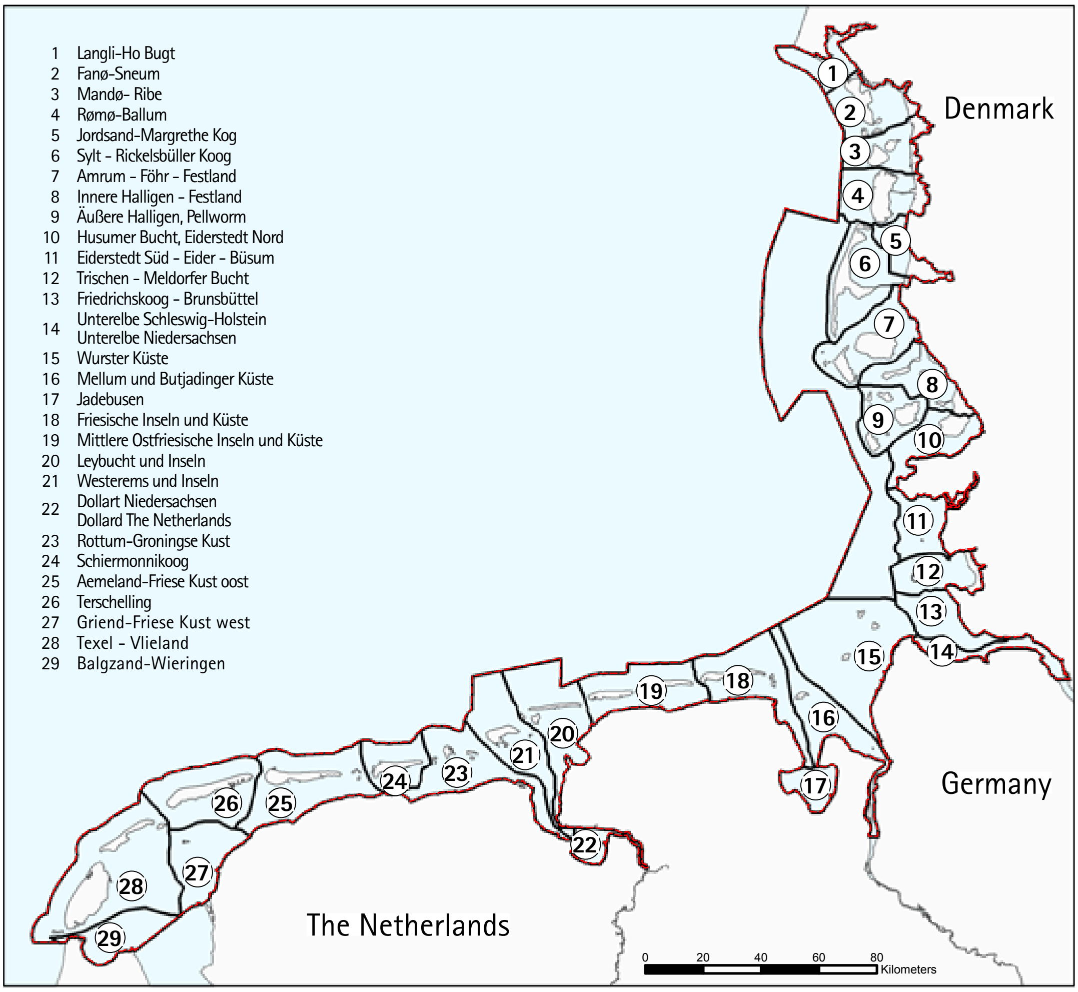


Figure 5.1
Map of 29 so-called "sub-areas", each of which covers an ecological unit of tidal flats and their adjacent roosting sites.

Phalacrocorax carbo

DK: Skarv D: Kormoran NL: Aalscholver 00720

Flyway population:	380,000-405,000
Breeding range:	North and Central Europe
1%:	3,900
Status:	Increasing

Region	Overall trends	
	short-term 10 years	long-term 21 years
WS	→	↑↑
DK	▬	↑↑
SH	↑	↑↑
NDS/HH	↑	↑↑
NL	→	↑↑

↑↑ strong increase ↑ moderate increase → stable
↓↓ strong decrease ↓ moderate decrease ▬ uncertain

Seasons (month no.)	Early period 1987/88-1994/95	Late period 1999/00-2006/07	% of flyway population 1999/00-2006/07
	mean of 3 maximum estimates		
Breeding: (4, 5, 6, 7)	3,804	15,684	4.0
Moult: --			
Autumn: (8, 9, 10)	11,420	25,152	6.4
Winter: (11, 12, 1,)	708	3,535	0.9
Spring: (2, 3)	681	3,049	0.8

Population

Cormorants occurring in the Wadden Sea belong to the sub-species *P. c. sinensis* that has a large breeding range from southern Scandinavian through Central Europe and Asia. In Europe the species winters in Central Europe and North Africa. The midwinter population is estimated at 380,000-405,000 and decreasing after the early 1990s (Wetlands International, 2006). Cormorants breed in the Wadden Sea and they are most numerous during migration in late summer and autumn. Only very few birds stay over winter and small numbers pass through during spring migration. The breeding population in The Netherlands, Germany, Denmark and Sweden was about 8,000 pairs in the early 1980s and increased to 45,000 ten years later. During the middle 1990s, the numbers in The Netherlands and Denmark stabilized, and thereafter the increase in the Baltic population also ceased (Kieckbusch and Knief, 2007). The breeding population in the Wadden Sea was estimated at 274 pairs in 1991 and increased to 2,337 pairs in 2001. Over 50% of the population breeds in The Netherlands, and larger colonies were also found in Niedersachsen and Schleswig-Holstein (Koffijberg *et al.*, 2006).

Ecology

In the Wadden Sea, Cormorants forage in the gullies and deeps during all tides. They mainly roost on sand banks and beaches near the water line, and also often use anthropogenic structures such as breakwaters in harbours, platforms, light houses and electric power cables (Koffijberg *et al.*, 2003). Their diet is dominated by flatfish (79% calculated by mass) and the first year group

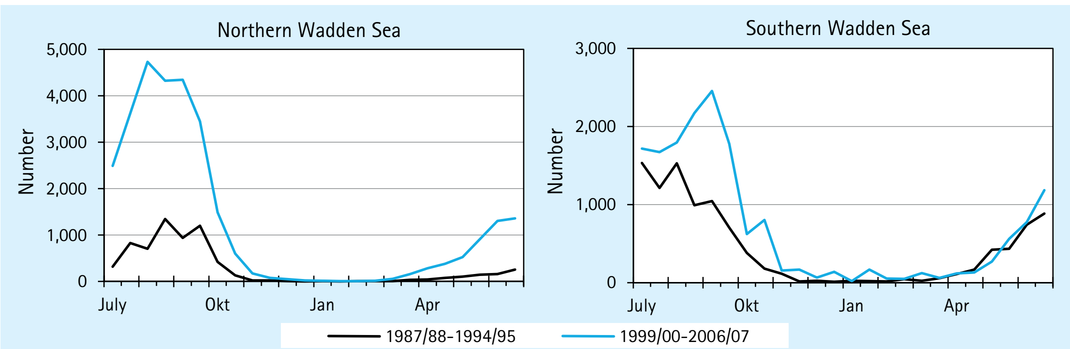


Figure 5.2
Penology (mean bi-monthly numbers) of Great Cormorant in the Northern and the Southern Wadden Sea during the periods 1987/88-1994/95 and 1999/00-2006/07. Counted numbers from spring-tide-counting sites, no gap-filling.

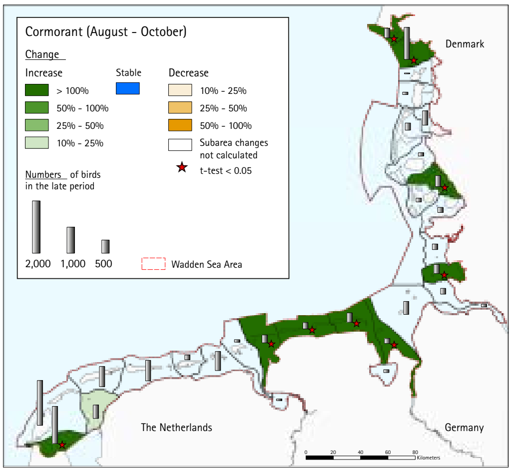


Figure 5.3
Distribution of Great Cormorant in Wadden Sea during autumn (August-October) for the periods1987/88-1994/95 and 1999/00-2006/07. Changes between the two periods are indicated (colours) and numbers are given for the late period (bars). Asterisks indicate statistical significant differences in numbers (P <0.05).

of the species plaice (P*leuronectes platessa*), dab (*Limanda limanda*) and flounder (*Platichthys flesus*) (Leopold *et al.*, 1998). During spring the polychaete *Nereis virens* also contributes considerably to the diet (Leopold and van Damme, 2002).

Phenology

During July, Cormorant numbers in the Wadden Sea increase to a peak in August-September (Blew *et al.*, 2005a). In the following months the birds move along coasts and rivers in central Europe to the winter grounds further south – the coasts of France and Portugal and around the Mediterranean; accordingly numbers in the Wadden Sea decrease until early November and stay at a very low level during the winter months. Birds that winter in the Wadden Sea move to their breeding grounds as early as January-February. Those wintering further south follow during March-April and numbers increase until June. Some birds wintering south of the Wadden Sea may fly directly to their breeding grounds without staging in the Wadden Sea (Bregnballe *et al.*, 1997).

The species phenology has changed between 1987/88-1994/95 and 1999/00-2006/07 (Fig. 5.2). In the Northern Wadden Sea in the early period Cormorant numbers peaked during autumn in August and September and dropped as they left during October. In the late period, their numbers peaked in the first part of August. The phenology in the Southern Wadden Sea shows peak numbers in early September in the late period compared to lower numbers in the first period. During spring there is no difference between the phenologies in the two periods in the Southern Wadden Sea, but in the Northern part Cormorants start to increase from March onwards in the late period.

Distribution

The Cormorant has an uneven distribution in the Wadden Sea with high numbers in sub-areas in Denmark and The Netherlands (Fig. 5.3), and in nine sub-areas, spread over the Wadden Sea the numbers had increased significantly.

Photo: Gundolf Reichert

Numbers

During recent years some 11,000 Cormorants may occur in the Northern and some 15,000 in the Southern Wadden Sea during autumn (Appendix 1). During winter, only up to 3,500 birds are present, mostly in the southern part. During spring migration (Feb, Mar) only small numbers occur compared to autumn, but during the breeding season up to 15,700 birds are recorded in the Wadden Sea. Locally during autumn high numbers are counted at Texel-Vlieland, NL (2,500), Balgzand-Wierinen, NL (2,000) and at Fanø-Sneum, DK (1,700). These numbers are based on average numbers during 1999/2000-2006/2007.

The total number of Cormorants in the entire Wadden Sea increased up to year 2002-2003 and decreased thereafter again, particularly in Denmark and The Netherlands (Fig. 5.4). Trend calculations show a strong increase during the long term (21 years) and a stable trend during the short term (10 years). The same trends are also found in the four Wadden Sea parts for the long term, while in the short term Schleswig-Holstein and Niedersachsen had moderately increasing numbers, The Netherlands had stable numbers and Denmark had fluctuating numbers.

Summary

Cormorant numbers started to increase in the Wadden Sea in the 1980s (Meltofte *et al.*, 1994), and have continued to increase during all seasons, reflecting the increase in the breeding populations in Northern Europe. However, the breeding numbers have now stabilized, and it seems that the Wadden Sea numbers follow this overall trend with some years delay. The strong increase during the long term has turned to a moderate increase during the short term and numbers are even decreasing since 2004. The presence of Cormorants in the Wadden Sea has slightly changed: they are staging in larger numbers in autumn and are more frequent in spring due to the increased number of breeding birds, in the northern parts especially.

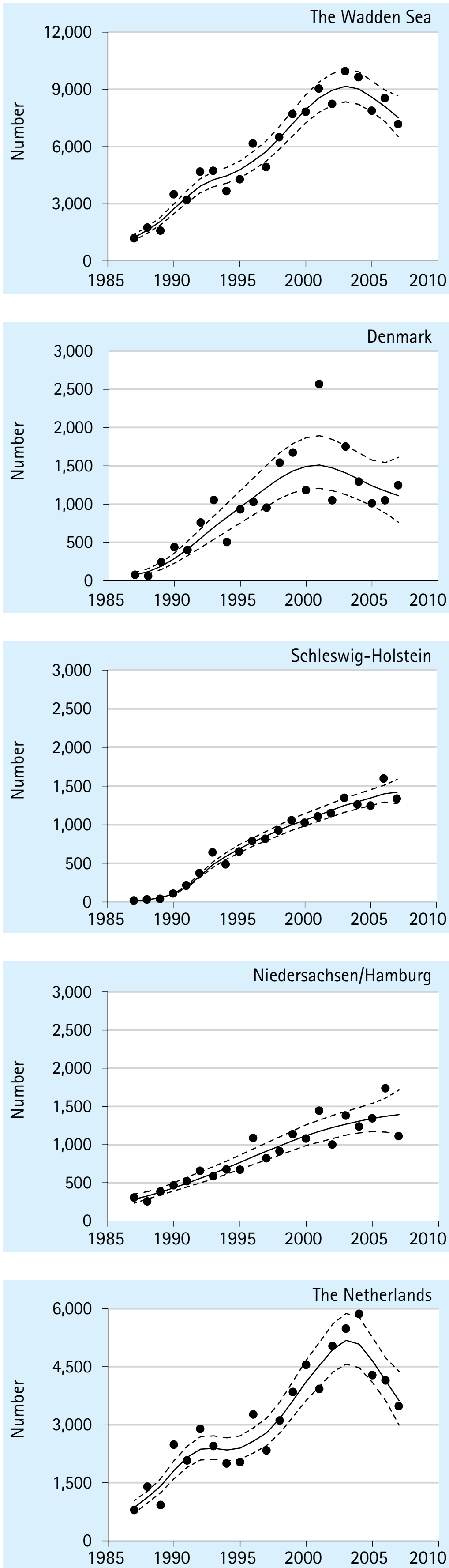


Figure 5.4
Trends of Great Cormorant in the International Wadden Sea (WS) and the four regions 1987/1988-2007/2008; dots represent annual averages; trendline calculated by Trendspotter (solid line) together with the ± 95 % confidence limits (dotted line).

5.2 Eurasian Spoonbill

Platalea leucorodia

01440

DK: Skestork **D: Löffler** **NL: Lepelaar**

Flyway population:	11,300
Breeding range:	Coastal Western Europe
1%:	110
Status:	Increasing

Region	Overall trends	
	short-term 10 years	long-term 21 years
WS	↑↑	↑↑
DK	↑↑	↑↑
SH	↑↑	↑↑
NDS/HH	↑↑	↑↑
NL	↑↑	↑↑

Seasons (month no.)		Early period 1987/88-1994/95	Late period 1999/00-2006/07	% of flyway population 1999/00-2006/07
		mean of 3 maximum estimates		
Breeding:	(5, 6)	163	938	8.5
Moult:	--			
Autumn:	(7, 8, 9, 10)	323	1,837	16.7
Winter:	--			
Spring:	(3, 4)	--	405	8.5

For details see species account Cormorant.

Population

The Eurasian Spoonbill breeds from Denmark in the north along the entire Wadden Sea coast and eastwards through Asia. European breeders winter in North-western Africa (Overdijk, 2004). The East Atlantic flyway population counts 11,300 individuals and is increasing (Wetlands International, 2006). The breeding population in the Wadden Sea reflects this trend. The population has increased from 217 pairs in 1991, to 831 pairs in 2001 (Koffijberg *et al.*, 2006) and 1,661 in 2009 (Overdijk pers. com.). The largest breeding colonies occur on the islands in The Netherlands with about 90 % of the population. However, increasing breeding numbers also occur in Niedersachsen and in Schleswig-Holstein (238 and 77 breeding pairs in the year 2009 respectively), and the species currently spreads north to the Danish Wadden Sea and the Ringkøbing Fjord.

Ecology

In the Wadden Sea, Spoonbills feed on shrimps, and small fishes such as flatfish and sticklebacks (*Gasterosteus aculeatus*). Often, several individuals feed together in gullies and small water bodies on tidal flats. Birds also feed inland in ponds and ditches (Koffijberg *et al.*, 2006).

Phenology

Spoonbills arrive in the Wadden Sea as early as February, but most of them come in March (Fig. 5.5). They start breeding in late March/early April and at that time they cluster into colonies with large numbers not occuring elsewhere. Most birds stay in the Wadden Sea after the breeding season, so peak numbers are reached from July to September. Few birds are seen in October.

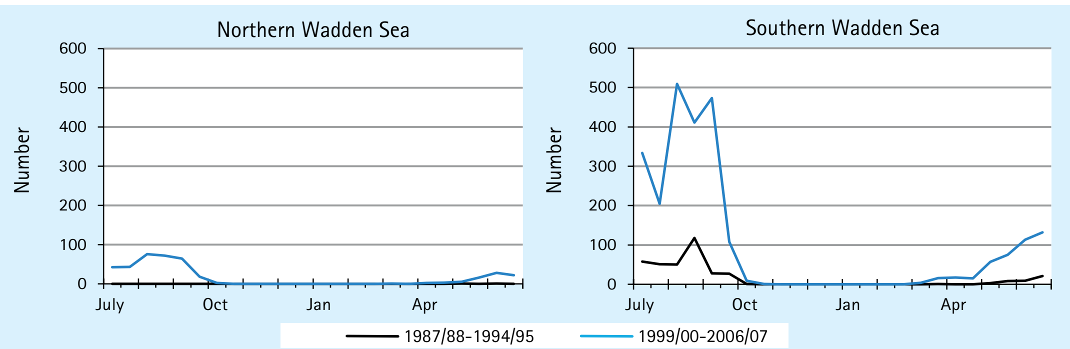


Figure 5.5
Phenology of Eurasian Spoonbill (bi-monthly mean number) in the Northern and the Southern Wadden Sea during the periods 1987/88-1994/95 and 1999/00-2006/07. Counted numbers from spring-tide-counting sites, no gap-filling.

Photo: Stefan Pfützke / green-lens.de

Photo: Gundolf Reichert

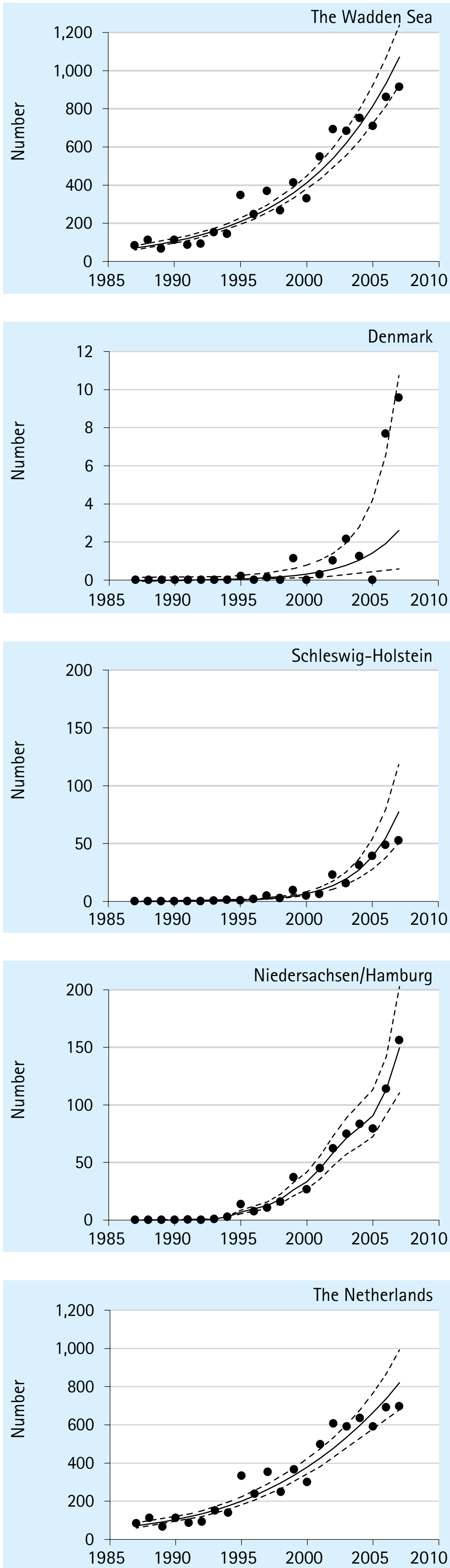


Figure 5.6
Trends of Eurasian Spoonbill in the International Wadden Sea (WS) and the four regions 1987/1988-2007/2008; dots represent annual averages; trendline calculated by Trendspotter (solid line) together with the ± 95 % confidence limits (dotted line).

Numbers

Up to 1,800 Spoonbills occur in the Wadden Sea after the breeding season with the main concentration in the Dutch Wadden Sea (Appendix 1). Largest numbers are recorded in September in Texel-Vlieland, NL (400) and Kop van Noord-Holland-Afslutdijk, NL (350), based on average numbers during 1999/2000-2006/2007.

The overall trend shows a strong increase during the long (21 years) and the short term (10 years), consistent in the different parts of the Wadden Sea (Fig. 5.6).

Summary

The Wadden Sea has been populated by more than 1,660 breeding pairs of Spoonbills in recent years (2009). Here they almost reach the northern edge of their breeding range. The Spoonbills' stronghold with highest breeding numbers is the Dutch Wadden Sea, where they started to increase and from where they recolonised the northern Wadden Sea (Lok *et al.*, 2009). Breeding bird numbers are highest in The Netherlands and get smaller up towards Denmark, where breeding bird numbers are smallest. The same pattern is true for the non-breeding numbers. After the breeding season, numbers peak from July to September. Peak numbers have continued to increase similarly in all parts of the Wadden Sea in recent years.

Branta leucopsis

DK: Bramgås D: Weißwangengans NL: Brandgans

01670

Flyway population:	780,000
Breeding range:	North Russia, East Baltic, South North Sea
1%:	7,800
Status:	Increasing (Koffijberg *et al.* 2010)

Region	Overall trends	
	short-term 10 years	long-term 21 years
WS	↑	↑↑
DK	↑	↑↑
SH	↑	↑↑
NDS/HH	▬	↑
NL	↑	↑↑

Seasons (month no.)		Early period 1987/88-1994/95	Late period 1999/00-2006/07	% of flyway population 1999/00-2006/07
		mean of 3 maximum estimates		
Breeding:	--			
Moult:	--			--
Autumn:	(9, 10, 11)	191,545	238,671	56.8
Winter:	(12, 1, 2)	115,573	155,626	37.1
Spring:	(3, 4, 5)	206,459	352,544	83.9

For details see species account Cormorant.

Population

The Barnacle Goose breeds mainly in Arctic Russia and the Baltic, however, increasing numbers are now breeding on Gotland, Sweden, and most recently also in the Wadden Sea countries, with some 8,300 pairs in The Netherlands (Voslamber *et al.* 2009) and small but increasing numbers in Niedersachsen, Schleswig-Holstein and in Denmark (van der Jeugd and Litvin, 2006; Feige *et al.*, 2008). The species winters in Germany and The Netherlands. The flyway population is estimated at 780,000 birds and is still increasing (Koffijberg *et al.*, 2010; Wetlands International, 2006).

Ecology

In the Wadden Sea, Barnacle Geese generally prefer to stay on the salt marshes along the mainland coasts, especially during spring and autumn, where they feed on Puccinellia and Festuca-dominated vegetation (Ydenberg and Prins, 1981). However, in winter many of the birds also feed on semi-natural grasslands in the polder areas as well as on fertilized grasslands or arable farmland (Koffijberg and Günther, 2005).

Phenology

The Barnacle Geese arrive to the northern parts of the Wadden Sea in September and these birds belong to the Baltic breeding population (Blew *et al.*, 2005a). Later in October they are followed by the largest part of the population that breeds in the high Arctic regions of Russia. During November and December the birds spread out to sites outside the Wadden Sea and the numbers thus decrease. During winter they almost leave

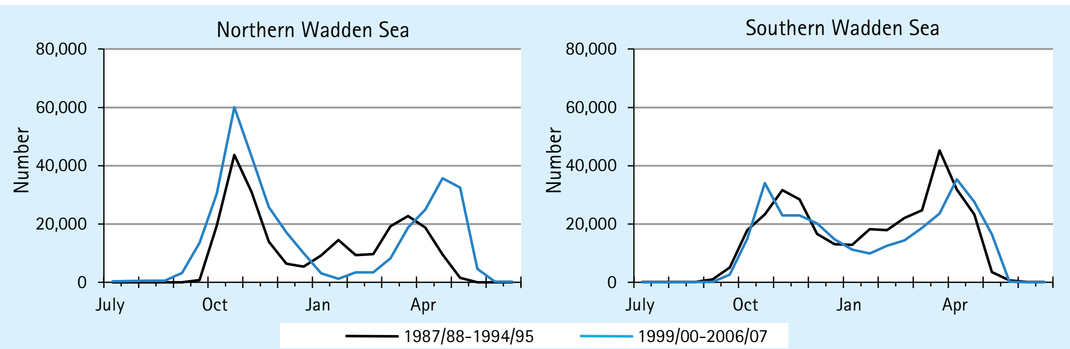
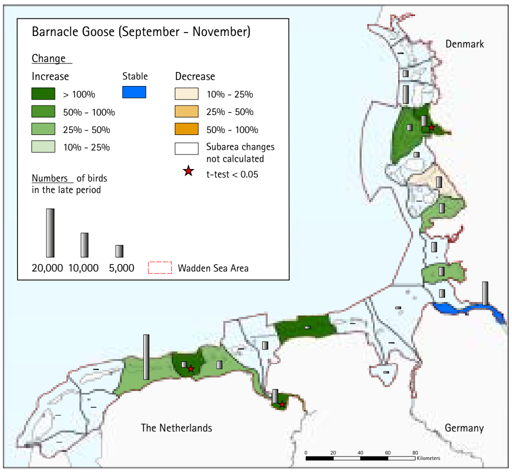
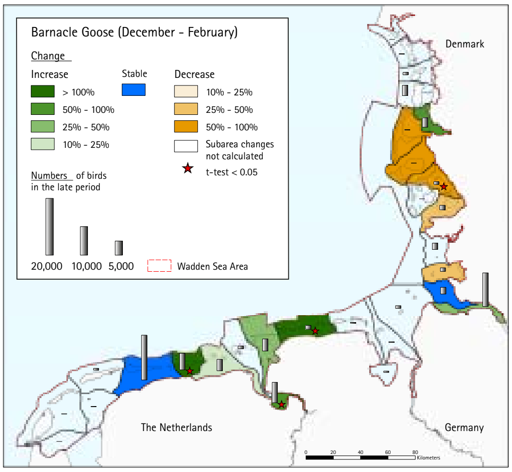
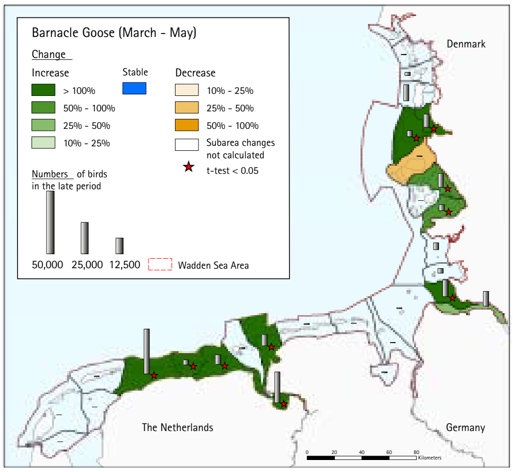


Figure 5.7
Phenology of Barnacle Goose (bi-monthly mean number) in the Northern and the Southern Wadden Sea during the periods 1987/88-1994/95 and 1999/00-2006/07. Counted numbers from spring-tide-counting sites, no gap-filling.

Figure 5.8
Distribution of Barnacle Goose in the Wadden Sea during autumn (September-November), winter (December-February) and spring (March-May) for the periods1987/88-1994/95 and 1999/00-2006/07. Changes between the two periods are indicated (colours) and numbers are given for the late period (bars). Asterisks indicate statistical significant differences in numbers (P <0.05).







the Northern Wadden Sea but some stay in the Southern part. In February and March numbers increase and reach a maximum in late April. By mid May, nearly all birds have left for their breeding grounds.

The phenology of Barnacle Goose has undergone marked changes from the early (1987/88-1994/95) to the late period (1999/00-2006/07) (Fig. 5.7). In the Northern Wadden Sea, birds stay somewhat longer during autumn in the late period compared to the early period. In the Southern Wadden Sea, the Barnacle Goose's time of arrival has not changed, but the peak has shifted from November to October comparing the early and late period. During spring in the Northern part the time of peak numbers has shifted from late March in the early period to late April and early May in the late period, and likewise their stay has been prolonged by four to six weeks (Fig. 5.7). In the Southern Wadden Sea the phenology has not changed that much during spring but the peak number has shifted from late March to early April.

Distribution

Barnacle Geese prefer salt marshes and inland meadows along the mainland Wadden Sea coast and in a few cases they also occur on islands. They use roughly the same areas during autumn, winter and spring, being concentrated in areas with large inland meadow and freshwater bodies like lakes or estuaries (Fig. 5.8). However, some changes have occurred between 1987/88-1994/95 and 1999/00-2006/07). During autumn, increased numbers were recorded in nine Wadden Sea sub-areas, significant only at three sites in The Netherlands and in Denmark; decreases only occurred in one sub-area. During winter, decreases were observed in four sub-areas in Schleswig-Holstein, while increases had occurred in Niedersachsen and The Netherlands. During spring, increasing numbers were recorded in 11 sub-areas spread out over most of the Wadden Sea area and the increases were significant in ten of these (Fig. 5.8). This may suggest that changes during autumn and winter distributions are climate or habitat driven, while changes in spring may be mainly attributed to the population increase.

Numbers

During autumn in recent years, peak estimates suggest some 114,000 Barnacle Geese are in the Northern and some 133,000 birds in the Southern Wadden Sea. Thereafter numbers decrease, rapidly in the Northern part and more slowly in the Southern part, with estimates of 51,000 in the Northern and 114,000 in the Southern Wadden Sea during mild winters. During recent springtimes, peak estimates are 213,000 birds in the Southern Wadden Sea and 169,000 in the Northern Wadden Seas (Appendix 1). Locally high numbers are recorded during autumn and winter in Ameland-Friese Kust Oost, NL (25,700 and 22,300), Unterelbe Schleswig-Holstein/Niedersachsen (13,500 and 16,800) and Jordsand-Margrethe Kog, DK (10,200 and 5,000); during spring in Ameland-Friese Kust Oost, NL (50,000), Dollard, NDS/NL (34,000), Friedrichskoog-Brunsbüttel, SH (18,600), Unterelbe Schleswig-Holstein/Niedersachsen (16,400) and Jordsand-Margrethe Kog, DK (17,800), based on average numbers during the late period.

Barnacle Goose numbers in the entire Wadden Sea have increased steadily during the last 21 years, with a strong increase for the long term period (21 years) and a moderate increase still during the short term (10 years) (Fig. 5.9). Increasing trends are also found in the four parts of the Wadden Sea during the long and the short terms, except for fluctuating numbers in Niedersachsen.

Summary

The flyway population is increasing, and so is the trend in the Wadden Sea, but this is less pronounced. The species uses mostly the same salt marshes and meadow areas along the mainland coast of the Wadden Sea during autumn, winter and spring. Barnacle Geese have prolonged their stay during recent years by arriving earlier in autumn, staying longer during autumn/winter and many of them are departing 4-6 weeks later in spring until mid May.

Photo: Bo Lassen Christiansen

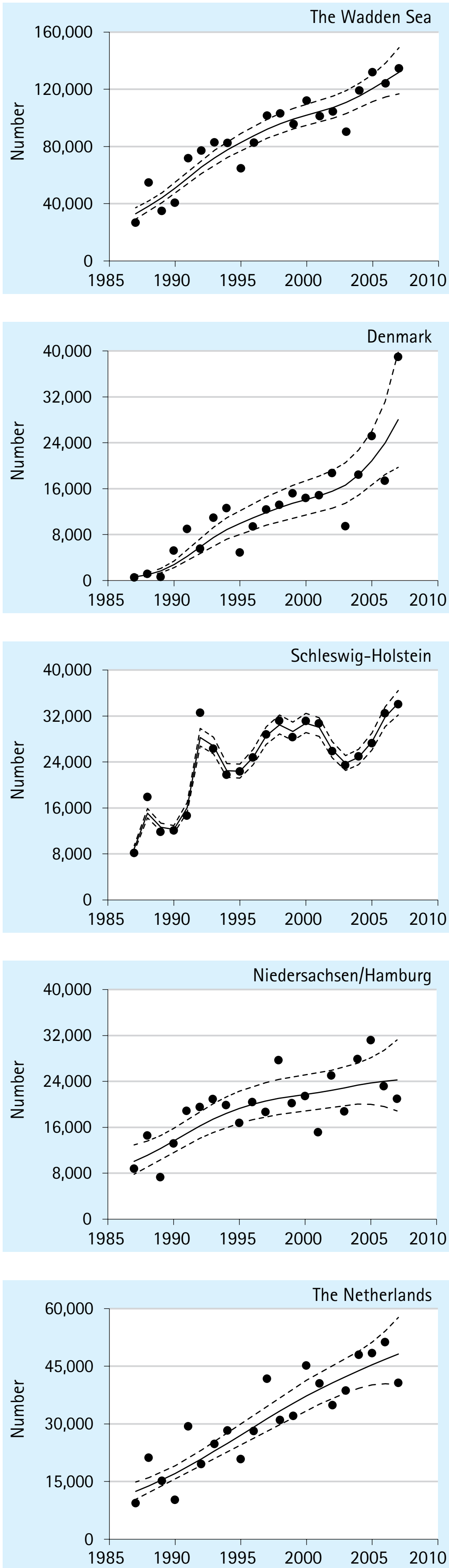


Figure 5.9
Trends of Barnacle Goose in the International Wadden Sea (WS) and the four regions 1987/1988-2007/2008; dots represent annual averages; trendline calculated by Trendspotter (solid line) together with the ± 95 % confidence limits (dotted line).

Photo G. Reichert

5.4 Dark-bellied Brent Goose

Branta bernicla bernicla

01680

DK: Mørkbuget Knortegås   D: Dunkelbäuchige Ringelgans
NL: Rotgans

Flyway population:	243,000
Breeding range:	Western Siberia
1%:	2,430
Status:	Decreasing (Ebbinge, 2009)

Region	Overall trends	
	short-term 10 years	long-term 21 years
WS	→	→
DK	–	→
SH	→	↓
NDS/HH	↓	↓
NL	→	→

Seasons (month no.)		Early period 1987/88-1994/95	Late period 1999/00-2006/07	% of flyway population 1999/00-2006/07
		mean of 3 maximum estimates		
Breeding:	--			
Moult:	--			
Autumn:	(9, 10, 11)	95,123	83,269	41.6
Winter:	(12, 1, 2)	53,141	38,808	19.4
Spring:	(3, 4, 5)	279,453	199,588	99.8

For details see species account Cormorant.

Population

The Dark-bellied Brent Goose breeds in Western Siberia along the coasts of the Arctic Sea and winters mainly along the coasts of south-eastern Great Britain and north-western France. The population is recently estimated at 243,000 birds, decreasing from 314,000 birds in the early 1990s, probably due to low breeding success (Wetlands International, 2006). During the autumn migration, Dark-bellied Brent Geese stage in the White Sea area before they fly to the Wadden Sea.

Ecology

While staying in the Wadden Sea in autumn, the majority of the species occurs around the islands. Its diet consists mainly of marine plants such as green algae and eelgrass (*Zostera sp.*) and changes to terrestrial plants on the forelands during winter and spring (Smit and Wolf 1983). However, an increasing number of Brent Geese graze in polder areas in recent years compared to the situation in the 1970s (Koffijberg and Günther, 2005).

Phenology

The Dark-bellied Brent Geese arrive in the Wadden Sea in September, and autumn maximum numbers occur in October (Blew *et al.*, 2005a). Thereafter the birds move on to the winter quarters along the coasts of south-eastern Great Britain and north-western France (Madsen *et al.*, 1999) with low numbers staying in the Southern Wadden Sea. In late February and March they return to the Wadden Sea and the numbers peak in April and early May. During the second half of

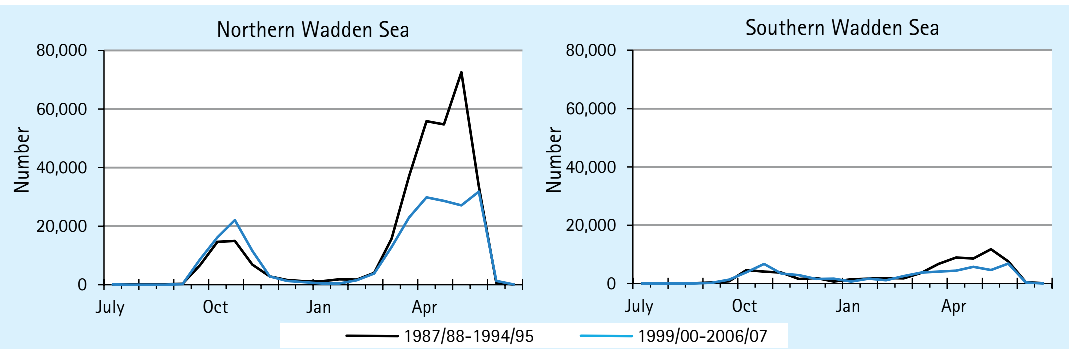


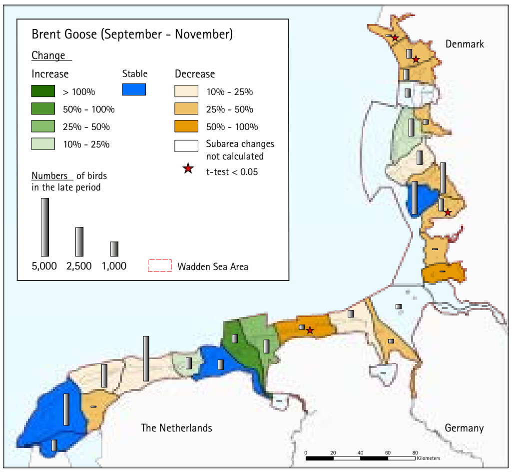
Figure 5.10
Phenology of Dark-bellied Brent Goose (bi-monthly mean number) in the Northern and the Southern Wadden Sea during the periods 1987/88-1994/95 and 1999/00-2006/07. Counted numbers from spring-tide-counting sites, no gap-filling.

May they depart for their breeding grounds.

The general phenology of the species has not changed much between 1987/88-1994/95 and 1999/00-2006/07 in the Northern Wadden Sea, but in the Southern part the peak numbers occur slightly later in the late compared to the early period (Fig. 5.10).

Distribution

Dark-bellied Brent Geese occur during autumn and spring mainly at the islands, and less numerous along the mainland coast, with highest numbers in northern Schleswig-Holstein and the western parts of the Dutch Wadden Sea (Fig. 5.11). However, the geographical distribution shows some remarkable changes between 1987/88-1994/95 and 1999/00-2006/07, with the changes being more or less similar in both time periods. Brent Goose numbers have decreased in 16 sub-areas in autumn and in 15 in spring; stable numbers were found in four (autumn) and six sub-areas (spring); and in four sub-areas, numbers had increased. Most sub-areas with decreases, most of which were significant, were situated in Denmark and Schleswig-Holstein. Most sub-areas with stable and increasing numbers occurred in Niedersachsen and The Netherlands.



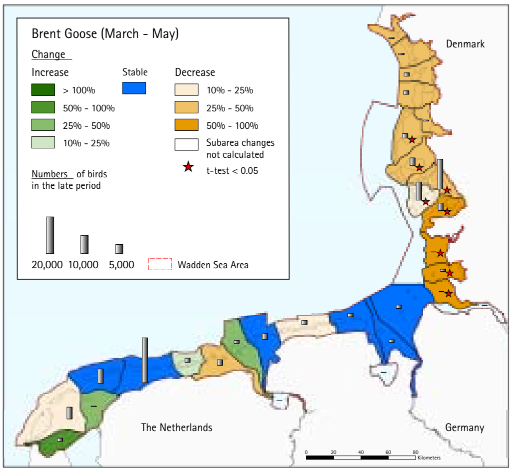


Figure 5.11 Distribution of Dark-bellied Brent Goose in the Wadden Sea during autumn (September-November), and spring (March-May) for the periods1987/88-1994/95 and 1999/00-2006/07. Changes between the two periods are indicated (colours) and numbers are given for the late period (bars). Asterisks indicate statistical significant differences in numbers (P <0.05).

Photo: Thorsten Krüger

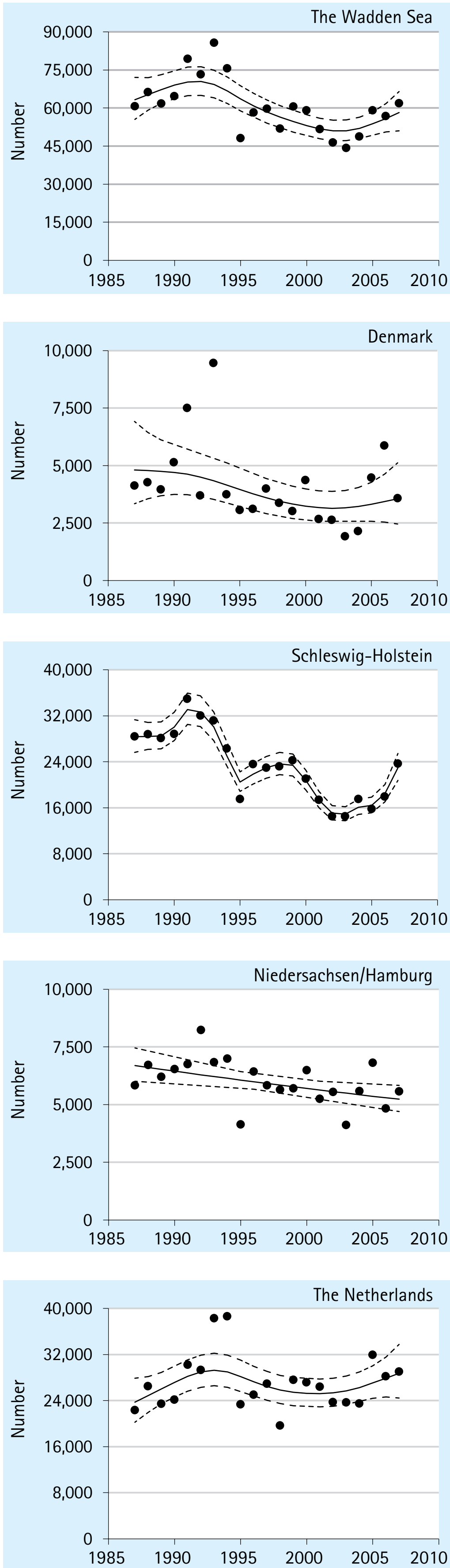


Figure 5.12
Trends of Dark-bellied Brent Goose in the International Wadden Sea (WS) and the four regions 1987/1988-2007/2008; dots represent annual averages; trendline calculated by Trendspotter (solid line) together with the ± 95 % confidence limits (dotted line).

Numbers

The maximum estimates in autumn amounted to some 40,000 birds both in the Northern and the Southern Wadden Sea During winter, up to 10,000 birds may stay in the Northern part, but more than 35,000 birds in the Southern part (Appendix 1). Peak estimates during spring in recent years reached 98,000 in the Northern and over 118,000 birds in the Southern Wadden Sea. However, during the 1990s total estimates – up to 280,000 birds – were higher by 30% (Blew *et al.*, 2005a). Large numbers stay during autumn and spring in the sub-areas Ameland-Friese Kust Oost, NL (5,500 and 35,000), Innere Halligen-Festland, SH (3,800 and 23,200) and Äußere Halligen-Pellworm, SH (4,000 and 14,100), according to average numbers during 1999/2000-2006/2007.

Total numbers in the Wadden Sea are fluctuating, with peaks in the mid-1990s. The trend is estimated as stable during the long (21 years) and the short term (10 years). These overall trends are different in the four parts of the Wadden Sea, showing stable trends in The Netherlands and Denmark but decreasing trends in Schleswig-Holstein and Niedersachsen during the long trend. For the short trend, numbers fluctuate in Denmark, are stable in Schleswig-Holstein and The Netherlands, but decrease in Niedersachsen.

Summary

The Dark-bellied Brent Goose population has decreased since 1996, probably due to a low breeding success (Koffijberg and Günther, 2005). However, the overall trend in the Wadden Sea is stable during the long term (21 years), and even increasing during the short term, indicating that the population might have recovered. These recent increases occur in Niedersachsen, while decreases occur in Denmark and Schleswig-Holstein.

5.5 Common Shelduck

Tadorna tadorna

DK: Gravand D: Brandgans NL: Bergeend 01730

Flyway population:	300,000
Breeding range:	North-West Europe
1%:	3,000
Status:	Stable

Region	Overall trends	
	short-term 10 years	long-term 21 years
WS	→	↓
DK	↑↑	↑
SH	↓	↓
NDS/HH	↓↓	↓
NL	→	→

Seasons (month no.)		Early period 1987/88-1994/95	Late period 1999/00-2006/07	% of flyway population 1999/00-2006/07
		mean of 3 maximum estimates		
Breeding:	(4, 5, 6)	47,564	74,963	25.0
Moult: *	(7, 8)	186,073	215,345	71.8
Autumn:	(9, 10, 11)	252,824	245,723	81.9
Winter:	(12, 1)	205,533	201,345	67.1
Spring:	(2, 3)	89,754	131,509	43.8

* Mean of 3 maximum counts taken from aerial counts of moulting individuals offshore (see text).
For details see species account Cormorant.

Population

The Common Shelduck breeds in North-Western Europe and winters in Western Europe. The population counts 300,000 birds and is stable. The breeding population in the Wadden Sea increased from 4,400 pairs in 1991 to 6,500 pairs in 2001 (Koffijberg *et al.*, 2006).

Ecology

In the Wadden Sea, the Shelducks feed on mudflats on small crustaceans and molluscs that they take by 'upending' or trampling (Smit and Wolff, 1983). During the moult, large numbers of the birds occur offshore in the Wadden Sea, and later during autumn and in spring they roost at mudflats along or at the edges of the salt marshes and also at sea walls (Koffijberg *et al.*, 2003).

Phenology

Large numbers of Shelducks from Scandinavia and the Baltic as well as from Great Britain and France moult in the Wadden Sea in July and August with peak numbers reached in late July/ early August (Blew *et al.*, 2005a; Meltofte *et al.*, 1994). In August-September juveniles immigrate to the Wadden Sea from northern breeding grounds. The immature birds initiate their body moult in June; the wing moult starts in the first half of June and in August most birds are flightless. The juveniles continue the body moult until December. After September, numbers show a gradual decrease until December, due to birds flying to winter grounds on the British Isles and in western France. After midwinter, numbers decrease through spring and in April all birds have left for their breeding grounds, except the local

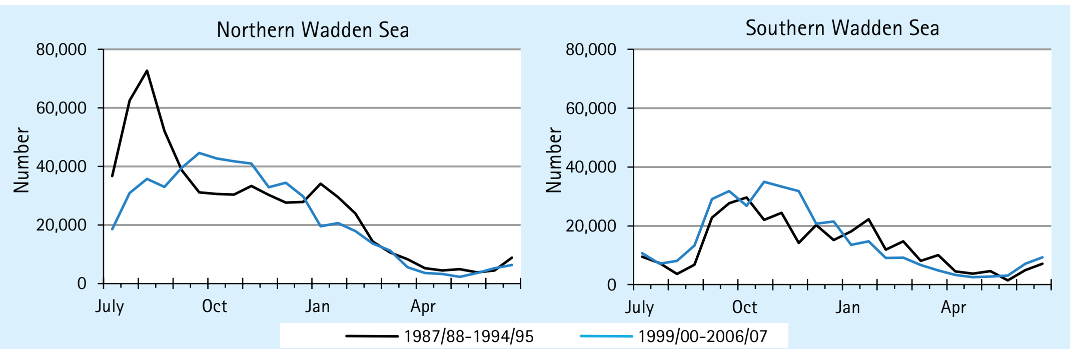
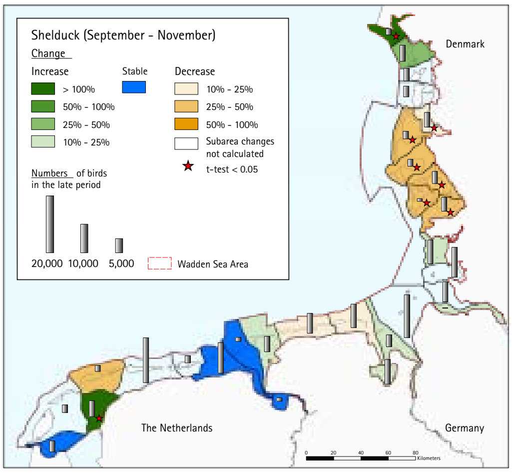
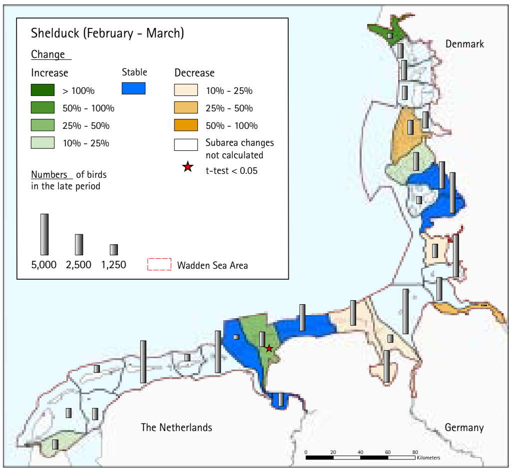


Figure 5.13
Phenology of Common Shelduck (bi-monthly mean number) in the Northern and the Southern Wadden Sea during the periods 1987/88-1994/95 and 1999/00-2006/07. Counted numbers from spring-tide-counting sites, no gap-filling.

Figure 5.14
Distribution of Common Shelduck in the Wadden Sea during autumn (September-November), moulting season (July-August) and spring (February-March) for the periods1987/88-1994/95 and 1999/00-2006/07. Changes between the two periods are indicated (colours) and numbers are given for the late period (bars). Asterisks indicate statistical significant differences in numbers (P <0.05).





breeders.

The Shelduck phenology has not changed much between 1987/88-1994/95 and 1999/00-2006/07 (Fig. 5.13). In the Northern Wadden Sea, the birds arrive at the same time during July in the two periods. However, in the late period a larger number stays longer during autumn. In the Southern Wadden Sea, the Shelduck numbers increase about half a month earlier during autumn in the late compared to the early period, and the high level is prolonged until November (compared to beginning of October in the early period). Thereafter, numbers decrease. The decrease in numbers over the winter period occurs in the entire Wadden Sea with some fluctuations probably due to winter severity.

The numbers of moulting Shelduck in July/August off the coast of Schleswig-Holstein are only partly included in these phenology figures, since they are not fully covered by the ground counts. During the last 20 years, the numbers of moulting birds have been surveyed from aircraft as a supplement to the Trilateral monitoring scheme. More than 200,000 birds annually had been recorded staging offshore Schleswig-Holstein during July/August, but in recent years numbers had dropped to less than 150,000 birds, which is still the vast majority of all birds moulting in the Wadden Sea.

Distribution

During moult (July-August) the majority of birds is concentrated north off the Elbe river mouth (Fig. 5.14); during autumn they spread out and most birds are staging from the southern parts of the Schleswig-Holstein Wadden Sea to the south-western part of Niedersachsen and The Netherlands (Fig. 5.14). During spring, the birds are more evenly distributed, but relatively more birds occur in northern parts of Schleswig-Holstein and Denmark than during autumn.

Photo: Gundolf Reichert

The geographical distribution has changed in some sub-areas between 1987/88-1994/95 and 1999/00-2006/07. During autumn (September-November), significant decreases of Shelduck numbers were recorded in six sub-areas in Schleswig-Holstein and Denmark, and significant increases were seen in only two sub-areas (one in Denmark and one with larger numbers in The Netherlands). During spring, one sub-area in Niedersachsen shows a significant increase, and several other sub-areas show either increasing, decreasing or stable numbers.

Number

During the moulting period, up to 200,000 individuals were counted between 1994 and 2002, but numbers decreased to some 145,000 in 2007 (130,000 in 2008 and 137,000 in 2009). After the moulting period, maximum numbers in the Wadden Sea reach some 250,000 birds in autumn (Appendix 1). These numbers appear in both periods. However, it must be noted, that the decrease has occurred only in the recent 6-7 years. After the autumn peak, numbers gradually decrease in both the Northern and Southern parts to a total number of about 200,000 in winter, after which numbers continuously decrease until May. Thereafter a minor increase occurs due to breeding birds.

Summary

Shelduck numbers in the Wadden Sea – counted from the ground throughout the year – decreased to the mid 1990s and became stable afterwards. In Germany, numbers decreased slightly after 1990, but numbers are now increasing as they also are in both The Netherlands and Denmark (Blew *et al*., 2005b; Hustings *et al*. 2009; Laursen and Frikke, 2006). The moulting population, with main concentration in the Schleswig-Holstein Wadden Sea, has been increasing up to the year 2000 but decreased thereafter. The phenology has changed slightly because Shelducks have stayed longer during autumn in recent years. This is most pronounced in the Northern Wadden Sea.

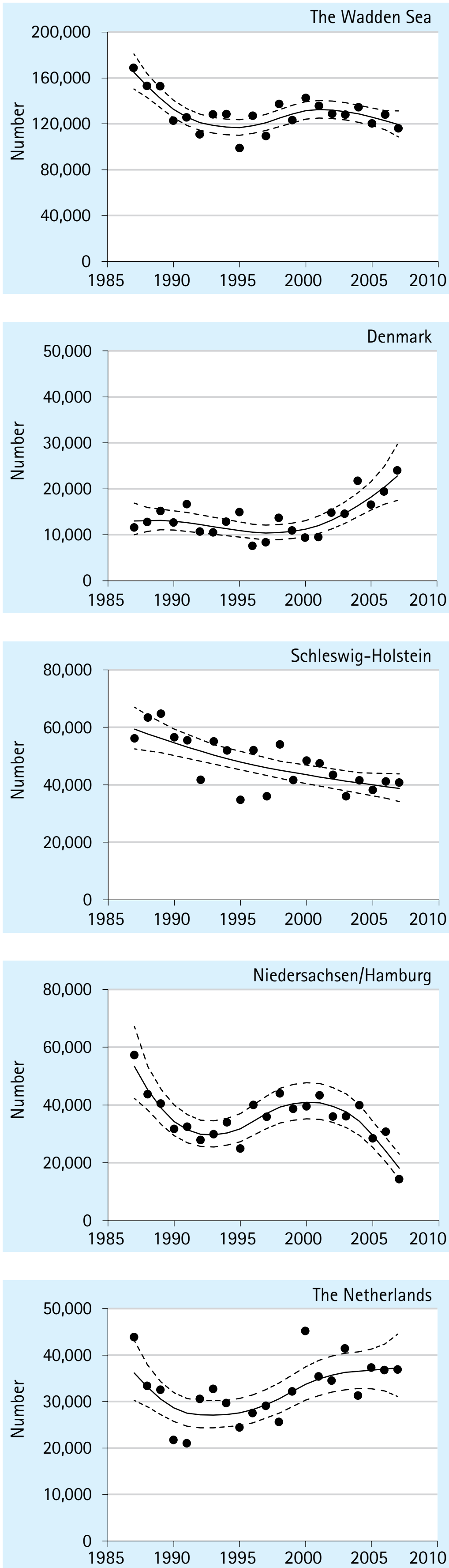


Figure 5.15
Trends of Common Shelduck in the International Wadden Sea (WS) and the four regions 1987/1988-2007/2008; dots represent annual averages; trendline calculated by Trendspotter (solid line) together with the ± 95 % confidence limits (dotted line).

5.6 Eurasian Wigeon

Anas penelope

01790

DK: Pibeand **D: Pfeifente** **NL: Smient**

Flyway population:	1,500,000
Breeding range:	West Siberia, North-West and North-East Europe
1%:	15,000
Status:	Stable

Region	Overall trends	
	short-term 10 years	long-term 21 years
WS	→	→
DK	↑	↑
SH	→	→
NDS/HH	↓	→
NL	↓	↓

Seasons (month no.)		Early period 1987/88-1994/95	Late period 1999/00-2006/07	% of flyway population 1999/00-2006/07
		mean of 3 maximum estimates		
Breeding:	--			
Moult:	--			
Autumn:	(9, 10, 11)	327,525	331,807	22.1
Winter:	(12, 1, 2)	273,117	259,479	17.3
Spring:	(3, 4)	94,972	124,623	8.3

For details see species account Cormorant.

Population

The breeding range includes Western Siberia to the east, Northern Europe and Iceland to the west. The species winters in North West and West Europe, and the flyway population is stable and estimated at 1,500,000 birds (Wetlands International, 2006).

Ecology

In the Wadden Sea, Wigeons roost during high tide near the coast line, on salt marshes or in polder areas (Koffijberg *et al.*, 2003). During daytime they forage on tidal flats, salt marshes and in polder areas behind the seawalls. On the tidal flats during autumn they feed on Zostera and Enteromorpha, on salt marshes they take various grasses, such as Puccinellia and Agrostis, together with seeds from Heleocharie and Carex (Smit and Wolff, 1983). But during autumn and winter, at nighttime, Wigeons also fly inland to feed on arable land, especially in areas where natural habitats are disturbed by hunting (Frikke and Laursen, 1994).

Phenology

During autumn Wigeons start to arrive from the northern breeding grounds to the Wadden Sea in September and peak numbers are reached in October. Thereafter the numbers decrease due to birds moving to inland areas or continuing their autumn migration (Blew *et al.*, 2005a; van Eerden, 1990). In mild winters, Wigeons occur in all parts of the Wadden Sea with most birds in Schleswig-Holstein and The Netherlands. However, in severe winters, large proportions of the

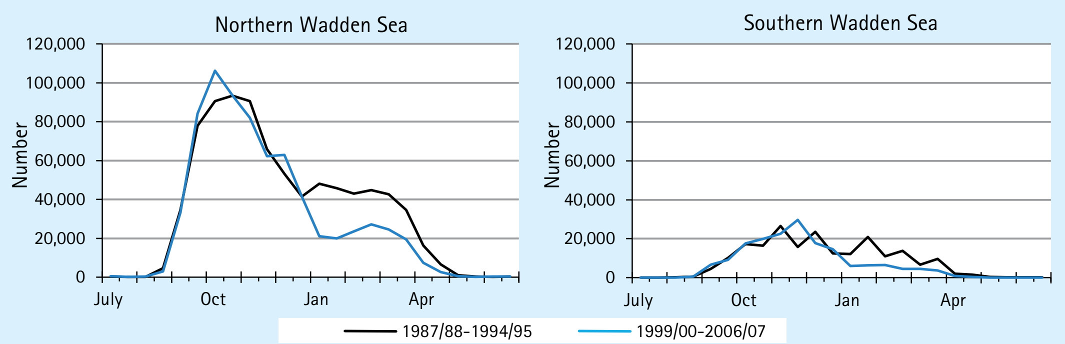
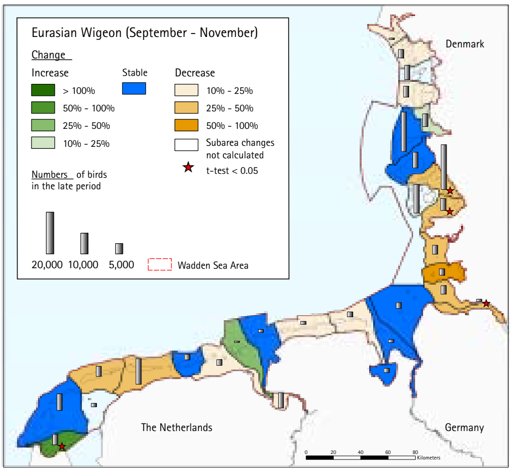
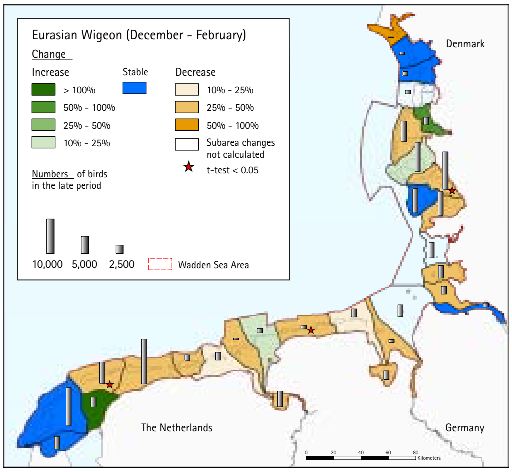


Figure 5.16
Phenology of Eurasian Wigeon (bi-monthly mean number) in the Northern and the Southern Wadden Sea during the periods 1987/88-1994/95 and 1999/00-2006/07. Counted numbers from spring-tide-counting sites, no gap-filling.

Wigeon population move south-west within the Wadden Sea and to Great Britain and France (Meltofte *et al.*, 1994). After mid-winter the numbers decrease rapidly, but increase in late February and early March, when birds from the winter quarters stage briefly in the Wadden Sea. In April most Wigeons have left for their breeding areas.

The Wigeon's phenology in the Wadden Sea has changed between 1987/88-1994/95 and 1999/00-2006/07 (Fig. 5.16). In the Northern Wadden Sea the autumn peak number occurred a month earlier during the late period compared to the early period, and in Southern Wadden Sea, the former spring peak had disappeared.





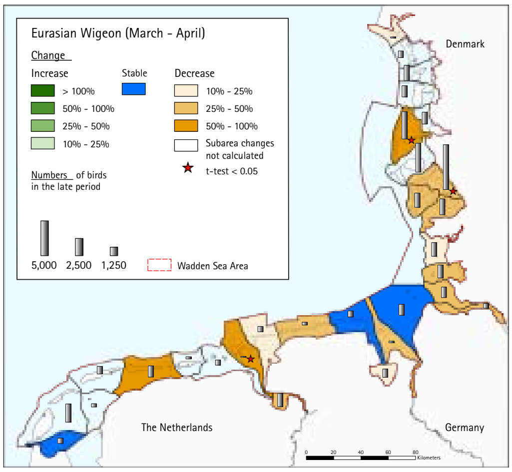


Figure 5.17
Distribution of Eurasian Wigeon in the Wadden Sea during autumn (September-November), winter (December-February) and spring (March-April) for the periods1987/88-1994/95 and 1999/00-2006/07. Changes between the two periods are indicated (colours) and numbers are given for the late period (bars). Asterisks indicate statistical significant differences in numbers (P <0.05).

Distribution

The Wigeon's general distribution shows high numbers during autumn, winter and spring in the sub-areas in Schleswig-Holstein together with high numbers in The Netherlands during winter (Fig. 5.17). The geographical distribution has changed between 1987/88-1994/95 and 1999/00-2006/07 and is dominated by decreasing numbers. During autumn, numbers have decreased in 15 sub-areas, significantly in three distributed in Schleswig-Holstein and Niedersachsen, and increased in one – The Netherlands. During winter, significant decreases had occurred in one sub-area in Schleswig-Holstein, Niedersachsen and in The Netherlands, respectively. During spring, 16 sub-areas in total show decreasing numbers, and three of these are significant (two in Schleswig-Holstein and one in Niedersachsen).

Numbers

During autumn, maximum estimates of Wigeons are some 250,000 birds during October in the Northern Wadden Sea, and 115,000-180,000 birds in the Southern part. The numbers decrease thereafter until mid-winter, and during spring about 78,000 to 94,000 birds are recorded in the Northern and 9,000-22,000 birds in the Southern part, more birds in former years and fewer during recent years (Appendix 1). Locally high numbers were recorded during autumn, winter and spring in Sylt-Rickelsbüller Koog, SH (30,700; 8,500 and 5,400) Amrum-Föhr-Festland, SH (10,800; 12,000 and 5,800), Innere Halligen-Festland, SH (30,700; 15,200 and 9,000), Äußere Halligen-Pellworm, SH (19,600; 10,000 and 3,000) and in addition during winter in Ameland-Friese Kust

Figure 5.18
Trends of Eurasian Wigeon in the International Wadden Sea (WS) and the four regions 1987/1988-2007/2008; dots represent annual averages; trendline calculated by Trendspotter (solid line) together with the ± 95 % confidence limits (dotted line).

Oost, NL (18,200). These numbers are based on average numbers during 1999/2000-2006/2007.

Despite decreasing numbers when comparing the early with the late period, Wigeons show a stable trend for the entire Wadden Sea during both the long term (21 years) and short term trend (10 years); the peak of birds during the mid-1990s does not influence those trend estimates. Consequently, stable trends are also found in the different parts of the Wadden Sea during both the long and short term, except for increases in Denmark, decreases in The Netherlands and Niedersachsen (short term).

Summary

The Wigeon is a numerous, herbivorous species that occurs during the non-breeding season. The trend has changed from increasing numbers to stable numbers during the long term period, and thus the trend in the Wadden Sea has followed the trend of the flyway population, which increased up to about 1995. Thereafter numbers decreased, most likely due to severe winters in the Wadden Sea region, but then increased steadily again. It has been argued that Wigeon numbers benefited from embankments and creations of new polder areas (Brunckhorst and Rösner, 1998), and this is supported by results from the Margrethe Koog, Denmark (Laursen *et al.*, 2008). Following an increase in winter mortality after the severe winters in 1996 and 1997, numbers decreased in all parts of the Wadden Sea, but increased again in the Northern Wadden Sea, (Blew *et al.*, 2005b, Laursen and Frikke, 2006) and decreased even more in the Southern part (van Roomen *et al.* 2007). The phenology has changed slightly with more birds arriving early during autumn and a lack of a former spring peak.

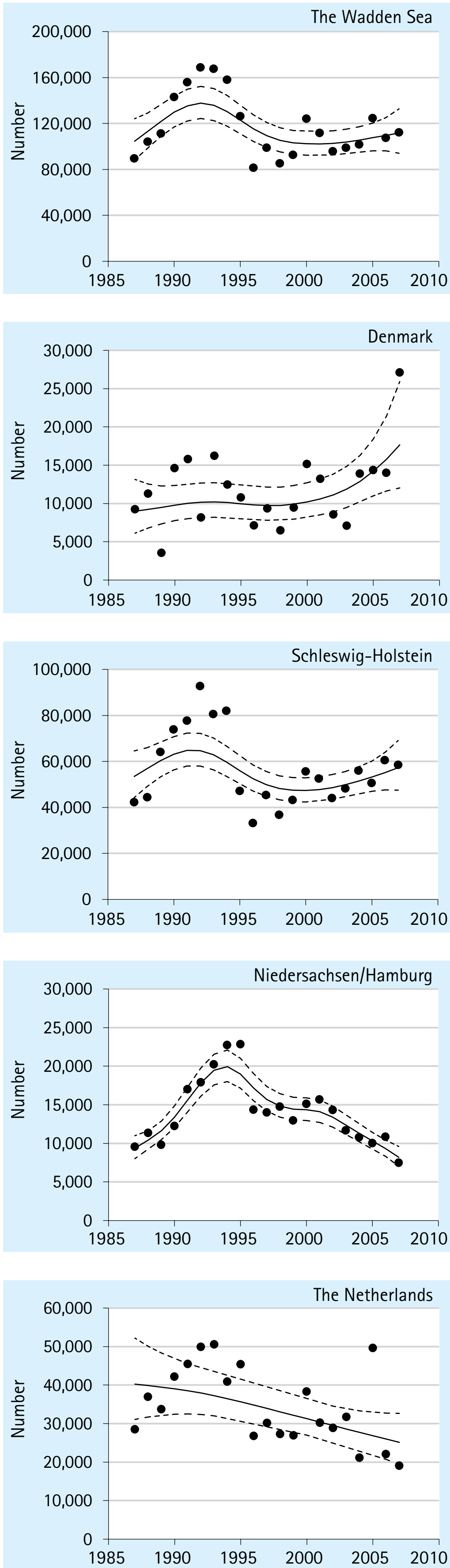


Photo: Gundolf Reichert

Anas crecca

DK: Krikand D: Krickente NL: Wintertaling

01840

Flyway population:	500,000
Breeding range:	North and North-West Europe
1%:	5,000
Status:	Increasing

Region	Overall trends	
	short-term 10 years	long-term 21 years
WS	→	↓
DK	↑	→
SH	→	→
NDS/HH	–	↓
NL	–	–

Seasons (month no.)		Early period 1987/88-1994/95	Late period 1999/00-2006/07	% of flyway population 1999/00-2006/07
		mean of 3 maximum estimates		
Breeding:	--			
Moult:	(7, 8)	8,904	10,454	2.1
Autumn:	(9, 10, 11)	48,154	43,080	8.6
Winter:	(12, 1, 2)	22,828	24,626	4.9
Spring:	(3, 4)	17,502	18,170	3.6

For details see species account Cormorant.

Population

The Teal breeds in Northern Europe through Russia, Scandinavia and Iceland, and winters in North-West Europe along the coasts and inland. The population is estimated at 500,000 birds, and it is increasing both during a long (1974-2002) and a short term (1993-2002) (Wetlands International, 2006).

Ecology

In the Wadden Sea Teal roost and feed along the edges of the salt marshes, on mudflats near the coast and at inland wetlands such as polders. They may also fly several kilometres inland to feed during the night (Fog, 1968). They are primarily herbivorous and feed especially on seeds (Smit and Wolff, 1983).

Phenology

Teal using the Wadden Sea originate from western Russia and Fenno-Scandinavia and after the breeding season they migrate over a broad front to the Wadden Sea, which acts as a bottleneck and concentrates a large number of migrating birds (Smit and Wolff, 1983). In September, Teal arrive in the Wadden Sea and the numbers reach a peak during October, staying into November as long as seeds are available for feeding (Madsen, 1988). Thereafter Teal numbers decrease and they are least numerous in January, depending on the severity of winters. A large proportion of Teal winters in Great Britain and France from where they return to the Wadden Sea, building up to a spring maximum in late February and March (Blew *et al.*, 2005a). However, the numbers in spring are much lower than during autumn, indi-

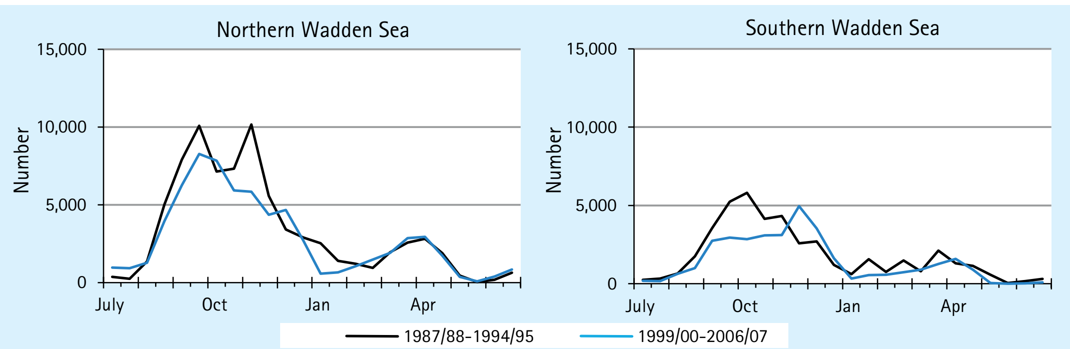
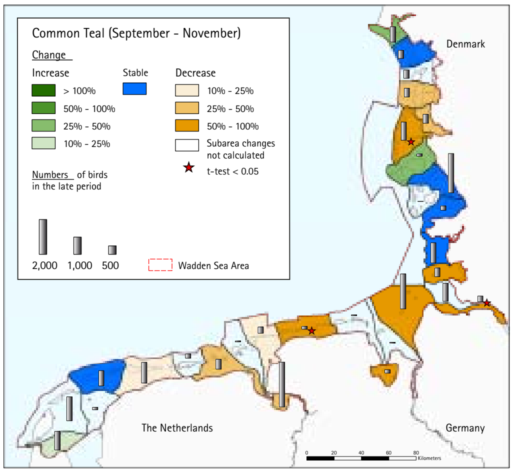


Figure 5.19
Phenology of Common Teal (bi-monthly mean number) in the Northern and the Southern Wadden Sea during the periods 1987/88-1994/95 and 1999/00-2006/07. Counted numbers from spring-tide-counting sites, no gap-filling.

Figure 5.20
Distribution of Common Teal in the Wadden Sea during autumn (September-November) for the periods1987/88-1994/95 and 1999/00-2006/07. Changes between the two periods are indicated (colours) and numbers are given for the late period (bars). Asterisks indicate statistical significant differences in numbers (P <0.05).

cating that many Teal might migrate directly to their breeding grounds (Smit and Wolff, 1983). In the Wadden Sea, the numbers decrease until April, when birds leave for the breeding grounds.

In the Northern Wadden Sea, no clear changes had occurred in the Teal´s phenology between 1987/88-1994/95 and 1999/00-2006/07 (Fig. 5.19). However, in the Southern Wadden Sea the autumn peak had shifted from early October in the early period to late November in the late period.



Distribution

The Teal are distributed all over the Wadden Sea during autumn, with most birds in sub-areas in Schleswig-Holstein and in the Dollard (Niedersachsen). Some changes had occurred in the autumn distribution between 1987/88-1994/95 and 1999/00-2006/07 (Fig. 5.20), with increasing numbers in three sub-areas, though none were statistically significant. Decreasing numbers occurred in 12 sub-areas, and three of these were significant, all in Schleswig-Holstein and Niedersachsen.

Number

During autumn, the Teal estimates produce a total of some 23,000 individuals in the Northern Wadden Sea and 33,000 birds in the Southern part (Appendix 1). However, those high estimates originate from the period before 1995. After mid-winter, numbers decrease and during spring only 9,000 birds occur in the Northern and 16,000 birds in the Southern part, and these estimates are also valid for recent years. In some sub-areas, large Teal numbers are recorded during autumn in Innere Halligen-Festland, SH (3,100), Wurster Küste, NDS (2,800) and in Dollard, NDS/NL (3,600). These are average numbers during 1999/2000-2006/2007.

Teal numbers in the Wadden Sea show large fluctuations during the last 21 years, showing decreasing numbers in the early 1990s and later on a recovery. The trend is reflecting this by showing a decrease during the long term (21 years) and stable numbers during the short term (10 years). Different trends occur in the four Wadden Sea parts: during the long term the trends are stable in Denmark and Schleswig-Holstein, but fluctuate in The Netherlands and decrease in Niedersachsen. During the short term, numbers increase in Denmark, are stable in Schleswig-Holstein and fluctuate in Niedersachsen and The Netherlands.

Photo: Bo Lassen Christiansen

Summary

The flyway population of Teal is increasing. Despite this, the numbers in the Wadden Sea are decreasing over the long term; however, the short term trend is increasing. This may be due to the fact that the Teal in the Wadden Sea only represent 10% of the flyway population and local trends depend more on climate, habitat and food-availability and are thus relatively independent of the flyway trends. The number of Teals during autumn fluctuates considerably, and results from Denmark show that the Teal´s autumn numbers are closely related to the annual breeding success (Laursen and Frikke, 2006). Reports from Denmark and Germany show fluctuating numbers (Laursen and Frikke, 2006; Blew *et al.*, 2005b), while large fluctuations are shown in The Netherlands (Hustings *et al.*, 2009). Changes in phenology had occurred in the Southern Wadden Sea, postponing a former autumn peak number by more than one month from October to November in recent years.

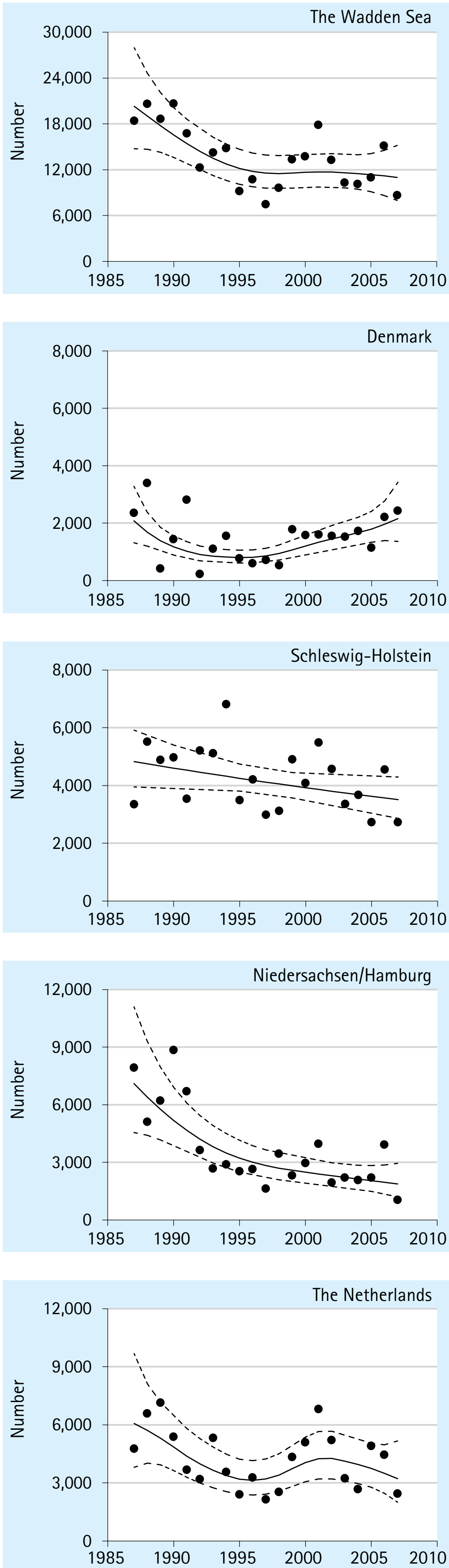


Figure 5.21
Trends of Common Teal in the International Wadden Sea (WS) and the four regions 1987/1988-2007/2008; dots represent annual averages; trendline calculated by Trendspotter (solid line) together with the ± 95 % confidence limits (dotted line).

5.8 Mallard

Anas platyrhynchos

01860

DK: Gråand D: Stockente NL: Wilde Eend

Flyway population:	4,500,000
Breeding range:	North Europe
1%:	20,000
Status:	Decreasing / Stable

Region	Overall trends	
	short-term 10 years	long-term 21 years
WS	↓	↓
DK	↑	↓
SH	→	↓
NDS/HH	↓↓	↓↓
NL	↓	↓

Seasons (month no.)		Early period 1987/88-1994/95	Late period 1999/00-2006/07	% of flyway population 1999/00-2006/07
		mean of 3 maximum estimates		
Breeding:	(5)	9,373	11,760	0.3
Moult:	(6, 7, 8)	53,879	57,702	1.3
Autumn:	(9, 10, 11)	126,257	111,616	2.5
Winter:	(12, 1)	179,562	156,239	3.5
Spring:	(2, 3, 4)	58,455	102,407	2.3

For details see species account Cormorant.

Population

The Mallard breeds in Northern Europe and it winters in North Western Europe including the Baltic area. The flyway population is estimated at 4,500,000 birds. This sank to a lower level in 1997 but has since recovered. However, the population trend still shows a moderate decrease (Wetlands International, 2006).

Ecology

In the Wadden Sea, the Mallards occur at salt marshes and on mudflats off the salt marshes. During autumn they fly inland, feeding on agricultural areas. Their food is dominated by plant material; in particular various seeds and to a lesser extent crustaceans and snails (Smit and Wolff, 1983).

Phenology

Mallards occur in the Wadden Sea all the year round. Numbers increase in August and in the following months migrants arrive from the northern breeding grounds. This influx of birds continues throughout autumn until peak numbers are reached in January (Blew *et al.*, 2005a). Winter numbers are thus normally high, but during severe winters the Mallards leave for Western Europe and most birds gather in The Netherlands (Meltofte *et al.*, 1994). After January the numbers decrease rapidly and in April all birds have left for the breeding grounds, except for the local breeders.

Changes occur in the Mallard's phenology in both the Northern and the Southern Wadden Sea between 1987/88-1994/95 and 1999/00-2006/07 (Fig. 5.22). A January peak number oc-

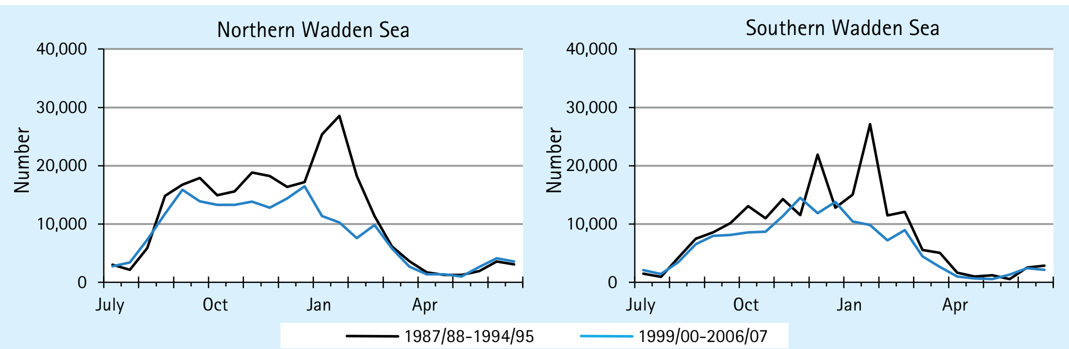
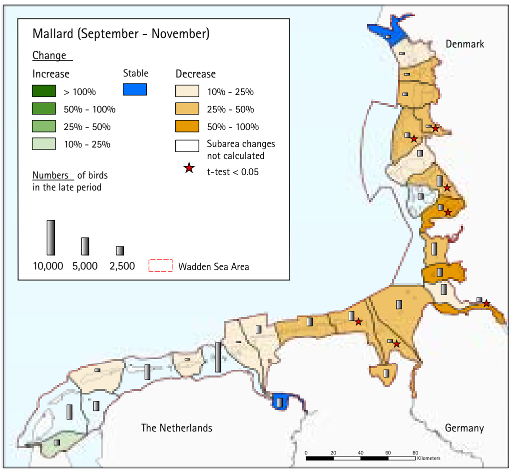


Figure 5.22
Phenology of Mallard (bi-monthly mean number) in the Northern and the Southern Wadden Sea during the periods 1987/88-1994/95 and 1999/00-2006/07. Counted numbers from spring-tide-counting sites, no gap-filling.

curred during the early period, but in the late period the numbers decreased from late December more or less continuously until April.

Distribution

The Mallards are distributed all over the Wadden Sea, with high numbers in sub-areas in the southern parts of Schleswig-Holstein, Niedersachsen and western parts of The Netherlands (Fig. 5.23). During spring high numbers occur in most sub-areas, except in Denmark. Decreasing numbers had occurred between 1987/88-1994/95 and 1999/00-2006/07 during both autumn and spring in sub-areas in all four Wadden Sea parts. Seven of these are statistically significant during autumn and three during spring all in Denmark, Schleswig-Holstein and Niedersachsen.



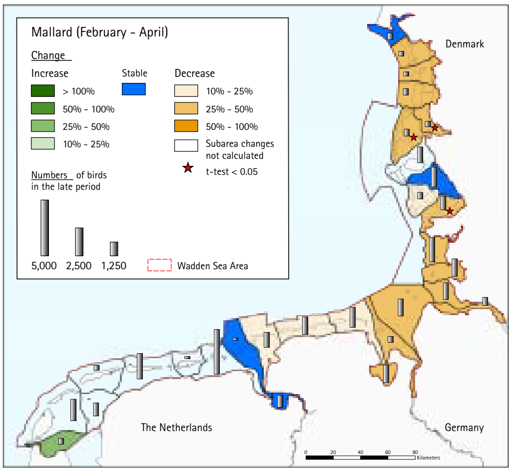


Figure 5.23
Distribution of Mallard in the Wadden Sea during autumn (September-November) and spring (February-April) for the periods1987/88-1994/95 and 1999/00-2006/07. Changes between the two periods are indicated (colours) and numbers are given for the late period (bars). Asterisks indicate statistical significant differences in numbers (P <0.05).

Photo: Gundolf Reichert

Numbers

During autumn, the Mallards increase to estimates of 50,000 birds in the Northern Wadden Sea and some 80,000 birds in the Southern Wadden Sea (Appendix 1). The winter peak estimates in the Wadden Sea during the early period were 180,000 and 156,000 birds in recent years; the decrease has taken place mostly in the Northern Wadden Sea. Locally, the largest concentrations of Mallards occur during autumn and spring in Rottum-Groninger Kust, NL (11,900 and 5,600), and during spring in Ameland-Friese Kust Oost, NL (3,200), Eiderstedt Süd-Eider-Büsum, SH (3,100) and in Innere Halligen-Festland, SH (2,500), based on average numbers during 1999/2000-2006/2007.

During the long (21 years) and short (10 years) term, the Mallard numbers had shown a moderate decrease in the Wadden Sea and in all regions, except for a strong decrease in Niedersachsen and (during the short term) increases in Denmark and stable numbers in Schleswig-Holstein (Fig. 5.24).

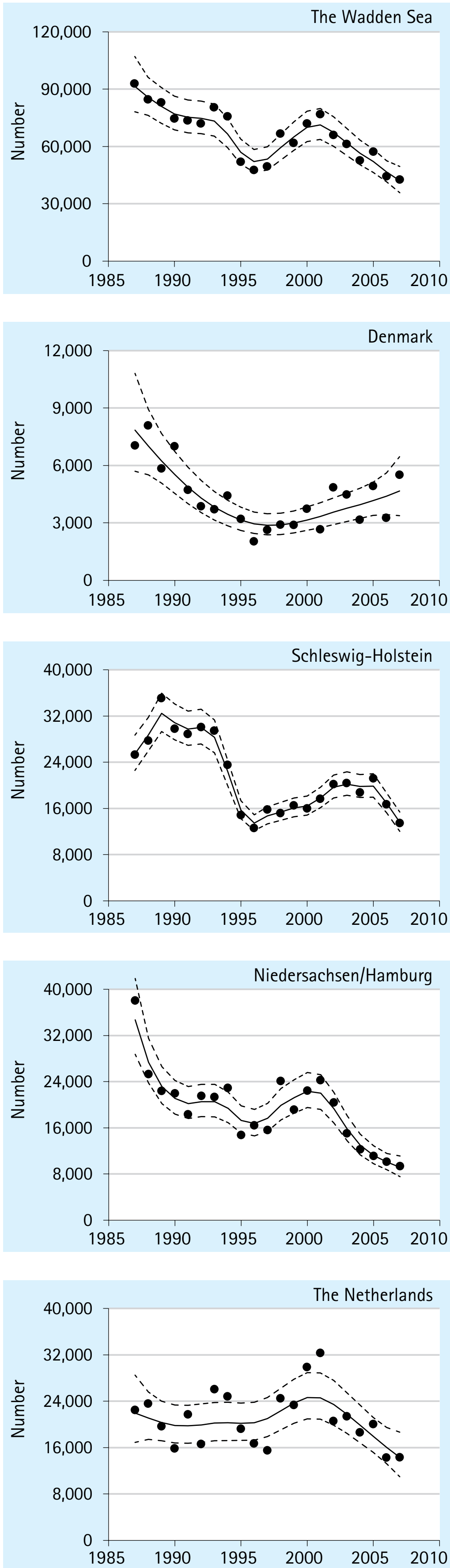


Figure 5.24
Trends of Mallard in the International Wadden Sea (WS) and the four regions 1987/1988-2007/2008; dots represent annual averages; trendline calculated by Trendspotter (solid line) together with the ± 95 % confidence limits (dotted line).

Summary

The Mallard's flyway population shows a moderate decreasing trend. During the non-breeding season the species is found in wetland habitats throughout a very large region, and the Wadden Sea holds only a small part of the total flyway population. The Mallard´s trend in the Wadden Sea shows a moderate decrease during both the long term and the short term. Denmark, Germany and The Netherlands report decreasing numbers (in Germany strong decreases) (Laursen and Frikke, 2006; Blew *et al.*, 2005b; Hustings *et al.*, 2004). The phenology had changed such that winter peak numbers from the early period do not occur in recent years, but numbers steadily decrease from late fall towards the breeding season.

5.9 Northern Pintail

Anas acuta

DK: Spidsand D: Spießente NL: Pijlstaart 01890

Flyway population:	60,000
Breeding range:	North Europe and West Siberia
1%:	600
Status:	Stable

Region	Overall trends	
	short-term 10 years	long-term 21 years
WS	↑	↑
DK	↑	–
SH	↑	→
NDS/HH	–	→
NL	↑	↑

Seasons (month no.)		Early period 1987/88-1994/95	Late period 1999/00-2006/07	% of flyway population 1999/00-2006/07
		mean of 3 maximum estimates		
Breeding:	--			
Moult:	--			
Autumn:	(9, 10, 11)	18,587	31,671	52.8
Winter:	(12, 1, 2)	15,787	27,856	46.4
Spring:	(3, 4)	12,832	22,184	37.0

For details see species account Cormorant.

Population

Northern Pintails breed in North Europe and Western Siberia. The flyway population of 60,000 birds is overall stable. However, it showed a decrease up to 1993 and a moderate increase afterwards (Wetlands International, 2006). The population winters in north-west Europe.

Ecology

In the Wadden Sea Northern Pintails roost in the salt marshes and on the mud flats as well as on inland wetlands. During autumn they take seeds from Carex and other grass species. During spring the preferred food consists of small crustaceans and molluscs taken in ponds, creeks and on the mudflats. Main feeding activity takes place after sunset, and they may fly inland to feed on flooded meadows and cereal fields (Smit and Wolff, 1983).

Phenology

Pintails arrive during autumn in the Wadden Sea during September and in October peak numbers occur (Blew *et al.*, 2005a). Generally the males arrive before the females. Parts of the population continue their migration to France and Great Britain, and therefore the numbers in the Wadden Sea decrease and fluctuate through the winter, depending on its severity. During spring migration a small increase of numbers occurs in February and March, whereafter numbers decrease by the end of April, when all birds have left for their breeding grounds.

In the Northern Wadden Sea the Pintail's phenology had not shown pronounced changes

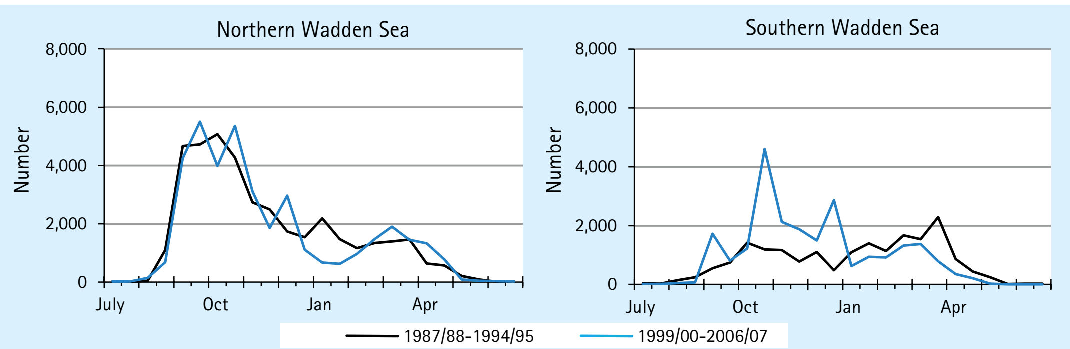


Figure 5.25 Phenology of Northern Pintail (bi-monthly mean number) in the Northern and the Southern Wadden Sea during the periods 1987/88-1994/95 and 1999/00-2006/07. Counted numbers from spring-tide-counting sites, no gap-filling.

during autumn between 1987/88-1994/95 and 1999/00-2006/07. However, in the Southern Wadden Sea only small peaks occurred during autumn in the early period, whereas in the late period numbers increased and several peaks occurred in September, October and in December (Fig. 5.25). Also, the spring peak of Pintail in the Southern Wadden Sea has shifted from April to March, and it seems that Pintails leave the southern Wadden Sea about half a month earlier in the late period.

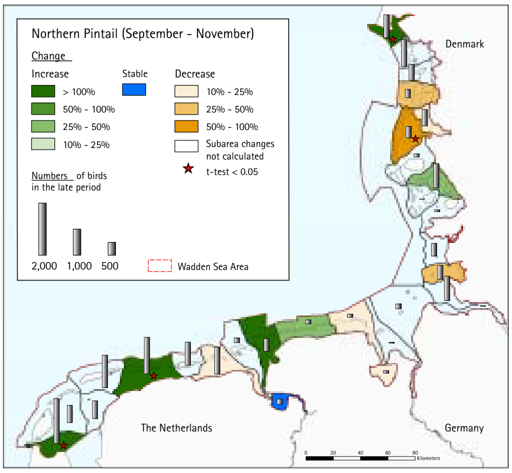


Figure 5.26
Distribution of Northern Pintail in the Wadden Sea during autumn (September-November) for the periods1987/88-1994/95 and 1999/00-2006/07. Changes between the two periods are indicated (colours) and numbers are given for the late period (bars). Asterisks indicate statistical significant differences in numbers ($P < 0.05$).

Distribution

Pintails occur in all parts of the Wadden Sea, with most birds in sub-areas in Denmark, Schleswig-Holstein and The Netherlands (Fig. 5.26). Between 1987/88-1994/95 and 1999/00-2006/07 numbers had increased or been stable in six sub-areas of which three are significant in Denmark and The Netherlands. Decreases had occurred in seven sub-areas and one of these is significant.

Photo: Bo Lassen Christiansen

Numbers

In the Northern Wadden Sea the maximum estimates may be as high as 17,000, while recently also 19,000 may appear in the Southern Wadden Sea (Appendix 1); however, the latter have only been registered in the recent period, substantiating the increases mentioned above (Fig. 5.25). Autumn estimates for the entire Wadden Sea are up to 32,000, while during winter estimates as high as 28,000 have been made in recent years, presumably accounting for birds staying in mild winters. Spring estimates are somewhat lower overall. In the sub-areas, highest average numbers of Pintail during 1999/2000-2006/2007 are recorded during autumn in Balgzand-Wieringen, NL (2,400), Terschelling, NL (1,700), Ameland-Friese Kust Oost, NL (1,900), Rottum-Groningse Kust, NL (1,400) and in Fanø-Sneum, DK (1,400).

The trend for the Wadden Sea Pintail numbers is increasing during both the long (21 years) and short term (10 years). The long term trend is composed of increasing numbers in The Netherlands, stable numbers in Schleswig-Holstein and Niedersachsen but fluctuations in Denmark. For the short term, all regions show increases, except for fluctuations in Niedersachsen.

Summary

The flyway population of Pintail is stable, but the trend is increasing in the Wadden Sea, potentially indicating favourable conditions for the species here. However, Pintail numbers show large fluctuations and results from Denmark have shown that these fluctuations are mainly due to annual variance in breeding success (Laursen and Frikke, 2006). Reports show large fluctuations in The Netherlands (van Roomen *et al.*, 2007), and in Germany (Blew *et al.*, 2005b), while numbers are increasing in Denmark (Laursen and Frikke, 2006). The phenology has changed especially in the Southern Wadden Sea, with more birds staying during autumn and early winter, and an earlier departure during spring in the recent period compared to the former period.

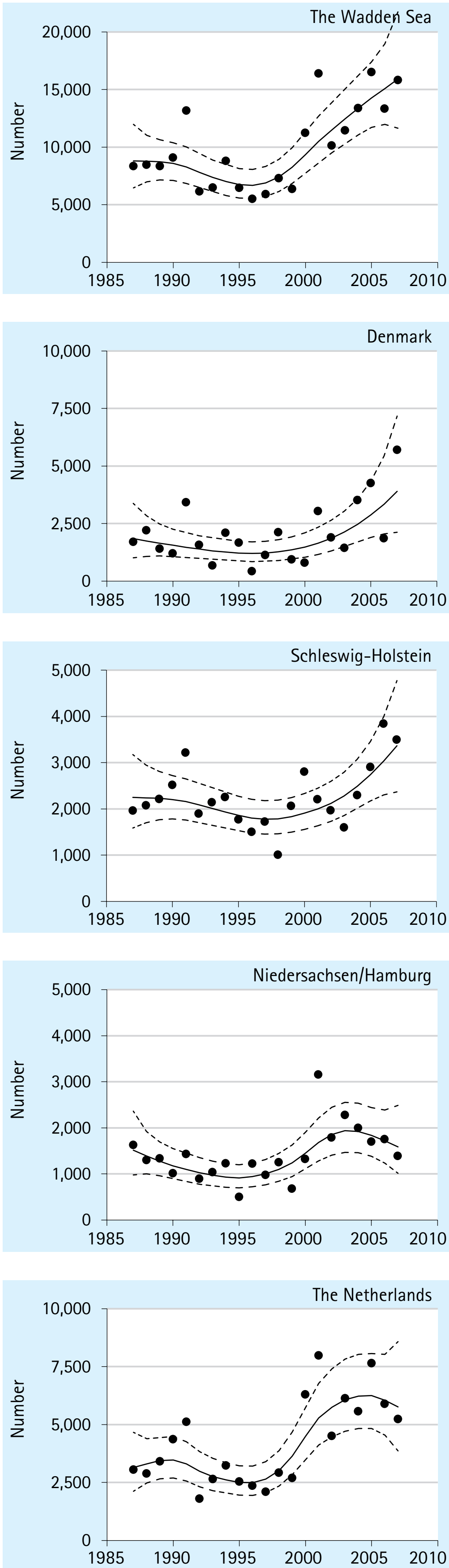


Figure 5.27
Trends of Northern Pintail in the International Wadden Sea (WS) and the four regions 1987/1988-2007/2008; dots represent annual averages; trendline calculated by Trendspotter (solid line) together with the ± 95 % confidence limits (dotted line).

5.10 Northern Shoveler

Anas clypeata

01940

DK: Skeand D: Löffelente NL: Slobeend

Flyway population:	40,000
Breeding range:	North, North-West and Central Europe
1%:	400
Status:	Stable

Region	Overall trends	
	short-term 10 years	long-term 21 years
WS	→	→
DK	↑↑	↑↑
SH	↑	↑
NDS/HH	↓	↓
NL	→	→

Seasons (month no.)		Early period 1987/88-1994/95	Late period 1999/00-2006/07	% of flyway population 1999/00-2006/07
		mean of 3 maximum estimates		
Breeding:	(5, 6)	2,153	1,591	4.0
Moult:	(7, 8)	3,155	2,144	5.4
Autumn:	(9, 10, 11)	5,655	8,082	20.2
Winter:	(12, 1, 2)	3,040	3,761	9.4
Spring:	(3, 4)	1,805	3,128	7.8

For details see species account Cormorant.

Population

The total population is 40,000 birds and stable (Wetlands International, 2006). The breeding range covers Northern, North-West and Central Europe and the wintering range is within the same geographical range.

Ecology

In the Wadden Sea, Shovelers exploit areas with shallow water, muddy substrate and wet meadows both outside and inside the sea walls along the mainland coast and along the islands (Meltofte *et al.*, 1994). Most birds are found in brackish or fresh water sites rich in plankton organisms and plant seeds, which they feed on (Berndt and Busche, 1991).

Phenology

During autumn, Shovelers arrive in August and high numbers are present during September to November. Numbers are low during winter and a small increase occurs in March and April when birds pass the Wadden Sea to the breeding grounds in Scandinavia. The peak number during spring is much lower than in autumn, indicating that most birds move straight over continental Europe in spring (Cramp and Simmon, 1977).

The Shoveler's penology has changed between 1987/88-1994/95 and 1999/00-2006/07 in the Northern Wadden Sea, where most birds occur; autumn peak numbers are higher and the departure has been delayed compared to the earlier period. Nevertheless, winter numbers were much smaller in recent years. In the Southern Wadden Sea some variations occurred, average numbers

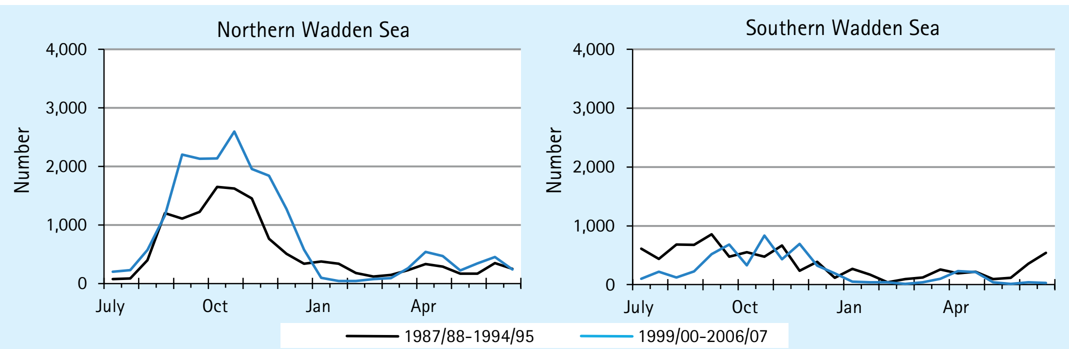


Figure 5.28
Phenology of Northern Shoveler (bi-monthly mean number) in the Northern and the Southern Wadden Sea during the periods 1987/88-1994/95 and 1999/00-2006/07. Counted numbers from spring-tide-counting sites, no gap-filling.

were rather low (< 1,000) and in general phenology remained the same, except the postbreeding or moulting period in July/August, where numbers dropped by 50-80% (Fig. 5.28).

Distribution

The Shoveler is distributed in small numbers in most sub-areas in the Wadden Sea, with higher numbers in five sub-areas, one in Southern Denmark, two in northern Schleswig-Holstein and another two in southern parts of the Dutch Wadden Sea (Fig. 5.29). Changes during autumn have occurred in seven sub-areas. Of these, three are significant, all situated in Denmark and Schleswig-Holstein.

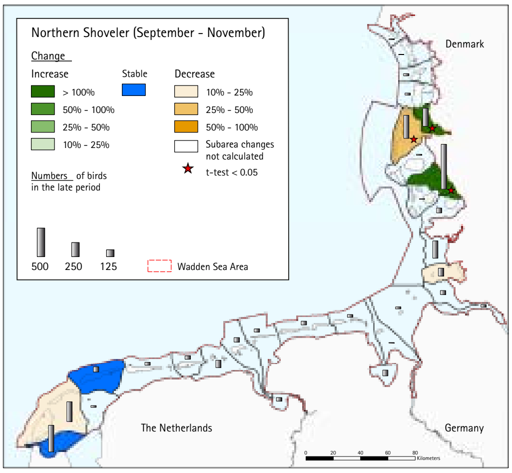


Figure 5.29
Distribution of Northern Shoveler in the Wadden Sea during autumn (September-November) for the periods1987/88-1994/95 and 1999/00-2006/07. Changes between the two periods are indicated (colours) and numbers are given for the late period (bars). Asterisks indicate statistical significant differences in numbers (P <0.05).

Photo: Gundolf Reichert

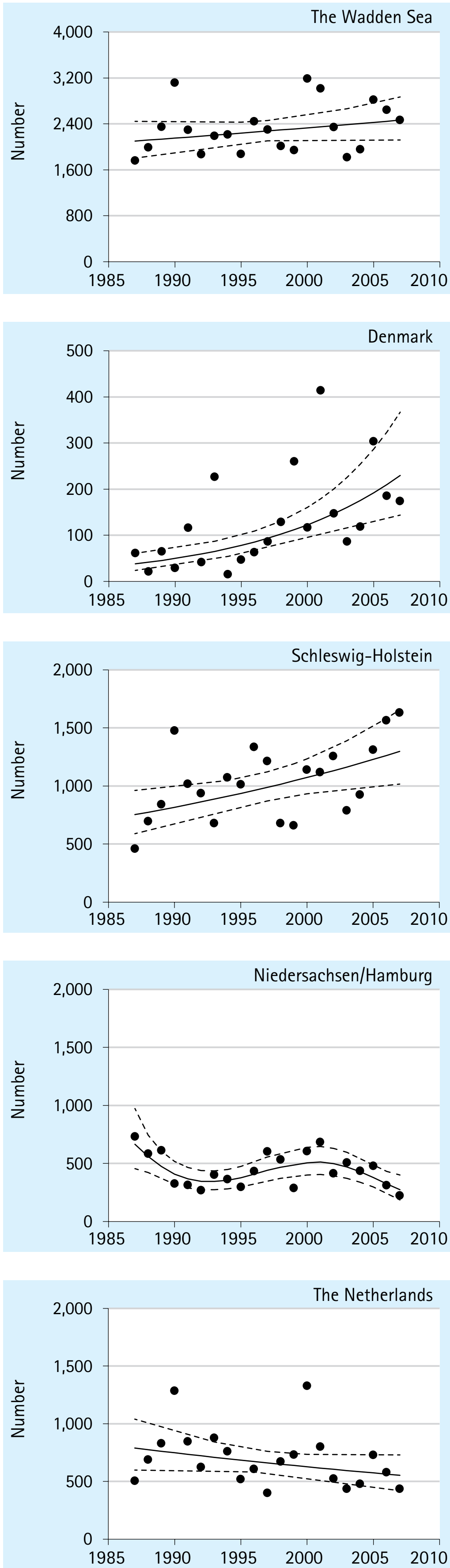


Figure 5.30
Trends of Northern Shoveler in the International Wadden Sea (WS) and the four regions 1987/1988-2007/2008; dots represent annual averages; trendline calculated by Trendspotter (solid line) together with the ± 95 % confidence limits (dotted line).

Numbers

During autumn maximum estimates in the Northern Wadden Sea are some 4,500 birds, with higher numbers in the late compared to the early period, and 3,000 - 4,000 birds during both periods in the Southern Wadden Sea (Appendix 1). Numbers during spring are smaller. Locally, most birds occur during autumn in the Innere Halligen-Festland, SH (1,100), Sylt-Rickelsbüeller Koog, SH (700) and in Balgzand-Wieringen, NL (600), based on average numbers during 1999/2000-2006/2007.

The Shoveler's trend in the Wadden Sea is stable during the long (21 years) and the short term (10 years). However, this general trend is composed by long and short term increases in Denmark and Schleswig-Holstein, stable trend in The Netherlands and slightly decreasing numbers in Niedersachsen (Fig. 5.30).

Summary

The number of Shovelers using the Wadden Sea is only some 20% of the total population. The overall trend is stable, but covers increases in Denmark and Schleswig-Holstein, stable trends in The Netherlands and decreases in Niedersachsen. For the autumn period the numbers have increased potentially due to creation of artificial freshwater ponds and embanked areas (Brunckhorst and Rösner, 1998; Laursen *et al.* 2008), which could have prolonged their stay also, especially in the northern part of the Wadden Sea.

5.11 Common Eider

Somateria mollissima

DK: Ederfugl D: Eiderente NL: Eidereend

02060

Flyway population:	760,000
Breeding range:	Baltic and Wadden Sea
1%:	7,600
Status:	Decreasing

Region	Overall trends	
	short-term 10 years	long-term 21 years
WS	↓	
DK	↓	
SH	–	
NDS/HH	–	
NL	↓	

For details see species account Cormorant.

Population

The total Eider population of 760,000 birds is decreasing. The breeding range includes the Baltic and the Wadden Sea and adjacent parts of the North Sea, which also serve as a wintering area (Wetlands International, 2006). The Eider breeds in the Wadden Sea, especially in the Dutch part. The total population is 10,500 pairs and is considered to be stable, though it has fluctuated between 8,500-10,500 pairs since 1991 (Koffijberg *et al.*, 2006).

Ecology

In the Wadden Sea, most birds occur between the mainland coast and the islands and during high tide they are distributed in the central parts between the islands and the mainland and in the deeps. Due to human disturbance and in situations with low food abundance in the Wadden Sea large proportions of the Eiders occur offshore in the North Sea (Laursen and Frikke, 2008; Laursen *et al.*, 2009). Eiders feed on molluscs, especially on blue mussels (*Mytilus edulis*) and cockles (*Cerastoderma edule*), but also on crustaceans (Swennen, 1976; Nehls, 1995). The food is taken by diving and the preferred diving depth is 2-8 m. Eiders feeding on blue mussel seem to have a better body condition, than Eiders feeding on other prey items (Petersen *et al.* 2006; Laursen *et al.* 2009).

Phenology

Eiders arrive in the Wadden Sea from their Baltic breeding grounds in late May and June to moult their wing feathers and the numbers increase

Photo: Gundolf Reichert

until August. These birds are mainly distributed in the central parts of the Wadden Sea. Numbers are stable during autumn, but males may leave while females and juveniles still immigrate. Numbers increase during October and peak numbers are reached in January with a large proportion in the Dutch Wadden Sea. During February and March most Eiders leave for the inner Danish waters, and fly to the Baltic breeding grounds in March and April (Swennen *et al*., 1989; Meltofte *et al*., 1994; Laursen *et al*. 1997; Scheiffarth and Frank, 2005).

Photo: Thorsten Krüger

Numbers

It is not possible to cover Eiders by the ordinary Trilateral Monitoring Programme, because most birds occur offshore. Thus, aerial counts are carried out during mid-winter and during moult in July/August. Coordinated regular total Wadden Sea counts started in 1993, and numbers at mid-winter were at a high level up to 1996 but decreased thereafter. Peak numbers occurred in 1996 with 324,500 birds, representing a slight increase compared to single complete surveys in 1987 and 1991 with 245,900 and 308,600 Eiders respectively (Swennen *et al.* 1989). However, numbers after 1996 decreased and during the last three midwinter surveys, 2005 to 2007, less then 200,000 Eiders were counted. The decrease in the Wadden Sea numbers seems to follow the decrease of the flyway population (Desholm *et al.*, 2002).

The moulting Eider population in Germany and Denmark is between 170,000-230,000 birds and it seems to be stable up to 1995; then it decreased to about 50,000 birds in 1997. It is especially the large numbers of moulting Eiders in the North-Frisian Wadden Sea that had decreased, and they are displaced to the western parts of the Wadden Sea (Scheiffarth and Frank, 2005).

Trend numbers calculated from 1993 to 2007 show a moderate but steady decreasing trend for the entire Wadden Sea. The same trend was found in Denmark and The Netherlands, but there were fluctuations in Schleswig-Holstein and Niedersachsen (Fig. 5.31).

Summary

Both Eider numbers counted at mid-winter and during moult (July/August) were stable up to 1995/1996 and decreased thereafter. A large mass mortality occurred in the Dutch part of the Wadden Sea due to large catchments of shellfish. The Eiders are not only sensitive to fluctuations in the shellfish stock, but also to the abundance and quality of blue mussels (Nehls, 2001; Laursen *et al.*, 2009), which raises severe conflicts with the shellfish fishery (Ens *et al.*, 2004; Scheiffarth and Frank, 2005).

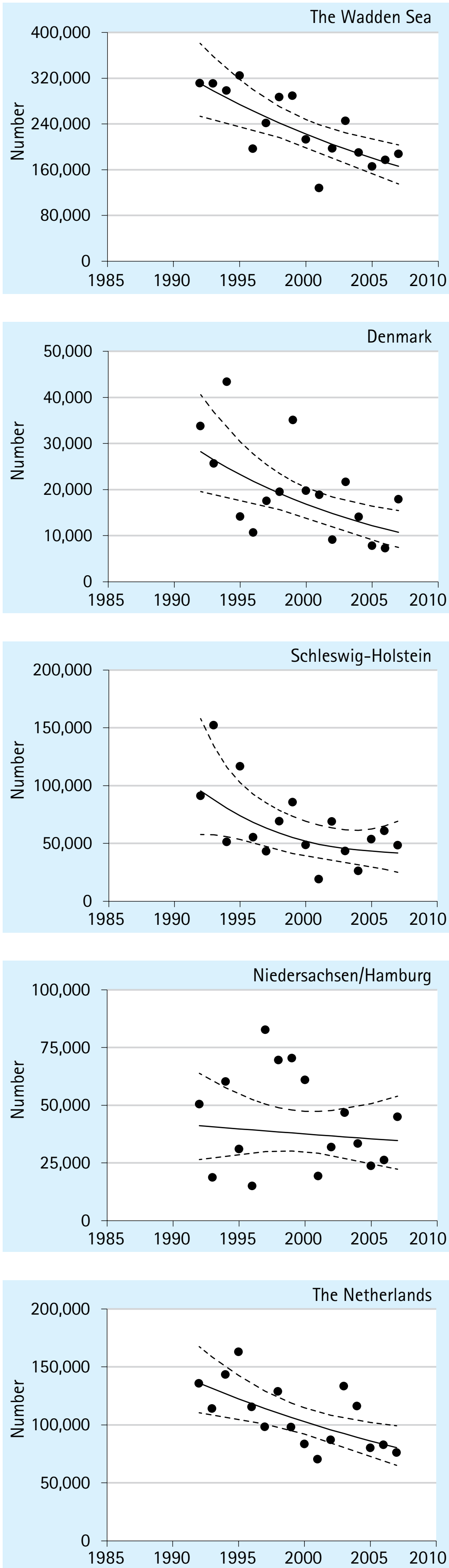


Figure 5.31
Trends of Common Eider in the International Wadden Sea (WS) and the four regions 1987/1988-2007/2008; dots represent annual averages; trendline calculated by Trendspotter (solid line) together with the ± 95 % confidence limits (dotted line).

5.12 Eurasian Oystercatcher

Haematopus ostralegus

04500

DK: Strandskade D: Austernfischer NL: Scholekster

Flyway population:	1,020,000
Breeding range:	North, West and Central Europe
1%:	10,200
Status:	Decreasing

Region	Overall trends	
	short-term 10 years	long-term 21 years
WS	↓	↓
DK	→	↑
SH	↓	↓
NDS/HH	↓	↓
NL	↓	↓

Seasons (month no.)		Early period 1987/88-1994/95	Late period 1999/00-2006/07	% of flyway population 1999/00-2006/07
		mean of 3 maximum estimates		
Breeding:	(5, 6,7)	181,113	210,854	20.7
Moult:	--			
Autumn:	(8, 9, 10)	653,829	506,709	49.7
Winter:	(11, 12, 1, 2)	664,231	472,190	46.3
Spring:	(3, 4)	267,202	351,988	34.5

For details see species account Cormorant.

Population

The total population of 1,020,000 birds breeds in North, Western and Central Europe and winters in parts of their breeding range, Western Europe together with North and Western Africa. The total population decreased ever since the 1980s in North-West Europe (Wetlands International, 2006). The breeding population in the Wadden Sea has been slightly increasing from 37,150 pairs in 1991 to 39,900 pairs in 2001; however, declines had occurred in the Dutch Wadden Sea from the mid 1990s and onwards (Koffijberg *et al.*, 2006).

Ecology

In the Wadden Sea the Oystercatchers use several habitat types. Most often they roost on salt marshes, but beaches and sand flats are also used, especially in the Dutch and the Danish Wadden Sea (Koffijberg *et al.*, 2003). Inland roosts are rare, but may occur in the Dutch Wadden Sea. Oystercatchers feed mainly on shellfish, with blue mussels and cockles the most important food items. Thus during low tide the majority of birds are located on blue mussel beds and on sand flats with cockles and to a lesser degree in areas with Mya and Scrobicularia (Smit and Wolff, 1983; Ens *et al.*, 1993).

Phenology

Oystercatchers use the Wadden Sea all year round. Numbers increase already in late July when local breeders and birds from Southern Scandinavia and the southern Baltic arrive. Numbers keep increasing in August when large num-

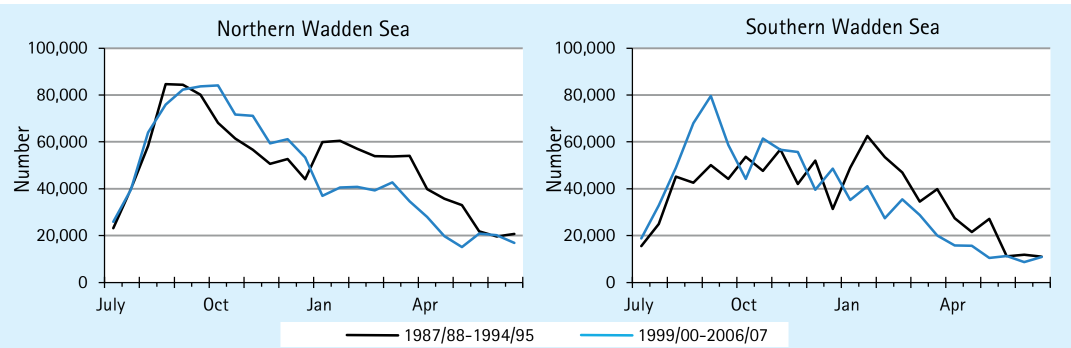


Figure 5.32
Phenology of Eurasian Oystercatcher (bi-monthly mean number) in the Northern and the Southern Wadden Sea during the periods 1987/88-1994/95 and 1999/00-2006/07. Counted numbers from spring-tide-counting sites, no gap-filling.

bers of Norwegian birds move in and continue in September when birds from the northern parts of the Baltic together with birds from the White Sea area arrive forming an autumn peak number (Blew *et al.*, 2005a, Meltofte *et al.*, 1994). Large numbers of birds from Scandinavia and southern Baltic apparently move straight to the German and Dutch parts, whereas those from the northern Baltic and the White Sea mainly flight to the Danish parts. Adult birds are generally migrating earlier than the juveniles. Numbers stay at a high level through autumn and decrease in winter. More than 50% of the total flyway population uses the Wadden Sea, and of these a small fraction continues migrating to France and Southern parts of Great Britain. Oystercatchers are not reacting as much as other species to severe winters; yet, in very cold winters the numbers also drop (Blew *et al.*, 2005a). After mid-winter numbers keep decreasing until March, when local breeders begin to establish territories, while birds breeding in Norway and southern Scandinavia leave the Wadden Sea in March and April, and the birds breeding in the northern Baltic and the White Sea areas depart in late April and early May (Meltofte *et al.* 1994).

The Oystercatcher's phenology has changed in the Northern Wadden Sea between 1987/88-1994/95 and 1999/00-2006/07 (Fig. 5.32). During the early period the autumn peak occurred in late August. This shifted to late September/early October in the late period, and it seems that more Oystercatchers stay in the Wadden Sea into November and December in the late period. However, the numbers decrease continuously after the autumn peak to a low number in May, for both periods. In the Southern Wadden Sea a similar pattern occurred as in the Northern parts; the numbers in the late period form a high autumn peak and thereafter the numbers decrease continuously during winter and spring, without a winter (Jan, Feb) peak as in the early period.

Distribution

Oystercatchers are distributed in high numbers throughout the Wadden Sea, with lowest numbers in the Danish part except during spring (Fig. 5.33). Marked changes had occurred in the distribution between 1987/88-1994/95 and 1999/00-2006/07, with significant decreases during autumn (August-October) in 11 sub-areas most in Schleswig-Holstein and Niedersachsen, and a significant increase in only one sub-area in Denmark. During winter (November-February) and spring (March-April) the changes show a simi-

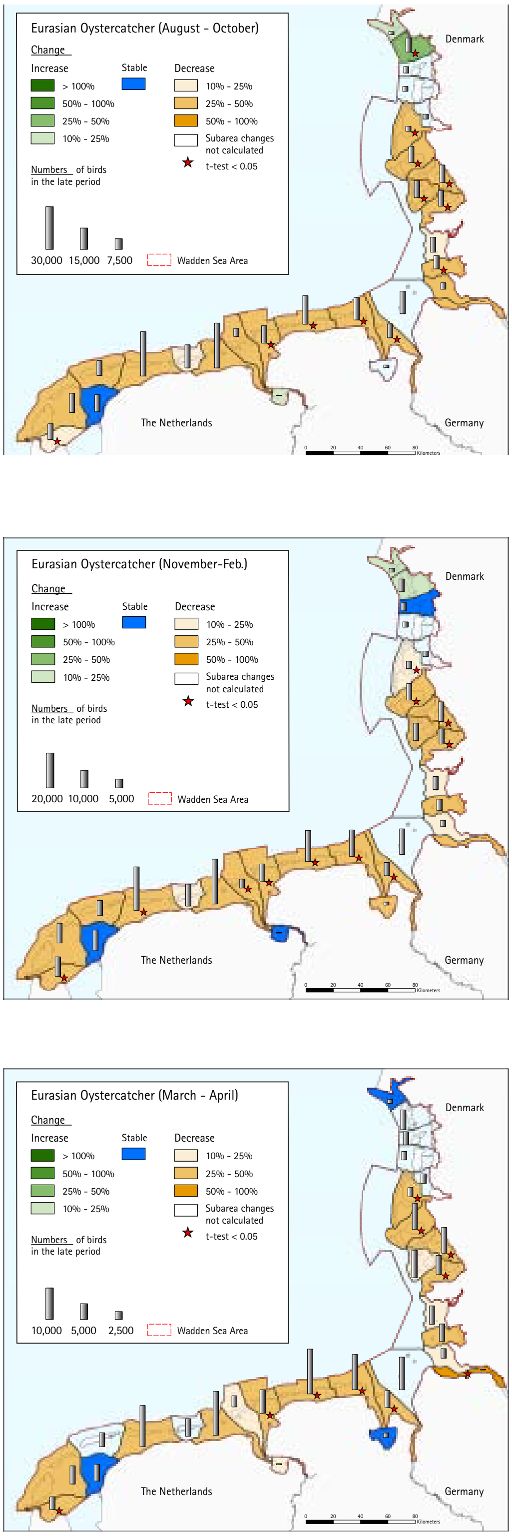


Figure 5.33 Distribution of Eurasian Oystercatcher in the Wadden Sea during autumn (August-October), winter (November-February) and spring (March-April) for the periods1987/88-1994/95 and 1999/00-2006/07. Changes between the two periods are indicated (colours) and numbers are given for the late period (bars). Asterisks indicate statistical significant differences in numbers (P <0.05).

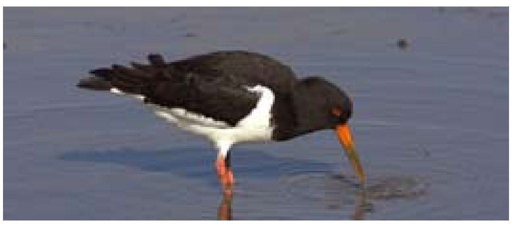


Photo. Bo Lassen Christiansen

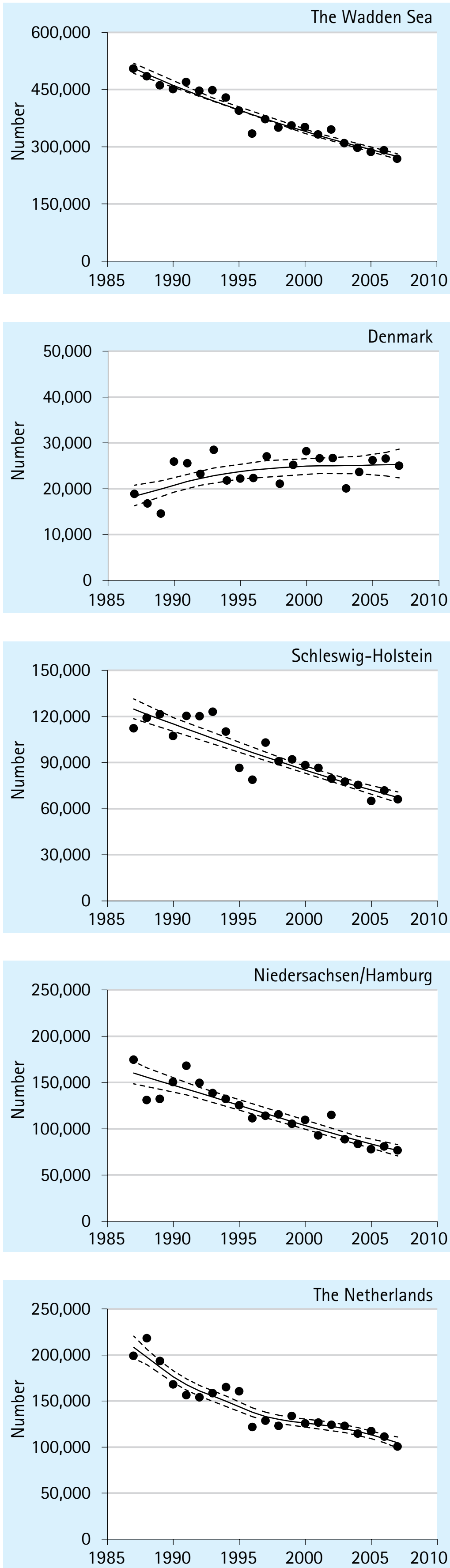


Figure 5.34
Trends of Eurasian Oystercatcher in the International Wadden Sea (WS) and the four regions 1987/1988-2007/2008; dots represent annual averages; trendline calculated by Trendspotter (solid line) together with the ± 95 % confidence limits (dotted line).

lar pattern with significant decreases in 11 and 10 sub-areas mainly in Schleswig-Holstein and Niedersachsen. Stable numbers occur in some sub-areas in The Netherlands, Denmark and in Niedersachsen (one sub-area).

Numbers

During the autumn maximum, the estimates in the Northern Wadden Sea have been up to 220,000 in the early and 161,000 in the late period, while in the Southern Wadden Sea some 463,000 are estimated in the early as compared to 350,000 in the late period. (Appendix 1). Winter numbers are only slightly lower and spring numbers considerably smaller. In local sub-areas high numbers occurred during autumn, winter and spring in Groningse Kust-Rottum, NL (43,000; 39,800 and 20,000), Ameland-Friese Kust Oost, NL (42,900; 38,700 and 18,800), and in addition during spring in Mittlere Ostfriesische Inseln und Küste, NDS (20,500), Friesländische Inseln und Küste, NDS (16,100) and in Mellum und Butjadinger Küste, NDS (14,900), based on average numbers during 1999/2000-2006/2007.

For the entire Wadden Sea the long (21 years) and the short (10 years) term trends show decreasing numbers (Fig. 5.34). These trends occur in all regions except the Danish Wadden Sea, where the numbers increase in the long term and are stable during the short term; however, here numbers represent only some 10% of the Wadden Sea population.

Summary

The total population of Oystercatchers increased up to the 1990s followed by a decrease (Delany *et al.*, 2009, Pol *et al.* in press). A sharp decrease in the Dutch Wadden Sea, where the winter numbers dropped from 266,000 birds in the early 1980s to 177,000 birds in the late 1990s is attributed to the disappearance of the inter-tidal mussel beds in the Dutch Wadden Sea, due to overfishing in a period without spatfall in the late part of the 1980s, and in addition to an intensive cockle fishery (Piersma and Koolhaas 1997, Ens *et al.*, 2004). Also in Niedersachsen and Schleswig-Holstein a steady decrease is observed; however, increases are reported from Denmark (Blew *et al.*, 2005b, Laursen *et al.*, 2010). The Oystercatcher phenology has changed from the early to the late period by prolonging their stay during autumn (in the northern part) and by a continuous decrease in numbers after the autumn peak in both Wadden Sea parts.

5.13 Pied Avocet

Recurvirostra avosetta

DK: Klyde **D: Säbelschnäbler** **NL: Kluut** **04560**

Flyway population:	73,000
Breeding range:	North-West Europe and West Mediterranean
1%:	730
Status:	Stable

Region	Overall trends	
	short-term 10 years	long-term 21 years
WS	↓	↓
DK	–	↓
SH	→	↓
NDS/HH	↓	↓
NL	↓	↓

Seasons (month no.)	Early period 1987/88-1994/95	Late period 1999/00-2006/07	% of flyway population 1999/00-2006/07
	mean of 3 maximum estimates		
Breeding: (5)	19,003	14,561	19.9
Moult: (6, 7)	20,364	27,217	37.3
Autumn: (8, 9, 10, 11)	53,874	38,932	53.3
Winter: --			
Spring: (3, 4)	11,979	18,651	25.5

For details see species account Cormorant.

Population

The total population of 73,000 birds is stable. It breeds in North-West Europe, West Mediterranean and Northwest Africa and winters along the Atlantic coast of Europe and North-West Africa (Wetlands International, 2006). The breeding population in the Wadden Sea is about 10,000 pairs (11,840 pairs in 1991 and 10,170 pairs in 2001, Koffijberg *et al.*, 2006).

Ecology

In the Wadden Sea Avocets prefer soft mud for feeding, and the main diet is small crustaceans and ragworms (*Nereis diversicolor*) (Smit and Wolff, 1983). The birds are mainly distributed along the mainland coast, and during high tide they roost on the mudflats near the water line or on the salt marshes (Koffijberg *et al.*, 2003).

Phenology

After the breeding season, Avocets gather in the Wadden Sea in July in large numbers to undergo their primary moult and peak numbers occur in August and again in October when birds arrive from a larger area, making up a vast majority of birds from the northern parts of their breeding range (Blew *et al.*, 2005a). While this species largely leaves the Wadden Sea during winter, the spring migration starts during March and reaches a maximum number in April. This level is more or less stable during the breeding period.

A considerable change in phenology occurred between 1987/88-1994/95 and 1999/00-2006/07 in both the Northern and Southern Wadden Sea, as the pronounced autumn peak numbers during

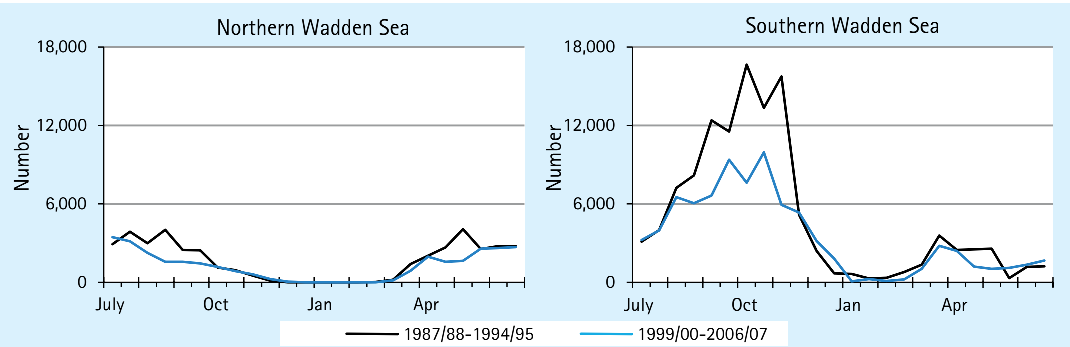


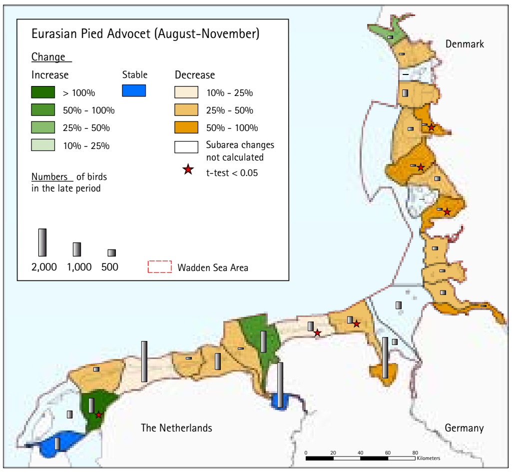
Figure 5.35
Phenology of Pied Avocet (bi-monthly mean numbers) in the Northern and the Southern Wadden Sea during the periods 1987/88-1994/95 and 1999/00-2006/07. Counted numbers from spring-tide-counting sites, no gap-filling.

Figure 5.36
Distribution of Pied Avocet in the Wadden Sea during autumn (August-October) and spring (March-April) for the periods1987/88-1994/95 and 1999/00-2006/07. Changes between the two periods are indicated (colours) and numbers are given for the late period (bars). Asterisks indicate statistical significant differences in numbers (P <0.05).

the early period reduced or disappeared during the late period. This may have been caused by changes in use of the Wadden Sea which may also contribute to a continuing decreasing trend (Fig. 5.35). During spring in the Northern Wadden Sea a peak number in late April in the early period had disappeared and numbers are continuously increasing during spring in the late period to a peak number in June, the breeding season.

Distribution

Avocets occur in most sub-areas in the Wadden Sea, but during autumn most birds occur in those situated in The Netherlands and Niedersachsen and during spring in those north of the river Elbe (Schleswig-Holstein); the Dollard (Niedersachsen - The Netherlands) holds large numbers in both seasons (Fig. 5.36). However, marked changes during autumn had occurred between 1987/88-1994/95 and 1999/00-2006/07 in Denmark, Schleswig-Holstein and Niedersachsen, with decreasing numbers in 14 sub-areas (of these five significantly) (Fig. 5.36). Stable or increasing numbers occurred in five sub-areas in The Netherlands, Niedersachsen and Denmark. Of these only one was significant. During spring, numbers in 9 sub-areas decreased (two significantly) and in 6 sub-areas the numbers were stable or increasing, although none were significant. Most sub-areas with significant decreasing numbers were situated in Schleswig-Holstein and Niedersachsen.



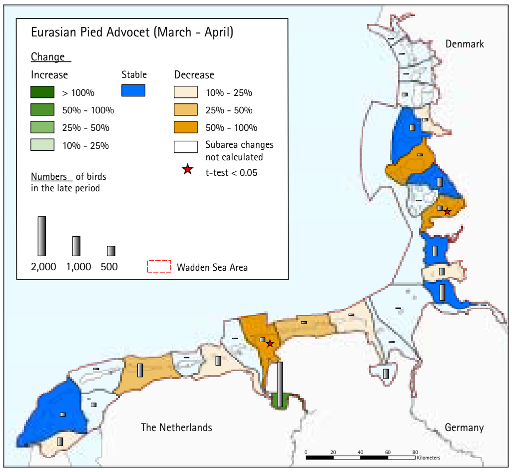


Photo: Gundolf Reichert

Numbers

During autumn, birds start arriving into the Wadden Sea in the first half of July and have increased to an autumn peak in the early periods, with some 17,000 in the Northern and 49,000 in the Southern Wadden Sea (Appendix 1). However, during the recent periods only some 9,000 and 35,000 are estimated, respectively. Avocets leave the Northern Wadden Sea in mid autumn and the Southern Wadden Sea in late autumn. Only few birds stay during winter, and during spring a maximum of some 9,000 birds are estimated in the Southern, and 10,000 in the Northern Wadden Sea. In sub-areas, largest concentrations of Avocet are recorded in autumn and spring in Dollard, NDS/NL (4,700 and 32,000), and in autumn in Jadebusen, NDS (4,300), in Ameland-Friese Kust Oost, NL (4.200) and in Leybucht und Inseln, NDS (2,200), based on average numbers during the study period.

The overall trend for the Avocets is decreasing during both the long (21 years) and the short term (10 years), and this trend is also shown in the different parts except for stable numbers in Schleswig-Holstein and fluctuations in Denmark (Fig 5.37).

Summary

Avocets are at their northern distribution border in the Wadden Sea, and thus more vulnerable to small changes. The overall population numbers are stable, but the trend for the Wadden Sea is decreasing. Decreasing numbers are also reported for Germany (Blew *et al.*, 2005b) while stable numbers are reported from The Netherlands and Denmark (Hustins *et al.*, 2009, Laursen and Frikke, 2006). The decreasing trends could be caused by the fact that birds leave the Wadden Sea much earlier during autumn, and could indicate that this part of the population using the Wadden Sea may have problems, potentially also due to hunting in France and Portugal, and a general reclamation of mudflats in the flyway area (Delany 2009).

Photo: Gundolf Reichert

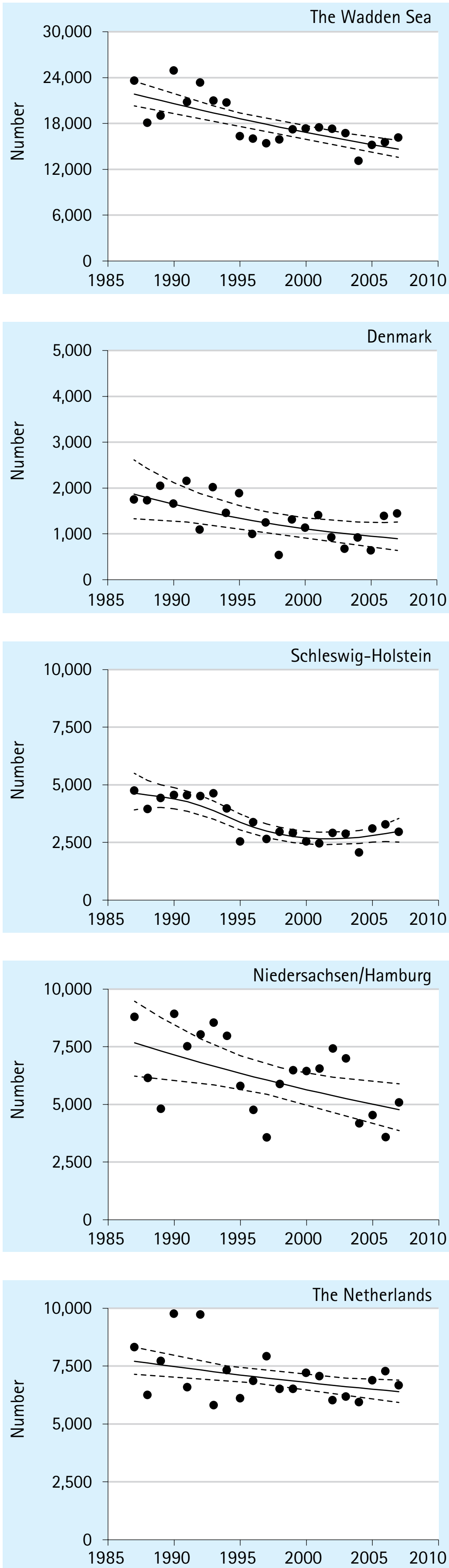


Figure 5.37
Trends of Pied Avocet in the International Wadden Sea (WS) and the four regions 1987/1988-2007/2008; dots represent annual averages; trendline calculated by Trendspotter (solid line) together with the ± 95 % confidence limits (dotted line).

5.14 Great Ringed Plover

04700

Charadrius hiaticula

DK: Stor Præstekrave D: Sandregenpfeifer
NL: Bontbekplevier

Flyway population:	*C. h. hiaticula*: 73,0000 *C. h. psammodroma*: 190.000 *C. h. tundrae*: 100,000-1,000,000
Breeding range:	*C. h. hiaticula*: Iceland, Baltic, Southern Scandinavia to Britain, Ireland and France *C. h. psammodroma*: North Eastern Canada, Greenland, Iceland, Faeroes *C. h. tundrae*: North Eastern Europe, Russia (high arctic)
1%:	*C. h. hiaticula*: 730 *C. h. psammodroma*: 1,900 *C. h. tundrae*: 10,000
Status:	*C. h. hiaticula*: Decreasing *C. h. psammodroma*: Decreasing *C. h. tundrae*: Unknown

Region	Overall trends short-term 10 years	Overall trends long-term 21 years
WS	↑	↑
DK	↓ ↓	→
SH	↑	↑
NDS/HH	↓	↓
NL	↑	↑

Seasons (month no.)		Early period 1987/88-1994/95	Late period 1999/00-2006/07	% of flyway population 1999/00-2006/07
		mean of 3 maximum estimates		
Breeding:	--			
Moult:	--			
Autumn:	(7, 8, 9, 10)	20,394	34,702	3.5
Winter:	--			2.4
Spring:	(3, 4, 5)	12,583	24,306	

For details see species account Cormorant.

Population

Three subspecies pass the Wadden Sea on migration. *C. h. hiaticula* breeds in the Wadden Sea and the countries around the North Sea, the Baltic Sea, in France and on Iceland. *C. h. hiaticula* passes the Wadden Sea on spring migration in March and April from the wintering grounds in South West Europe and North West Africa (Meltofte *et al.*, 1994). The breeding population in the Wadden Sea of *C. h. hiaticula* has slightly decreased from 1360 pairs in 1991 to 1100 pairs in 2001 (Koffijberg *et al.* 2006). The subspecies *C. h. psammodroma* breeds in North East Canada, Greenland and on Iceland. During spring it passes briefly through the Wadden Sea in May and early June, coming directly from the wintering areas in West and Southern Africa. The subspecies *C. h. tundrae* breeds in North East Europe and the high Arctic Russia. It winters in Southern and Eastern Africa and probably also in Western Africa and South West Asia, briefly passing through the Wadden Sea during late May. There is still some uncertainty in separating these sub-species and their wintering areas (Delany *et al.*, 2009). The three sub-populations all visit the Wadden

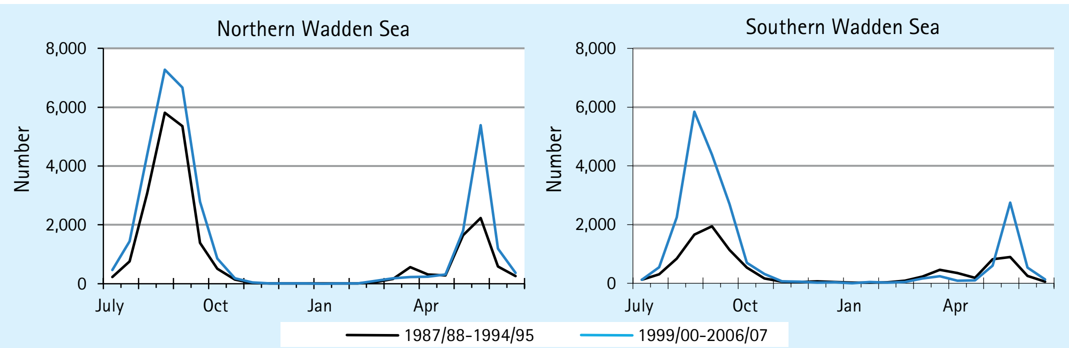


Figure 5.38
Phenology (mean bi-monthly number) of Great Ringed Plover in the Northern and the Southern Wadden Sea during the periods 1987/88-1994/95 and 1999/00-2006/07. Counted numbers from spring-tide-counting sites, no gap-filling.

Sea during autumn in August and September, so visiting times are difficult to differentiate.

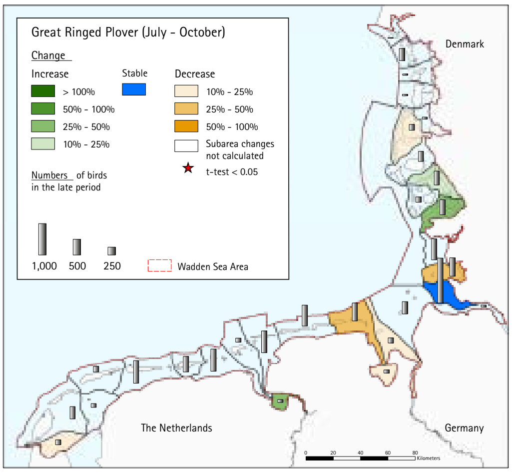
Ecology

In the Wadden Sea Great Ringed Plovers roost on the salt marshes and sand flats during high tide (Koffijberg *et al.* 2003). They feed on the upper parts of the tidal flats, on sandy, sandy/mud-mixed substrate, Enteromorpha beds and on salt marshes (Smit and Wolff, 1983). Due to the plentiful feeding sites, the birds are able to feed at both low and high tide. The preferred food items are ragworms, molluscs and insects (Smit and Wolff, 1983).

Phenology

In the Wadden Sea Great Ringed Plovers occur in two clearly separated periods during autumn and spring (Blew *et al.*, 2005a). In July local breeders are still present and are joined by hiaticula birds, which stay for a short period and leave for the winter grounds by mid August, while the tundrae birds visit during August-September, forming a pronounced peak number together with the less numerous Greenlandic psammodroma birds (Meltofte *et al.*, 1994). While staying in the Wadden Sea adult birds dominate in July-August and juveniles during September-October (Engelmoer, 2008). By the beginning of October most birds had left for the wintering grounds and only a few birds remain in January. During spring some birds arrive in late February and a small peak occurs in March, formed by hiaticula birds that are a mixture of local breeders and those passing for more northern breeding grounds. During May and early June large numbers of tundrae and psammodrama birds form a large peak before they leave for the breeding grounds (Engelmoer, 2008).

Changes in phenology between 1987/88-1994/95 and 1999/00-2006/07 had occurred especially in the Northern Wadden Sea. Here the birds pass through in somewhat larger numbers during August and September in the late compared to the early period (Fig. 5.38). During spring apparently more birds are registered in late May/early June in the late compared to the early period. In the Southern Wadden Sea the autumn peak number has increased and shifted from early September in the early period to late August in the late period.



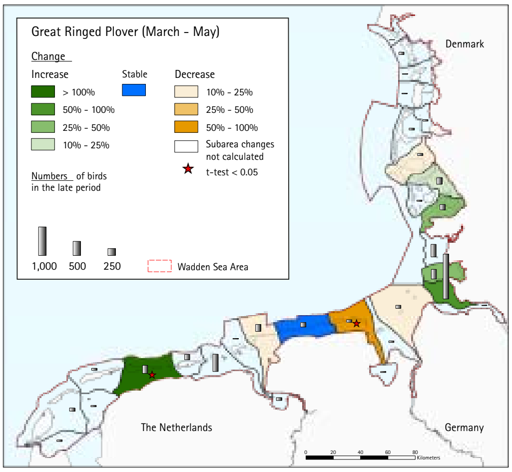


Figure 5.39
Distribution of Great Ringed Plover in the Wadden Sea during autumn (July-October) and spring (March-May) for the periods1987/88-1994/95 and 1999/00-2006/07. Changes between the two periods are indicated (colours) and numbers are given for the late period (bars). Asterisks indicate statistical, significant differences in numbers (P <0.05).

Photo: Gundolf Reichert

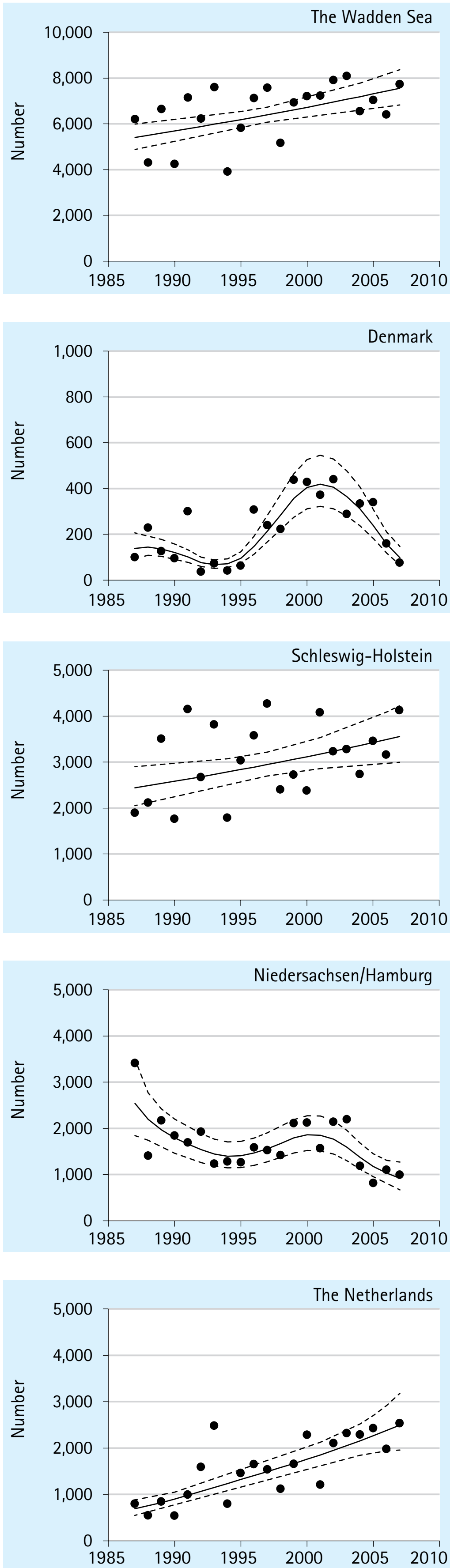


Figure 5.40
Trends of Great Ringed Plover in the International Wadden Sea (WS) and the four regions 1987/1988-2007/2008; dots represent annual averages; trendline calculated by Trendspotter (solid line) together with the ± 95 % confidence limits (dotted line).

Distribution

Great Ringed Plovers occur in almost all sub-areas in the Wadden Sea, most in Schleswig-Holstein, Niedersachsen and The Netherlands (Fig. 5.39); during spring most birds are situated in Schleswig-Holstein and the eastern parts of The Netherlands. Few changes had occurred in the distribution of the Ringed Plover between 1987/88-1994/95 and 1999/00-2006/07. During autumn increases occurred in three sub-areas and decreases in six, but none of them are significant. During spring, stable and increasing numbers were recorded in six sub-areas and decreases in four, of these one in Niedersachsen was significant.

Numbers

During autumn, maximum estimates of Ringed Plovers can be some 18,000 in the Northern Wadden Sea, and up to 19,000 in the Southern Wadden Sea during recent years (Appendix 1). Less than 100 birds stay during winter, and most of these are in the southern parts. During spring, distinct peak numbers occur in May with an estimated 9,000 birds in the Southern and 18,000 birds in the Northern Wadden Sea during recent years. Most Ringed Plovers are locally recorded during autumn and spring in Friedrichskoog-Brunsbüttel, SH (2,000 and 2,300), and during autumn in Eiderstedt Süd-Eider-Büsum, SH (1,000) and Trischen-Meldorfer Bucht, SH (800), based on average numbers.

The trend for the entire Wadden Sea on both the long (21 years) and short term (10 years) is increasing (Fig. 5.40). However, this applies mainly to the Dutch and the Schleswig-Holstein Wadden Sea, whereas a stable, decreasing or fluctuation trend occurs in the Danish Wadden Sea with low numbers and in Niedersachsen.

Summary

10-15% of the total population of Great Ringed Plover uses the Wadden Sea. The numbers for the entire Wadden Sea show a moderate increase for both the short and long term period, with different developments in the four regions. The increasing numbers are reinforced by increased staying time during autumn in recent years. National monitoring results from The Netherlands confirm the increasing trend (Hustins *et al.*, 2009). However a fluctuating trend is registered for the German Wadden Sea (Blew *et al.*, 2005b).

5.15 Kentish Plover

Charadrius alexandrinus

04770

DK: Hvidbrystet Præstekrave D: Seeregenpfeifer
NL: Strandplevier

Flyway population:	62,000-70,000
Breeding range:	Eastern Atlantic and Western Mediterranean
1%:	660
Status:	Decreasing

Region	Overall trends	
	short-term 10 years	long-term 21 years
WS	↓	↓
DK	↓↓	↓↓
SH	→	→
NDS/HH	↓↓	↓↓
NL	–	↓

Seasons (month no.)	Early period 1987/88-1994/95	Late period 1999/00-2006/07	% of flyway population 1999/00-2006/07
	mean of 3 maximum estimates		
Breeding: (5, 6)	536	385	0.6
Moult: --			
Autumn: (7, 8, 9)	655	698	1.1
Winter: --			
Spring: (3, 4)	228	101	0.2

For details see species account Cormorant.

Population

Kentish Plovers breed in coastal areas along the Atlantic/North Sea coasts from Denmark to Portugal and in the Eastern Mediterranean (Delany *et al.*, 2009). They winter in coastal areas in Northern and Western Africa. The flyway population is 62,000-70,000 birds and decreasing (Wetlands International, 2006). The Wadden Sea held a small breeding population of 340 pairs in 2001, decreased from 570 pairs in 1991 (Koffijberg *et al.*, 2006).

Ecology

In the Wadden Sea the favoured sites during migration are sand flats and beaches, and during roosting salt marshes and inland sites. Kentish Plovers feed in the upper, sandy part of the littoral zone and take insects, crustaceans and annelids, especially ragworms (Smit and Wolff, 1983).

Phenology

Kentish Plovers aggregate in the Wadden Sea from July to September. These birds are probably dominated by local breeders. Numbers peak in August (Blew *et al.*, 2005a). Birds leave during September and at the end of the month nearly all have left the Wadden Sea. Spring migration starts in March and peak numbers occur in April and May, but are smaller than during autumn.

Changes between 1987/88-1994/95 and 1999/00-2006/07 had not been calculated for the Kentish Plover due to the overall low numbers.

Photo: Gundolf Reichert

Numbers

The Kentish Plover occurs in small numbers in the Wadden Sea. During autumn, the mean estimates during the peak period are some 500 birds in the Northern and 250 in the Southern Wadden Sea (Appendix 1). No birds stay during winter, and a spring peak of less than 200 birds is estimated in both the Northern and Southern parts. Locally, largest numbers are recorded at Husumer Bucht-Eiderstedt Nord, SH (100) and at Eiderstedt Süd-Eider-Büsum, SH (90), based on average numbers.

The trends in the Wadden Sea are moderately decreasing, both during the long (21 years) and the short term (10 years) (Fig. 5.41). During the long term the decreasing trend occurs in all parts of the Wadden Sea except in The Netherlands, where the trend is stable. During the short term uncertain trends occur in Schleswig-Holstein and Niedersachsen. However, these assessments should be viewed with caution, as these trends are based on low overall numbers, and the species is difficult to cover.

Summary

The Wadden Sea holds only a small fraction of the entire flyway population, and both during spring and autumn these birds represent the local breeding population (Meltofte *et al.*, 1994). However, the trend in the Wadden Sea follows the same trend as for the entire flyway population, which could indicate common negative factors for the species. Koffijberg *et al.* (2003) point out that Kentish Plovers are easily disturbed by recreational activities on beaches, the birds' preferred breeding sites. In addition to that, nests and eggs are flooded during storm events, reducing the reproductive output. Delany *et al.* (2009) also argue that the species are particular vulnerable at the post-breeding staging and at the moulting sites due to disturbance and habitat destruction.

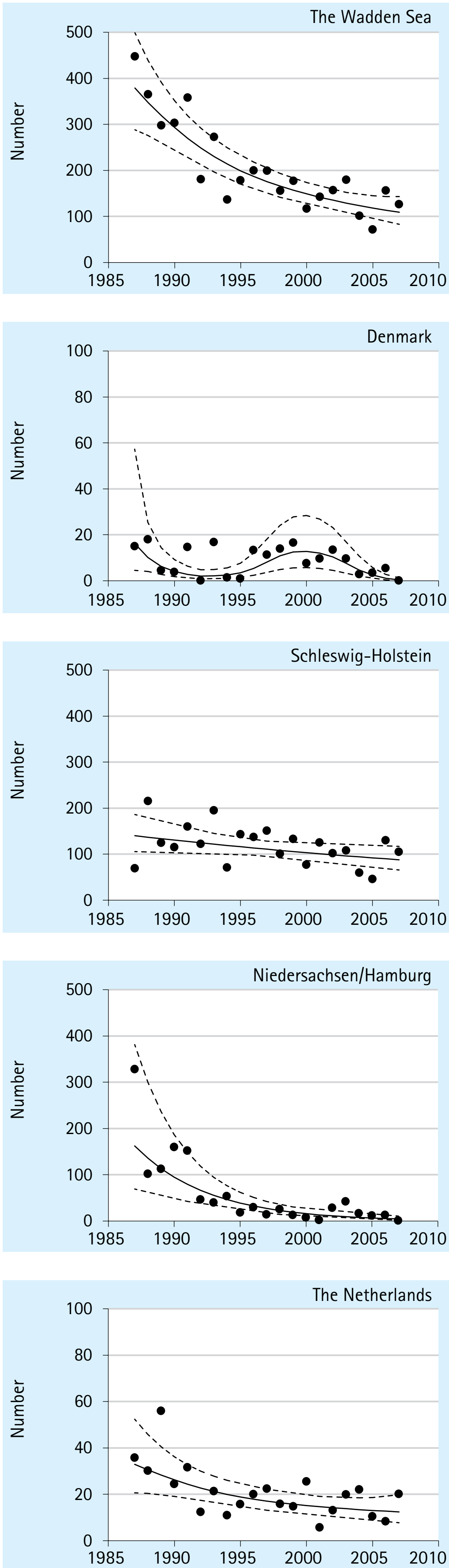


Figure 5.41
Trends of Kentish Plover in the International Wadden Sea (WS) and the four regions 1987/1988-2007/2008; dots represent annual averages; trendline calculated by Trendspotter (solid line) together with the ± 95 % confidence limits (dotted line).

5.16 Eurasian Golden Plover

Pluvialis apricaria

04850

DK: Hjejle D: Goldregenpfeifer NL: Goudplevier

Flyway population:	*P. a. apricaria*: 140,000-210,000 *P. a. altrifrons*: 500,000-1,000,000 *P. a. altifrons*: 930,000
Breeding range:	*P. a. apricaria*: Around the North Sea *P. a. altrifrons*: Northern Europe and Western Siberia *P. a. altifrons*: Iceland and Faeroes
1%:	*P. a. apricaria*: 1,750 *P. a. altrifrons*: 7,500 *P. a. altifrons*: 9,300
Status:	*P. a. apricaria*: Decreasing *P. a. altrifrons*: Stable *P. a. altifrons*: Stable?

Region	Overall trends	
	short-term 10 years	long-term 21 years
WS	↓	↓
DK	↓	↓
SH	↓	↓
NDS/HH	↓	↓
NL	↓	→

Seasons (month no.)		Early period 1987/88-1994/95	Late period 1999/00-2006/07	% of flyway population 1999/00-2006/07
		mean of 3 maximum estimates		
Breeding:	--			
Moult:	--			
Autumn:	(8, 9, 10, 11)	148,108	120,393	16.1
Winter:	--			
Spring:	(3, 4)		84,885	11.3

For details see species account Cormorant.

Population

The flyway population of the nominate sub-species *P. a. apricaria* counts 140,000-210,000 birds and decreases. It breeds in Ireland, Great Britain through Southern Scandinavia and the Baltic States and winters in North-Western Europe. Another sub-species, *P. a. altifrons*, occurs in Europe and is divided into two populations. One of those breeds in Greenland and on Iceland and Faeroes (Wetlands International, 2006; Delany *et al.*, 2009), counts 930,000 birds, and is supposed to be stable; it winters in the British Isles, West and South-West Europe and North-West Africa and migrates through Ireland and West Britain to France, most likely not using the Wadden Sea. The second *P. a. altifrons* population breeds in Northern Europe and winters in Central and Western Europe together with North-West Africa. It counts 500,000-1,000,000 birds and is stable (Wetlands International, 2006; Delany *et al.*, 2009); Golden Plovers wintering in the Wadden Sea area belong to this population.

Ecology

Only a small fraction of the Golden Plovers (14 %) occurs in the Wadden Sea outside the breeding season (Blew *et al.*, 2007; Hötker, 2004). While staying there the species mostly use inland sites

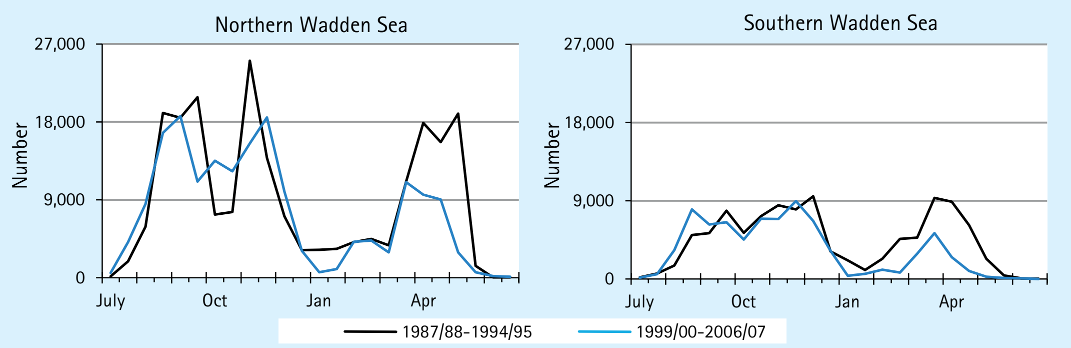


Figure 5.42
Phenology of Eurasian Golden Plover (mean bi-monthly number) in the Northern and the Southern Wadden Sea during the periods 1987/88-1994/95 and 1999/00-2006/07. Counted numbers from spring-tide-counting sites, no gap-filling.

while staging during autumn, winter and spring. The species use improved grasslands, arable land (stubble and ploughed fields) and thus most birds occur behind seawalls. During autumn in Schleswig-Holstein and Denmark large numbers are recorded outside the sea walls, roosting on salt marshes and feeding on mudflats (Koffijberg *et al.*, 2003).

Phenology

During autumn, adult Golden Plovers arrive from late July, and they are followed by juveniles in late August and together they form a first autumn peak which is dominated by Scandinavian birds. Later in November, birds form Northern Russia and Siberia move in forming a second autumn peak in November (Blew *et al.*, 2005a; Meltofte *et al.*, 1994). Few birds winter in the Wadden Sea region and from late February the numbers increase to almost the same number in April as during autumn. The birds moult their body feathers while staying and build up body reserves for the breeding season. They leave the Wadden Sea until early May.

Changes in phenology had occurred in the Southern Wadden Sea during autumn between 1987/88-1994/95 and 1999/00-2006/07 (Fig. 5.42). Here the Golden Plovers arrive somewhat earlier in the late period compared to the early period. During spring in both the Northern and Southern Wadden Sea the birds are leaving earlier in the late period and overall numbers are smaller.

Distribution

The Golden Plovers are distributed all over the Wadden Sea with relative large numbers in the Danish sub-areas, due to inclusion of inland polder areas. Large numbers also occur in some sub-areas in The Netherlands.

Changes had occurred in autumn between 1987/88-1994/95 and 1999/00-2006/07, especially in Denmark, Schleswig-Holstein and in eastern Niedersachsen, where significant decreases have occurred in five sub-areas. Increases had occurred in three sub-areas in western Niedersachsen and The Netherlands, although none of these were significant (Fig. 5.43).

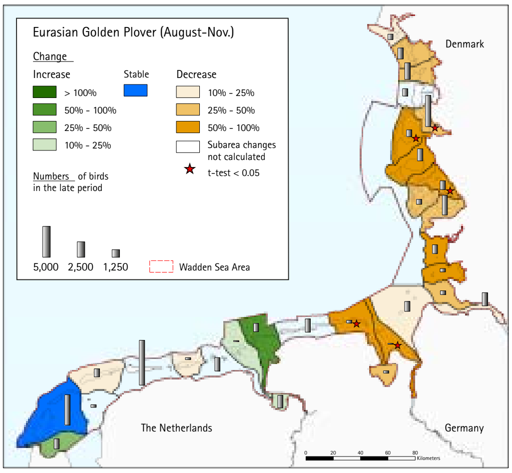
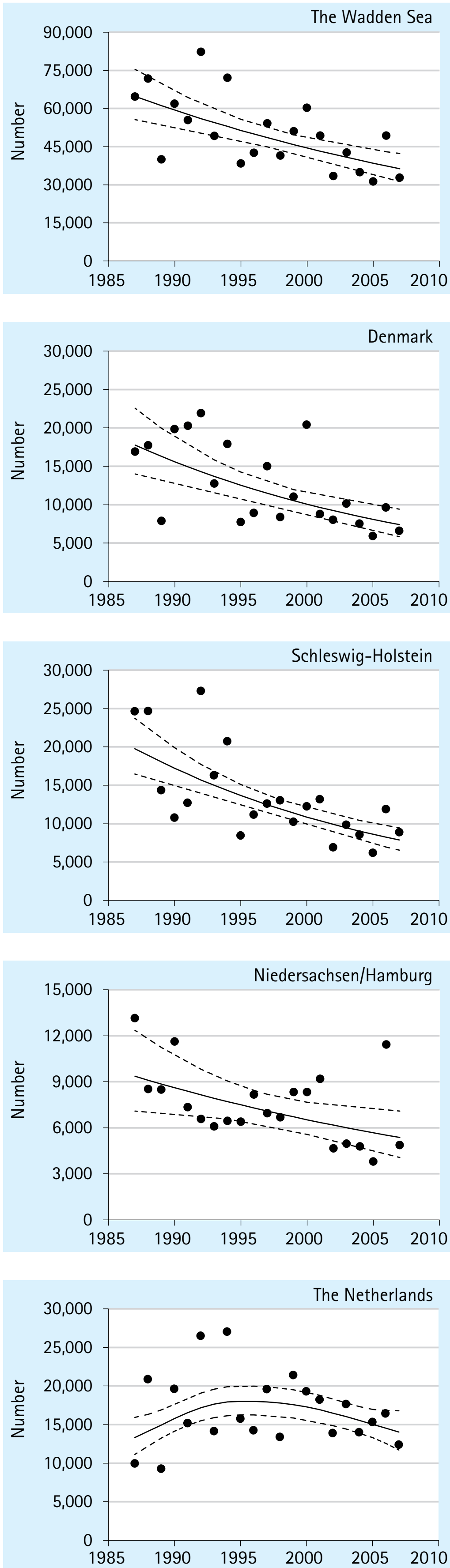


Figure 5.43
Distribution of Eurasian Golden Plover in the Wadden Sea during autumn (August-November) for the periods1987/88-1994/95 and 1999/00-2006/07. Changes between the two periods are indicated (colours) and numbers are given for the late period (bars). Asterisks indicate statistical, significant differences in numbers (P <0.05).

Photo: Gundolf Reichert

Figure 5.44
Trends of Eurasian Golden Plover in the International Wadden Sea (WS) and the four regions 1987/1988-2007/2008; dots represent annual averages; trendline calculated by Trendspotter (solid line) together with the ± 95 % confidence limits (dotted line).



Numbers

Autumn mean peak estimates in the Northern Wadden Sea add up to 121,000 birds, while in the Southern Wadden Sea only 73,000 are estimated. However, those maxima for the Northern Wadden Sea were only reached during the early period, while those for the Southern Wadden Sea are reached in the late period (Appendix 1). After autumn, total numbers decrease to a very low level in winter and, depending on the severity of the winter, Golden Plovers leave the Wadden Sea during frosty periods. During spring, mean estimates of 55.000 birds during former years and 43,000 birds during recent years were recorded in the Northern Wadden Sea, while some 50,000 are estimated in both periods in the Southern Wadden Sea. Sub-areas with large numbers during autumn are Friese Kust Oost-Ameland, NL (10,200) and Jordsand-Margrethe Kog, DK (7,000), based on average numbers during the study period.

Numbers for the entire Wadden Sea are decreasing and the trends for both the long (21 years) and the short term (10 years) are moderately decreasing (Fig. 5.44). The same trends are found for the two periods in other parts of the Wadden Sea, except for stable trends in The Netherlands.

Summary

Only a small part of the large Golden Plover flyway populations occurs inside the Wadden Sea and thus only a small fraction of the population is covered by the coordinated counts in the Wadden Sea. However, the overall trend of these counts is decreasing, and thus follows the trend of the flyway population. Countrywide counts in Denmark and The Netherlands in 2003 show clear increasing numbers for both countries compared to similar counts in 1993 and 1963 respectively (Rasmussen, 2007). Later counts in the Dutch Wadden Sea also show increasing trends (van Roomen *et al.*, 2007) which could be due to a shift from inland to coastal sites where the birds are easier to locate and count (Kleefstra *et al.* 2009). However decreasing numbers for both autumn and spring were found in the German Wadden Sea (Blew *et al.* 2005b). Thus the results are ambiguous, probably due to several populations involved and a poor coverage of the species. Hunting in France and central Europe most probably causes a threat to this species (Delany *et al.*, 2009).

5.17 Grey Plover

Pluvialis squatarola

DK: Strandhjejle D: Kiebitzregenpfeifer NL: Zilverplevier 04860

Flyway population:	247,000
Breeding range:	Arctic Russia and North-East Canada
1%:	2,500
Status:	Decreasing

Region	Overall trends	
	short-term 10 years	long-term 21 years
WS	→	→
DK	→	↑
SH	→	→
NDS/HH	↓	↓
NL	↑	↑

Seasons (month no.)		Early period 1987/88-1994/95	Late period 1999/00-2006/07	% of flyway population 1999/00-2006/07
		mean of 3 maximum estimates		
Breeding:	--			
Moult:	--			
Autumn:	(8, 9, 10, 11)	119,909	104,140	41.7
Winter:	(12, 1, 2)	47,966	51,107	20.4
Spring:	(3, 4, 5)	157,168	148,681	59.5

For details see species account Cormorant.

Population

The total population of 247,000 birds breeds in Arctic Russia to the Taymyr peninsula and in North-Eastern Canada. The wintering area includes the Wadden Sea, Britain, Ireland and south to West Africa (Gulf of Guinea). The population is decreasing (Wetlands International, 2006).

Ecology

In the Wadden Sea Grey Plovers utilize only some of the habitat types. During high tide the species roost in salt marshes and on sand flats. During low tide they feed on both mud and sandflats. Ragworms are important prey items and during spring they are taken nearly exclusively (Smit and Wolff, 1983).

Phenology

Adult Grey Plovers arrive in the Wadden Sea during autumn in late July/August and are followed by juveniles in September, and together they form a peak number. Most adults leave for Africa in September and the juveniles follow in October–November (Meltofte *et al.* 1994). Thereafter the numbers decrease continuously until December, with few birds staying during winter (Blew *et al.*, 2005a). During July/August, two thirds of birds in the Wadden Sea originate from west of Yamal and one third of the birds from Yamal and Taimyr. In September/October this balance changes to more than 80% birds from west of Yamal and 15% from Yamal and Taimyr. During winter the proportions change to 85% and 3% respectively. Only in winter (November–February) are birds from east of Taimyr present in a larger

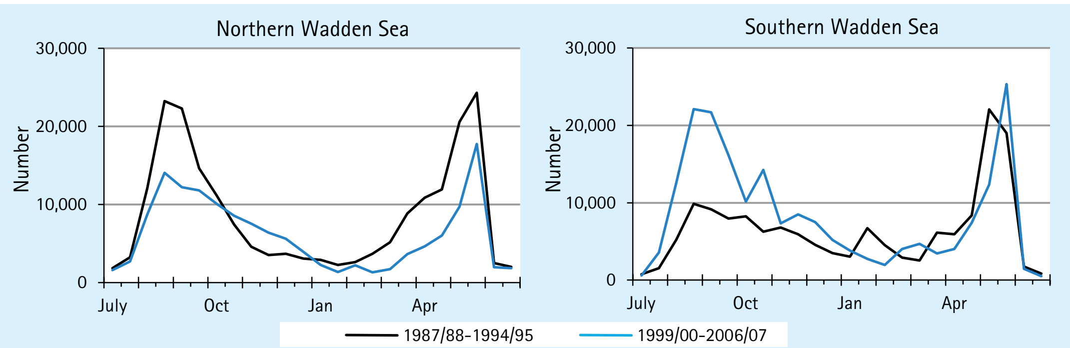
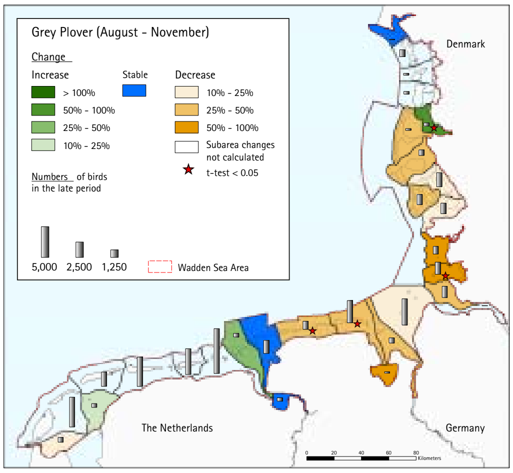


Figure 5.45 The phenology of Grey Plover (mean bi-monthly number) in the Northern and the Southern Wadden Sea during the periods 1987/88-1994/95 and 1999/00-2006/07. Counted numbers from spring-tide-counting sites, no gap-filling.

proportion (15%) (Engelmoer, 2008). In spring birds that had wintered in West Europe arrive in the Wadden Sea in March-April, representing the North European breeders (Engelmoer, 2008). Those wintering in Africa (the Siberian birds) follow in late April forming a steep increase into mid May, and leave for the breeding grounds through until early June.

Considerable changes in phenology had occurred between 1987/88-1994/95 and 1999/00-2006/07. During autumn some of the Grey Plovers in the Northern Wadden Sea stay longer; however, it seems that peak numbers have decreased in the Northern but increased in the Southern Wadden Sea (Fig. 5.45). During spring, birds in the Northern Wadden Sea are arriving later and in all parts of the Wadden Sea. The late spring peak seems to be more concentrated during late May and early June in the late period compared to the early period. This could indicate that especially birds from west of Yamal have changed in phenology or numbers in the Northern Wadden Sea.



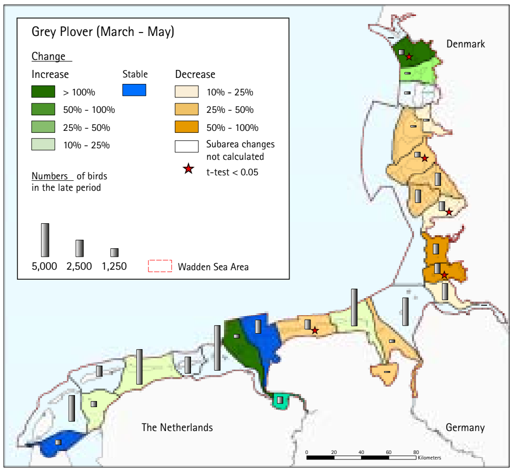


Figure 5.46
Distribution of Grey Plover in the Wadden Sea during autumn (August-November) and spring (March-May) for the periods1987/88-1994/95 and 1999/00-2006/07. Changes between the two periods are indicated (colours) and numbers are given for the late period (bars). Asterisks indicate statistical significant differences in numbers (P <0.05).

Distribution

Grey Plovers are distributed in almost all subareas with largest numbers during autumn and spring in Niedersachsen and The Netherlands (Fig. 5.46). Changes had occurred between 1987/88-1994/95 and 1999/00-2006/07 in both seasons, showing decreases in Schleswig-Holstein and Niedersachsen and increases mainly in The Netherlands and Denmark. During autumn decreases are recorded in 14 sub-areas (three were significant) and stable or increasing numbers in six sub-areas (one was significant). During spring 12 sub-areas showed decreases (five significant) and stable or increasing numbers in nine (four significant).

Numbers

During autumn in the Northern Wadden Sea maximum estimates of more than 60,000 are recorded during the early period, but only 31,000 during the late period. In turn, estimates in the Southern Wadden Sea increase from some 52,000 to 81,000 during the late period (Appendix 1). Thus considerable numbers of the Grey Plovers had shifted from the Northern to the Southern Wadden Sea during autumn between the two periods. Estimates in winter are much lower, but may still add up to some 50,000 in the entire Wadden Sea. In spring, peak estimates in the

Photo: Eva Foss Hendriksen

Northern Wadden Sea also decrease from some 54,000 in the early to some 37,000 in the late period, while in the Southern Wadden Sea estimates are around 110,000 in both periods. Subareas with high numbers during autumn and spring are Rottum-Groninger Kust, NL (10,200 and 9,400), Friesländische Inseln und Küste, NDS (5,100 and 7,700), and during spring Ameland-Friese Kust Oost, NL (7,200) and Wurster Küste, NDS (5,800), based on average numbers.

The overall trends – with a peak around 1995 – are stable in the Wadden Sea for both the long (21 years) and the short term (10 years) (Fig. 5.47). They have continued to show overall stability in recent years. However, the trends vary in the different parts: increasing trends occur in the Dutch and the Danish Wadden Sea during the long term, but stable trends are reported for Schleswig-Holstein and decreasing trends for Niedersachsen.

Summary

More than 50% of the total flyway population of Grey Plover use the Wadden Sea outside the breeding season, thus this region is of high importance for the species. The total flyway population is decreasing, but in the Wadden Sea the overall trend is stable during both the long and short term, although with some differences in the four Wadden Sea regions. The prolonged stay during autumn may partly explain the increasing numbers in the Wadden Sea. National count results report decreases in all seasons in Germany (Blew *et al.*, 2005b), and increases during both spring and autumn in Denmark and The Netherlands (Laursen and Frikke, 2006; Hustings *et al.*, 2009). The species has suffered from a loss of wintering grounds through human activity. In addition, massive oil and gas exploitation in northern Russia has degraded large areas of this species' breeding grounds (Delany *et al.*, 2009), which may affect the population passing through the Wadden Sea.

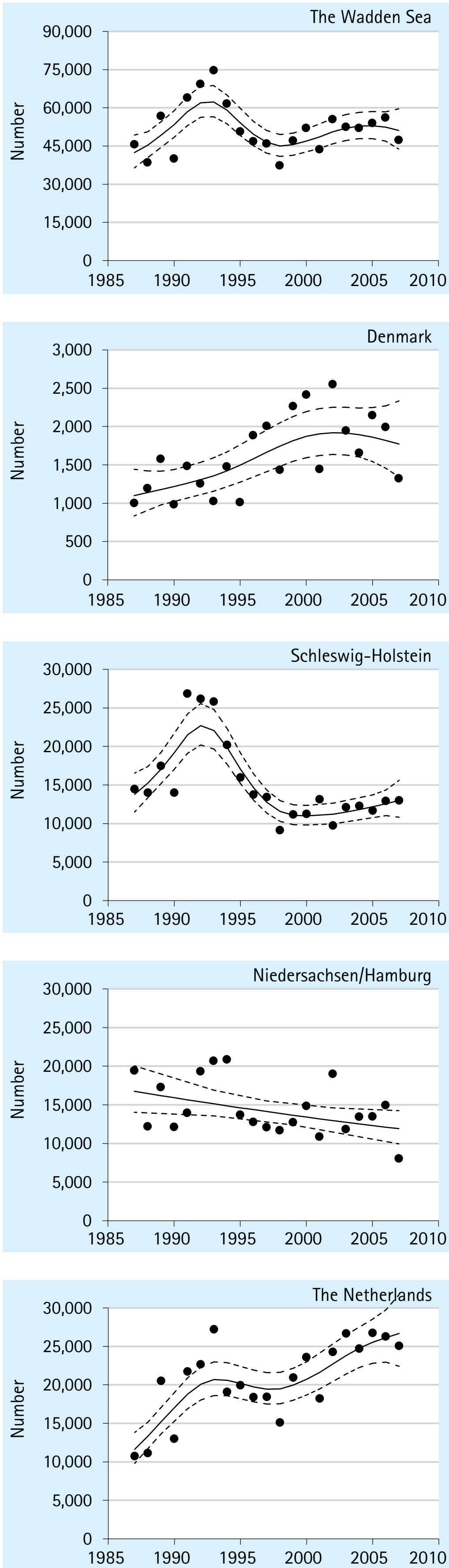


Figure 5.47
Trends of Grey Plover in the International Wadden Sea (WS) and the four regions 1987/1988-2007/2008; dots represent annual averages; trendline calculated by Trendspotter (solid line) together with the ± 95 % confidence limits (dotted line).

5.18 Northern Lapwing

Vanellus vanellus

04930

DK: Vibe D: Kiebitz NL: Kievit

Flyway population:	5,100,000-8,400,000
Breeding range:	Europe
1%:	20,000
Status:	Decreasing

Region	Overall trends	
	short-term 10 years	long-term 21 years
WS	→	→
DK	→	→
SH	→	→
NDS/HH	→	→
NL	–	↑

Seasons (month no.)		Early period 1987/88-1994/95	Late period 1999/00-2006/07	% of flyway population 1999/00-2006/07
		mean of 3 maximum estimates		
Breeding:	(4, 5, 6)	9,475	13,496	
Moult:	--			
Autumn:	(7, 8, 9, 10, 11)	99,862	98,757	
Winter:	(12, 1)	68,380	117,082	
Spring:	(2, 3)	36,524	36,212	

For details see species account Cormorant.

Population

Northern Lapwings breed in most parts of Europe with a population between 5.1-8.4 million birds, but its trend is decreasing. The wintering area covers Europe, Northern Africa and Asia Minor (Wetlands International, 2006). The breeding population in the Wadden Sea was 11,650 pairs in 2001; its trend is slightly decreasing and thus follows the flyway population (Koffijberg *et al.*, 2006) as well as other meadow breeding birds (Hötker *et al.*, 2007)

Ecology

Only a small fraction (3%) of the entire Lapwing population occurs in the Wadden Sea, thus it only plays a small role in the migration ecology of this species (Blew *et al.* 2007). They occur mostly in the polder areas behind the seawalls, feeding and roosting in grassland and on arable fields. On a few occasions they also use salt marshes and muddy tidal flats. Around full moon Lapwings also feed during the night and roost in large flocks during daytime, yet outside these periods they are more scattered and feed during daytime (Milson *et al.*, 1990).

Phenology

During summer immature birds from the northern part of the breeding range stay in the Wadden Sea, and adults that failed to breed also gather there (Meltofte *et al.*, 1993). In June and July birds from Northern and Eastern Europe pass through the Wadden Sea region and are followed by a larger number of moulting birds in August and September. A third wave of birds, which

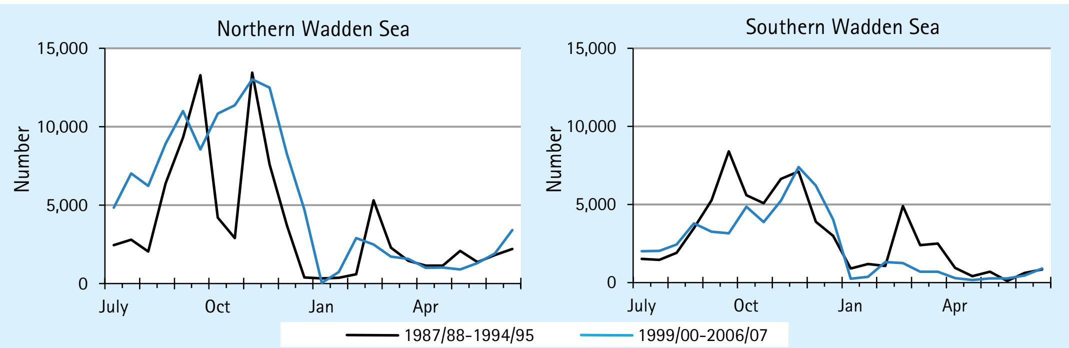


Figure 5.48
Phenology of Northern Lapwing (mean bi-monthly number) in the Northern and the Southern Wadden Sea during the periods 1987/88-1994/95 and 1999/00-2006/07. Counted numbers from spring-tide-counting sites, no gap-filling.

have moulted further east, arrive to the Wadden Sea in October and November (Meltofte *et al.*, 1993). These movements of Lapwings result in several peak numbers during autumn and an irregular phenology (Blew *et al.*, 2005a). Numbers decrease in December and only a few birds stay during winter since their main winter range lies south of the 3° isotherm (Delany *et al.*, 2009). Thus, winter numbers fluctuate due to the winter weather and in mild winters up to 76,000 birds may still be present during December (Blew *et al.*, 2005a).

The Lapwing's phenology changes between 1987/88-1994/95 and 1999/00-2006/07 are unclear due to large fluctuations over the years (Fig. 5.48). There is a slight tendency for birds to arrive earlier and leave somewhat later in autumn in the late period compared to the early period. More clearly, the former pronounced peaks in February/March are reduced, especially in the Southern Wadden Sea.

Distribution

Lapwings occur in all coastal areas in the Wadden Sea, with high numbers in sub-areas scattered over the whole region (Fig. 5.49). Changes had occurred between 1987/88-1994/95 and 1999/00-2006/07 with decreasing numbers in 11 sub-areas, of which two were significant, both of these in Niedersachsen. Stable or increasing numbers were observed in six sub-areas, although none were significant.

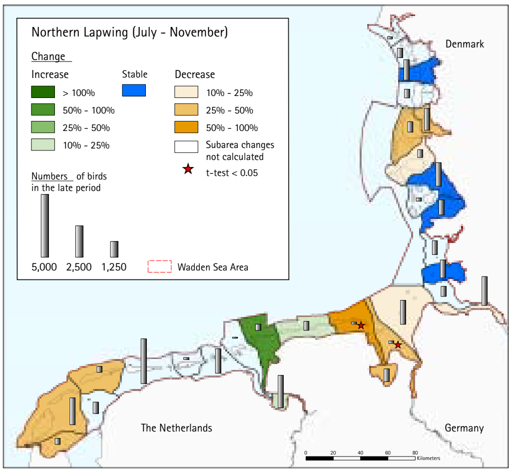


Figure 5.49 Distribution of Northern Lapwing in the Wadden Sea during autumn (July-November) for the periods1987/88-1994/95 and 1999/00-2006/07. Changes between the two periods are indicated (colours) and numbers are given for the late period (bars). Asterisks indicate statistical, significant differences in numbers (P <0.05).

Photo: Gundolf Reichert

Numbers

During autumn, maximum estimates in the Northern Wadden Sea decreased from 60,000 to some 42,000 in the later period, while they increased from 42,000 to some 65,000 in the Southern Wadden Sea (Appendix 1). Maximum estimates do not decrease considerably during winter, accounting for high numbers staying during mild winters. During spring, peak estimates have not changed with some 31,000 being registered for the entire Wadden Sea. High Lapwing numbers are recorded locally during autumn in Friese Kust Oost-Ameland, NL (5,100), Dollard, NDS/NL (3,700) and Unterelbe, SH/NDS (3,300), based on average numbers.

The overall Lapwing numbers recorded in the Wadden Sea are rather variable from year to year, however, the overall trend for the long (21 years) and the short term (10 years) is stable (Fig. 5.50). This applies for all regions but for the Dutch Wadden Sea, where increases (long term) and fluctuating numbers (short term) have been registered.

Summary

Lapwings have suffered a decrease in numbers of 20-50% over half the countries of Europe during 1970-1990, largely due to intensified farming, and this trend continues (Delany *et al.* 2009). However, only a small fraction of the flyway population uses the Wadden Sea, and the trend of this population part is stable, as are the trends in most parts of the Wadden Sea, except for an increasing trend in The Netherlands, which has experienced increasing but also fluctuating numbers in recent years. National counts show a fluctuating trend in Germany (Blew *et al.* 2005a) and stability in The Netherlands (Hustings *et al.* 2007). However, countrywide counts in The Netherlands show decreasing numbers for Lapwing, due to decreases in farmlands and a shift in distribution to more birds in coastal areas, and a more intensive monitoring programme which has meant that relatively more birds have been counted during recent years (Kleefstra *et al.*, 2009).

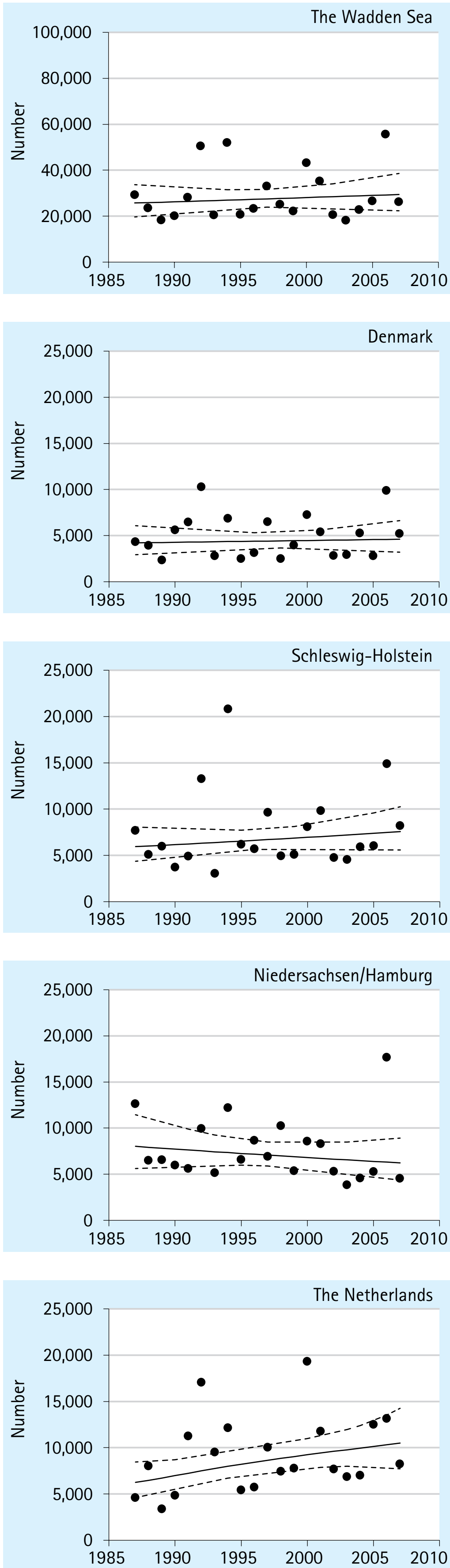


Figure 5.50
Trends of Northern Lapwing in the International Wadden Sea (WS) and the four regions 1987/1988-2007/2008; dots represent annual averages; trendline calculated by Trendspotter (solid line) together with the ± 95 % confidence limits (dotted line).

5.19 Red Knot

Calidris canutus

DK: Islandsk ryle   D: Knutt   NL: Kanoetstransloper

04960

Flyway population:	*C.c. canutus*: 400,000 *C.c. islandica*:* 450,000
Breeding range:	*C.c. canutus*: Central Siberia *C.c. islandica*:* High arctic Canada and Greenland
1%:	*C.c. canutus*: 3,400 *C.c. islandica*:* 4,500
Status:	*C.c. canutus*: Probably decreasing *C.c. islandica*:* Decreasing

*subspecies wintering in the Wadden Sea

Region	Overall trends	
	short-term 10 years	long-term 21 years
WS	→	→
DK	↑↑	↑
SH	↓	↓
NDS/HH	↑	→
NL	→	→

Seasons (month no.)	Early period 1987/88-1994/95	Late period 1999/00-2006/07	% of flyway population 1999/00-2006/07
	mean of 3 maximum estimates		
Breeding : --			
Moult: --			
Autumn: (7, 8, 9, 10)	396,198	358,710	79.7
Winter: (11, 12, 1, 2)	194,160	165,893	36.9
Spring: (3, 4, 5, 6)	501,018	466,215	103.6

For details see species account Cormorant.

Population

There are two sub-species of Red Knot visiting the Wadden Sea. The sub-species *C. c. canutus* breeds in central Siberia and winters in West, South West and Southern Africa. This flyway population covers 400,000 birds and the trend is possibly decreasing (Delany *et al*., 2009). The sub-species *C. c. islandica* is breeding in high arctic Canada and Greenland and winters in Western Europe including the Wadden Sea, Britain and Ireland. The flyway population of 450,000 birds is decreasing (Wetlands International, 2006).

Ecology

In the Wadden Sea Red Knots feed on slightly muddy and sandy tidal flats, frequently including cockle beds (Smit and Wolff 1983). They feed in dense flocks often with several hundreds or thousands of individuals and represent mollusc specialists feeding on Baltic tellins (*Macoma balthica*), small blue mussels (*Mytilus edulis*) and small cockles (*Cerastoderma edule*). They also take small snails and crustaceans as Hydrobia, Crangon and Gammarus (Delany *et al*., 2009). Knots are faithful to their feeding places, but in areas with poor feeding conditions they move between more feeding sites (Spaans *et al*. 2009). The species aggregate during high tide in large, dense flocks of several thousand and even up to 50,000 individuals. During roosting they often stand in water near remote, sandy islands but they also roost near the mainland coast and on salt marshes (Smit and Wolff, 1983; Koffijberg *et al*., 2003).

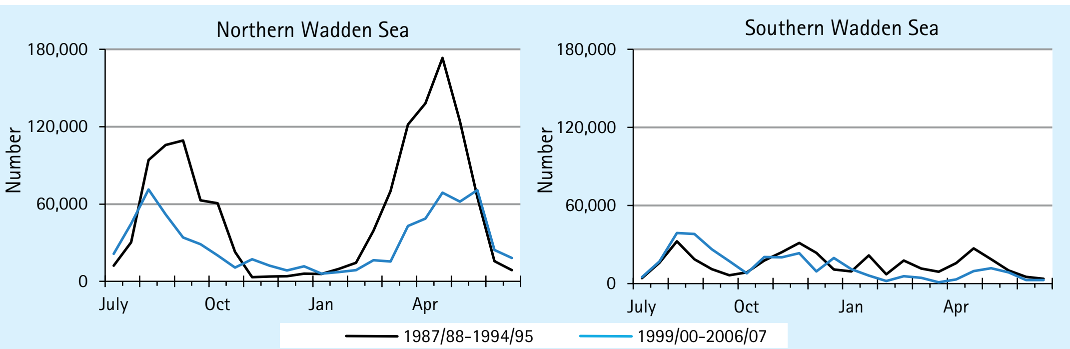
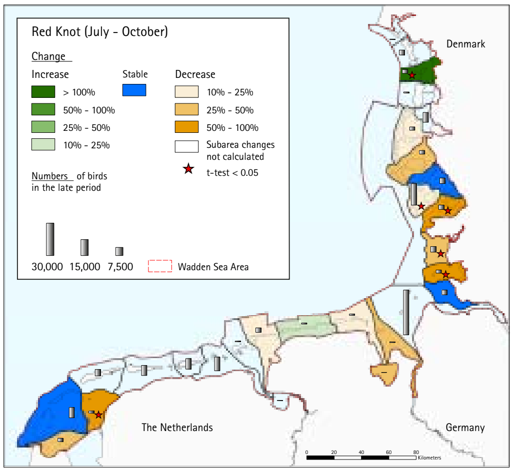


Figure 5.51
Phenology of Red Knot (mean bi-monthly number) in the Northern and the Southern Wadden Sea during the periods 1987/88-1994/95 and 1999/00-2006/07. Counted numbers from spring-tide-counting sites, no gap-filling.



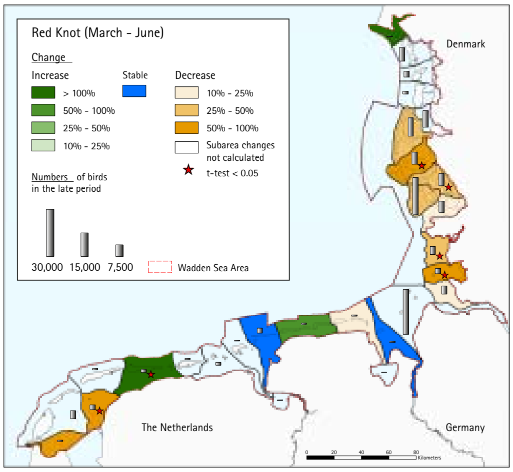


Figure 5.52
Distribution of Red Knot in the Wadden Sea during autumn (July-October) and spring (March-June) for the periods1987/88-1994/95 and 1999/00-2006/07. Changes between the two periods are indicated (colours) and numbers are given for the late period (bars). Asterisks indicate statistical significant differences in numbers (P <0.05).

Phenology

After the breeding season adult Knots, dominated by birds from Siberia (*C. c. canutus*), arrive in the Wadden Sea in July, followed by juveniles in August. Those Siberian birds stay for 4-6 weeks and without performing the wing-moult they continue their migration to the wintering grounds in Africa in August/September. During the same months birds from Canada/Greenland (*C. c. islandica*) stay especially in the Northern part of the Wadden Sea for wing moult, and the two sub-species form the peak number during August and September (Blew *et al.* 2005a). In October mainly birds from Canada/Greenland remain and numbers shift from the northern parts to the southern part of the Wadden Sea. Some tens of thousands of birds occur during winter also. Spring migration starts in February-March dominated by *C. c. islandica*, which build up peak numbers in April. They leave in early May. These are followed by a large influx of the *C. c. canutus*, which stay for 2-3 weeks, mainly in the Northern Wadden Sea and depart for the breeding grounds in Siberia in late May and early June (Engelmoer, 2008; Delany *et al.*, 2009).

Changes in the phenology had occurred between 1987/88-1994/95 and 1999/00-2006/07 (Fig. 5.51). During the early period in the Northern Wadden Sea the autumn maximum numbers were recorded in September, but in the late period a lower peak occurs in the beginning of August and thereafter numbers decrease continuously until October. During spring the peak numbers occur about one month later in the late period compared to the early period, and there is a similar delay in time when the Knots start to leave the Northern Wadden Sea; spring numbers seem to be overall lower. In the Southern Wadden Sea there is no difference in the timing of the autumn peaks between the early and the late period, but the birds prolong their stay by a month in the late period. During spring the time of the peak number is half a month later in the late compared to the early period. There are at least two possible reasons for these changes: a) that the number of *C. c. islandica* in particular had decreased (which fits with lower numbers in the Northern Wadden Sea during late autumn and early spring), or b) that the Knots' spring departure has become delayed during the 21 year study period. Of these two explanations, the first is probably the most reliable.

Photo: Klaus Günther

Distribution

During autumn and spring Knots occur in high numbers in sub-areas in Schleswig-Holstein and The Netherlands, and during spring in Schleswig-Holstein and Niedersachsen (Fig. 5.52). Between 1987/88-1994/95 and 1999/00-2006/07 significant decreases had occurred during autumn and spring in six and seven sub-areas in Schleswig-Holstein, and in two sub-area in The Netherlands. Stable or increasing numbers were recorded in Niedersachsen, and in one sub-area in both Denmark and The Netherlands numbers had increased significantly (Fig. 5.52).

Numbers

Maximum estimates of Knots are difficult to assess due to high imputed numbers for this very mobile species; counting results show high fluctuations and counting coverage for this species depends largely on the coverage of remote sands and areas potentially holding very large numbers. However, there is the tendency that autumn maximum estimates in the Northern Wadden Sea decrease from 270,000 to 178,000 comparing the early with the late period, and from 427,000 to 294,000 during spring (Appendix 1). For the Southern Wadden Sea estimates may not show this decrease. Yet phenology figures suggest a drop in numbers also for these regions (Fig. 5.51). Locally large numbers of Knots are notable in autumn and spring at Wurster Küste, NDS (58,500 and 40,400) and at Außensände–äußere Halligen-Pellworm, SH (20,400 and 33,000). These numbers are average numbers for the entire period.

The overall trend of the Knot in the Wadden Sea is stable in both the long (21 years) and the short term (10 years) (Fig 5.53). However, large variations occur in the different Wadden Sea parts. In Denmark comparably low numbers show a moderate increase in the long term and a strong increase in the short term. In both periods numbers are stable in The Netherlands but decreasing in Schleswig-Holstein, whereas in Niedersachsen numbers are stable during the long term and increasing during the short term.

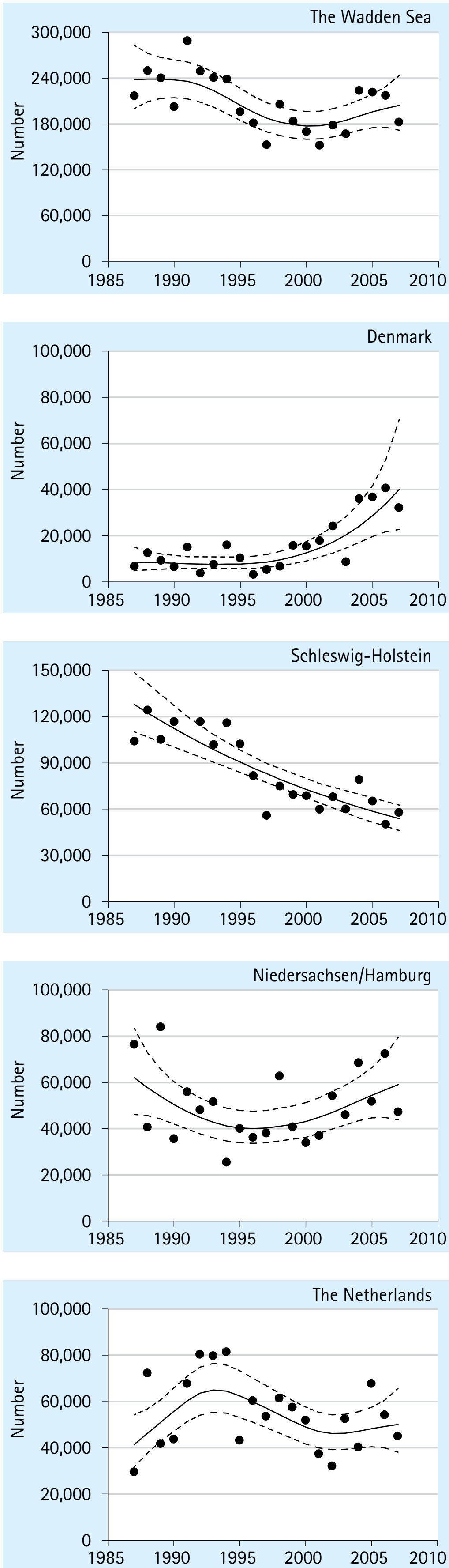


Figure 5.53
Trends of Red Knot in the International Wadden Sea (WS) and the four regions 1987/1988-2007/2008; dots represent annual averages; trendline calculated by Trendspotter (solid line) together with the ± 95 % confidence limits (dotted line).

Summary

Large parts of both flyway populations use the Wadden Sea. For *C. c. canutus* probably the whole population is present during both spring and autumn, and for *C. c. islandica* probably 75% is present during spring (Delany *et al.*, 2009). The species feeds on small molluscs, especially cockles and was affected by intense shellfish fisheries in The Netherlands before 2004, which removed the cockles, changed the sediment type and the invertebrate fauna leading to decreases in numbers there (Ens *et al.*, 2004, Kraan *et al.* 2009). However, the Knots are difficult to count due to very large aggregations, roosts on remote sandbanks and inaccessible islands and finally high variation in the use of individual sites, giving large variations in counting results. Reports from Germany show decreasing numbers of Knot (Blew *et al.*, 2005). This is important since most birds occur here. However, results from Denmark show increasing numbers (Laursen *et al.*, 2006), and fluctuating numbers during recent years in The Netherlands (Hustings *et al.*, 2009).

5.20 Sanderling

Calidris alba

04970

DK: Sandløber D: Sanderling NL: Drieteenstrandloper

Flyway population:	123,000
Breeding range:	North-East Canada, North and North-East Greenland, Svalbard and Central Siberia
1%:	1,200
Status:	Stable / Increasing?

Region	Overall trends	
	short-term 10 years	long-term 21 years
WS	↑	↑
DK	↑	↑
SH	▬	→
NDS/HH	→	→
NL	↑↑	↑↑

Seasons (month no.)		Early period 1987/88-1994/95	Late period 1999/00-2006/07	% of flyway population 1999/00-2006/07
		mean of 3 maximum estimates		
Breeding:	--			
Moult:	--			
Autumn:	(7, 8, 9, 10)	14,801	24,875	20.7
Winter:	(11, 12, 1, 2, 3)	7,535	16,462	13.7
Spring:	(4, 5, 6)	21,429	36,770	30.6

For details see species account Cormorant.

Population

Sanderlings have a circumpolar distribution, and the population visiting the Wadden Sea breeds in North-East Canada, North and North-East Greenland, Svalbard and Northern Siberia (Western Taimyr). It winters along the Atlantic coasts of Europe and in Western and Southern Africa. Within the wintering range, the southernmost birds are believed to be Siberian birds, whereas there is an almost complete overlap between the Greenland and Siberian birds on the other African wintering grounds (Delany *et al.*, 2009). The flyway population trend is stable or likely to be increasing (Wetlands International, 2006), whereas increasing numbers can potentially be attributed to improvements in count coverage (Delany *et al.*, 2009).

Ecology

Only a small proportion of the Sanderling flyway population (22%) visits the Wadden Sea. Here in autumn, winter and early spring (March-April) they prefer sandy beaches and high sands both as roosting and as feeding places. In May, birds are recorded mainly on tidal flats, muddy and sandy and they roost on high sands as well as on salt marshes along the mainland coasts, in southern Schleswig-Holstein especially (Koffijberg *et al.* 2003). When feeding on sandy beaches, Sanderlings take polychaetes and small crustaceans washed ashore and then feeding behaviour is typically fast running following the waves (Smit and Wolff, 1983). When feeding on muddy tidal flats they search actively by probing, similar to other calidris species.

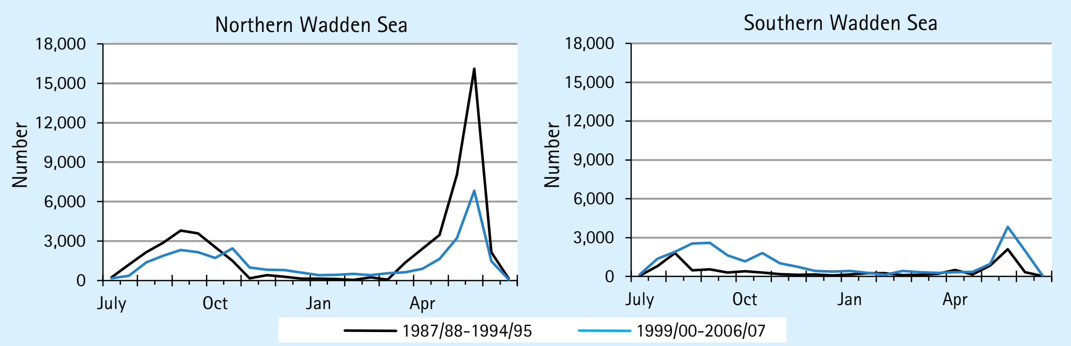


Figure 5.54
Phenology of Sanderling (mean bi-monthly number) in the Northern and the Southern Wadden Sea during the periods 1987/88-1994/95 and 1999/00-2006/07. Counted numbers from spring-tide-counting sites, no gap-filling.

Phenology

After the breeding period in the Arctic tundra, the adult birds return to the Wadden Sea in mid-July and numbers increase during August and peak in September when the juveniles also pass. The Siberian birds moult in Western Europe before large numbers continue the migration to their southern wintering grounds (Delany *et al.*, 2009). A smaller part of the population winters in the Wadden Sea, apparently unaffected by winter climate and thus it is an exception to most other species (Blew *et al.*, 2005a). The vast majority of Sanderlings is observed during the spring migration, which starts in March and increases to a peak number in a short time period in late May. At the end of May and beginning of June birds depart to the Arctic breeding grounds (Blew *et al.*, 2007).

Small changes in the phenology had occurred from 1987/88-1994/95 to 1999/00-2006/07 (Fig. 5.54). In the Northern Wadden Sea, Sanderlings arrive somewhat later during autumn and spring in the late compared to the early period. In the Southern Wadden Sea the autumn peak number has changed from early August in the early period to early September in the late period, and more of the birds stay in autumn in the late period. During spring the departure of many Sanderlings shifted from late May to early June in the late period. However, the time of the spring peaks did not change between the two periods in either the Northern or Southern Wadden Sea.

Distribution

Sanderlings occur particularly in sub-areas with sandy beaches, and are thus unevenly distributed in the Wadden Sea, with concentrations in the south-western parts of The Netherland and the northern parts of Denmark. A significant decrease is registered in the sub-area Trischen-Meldorfer Bucht in Schleswig-Holstein, formerly holding a large number of Sanderlings (Fig. 5.55). Stable or increasing numbers had occurred in six sub-areas distributed in both the Northern and Southern Wadden Sea, and in two of these the changes were significant.

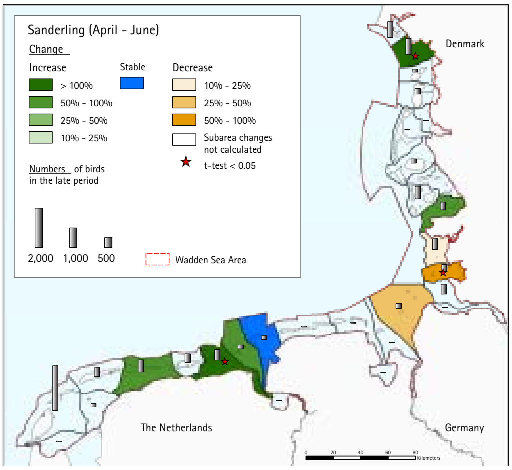


Figure 5.55 Distribution of Sanderling in the Wadden Sea during spring (April-June) for the periods1987/88-1994/95 and 1999/00-2006/07. Changes between the two periods are indicated (colours) and numbers are given for the late period (bars). Asterisks indicate statistical, significant differences in numbers (P <0.05).

Photo: Thorsten Krüger

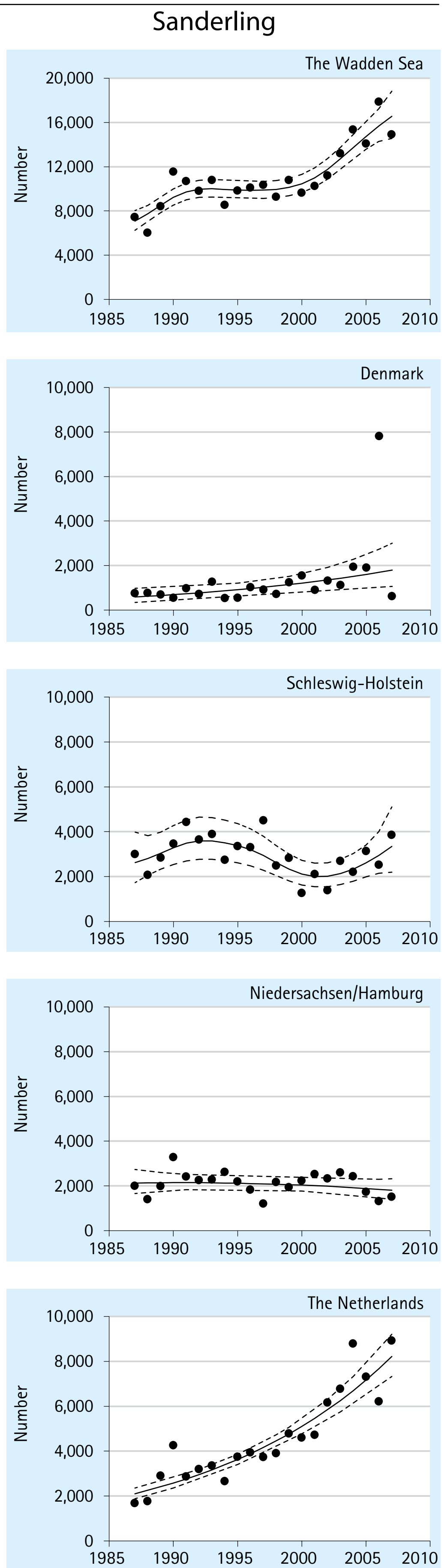


Figure 5.56
Trends of Sanderling in the International Wadden Sea (WS) and the four regions 1987/1988-2007/2008; dots represent annual averages; trendline calculated by Trendspotter (solid line) together with the ± 95 % confidence limits (dotted line).

Numbers

During autumn maximum numbers are estimated at some 8,000 both in the Northern and Southern Wadden Sea; however an increase to some 18,000 has been registered for the Southern Wadden Sea (Appendix 1). During winter, some 8,000 are estimated during the early and some 16,000 during the late period, with more than 50% of those in The Netherlands. During spring some 15,000 are estimated in the Northern Wadden Sea whereas in the Southern Wadden Sea estimates have increased from approx. 5,000 to peaks of some 17,000, with most of these being found in The Netherlands. Sub-areas with especially high numbers are Trischen-Meldorfer Bucht, SH (3,100, early period), Langli-Ho Bugt and Fanø-Sneum, DK (1,100; 1,100, late period), based on average numbers recorded in spring.

The overall trend for both the long (21 years) and the short term (10 years) is a moderate increase (Fig. 5.56). For both periods strong or moderate increasing numbers occur in The Netherlands, Schleswig-Holstein and Denmark with moderate increases or fluctuating numbers in Niedersachsen.

Summary

Sanderling numbers can be difficult to survey due to high peak numbers occurring during a short period in spring, often at remote sites. Fluctuations in numbers are large for Niedersachsen, where high numbers are recorded; however, the overall trends in the Wadden Sea are increasing, partly due to prolonged stay in the southern Wadden Sea. Special annual counts, not organised trilaterally, are made to improve the data for this species.

5.21 Curlew Sandpiper

Calidris ferruginea

DK: Krumnæbbet Ryle D: Sichelstrandläufer NL: Krombekstrandloper

05090

Flyway population:	1,000,000
Breeding range:	Arctic Siberia
1%:	10,000
Status:	Strong increase

Region	Overall trends	
	short-term 10 years	long-term 21 years
WS	↑	↑
DK	–	–
SH	↑	↑
NDS/HH	↓	↓
NL	–	–

Seasons (month no.)	Early period 1987/88-1994/95 (mean of 3 maximum estimates)	Late period 1999/00-2006/07 (mean of 3 maximum estimates)	% of flyway population 1999/00-2006/07
Breeding: --			
Moult: --			
Autumn: (7, 8, 9, 10)	10,812	13,544	1.4
Winter: --			
Spring: (4, 5, 6)	105	1,656	0.2

For details see species account Cormorant.

Population

This species has a large flyway population of 1,000,000 birds, of which only a small fraction (2-3%) visits the Wadden Sea (Wetlands International, 2006; Blew *et al.*, 2007). It breeds in Northern Siberia and most of the population migrates on a broad front over land to the Black Sea and the Mediterranean to Western Africa, to winter. The total population is increasing (Wetlands International, 2006) or even showing a strong increase (Delany *et al.*, 2009).

Ecology

In the Wadden Sea, Curlew Sandpipers feed on muddy tidal flats; especially those in estuaries with brackish water and in freshwater reservoirs. Normally they roost among other shorebirds on salt marshes, sandbars or inland wetlands. Curlew Sandpipers prefer ragworms, but probably also eat crustaceans like Corophium. Since they often occur together with Dunlins, it is supposed that their food items are similar (Smitt and Wolff, 1983).

Phenology

The Curlew Sandpiper visits the Wadden Sea during autumn migration, with the adult males arriving in early July followed by the adult females in late July. The juveniles follow in late August when their population peaks for a short time (Thorup, 2006; Delany *et al.*, 2009). During September they leave for the wintering quarters. Only very few birds pass the Wadden Sea on spring migration in May (Blew *et al.* 2005a).

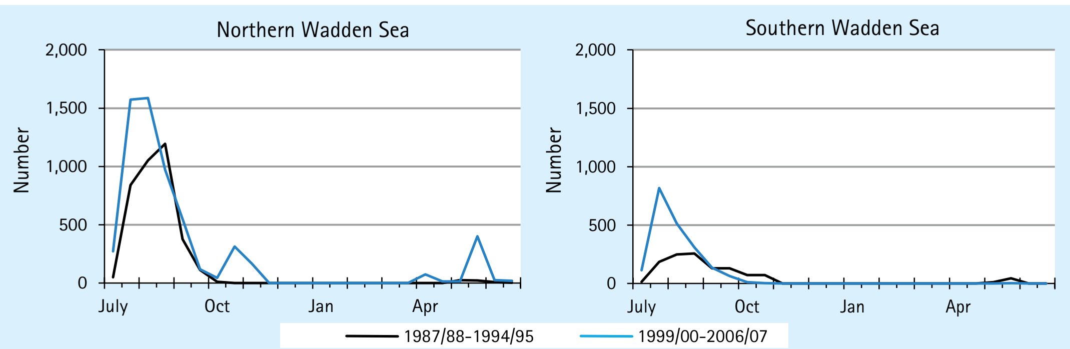


Figure 5.57
Phenology of Curlew Sandpiper (mean bi-monthly number) in the Northern and the Southern Wadden Sea during the periods 1987/88-1994/95 and 1999/00-2006/07. Counted numbers from spring-tide-counting sites, no gap-filling.

It seems that Curlew Sandpipers arrive earlier during the late period than during the early period, but this assessment is problematic due to rather low numbers and the difficulty in covering this species during its short staging period (Fig. 5.57).

Photo: Gundolf Reichert

Numbers

During autumn the mean peak estimates have increased from 10,800 to 13,500 comparing the early with the late period (Appendix 1), with a large proportion of these numbers being registered in Schleswig-Holstein and recently also in The Netherlands. No birds are staying during winter and only some hundreds are registered during spring in the former period, and up to 1,700 in the late period. The majority of Curlew Sandpiper are recorded at Friedrichskoog-Brunsbüttel, SH (3,100), followed by Ameland-Friese Kust Oost, NL (750) and Trischen-Meldorfer Bucht, SH (300), based on average numbers.

The overall trend of the species is moderately increasing both in the long (21 years) and short (10 years) term (Fig. 5.58). However, the trend is uncertain for the different parts except for a moderate increase in the Schleswig-Holstein Wadden Sea, which holds a large proportion of the birds. The species is only present during a very short time window and thus its peak number can easily be missed, causing variations between years.

Summary

The Curlew Sandpiper has a large population of which only a small fraction visits the Wadden Sea. The species occurs during a short period during July/August, and in a small number of sites, thus the species is difficult to cover in the Trilateral Monitoring Program. Increases are seen in the Schleswig-Holstein Wadden Sea, but the species fluctuates in Denmark and The Netherlands and decreases in Niedersachsen. Recent results from the Dutch Wadden Sea show an uncertain trend (van Roomen *et al.*, 2007), and from Denmark increasing numbers are reported recently (Thorup, 2006).

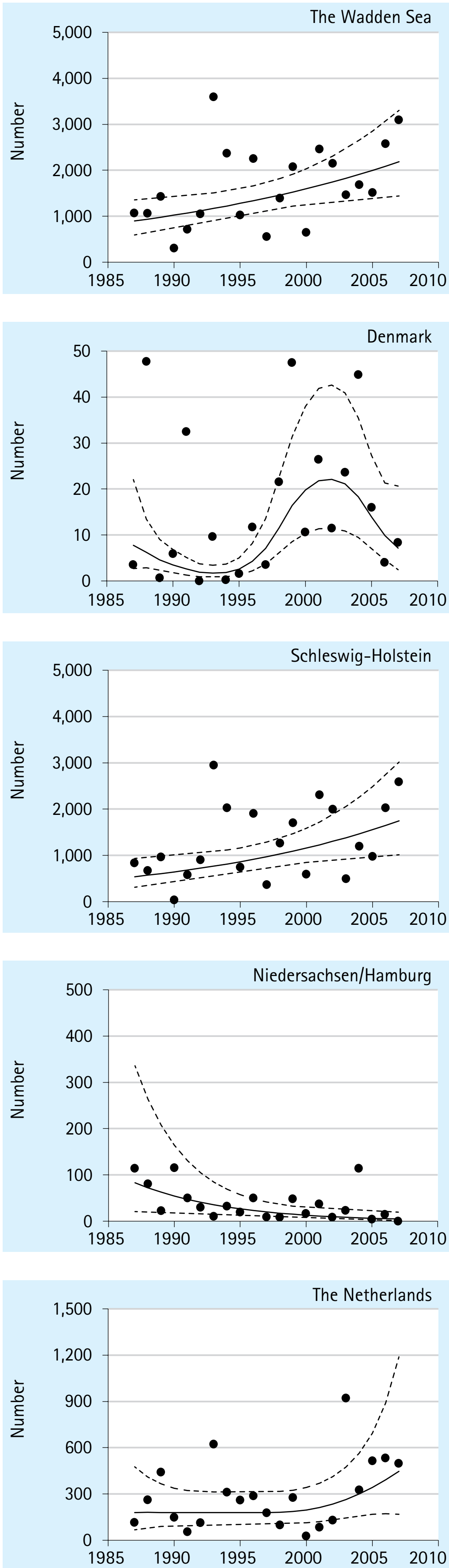


Figure 5.58
Trends of Curlew Sandpiper in the International Wadden Sea (WS) and the four regions 1987/1988-2007/2008; dots represent annual averages; trendline calculated by Trendspotter (solid line) together with the ± 95 % confidence limits (dotted line).

5.22 Dunlin

Calidris alpina

05120

DK: Almindelig Ryle D: Alpenstrandläufer NL: Bonte Strandloper

Flyway population:	*C. a. alpina*: 1,330,000 *C. a. schinzii*: 940,000-960,000 *C. a. schinzii*: 3,300-4,100 *C. a. schinzii*: 23,000-26,000
Breeding range:	*C. a. alpina*: North Scandinavia, North Russia and North-West Siberia *C. a. schinzii*: Iceland *C. a. schinzii*: Baltic and South Scandinavia *C. a. schinzii*: Britain and Ireland
1%:	*C. a. alpina*: 13,300 *C. a. schinzii*: 9,500 *C. a. schinzii*: 40 *C. a. schinzii*: 250
Status:	*C. a. alpina*: Stable *C. a. schinzii*: Stable *C. a. schinzii*: Decreasing *C. a. schinzii*: Decreasing (Delany *et al.*, 2009)

Region	Overall trends	
	short-term 10 years	long-term 21 years
WS	→	→
DK	↓	↓
SH	↓	↓
NDS/HH	→	→
NL	↑	↑

Seasons (month no.)		Early period 1987/88-1994/95	Late period 1999/00-2006/07	% of flyway population 1999/00-2006/07
		mean of 3 maximum estimates		
Breeding:	--			
Moult:	--			
Autumn:	(7, 8, 9, 10, 11)	1,236,333	1,153,879	86.8
Winter:	(12, 1, 2)	299,121	390,001	29.3
Spring:	(3, 4, 5)	1,073,707	946,807	71.2

For details see species account Cormorant.

Population

There are two subspecies of which the *C. a. alpina* population of 1,330,000 birds is stable. It breeds in Northern Scandinavia and Northern Russia and winters in Western Europe to the Mediterranean; most of the birds visiting the Wadden Sea belong to this subspecies. The *C. a. schinzii* population is divided into three geographical sub-populations breeding on Iceland, in the Baltic and Britain/ Ireland. The Iceland and Baltic sub-population winters in South-West Europe and North-West Africa. The Britain/Ireland subpopulation winters also in South-West Europe but mostly in North-Western Africa. The population sizes are very different from the stable Iceland sub-population counting 940,000-960,000 birds, over the decreasing Britain/Ireland sub-population of some 23,000-26,000 birds to the small decreasing Baltic sub-population of 3,300-4,100 birds (Wetlands International, 2006). Of these three schinzii-populations, only the *C. a. schinzii*

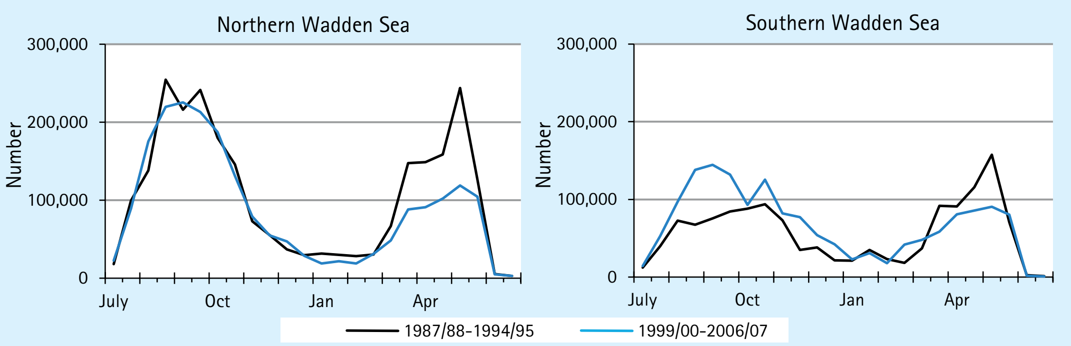


Figure 5.59
Phenology of Dunlin (mean bi-monthly number) in the Northern and the Southern Wadden Sea during the periods 1987/88-1994/95 and 1999/00-2006/07. Counted numbers from spring-tide-counting sites, no gap-filling.

Baltic sub-species breeds in the Wadden Sea. It consists of only 25 pairs, most of which breed in Denmark. The number had decreased from 51 pairs in 1991 (Koffijberg *et al.* 2006).

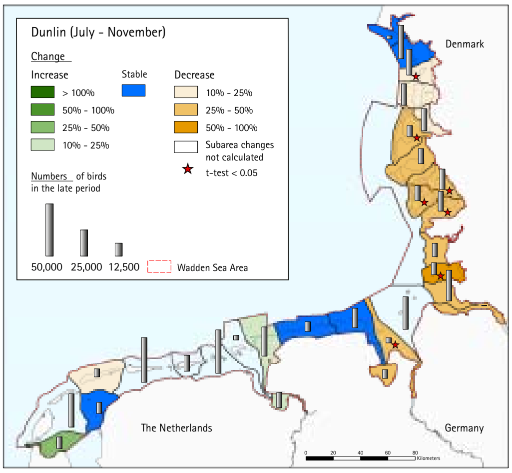
Ecology

In the Wadden Sea the Dunlins use the muddy and sand-mixed flats for feeding, and they prey on Nereis, Corophium, Hydrobia and other small species of crustaceans and molluscs (Smit and Wolff, 1983). They roost during high tide in huge flocks on high sands and along salt marshes.

Phenology

Dunlins in the Wadden Sea are mainly birds of the sub-species *C. a. alpina*. During autumn adult birds arrive in the Wadden Sea in July and in early August, and most of these stay to moult (Blew *et al.*, 2005a). The juveniles follow during August and thus peak numbers occur in August and September. During October and November numbers decrease after the adults have completed the post-breeding moult and move to the wintering quarters together with the juveniles (Meltofte *et al.*, 1994). During winter, numbers are low and strongly depend on the severity of the winter; in mild winters the birds are evenly distributed in the different parts of the Wadden Sea, whereas in severe winters the northern and eastern parts are almost deserted (Meltofte *et al.*, 1994). In spring, birds move into the Wadden Sea from late February onwards; these are birds wintering further west and south in Europe. Birds staging in spring are moulting to breeding plumage and build up body reserves in the Wadden Sea. Numbers increase during March and April and are followed by a new influx in early May. It is supposed that the birds arriving in March and April are European sub-Arctic breeders, and those staging in May are breeding in Siberia (Meltofte *et al.* 1994; Clark, 2002; Engelmoer, 2008).

There are no obvious changes in the Northern Wadden Sea in the Dunlin's autumn phenology between 1987/88-1994/95 and 1999/00-2006/07 (Fig. 5.59). However, in the Southern Wadden Sea the autumn peak numbers occur earlier (August) and the birds stay longer during autumn in the late period compared the early period with peak numbers in October. During spring in both the Northern and Southern Wadden Sea the late spring peak is less pronounced. However, the final departure has not changed.



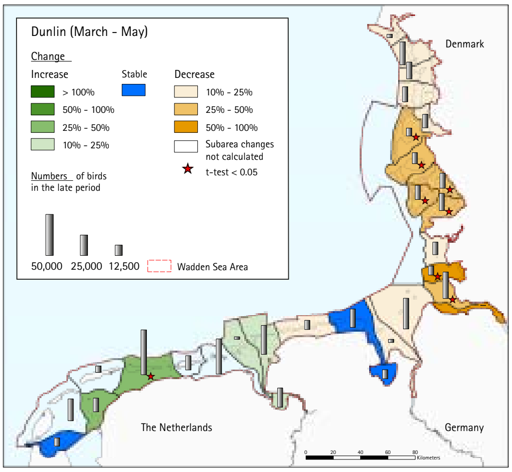
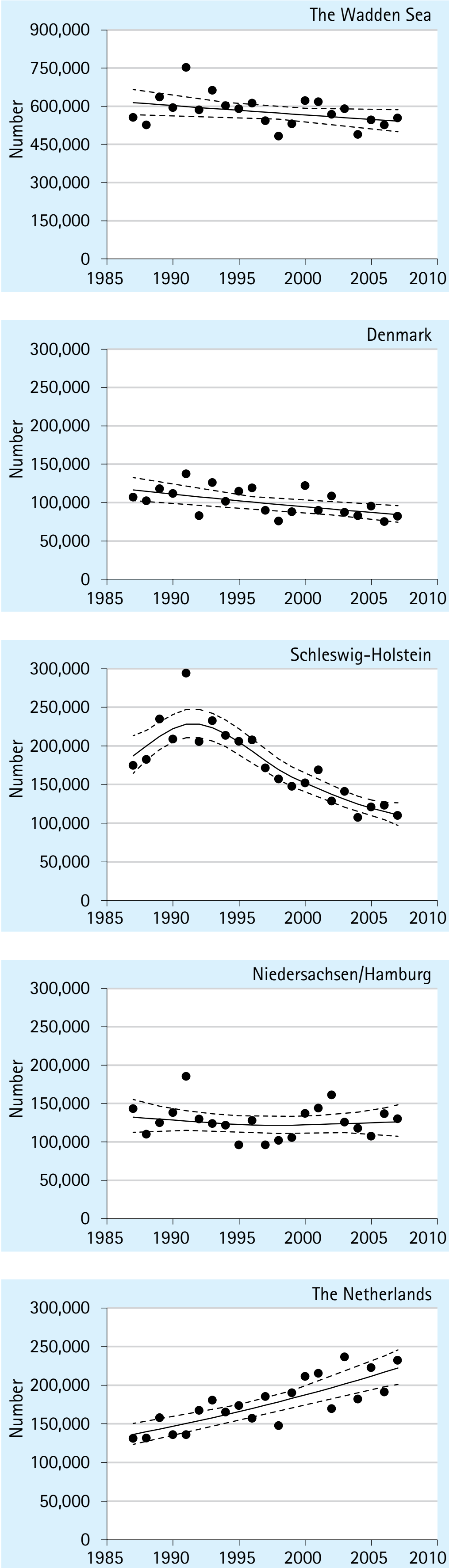


Figure 5.60
Distribution of Dunlin in the Wadden Sea during autumn (July-November) and spring (March-May) for the periods1987/88-1994/95 and 1999/00-2006/07. Changes between the two periods are indicated (colours) and numbers are given for the late period (bars). Asterisks indicate statistical significant differences in numbers (P <0.05).

Distribution

The Dunlins are widely distributed throughout the Wadden Sea, with high numbers in most sub-areas (Fig. 5.60). However, changes occurred between 1999/88-1994/95 and 1999/00-2006/07. During autumn, increasing or stable numbers had occurred in sub-areas in Niedersachsen and in The Netherlands, although none significantly. Six sub-areas with significantly decreasing numbers are situated in Schleswig-Holstein and Denmark. During spring a similar pattern was found, with decreasing numbers in sub-areas in Schleswig-Holstein and Denmark. Of these, seven changes were significant.

Figure 5.61
Trends of Dunlin in the International Wadden Sea (WS) and the four regions 1987/1988-2007/2008; dots represent annual averages; trendline calculated by Trendspotter (solid line) together with the ± 95 % confidence limits (dotted line).



Numbers

During autumn the Dunlin maximum estimates reached up to 722,000 during the early period in the Northern Wadden Sea, dropping to some 558,000 during the late period (Appendix 1); in turn, autumn estimates in the Southern part have risen from 493,000 to 641,000 (Fig. 5.61). During winter, estimates decreased considerably with the majority being registered in The Netherlands. During spring the maximum estimates have decreased from 617,000 to 432,000 in the Northern part; in the Southern part they increased from 483,000 to 597,000 again. Locally, large average numbers are recorded during autumn and spring in Ameland-Friese Kust Oost, NL (59,000 and 75,000), Rottum-Groningse Kust, NL (57,300 and 59,000), Fanø-Sneum, DK (43,700 and 38,500) and during spring in Leybucht und Inseln, NDS (48,700).

The overall trend in the Wadden Sea is stable for both the long (21 years) and the short term (10 years) (Fig. 5.61). This general trend is a mixture of positive trends in The Netherlands, a stable trend in Niedersachsen and negative trends in both the Schleswig-Holstein and the Danish Wadden Sea, reflecting the decreasing numbers found in these parts. The trends in the four Wadden Sea parts were consistent during the long and short term.

Summary

The trends for the flyway populations of the two sub-species (*C. a. alpina* and *C. a. schinzii*) are stable, as is the overall trend in the Wadden Sea. This is important for this species, since almost 75 % of the flyway population stays here during spring to moult and build up body reserves. Increasing numbers were found during autumn in the Southern and a large decrease in numbers during spring in the Northern Wadden Sea. Reports from Denmark show a stable trend, but decreases were found in Germany and moderate increases in The Netherlands (Laursen and Frikke, 2006; Blew *et al.*, 2005b; van Roomen *et al.* 2007).

Photo: Stefan Pfützke / green-lens.de

5.23 Ruff

Philomachus pugnax

DK: Brushane D: Kampfläufer NL: Kemphaan

05170

Flyway population:	1,000,000-1,500,000
Breeding range:	North and Central Europe, North-West Russia, West and Central Siberia
1%:	12,500
Status:	Decreasing

Region	Overall trends	
	short-term 10 years	long-term 21 years
WS	↓↓	↓↓
DK	↓↓	↓↓
SH	↓↓	↓↓
NDS/HH	↓↓	↓↓
NL	→	→

Seasons (month no.)		Early period 1987/88-1994/95	Late period 1999/00-2006/07	% of flyway population 1999/00-2006/07
		mean of 3 maximum estimates		
Breeding:	--			
Moult:	--			
Autumn:	(7, 8, 9, 10)	5,507	5,282	0.4
Winter:	--			
Spring:	(3, 4, 5)	19,045	2,318	0.2

For details see species account Cormorant.

Population

Ruffs breed in Central and Northern Europe, North-West Russia, Western and Central Siberian, and winters in Western Africa. The population of 1,000,000-1,500,000 birds is decreasing (Wetlands International, 2006). Ruffs breed in the Wadden Sea but only 33 females were recorded in 2001, a severe decrease from 242 females in 1991 (Koffijberg *et al.*, 2006).

Ecology

During migration Ruffs occur inland on muddy margins of lakes, pools, rivers, marshes and flooded areas as well as freshly mown and grazed grasslands. In saline areas they use shorelines, *e.g.* muddy creeks in salt marshes and occasionally tidal mudflats and coastal lagoons (Delany *et al.*, 2009). They feed on insects and other invertebrates, but also eat seeds (Cramp and Simmons, 1983). Due to their preference for inland areas, only a small part of the population (2%) is counted in the Wadden Sea cooperation area (Blew *et al.*, 2007).

Phenology

The adult males leave the breeding ground first, from late June to early July, followed by females from mid July and juveniles in late July to August. They appear in the Wadden Sea from mid June on and peak in July-August (Blew *et al.*, 2005a). The Ruffs moult while they stay in Western Europe. Only very few Ruff stay during November to March, and these are predominantly males (Delany *et al.*, 2009). The northward migration starts from Africa in mid February for

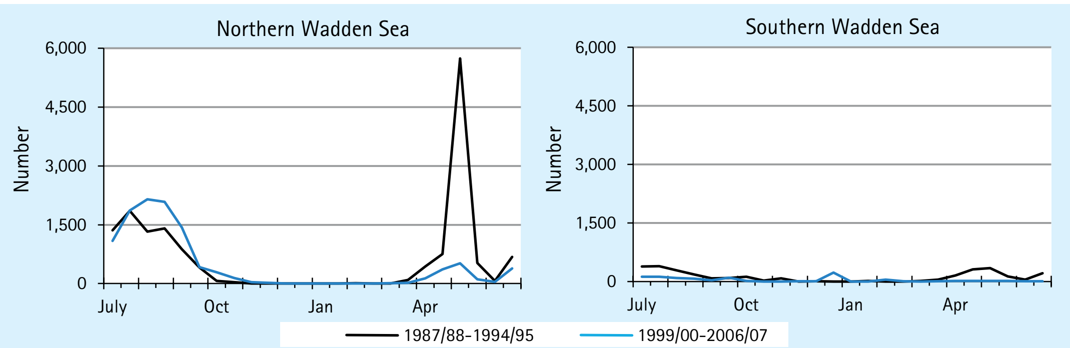


Figure 5.62
Phenology of Ruff (mean bi-monthly number) in the Northern and the Southern Wadden Sea during the periods 1987/88-1994/95 and 1999/00-2006/07. Counted numbers from spring-tide-counting sites, no gap-filling.

males and a month later for females. They start passing the Wadden Sea at the end of April and continue throughout May. Those birds had winter quarters in sub-Saharan Africa in contrast to birds wintering in South Europe and North Africa that migrate in late March and do not occur in the Wadden Sea area (Delany *et al.*, 2009).

There are small changes in the Ruff's phenology between 1999/88-1994/95 and 1999/00-2006/07. During autumn in the northern Wadden Sea the peak number occurs somewhat earlier in the early period compared to the late period. In turn, the spring peak has been considerably higher in the early period (Fig. 5.62).

Photo: Jens Enemark

Numbers

During autumn mean peak estimates are 3,500 Ruffs in the Northern and 1,800 in the Southern Wadden Sea. However, spring estimates had been up to 19,000 in the early period. Those estimates have decreased between 1999/88-1994/95 and 1999/00-2006/07 particularly during spring in the Northern Wadden Sea (Appendix 1). High numbers of Ruffs are locally recorded at Innere Halligen-Festland, SH (700), Eiderstedt Süd-Eider-Büsum, SH (300) and in Trischen-Meldorfer Bucht, SH (300), based on average numbers

The overall trend is strongly decreasing during both the long (21 years) and the short term (10 years) in the entire Wadden Sea and its regions, with the exception of a stable trend of low numbers in The Netherlands during the recent 10 year (Fig. 5.63).

Summary

Only a very small fraction of the Ruff population migrates through the Wadden Sea. It is strongly decreasing, apparently following the trend of the flyway population, but probably also due to change in the migratory pattern from Frisian staging areas to Belarus (Rakhimverdiev *et al.*, in press). The species is difficult to monitor due to nomadic movements, dependent probably on feeding possibilities and weather, and thus numbers can be highly variable from year to year, *e.g.* in Margrethe Kog in southern Denmark up to 17,000 Ruffs were counted in May 1989 and only 150 birds in the years after (Laursen *et al.*, 2009). In Germany numbers are also reported as decreasing (Blew *et al.*, 2005b).

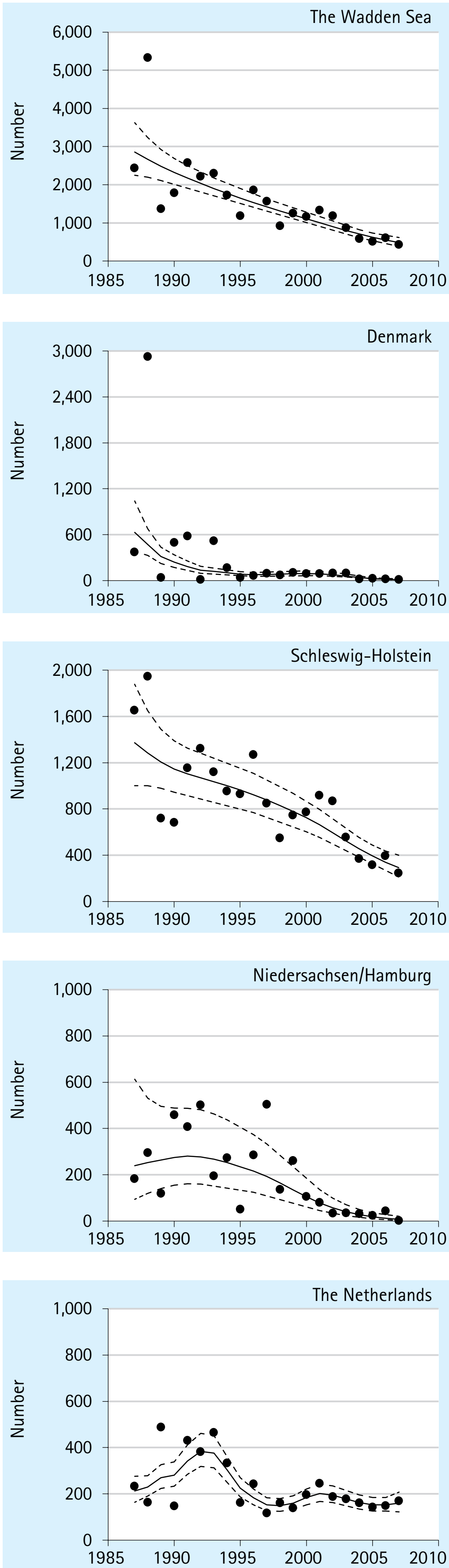


Figure 5.63
Trends of Ruff in the International Wadden Sea (WS) and the four regions 1987/1988-2007/2008; dots represent annual averages; trendline calculated by Trendspotter (solid line) together with the ± 95 % confidence limits (dotted line).

5.24 Bar-tailed Godwit

Limosa lapponica

05340

DK: Lille kobbersneppe D: Pfuhlschnepfe NL: Rosse Grutto

Flyway population:	*L. l. lapponica*: 120,000 *L. l. taymyrensis*: 600,000	
Breeding range:	*L. l. lapponica*: High arctic Scandinavia and North Russia *L. l. taymyrensis*: Northern central Siberia	
1%:	*L. l. lapponica*: 1,200 *L. l. taymyrensis*: 6,000	
Status:	*L. l. lapponica*: Stable *L. l. taymyrensis*: Decreasing	

Region	Overall trends	
	short-term 10 years	long-term 21 years
WS	↑	↑
DK	↑	→
SH	↓	↓
NDS/HH	→	→
NL	↑	↑

Seasons (month no.)		Early period 1987/88-1994/95	Late period 1999/00-2006/07	% of flyway population 1999/00-2006/07
		mean of 3 maximum estimates		
Breeding:	--			
Moult:	--			
Autumn:	(7, 8, 9, 10)	126,709	151,762	25.3
Winter:	(11, 12, 1, 2)	52,564	85,713	14.3
Spring:	(3, 4, 5, 6)	367,066	347,958	58.0

For details see species account Cormorant.

Population

Two populations of Bar-tailed Godwits pass through the Wadden Sea during migration. The nominate sub-species breeds in high arctic Scandinavia and Northern Russia, and winters in coastal Western Europe and North-West Africa. The population is 120,000 birds and stable. The *L. l. taymyrensis* breeds in Western and Central Siberia, passes Western Europe and winters in coastal West and South-West Africa. This sub-population counts 600,000 birds and is decreasing (Wetlands International, 2006).

Ecology

In the Wadden Sea the Bar-tailed Godwits often feed on sandy sediments, but also on muddy tidal flats and mussel beds. They follow the water edges of the rising tide searching for food. The dominant prey is Neries, but Corophium and Macoma are also taken. During high tide they concentrate in large flocks of thousands of birds in open sandy areas near the water edge or they stand roosting in the water. They also roost on the edge of the salt marshes and in The Netherlands also on beaches (Smit and Wolff, 1983; Koffijberg *et al.*, 2003).

Phenology

Both populations reach the Wadden Sea in autumn via the Baltic Sea (Delany *et al.*, 2009). Adult birds arrive in mid July and stay until mid August, followed by the juveniles during September-October. Although these birds belong to both sub-populations, they are dominated by birds from Taimyr during July-August (Engel-

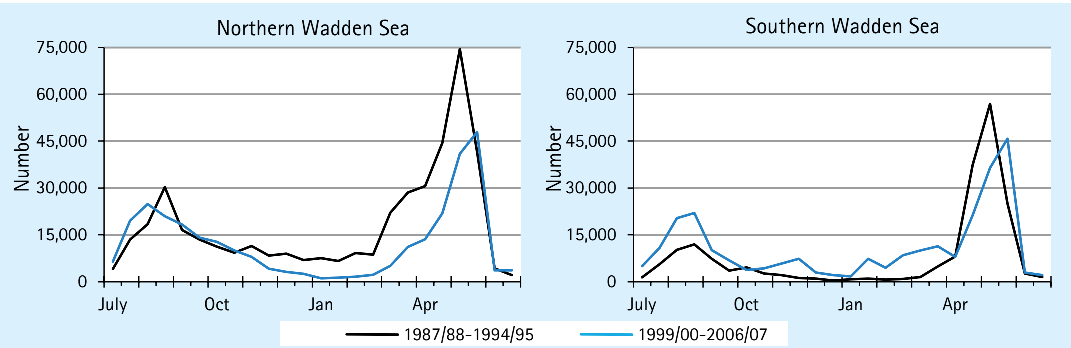
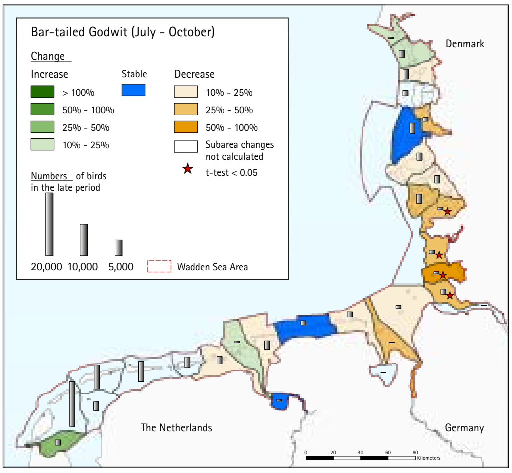


Figure 5.64
Phenology of Bar-tailed Godwit (mean bi-monthly number) in the Northern and the Southern Wadden Sea during the periods 1987/88-1994/95 and 1999/00-2006/07. Counted numbers from spring-tide-counting sites, no gap-filling.

moer, 2008). In September-October the North-European *L. l. lapponica* increase and during mid winter they make up 80%. Birds wintering in Africa, mainly *L. l. taymyrensis* stay only a short time in July-August in the Wadden Sea to build up fat reserves for the further migration. In turn, the European winterers, mainly *L. l. lapponica*, stay through the autumn to moult (Meltofte *et al.*, 1994). Thus the numbers in the Wadden Sea gradually decrease during autumn to a minimum in late winter (Blew *et al.*, 2005a). The spring migration starts in February when the European winterers return to the Wadden Sea, and in late April and beginning of May the Africa winterers (*L. l. taymyrensis*) arrive and during the first half of May both populations are present in the Wadden Sea. In total they represent about 58% of the flyway population. While staging in the Wadden Sea, the two populations are probably geographically separated such that the *L. l. taymyrensis* population stays along the mainland coast and the *L. l. lapponica* near the islands (Scheiffarth *et al.*, 2002).

The Bar-tailed Godwit shows changes in phenology between 1987/88-1994/95 and 1999/00-2006/07 (Fig. 5.64). In both the Northern and Southern Wadden Sea the autumn peak numbers occur somewhat earlier in the late period than the first period. During spring in both the Northern and Southern Wadden Sea, the peak occurred later in the late period compared to the early period. However, this change in phenology can be due to lower numbers in the *L. l. taymyrensis* sub-population that passes the Wadden Sea during late April and early May, the period that shows low numbers during the late period. Thus the changes observed in phenology are propably due to low numbers during the first part of the spring migratory period, instead of true changes in phenology.

Photo: Christian Gelpke / green-lens.de



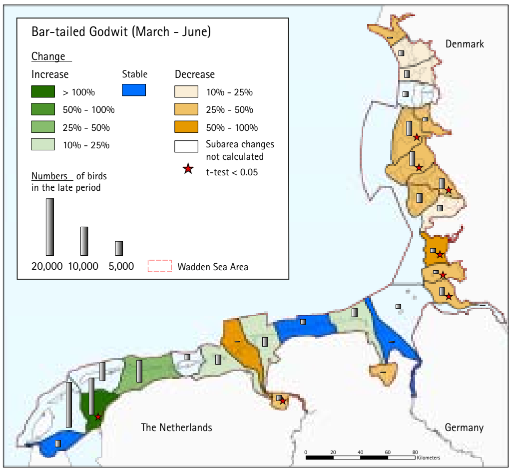


Figure 5.65 Distribution of Bar-tailed Godwit in the Wadden Sea during autumn (July-October) and spring (March-June) for the periods1987/88-1994/95 and 1999/00-2006/07. Changes between the two periods are indicated (colours) and numbers are given for the late period (bars). Asterisks indicate statistical significant differences in numbers (P <0.05).

Distribution

The Bar-tailed Godwits are distributed all over the Wadden Sea with highest numbers in The Netherlands during autumn, and during spring also in Schleswig-Holstein (Fig. 5.65). Between 1987/88-1994/95 and 1999/00-2006/07 numbers during autumn (July-October) had been stable or increased in sub-areas in The Netherlands, Niedersachsen and Denmark, although none significantly. However, decreases had occurred in seven sub-areas in Schleswig-Holstein. Of these, four were significant. During spring (March-June) a similar pattern was found, increasing numbers in Niedersachsen and The Netherlands although with a few exceptions. However, decreasing numbers were found in 12 sub-areas in Schleswig-Holstein and Denmark, of these six were significant.

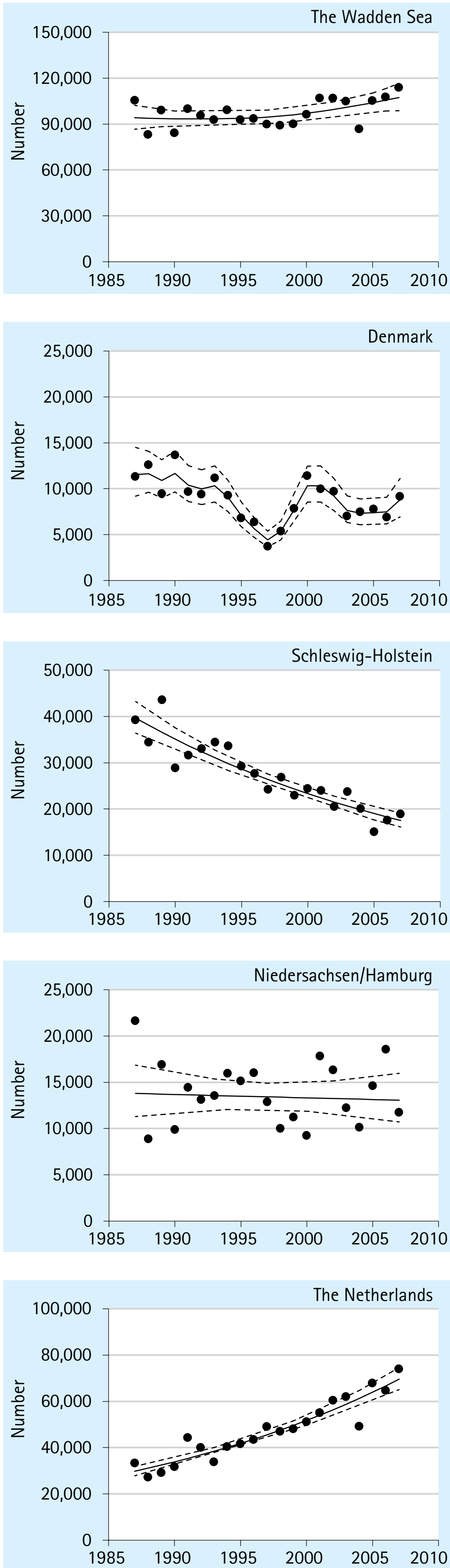


Figure 5.66
Trends of Bar-tailed Godwit in the International Wadden Sea (WS) and the four regions 1987/1988-2007/2008; dots represent annual averages; trendline calculated by Trendspotter (solid line) together with the ± 95 % confidence limits (dotted line).

Numbers

During autumn maximum numbers slightly increased from some 127,000 birds in the early to 152,000 in the late period in the entire Wadden Sea, with decreasing numbers in the Northern Wadden Sea and increasing numbers in the Southern part (Appendix 1). Winter maximum numbers also increased from some 52,000 in the early to 86,000 in the late period. Spring maximum estimates are considerably higher with some 350,000 in the entire Wadden Sea, but again the numbers decreased in the Northern and increased in February-March in the Southern Wadden Sea. Locally, most Bar-tailed Godwits were recorded during autumn and spring at Texel-Vlieland, NL (20,500 and 22,900), Terschelling, NL (11,000 and 9,200) and during spring in Griend-Friese Kust west, NL (18,900), based on average numbers.

The overall trend in the Wadden Sea is slightly increasing during both the long (21 years) and the short term (10 years) (Fig. 5.66). However, this trend is a mixture of considerably different trends in the Wadden Sea regions: clearly increasing trends in The Netherlands are contrasting to clearly decreasing trends in Schleswig-Holstein, consistent both for the short- and the long-term. Stable trends are reported for Niedersachsen. For the Danish Wadden Sea the trend is stable during the long term, but increasing during the short term with a low number in 1997.

Summary

The Wadden Sea is a key site for Bar-tailed Godwits of two flyway populations. It supports more than half of the flyway population during spring, when birds are fattening before their non-stop flight to the breeding grounds. Overall, numbers in the Wadden Sea are increasing, but there are regional differences. Recent counts in The Netherlands and Denmark (in spring) show increasing trends for the species (Husting *et al.*, 2009; Laursen and Frikke, 2006), whereas in Germany the trend was strongly decreasing in spring and moderately decreasing during autumn (Blew *et al.*, 2005b).

Numenius phaeopus

DK: Lille regnspove D: Regenbrachvogel NL: Reenwulp

05380

Flyway population:	190,000-340,000
Breeding range:	Fennoscandia, Baltic, North-West Russia and Greenland
1%:	2,700
Status:	Stable?

Region	Overall trends	
	short-term 10 years	long-term 21 years
WS	→	↓
DK	↓	↓
SH	→	→
NDS/HH	↓	↓
NL	–	↑

Seasons (month no.)		Early period 1987/88-1994/95	Late period 1999/00-2006/07	% of flyway population 1999/00-2006/07
		mean of 3 maximum estimates		
Breeding:	--			
Moult:	--			
Autumn:	(7, 8, 9)	2,210	3,857	1.4
Winter:	--			
Spring:	(3, 4, 5)	1,389	3,857	0.5

For details see species account Cormorant.

Population

Whimbrels breed in Fennoscandia, the Baltic States and North-Western Russia with a population of 190,000-340,000 birds that is probably stable. They winter in West Africa south to Angola, with very few in South-West Europe (Wetlands International, 2006).

Ecology

A tiny fraction (about 1%) of the flyway population occurs in the Wadden Sea (Blew *et al.*, 2007a), since a large number of birds migrate and stay inland feeding in fresh water wetlands, meadows and heathlands. In coastal habitats they forage on intertidal mudflats, creeks and salt marshes (Delany *et al.*, 2009).

Phenology

In the Wadden Sea adults arrive from mid June onwards and numbers peak in mid to late July. Juveniles arrive a bit later, from late July to early August (Blew *et al.*, 2005a). They have a short stopover and leave for the wintering quarters in August, without building up large concentrations on staging sites and they probably flight directly to *e.g.* Mauritania (Delany *et al.*, 2009). In spring the peak passage takes place in late April and early May, and numbers are much smaller than during autumn. There are no clear changes in the phenology between 1987/88-1994/95 and 1999/00-2006/07, yet the naturally small spring peaks had been higher during the early than during the late period (Fig. 5.67).

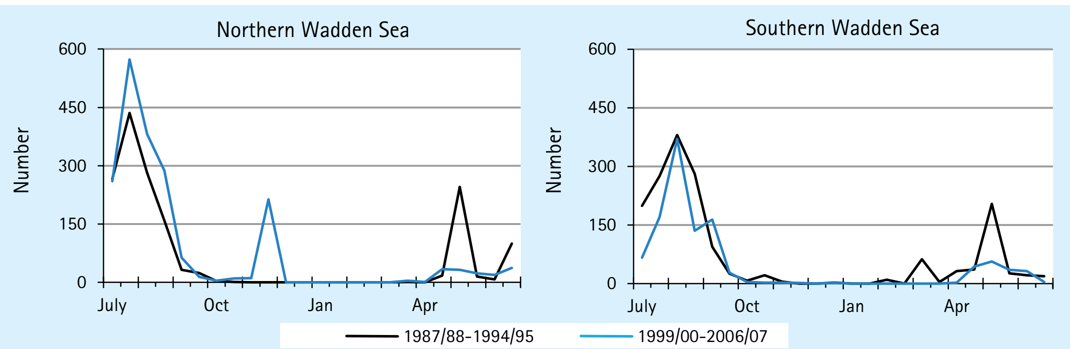


Figure 5.67 Phenology of Whimbrel (mean bi-monthly number) in the Northern and the Southern Wadden Sea during the periods 1987/88-1994/95 and 1999/00-2006/07. Counted numbers from spring-tide-counting sites, no gap-filling.

Photo: Bo Lassen Christiansen

Numbers

Whimbrel occurs only in small numbers in the Wadden Sea. During autumn the maximum estimates in the Northern parts are up to 1,000 birds and some 3,200 in the Southern Wadden Sea (Appendix 1). The species is not present during winter, but during spring up to 1,300 are estimated. Most Whimbrels were locally counted during autumn in Ameland-Friese Kust Oost-, NL (350), in Rottum-Groningse Kust, NL (200) and in Sylt-Rickelsbüller Koog, SH (150), based on average numbers.

The overall trend for the Wadden Sea numbers is a decrease during the long term (21 years) and a stable trend during the short term (10 years) (Fig. 5.68). However, these general trends are common denominators of antagonistic trends in the different parts of the Wadden Sea, as decreases take place in Denmark and Niedersachsen, stable numbers in Schleswig-Holstein and increasing trend during the long term in The Netherlands, but fluctuating numbers during the short term.

Summary

Only a very small proportion of the flyway population of Whimbrels stages in the Wadden Sea region, thus the Wadden Sea trend does not reflect the overall trend of the flyway population. The Whimbrel can be difficult to monitor due to its scattered occurrences in small numbers and may be easily overlooked in large Eurasian Curlew flocks. Recent results from Germany show a decreasing trend (Blew *et al.*, 2005b), and studies in The Netherlands had shown decreasing spring numbers in the largest roosting site in Friesland, probably due to changes in grassland areas and use (Versluys *et al.*, 2009).

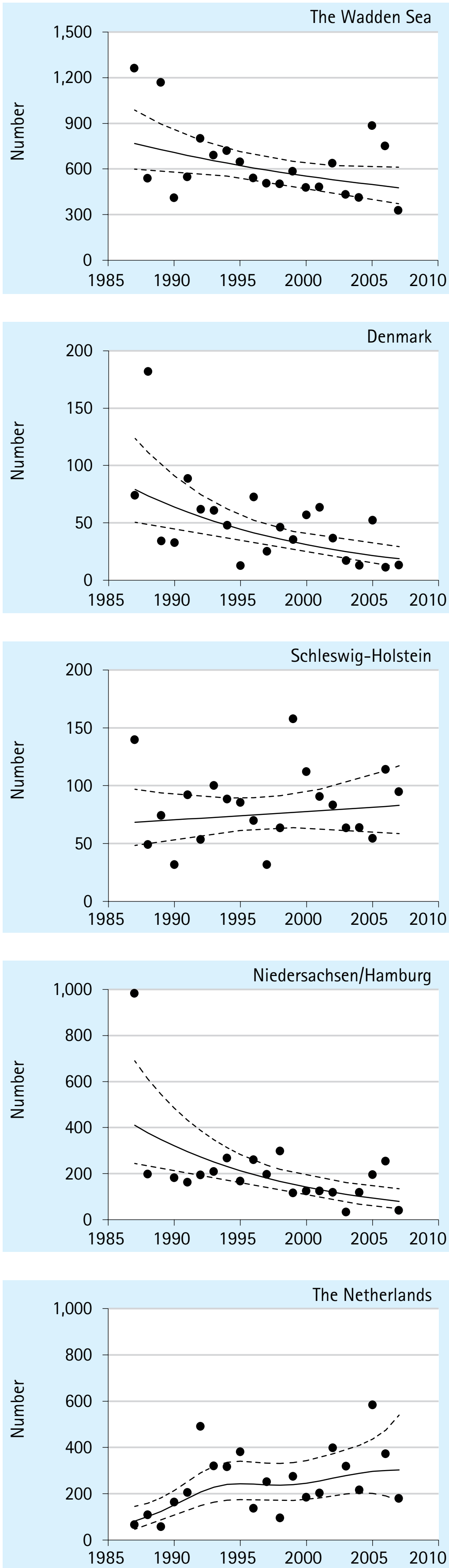


Figure 5.68
Trends of Whimbrel in the International Wadden Sea (WS) and the four regions 1987/1988-2007/2008; dots represent annual averages; trendline calculated by Trendspotter (solid line) together with the ± 95 % confidence limits (dotted line).

5.26 Eurasian Curlew

Numenius arquata

05410

DK: Stor regnspove D: Grosser Brachvogel NL: Wulp

Flyway population:	700,000-1,000,000
Breeding range:	West, Central and North Europe
1%:	8,500
Status:	Decreasing

Region	Overall trends	
	short-term 10 years	long-term 21 years
WS	→	→
DK	↑↑	↑↑
SH	↓	↓
NDS/HH	→	→
NL	↑	↑

Seasons (month no.)		Early period 1987/88-1994/95	Late period 1999/00-2006/07	% of flyway population 1999/00-2006/07
		mean of 3 maximum estimates		
Breeding:	(5, 6)	31,513	48,535	26.2
Moult:	--			
Autumn:	(7, 8, 9, 10, 11)	282,886	323,911	38.2
Winter:	(12, 1, 2)	270,468	240,876	28.3
Spring:	(3, 4)	225,893	222,648	26.2

For details see species account Cormorant.

Population

Curlews breed in West, Central and North Europe to Ural in the East. They winter in Western Europe, around the Mediterranean and in North-West Africa. The total population of 700,000-1,000,000 birds is decreasing (Wetlands International, 2006). In the Wadden Sea some 640 pairs are breeding in 2001, and numbers have decreased from 782 pairs in 1991. Most of the breeding population occurs in The Netherlands and Niedersachsen (Koffijberg *et al.*, 2006).

Ecology

A substantial part of the Curlew population (68%) uses the Wadden Sea. The birds feed on the lower, muddy parts of the tidal flats and roost at the edge of the salt marshes and on high sands at remote sites due to their high sensitivity to human disturbances (Koffijberg *et al.*, 2003; Laursen *et al.* 2005). They feed on Carcinus, other crustaceans and polychaetes as Nereis, Arenicola and Lanice. On inland meadows they take Lumbricus and Tipulidae (Smit and Wolff, 1983).

Phenology

In the Wadden Sea autumn migration starts in June or early July, with non-breeders arriving, followed by adult females and from the second half of July adult males and juveniles follow and continue through August (Meltofte *et al.*, 1994; Blew *et al.*, 2005a). Thus, numbers in the Wadden Sea increase rapidly through July and August and peak in August-September, when the post-breeding moult is at its highest. Numbers decrease in October in the Northern Wadden Sea but stay at

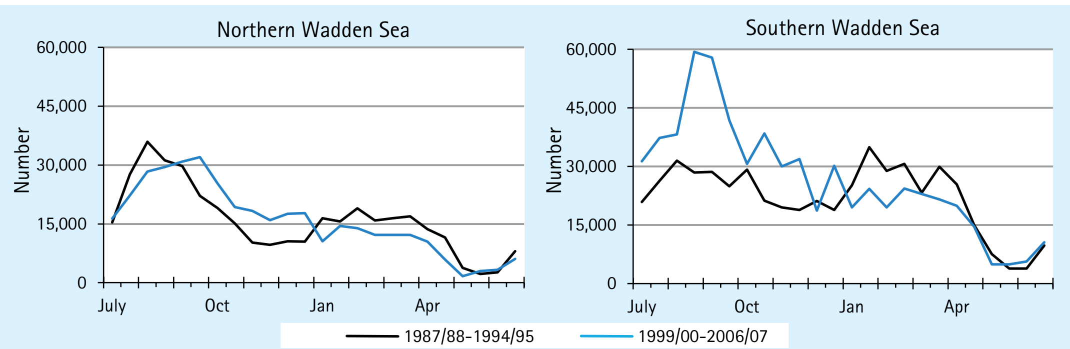


Figure 5.69 Phenology of Eurasian Curlew (mean bi-monthly number) in the Northern and the Southern Wadden Sea during the periods 1987/88-1994/95 and 1999/00-2006/07. Counted numbers from spring-tide-counting sites, no gap-filling.

quite a high level during winter depending on the severity of the weather conditions. During severe winters most of the Curlews occur in The Netherlands. Curlews stay until mid April while they undergo their pre-breeding moult and build up body reserves. At the end of April most birds have departed to the Fenno-Scandian and Russian breeding grounds (Meltofte *et al.*, 1994).

There are clear changes in the phenology between 1987/88-1994/95 and 1999/00-2006/07 (Fig. 5.69). In the early period the Curlew's autumn peak numbers occurred earlier in both the Northern and Southern Wadden Sea compared to the late period; in turn, birds stay longer during autumn in the late period.

Distribution

The Curlews are distributed in almost all Wadden Sea sub-areas, but highest numbers during autumn, winter and spring occur in Niedersachsen and The Netherlands (Fig. 5.70). Between 1987/88-1994/95 and 1999/00-2006/07 significant increases occurred during autumn, winter and spring in sub-areas in Denmark and in The Netherlands. In Niedersachsen the sub-areas are dominated by stable or increasing numbers in autumn and spring, and decreasing numbers during winter. In Schleswig-Holstein numbers in most sub-areas are decreasing during all three seasons, and several of these changes are statistically significant.

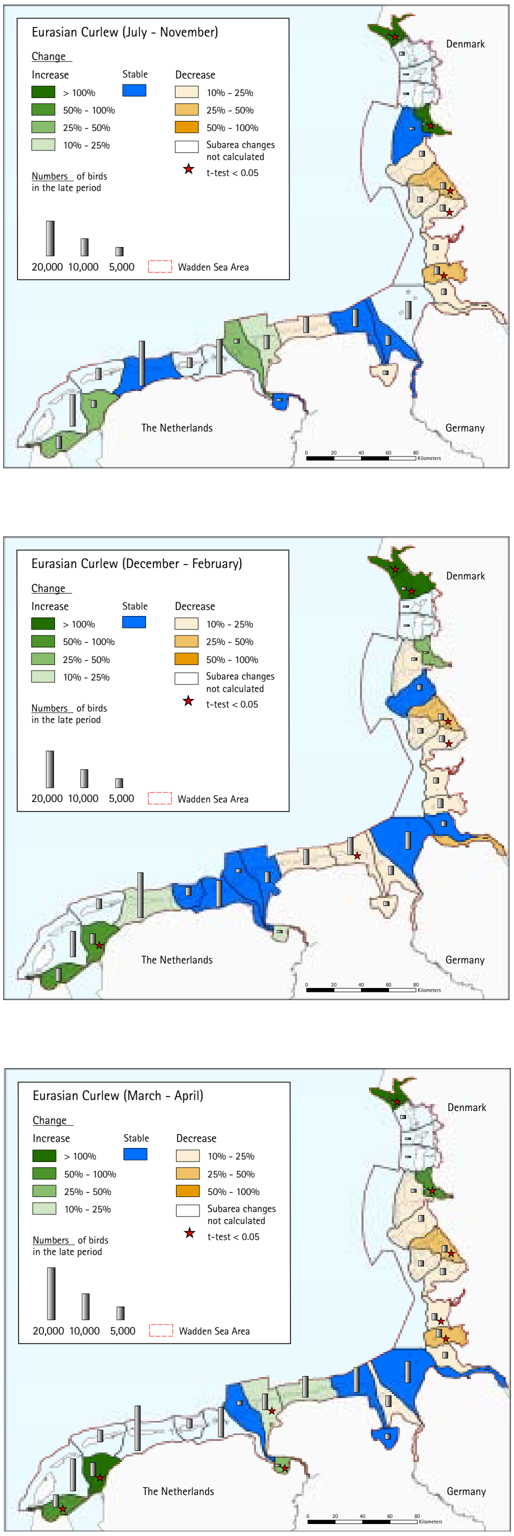


Figure 5.70
Distribution of Eurasian Curlew in the Wadden Sea during autumn (July-November), winter (December-February) and spring (March-April) for the periods1987/88-1994/95 and 1999/00-2006/07. Changes between the two periods are indicated (colours) and numbers are given for the late period (bars). Asterisks indicate statistical significant differences in numbers (P <0.05).

Photo: Gundolf Reichert

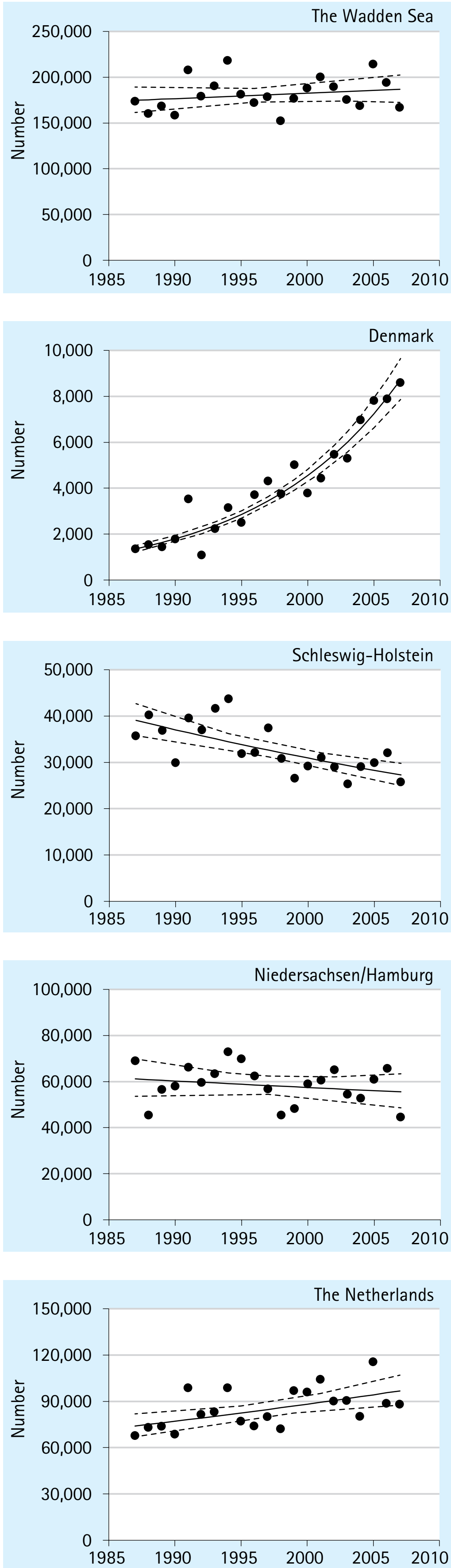


Figure 5.71
Trends of Eurasian Curlew in the International Wadden Sea (WS) and the four regions 1987/1988-2007/2008; dots represent annual averages; trendline calculated by Trendspotter (solid line) together with the ± 95 % confidence limits (dotted line).

Numbers

During autumn the peak estimates in the Northern Wadden Sea are up to 78,000 in the early, but only 57,000 in the late period, while autumn estimates in the Southern Wadden Sea have increased from a maximum of 213,000 to some 270,000 (Appendix 1). Winter estimates are almost as high, and decrease steadily towards spring, with most birds estimated in The Netherlands. Locally, most birds were recorded during autumn, winter and spring at Friese Kust Oost-Ameland, NL (35,600; 34,700 and 24,800), Groningse Kust-Rottum, NL (27,400; 20,300 and 16,500) and at Texel-Vlieland, NL (15,100; 19,700 and 17,800), and during winter and spring in Friesländische Inseln und Küste, NDS (13,600 and 13,800), based on average numbers recorded.

The overall trend in the Wadden Sea numbers is stable during both the long (21 years) and the short term (10 years) (Fig. 5.71). However, both Denmark and The Netherlands register increasing trends, while stabled numbers were recorded in Niedersachsen and decreasing numbers in Schleswig-Holstein. The regional trends are consistent during the long and short term.

Summary

The Curlew flyway population is decreasing, but the overall Wadden Sea trend is stable. Recent studies show increasing numbers in Denmark and The Netherlands (Laursen and Frikke, 2006; Hustins *et al.*, 2007, Meltofte *et al.*, 2009), but decreases in Germany (Blew *et al.*, 2005b). The species was hunted in Denmark up to 1994, and hunting disturbance had probably affected the distribution of the population using the Wadden Sea during migration and as a wintering ground (Laursen, 2005).

5.27 Spotted Redshank

Tringa erythropus

DK: Sortklire D: Dunkler Wasserläufer NL: Zwarte Ruiter

05450

Flyway population:	60,000-120,000
Breeding range:	North Scandinavia and North-West Russia
1%:	900
Status:	Stable?

Region	Overall trends	
	short-term 10 years	long-term 21 years
WS	↓	↓
DK	–	–
SH	↓	↓
NDS/HH	→	→
NL	↓↓	↓

Seasons (month no.)	Early period 1987/88-1994/95	Late period 1999/00-2006/07	% of flyway population 1999/00-2006/07
	mean of 3 maximum estimates		
Breeding: --			
Moult: --			
Autumn: (7, 8, 9, 10, 11)	19,660	20,491	22.8
Winter: --			11.0
Spring: (4, 5)	20,884	9,874	

For details see species account Cormorant.

Population

The Spotted Redshank's population of 60,000-120,000 birds is probably stable. It breeds in Northern Scandinavia and North-West Russia and winters in South and Western Europe as well as in Western and North-West Africa (Wetlands International, 2006).

Ecology

Only a small part of the population (20%) uses the Wadden Sea Area (Blew *et al.*, 2007), because the species uses inland sites and feeds in muddy freshwater habitats behind the seawalls. In marine areas, birds also forage on muddy tidal flats and in creeks and pools in salt marshes. They feed on small fishes and also take Crangon, Nereis and Carcinus (Smit and Wolff, 1983) and roost near the feeding areas.

Phenology

Spotted Redshanks stage in the Wadden Sea for only a short period during autumn and spring. During autumn the females arrive in June; they are followed by the males in July and form peak numbers in August together with the juveniles (Meltofte *et al.*, 1994). Hereafter the numbers decrease until the end of October. Very few birds stay during the winter. The spring migration commences in March, but the substantial numbers only occur during the short passage in late April and early May (Blew *et al.*, 2005a).

In the Northern Wadden Sea the Spotted Redshank's peak numbers occurred later in autumn during 1987/88-1994/95 compared to 1999/00-2006/07 (Fig. 5.72). In the Southern Wadden Sea

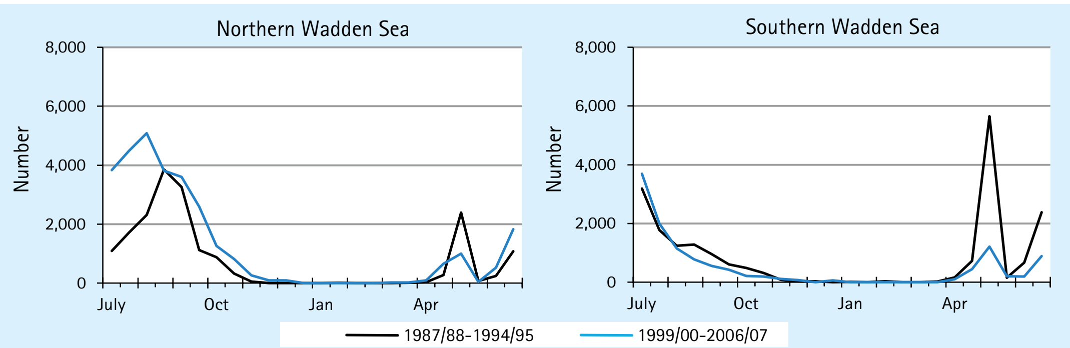


Figure 5.72
Phenology of Spotted Redshank (mean bi-monthly number) in the Northern and the Southern Wadden Sea during the periods 1987/88-1994/95 and 1999/00-2006/07. Counted numbers from spring-tide-counting sites, no gap-filling.

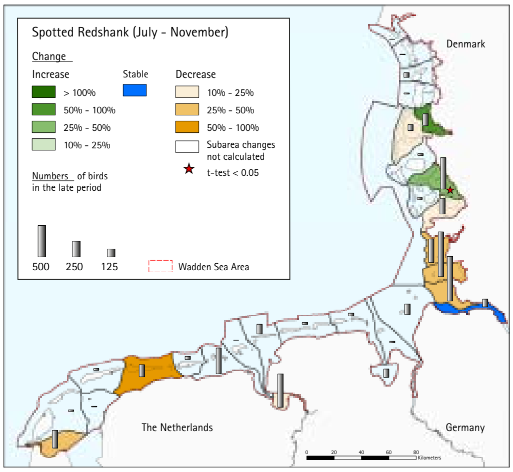


Figure 5.73
Distribution of Spotted Redshank in the Wadden Sea during autumn (July-November) for the periods1987/88-1994/95 and 1999/00-2006/07. Changes between the two periods are indicated (colours) and numbers are given for the late period (bars). Asterisks indicate statistical, significant differences in numbers (P <0.05).

there are no clear changes between the two periods, while spring peaks have apparently been higher in the early period.

Distribution

The Spotted Redshank distribution is rather scattered in the Wadden Sea, with high numbers in only a few sites in Schleswig-Holstein, Niedersachsen and The Netherlands (Fig. 5.73). Between 1987/88-1994/95 and 1999/00-2006/07 subareas with increasing numbers were recorded in Schleswig-Holstein (significant) and Denmark.

Photo: John Frikke

Numbers

During autumn estimates record a maximum of some 20,000, with most being registered in Schleswig-Holstein (Appendix 1). Almost no Spotted Redshanks stay during winter. During spring up to 20,000 have been estimated during the early period, but recent estimates are lower than 10,000, again showing the decrease of spring peaks. Local sub-areas with large numbers were Trischen-Meldorfer Bucht, SH (1,000), Friedrichskoog-Brunsbüttel, SH (1,000), Dollard, NDS/NL (750) and Innere Halligen-Festland, SH (700), based on average numbers recorded.

The overall trend in the Wadden Sea of the Spotted Redshank is a moderate decrease during both the long (21 years) and short term (10 years) (Fig. 5.74). These decreases were found in Schleswig-Holstein and The Netherlands (during the long term). A stable situation was registered in Niedersachsen and fluctuations in Denmark. During the short term increasing trend are recorded in The Netherlands (Kleefstra *et al.*, 2008).

Summary

The Spotted Redshank is difficult to monitor due to its short passage. It depends on few sites that support large numbers. Only a small part of the flyway population stages in the Wadden Sea. The overall decreasing trend is supported by results from Germany and The Netherlands (Blew *et al.*, 2005b; Hustings *et al.*, 2009). However, stable numbers are shown from one of the important sites in Denmark (Laursen *et al.*, 2009), and in Lauwersmeer, next to the Dutch Wadden Sea, the species shows a sharp increase over the last ten years (Kleefstra *et al.*, 2008).

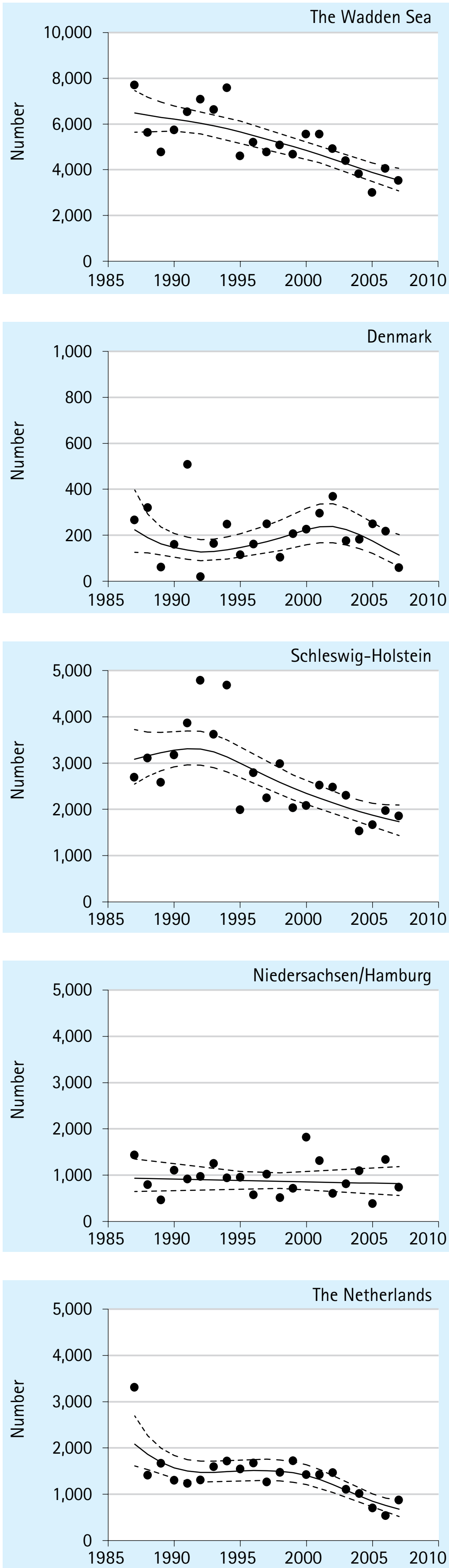


Figure 5.74
Trends of Spotted Redshank in the International Wadden Sea (WS) and the four regions 1987/1988-2007/2008; dots represent annual averages; trendline calculated by Trendspotter (solid line) together with the ± 95 % confidence limits (dotted line).

5.28 Common Redshank

Tringa totanus

05460

DK: Rødben D: Rotschenkel NL: Tureluur

Flyway population:	*T. t. totanus*:	200,000-300,000
	T. t. totanus:	570,000-870,000
	T. t. robusta:	150,000-400,000
	T. t. britannica:	95,000-135,000
Breeding range:	*T. t. totanus*:	Fennoscandia, Baltic and Western-central Europe
	T. t. totanus:	Central and Eastern Europe
	T. t. robusta:	Iceland and Faeroes Islands
	T. t. britannica:	Britain and Ireland
1%:	*T. t. totanus*:	2,500
	T. t. totanus:	7,200
	T. t. robusta:	2,800
	T. t. britannica:	1,200
Status:	*T. t. totanus*:	Stable?
	T. t. totanus:	Decreasing
	T. t. robusta:	Stable/Increasing?
	T. t. britannica:	Decreasing (Delany *et al.*, 2009)

Region	Overall trends	
	short-term 10 years	long-term 21 years
WS	→	→
DK	–	→
SH	→	↓
NDS/HH	↓	↓
NL	↑	↑

Seasons (month no.)		Early period 1987/88-1994/95	Late period 1999/00-2006/07	% of flyway population 1999/00-2006/07
		mean of 3 maximum estimates		
Breeding:	(5, 6)	26,267	25,967	10.4
Moult:	--			
Autumn:	(7, 8, 9, 10)	56,860	84,218	33.7
Winter:	(11, 12, 1, 2)	24,386	24,145	9.7
Spring:	(3, 4)	25,283	26,085	10.4

For details see species account Cormorant.

Population

Possibly four populations of Redshank use the Wadden Sea. The nominate form *T. totanus* is divided into North European breeders (Fennoscandia, the Baltic region and Western-Central Europe) and Continental European breeders (Central and Eastern Europe). The sub-species *T. t. robusta* breeds on Iceland and the Faeroes Islands and *T. t. brtiannica* breeds in Ireland and Britain. The Northern totanus population is of 200,000-300,000 birds and is possibly stable. It winters along the East Atlantic coasts south to West Africa. The Central and Eastern totanus population is of 570,000-870,000 birds and is decreasing. It winters in West Europe, around the Mediterranean and Minor Asia coasts and along the coasts of West Africa to Gabon. The Icelandic robusta population of 150,000-400,000 birds is stable or possible increasing. It winters in Britain, Ireland and along the North Sea coast south to Northern Spain. The *T. t. britannica* population holds 95.000-135,000 birds and is decreasing. It is partly sedentary and parts of the popula-

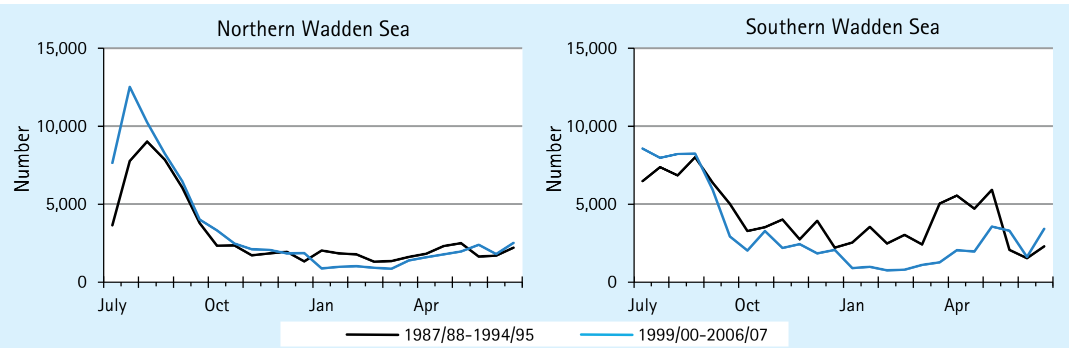


Figure 5.75
Phenology of Common Redshank (mean bi-monthly number) in the Northern and the Southern Wadden Sea during the periods 1987/88-1994/95 and 1999/00-2006/07. Counted numbers from spring-tide-counting sites, no gap-filling.

tion winter along the coasts of Western Europe from The Netherlands to Northern Spain (Delany *et al.*, 2009). In the Wadden Sea about 14,700 pairs breed, and the population is probably stable (Koffijberg *et al.*, 2006).

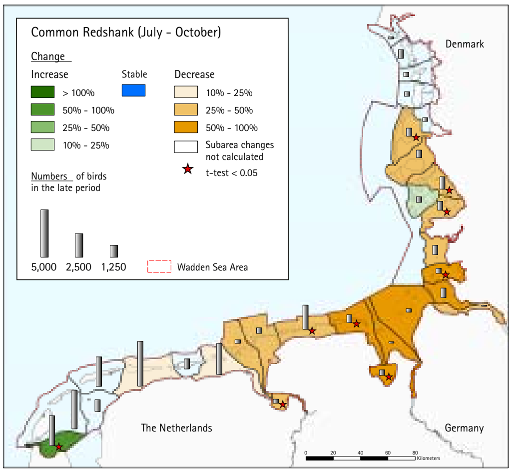
Ecology

In the Wadden Sea Redshanks feed at low tide seeking out the lower parts of the intertidal flats with muddy or mixed sandy/muddy sediments, but they are also found on blue mussel beds. During high tide they roost along the salt marsh edges (Koffiberg *et al.*, 2003). They feed on Corophium, Nereis, small molluscs, amphipods and insects (Smit and Wolff, 1983).

Phenology

Adult Continental breeders of the nominate subspecies aggregate in the Wadden Sea in July, initiating the post-breeding moult. Juvenile Continental birds follow in mid July and early August at the same time as numbers of adult Northern and adult Icelandic (*T. t. robusta*) birds arrive. The juvenile Icelandic birds pass during mid August and early September. During this period the Northern adults are also moulting and juveniles are passing. Together these populations form peak numbers in July and August and probably divide the Wadden Sea area among them, with the *T. t. totanus* birds foraging along the muddy mainland coast, while the *T. t. robusta* birds are found on the more sandy flats near the islands (Meltofte *et al.*, 1994; Engelmoer, 2008). The *T. t. totanus* birds leave during September and thereafter nearly all birds belong to *T. t. robusta*. The numbers stay at a low level during winter depending on its severity, and only a small spring migration peak occurs in late April (*T. t. robusta*) and early May (*T. t. totanus* and *T. t. britannica*) (Engelmoer, 2008). Thus most Redshank just pass through the Wadden Sea during spring without staging there.

During autumn in the Northern Wadden Sea, the Redshank's numbers peaked in early August in 1987/88-1994/95 compared to 1999/00-2006/07 where it peaked in late July (Fig. 5.75). During spring in the Southern Wadden Sea the pronounced spring peak that started in March during the early period almost vanished, while a smaller peak during May occurred later in the late period.



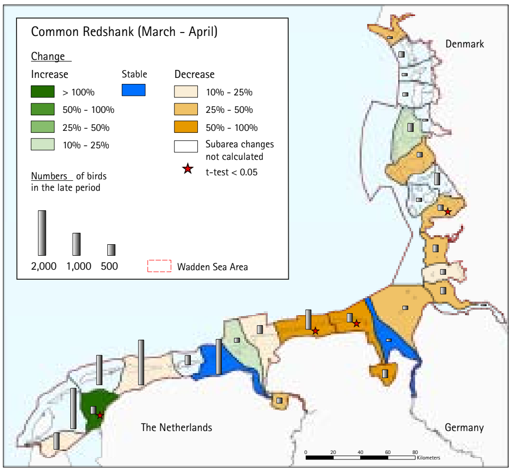
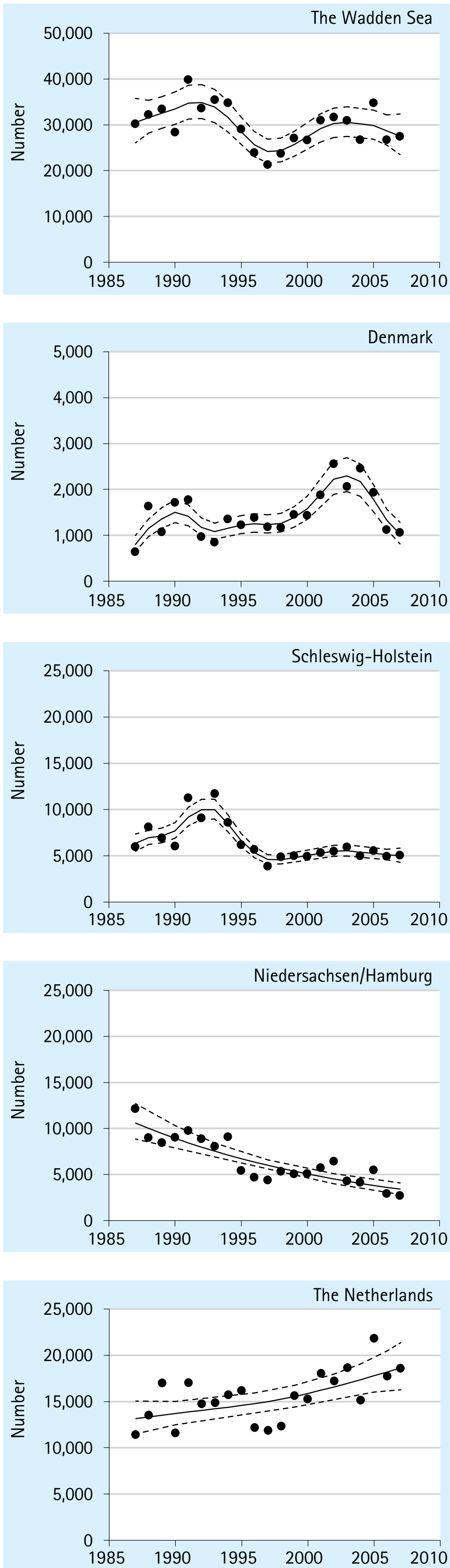


Figure 5.76
Distribution of Common Redshank in the Wadden Sea during autumn (July-October) and spring (March-April) for the periods1987/88-1994/95 and 1999/00-2006/07. Changes between the two periods are indicated (colours) and numbers are given for the late period (bars). Asterisks indicate statistical significant differences in numbers (P <0.05).

Distribution

The Redshanks are distributed in most sub-areas throughout the Wadden Sea, with the highest numbers in The Netherlands in both autumn and spring (Fig. 5.76). However, changes in distribution had occurred between 1987/88-1994/95 and 1999/00-2006/07. During autumn numbers had decreased significantly in eight sub-areas, mostly situated in Niedersachsen together with Schleswig-Holstein. Significant, increasing numbers were only seen in one sub-area in The Netherlands. During spring, decreasing numbers occurred in 14 sub-areas (three significant), the most pronounced in Denmark, Schleswig-Holstein and Niedersachsen. Significant, increasing numbers were again only seen in one sub-area in The Netherlands.

Figure 5.77
Trends of Common Redshank in the International Wadden Sea (WS) and the four regions 1987/1988-2007/2008; dots represent annual averages; trendline calculated by Trendspotter (solid line) together with the ± 95 % confidence limits (dotted line).



Numbers

During autumn, maximum estimates in the entire Wadden Sea are 57,000 in the early and 84,000 in the late period (Appendix 1). After the autumn peak, numbers are decreasing continuously. However, estimates stay around 25,000 for winter and spring season, with some 45% found in The Netherlands during the early and some 55% in the later period. Local sub-areas with most Redshanks during autumn and spring were recorded in Friese Kust Oost-Ameland, NL (6,700 and 2,900), Texel-Vlieland, NL (5,700 and 2,600) and in Groningse Kust-Rottum, NL (4,600 and 2,300), based on average numbers.

The overall trends in numbers in the Wadden Sea are stable during both the long (21 years) and short (10 years) term (Fig. 5.77). These results are composed of increasing trends in The Netherlands and decreasing trends in Niedersachsen; in Denmark and Schleswig-Holstein, the trends are stable, fluctuating or decreasing for the long and short term.

Summary

Most likely, Redshanks of several flyway populations occur in the Wadden Sea, thus showing its significant importance for the species. The overall Wadden Sea trend is stable, and stable and increasing trends are also found in most parts of the Wadden Sea. Only Niedersachsen shows a continuous decrease. Recent studies also show increasing trends in The Netherlands, but decreasing trends in Germany (Hustins *et al.*, 2009; Blew *et al.*, 2005).

Photo: Gundolf Reichert

5.29 Common Greenshank

Tringa nebularia

DK: Hvidklire D: Grünschenkel NL: Groenpootruiter 05480

Flyway population:	190,000-270,000
Breeding range:	Scotland and Scandinavia
1%:	2,300
Status:	Stable

Region	Overall trends	
	short-term 10 years	long-term 21 years
WS	→	→
DK	↓	→
SH	↓	↓
NDS/HH	→	→
NL	–	↑

Seasons (month no.)		Early period 1987/88-1994/95	Late period 1999/00-2006/07	% of flyway population 1999/00-2006/07
		mean of 3 maximum estimates		
Breeding:	--			
Moult:	--			
Autumn:	(7, 8, 9, 10)	12,489	25,971	11.3
Winter:	--			
Spring:	(4, 5)	7,299	6,844	3.0

For details see species account Cormorant.

Population

Greenshanks breed in Scotland and Fennoscandia with a total of 190,000-270,000 birds and their trend is stable. They winter in West and South-West Europe, North-West and West Africa east to Chad, and south to South Africa (Wetlands International, 2006).

Ecology

In the Wadden Sea, Greenshanks feed on muddy sandflats, in creeks, ponds in the salt marshes and in brackish areas. Inland they use a high variety of habitats such as fresh water ponds, rivers, streams and grasslands (Koffijberg *et al.*, 2003; Delany *et al.*, 2009). They feed on sticklebacks Gasterosteus and small crustaceans Crangon and Carcinus (Smit and Wolff, 1983), and roost in small flocks in the salt marshes and at inland water bodies.

Phenology

Adult females arrive in the Wadden Sea in late June followed by the males in July and juveniles in August, building a peak in late July and early August (Blew, *et al.*, 2005a; Delany *et al.*, 2009). In September they move on to their winter quarters. Many adults arrive already in North Africa in late June or July and moult before crossing Sahara, thus a large part do not stage in the Wadden Sea in autumn (Delany *et al.*, 2009). The northward migration passes the Wadden Sea in small numbers in late April and peaks during the first half of May.

There are no obvious changes in phenology comparing the periods 1987/88-1994/95 and

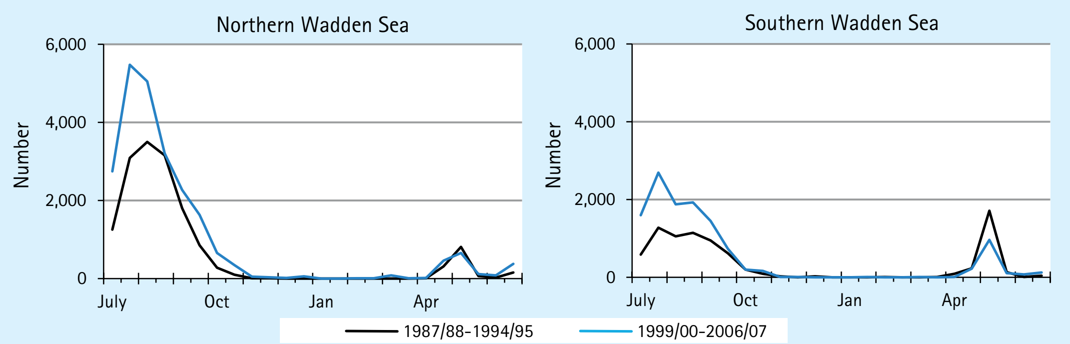


Figure 5.78 Phenology of Common Greenshank (mean bi-monthly number) in the Northern and the Southern Wadden Sea during the periods 1987/88-1994/95 and 1999/00-2006/07. Counted numbers from spring-tide-counting sites, no gap-filling.

1999/00-2006/07. July/August peaks seem to be somewhat higher in the late period (Fig. 5.78).

Distribution

Greenshanks occur uniformly all over the Wadden Sea (Fig. 5.79). However, changes occurred in the distribution between 1987/88-1994/95 and 1999/00-2006/07. Numbers increased in four sub-areas, including two with significant changes in Denmark, but the species decreased in eight sub-areas, the two most significant of these situated in Schleswig-Holstein.

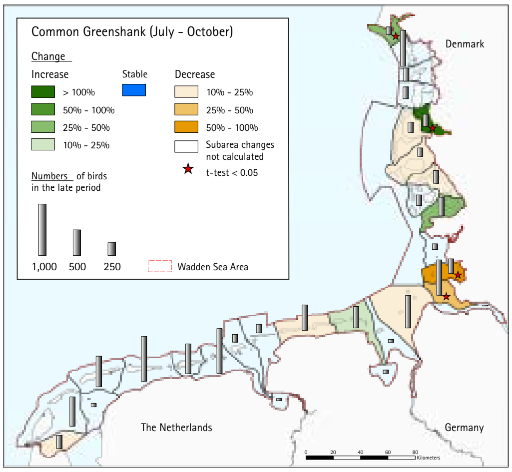


Figure 5.79
Distribution of Common Greenshank in the Wadden Sea during autumn (July-November) for the periods1987/88-1994/95 and 1999/00-2006/07. Changes between the two periods are indicated (colours) and numbers are given for the late period (bars). Asterisks indicate statistical, significant differences in numbers (P <0.05).

Photo: Bo Lassen Christiansen

Numbers

During autumn the mean peak estimates reach 12,000 in the early and 26,000 in the late period, with increases in all regions but Schleswig-Holstein (Appendix 1). No birds stay during winter. Spring estimates, however, are around 7,000 in the entire Wadden Sea with some 50% of these registered in Niedersachsen. Most Greenshanks were locally recorded at Rottum-Groningse Kust, NL (1,200), Ameland-Friese Kust Oost, NL (1,200), Fanø-Sneum, DK (980) and at Friedrichskoog-Brunsbüttel, SH (970), based on average numbers during autumn.

The overall trends for the Greenshank are stable in the Wadden Sea for both the long (21 years) and the short (10 years) term (Fig. 5.80). This trend is composed of stable trends in Niedersachsen and decreasing trends in Schleswig-Holstein for both the long and the short term. In The Netherlands the long term trends are increasing, but stable in Denmark and the short term trends are decreasing in Denmark and fluctuating in The Netherlands.

Summary

The Wadden Sea plays a minor role for Greenshanks with only about 8% of the population staging during autumn, and fewer during spring. The trend of the flyway is stable and so are the overall trends in the Wadden Sea. Recent results from The Netherlands and Germany show stable and fluctuating trends, respectively (Blew *et al.*, 2005b; Hustings *et al.*, 2009).

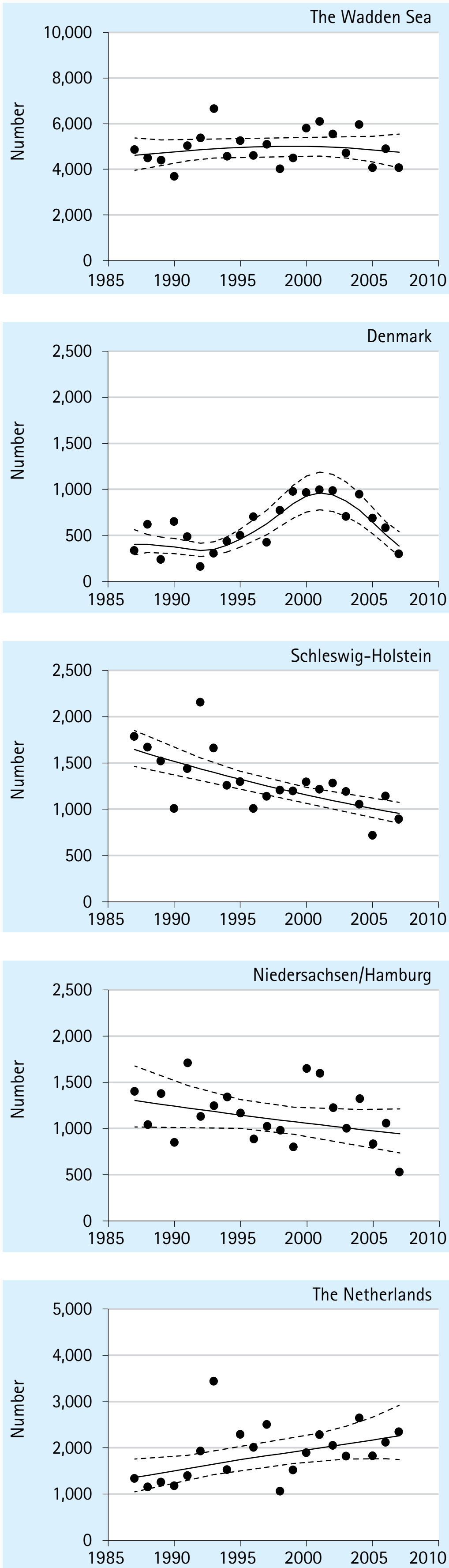


Figure 5.80
Trends of Common Greenshank in the International Wadden Sea (WS) and the four regions 1987/1988-2007/2008; dots represent annual averages; trendline calculated by Trendspotter (solid line) together with the ± 95 % confidence limits (dotted line).

5.30 Ruddy Turnstone

Arenaria interpres

05610

DK: Stenvender D: Steinwälzer NL: Steenloper

Flyway population:	*A. interpres*: 100,000-200,000 *A. interpres*: 45,000-120,000
Breeding range:	*A. interpres*: North-East Canada, North and North-East Greenland *A. interpres*: Fennoscandia and North-West Russia
1%:	*A. interpres*: 1,500 *A. interpres*: 830
Status:	*A. interpres*: Decreasing *A. interpres*: Decreasing

Region	Overall trends	
	short-term 10 years	long-term 21 years
WS	↑	→
DK	↓	→
SH	↑	↑
NDS/HH	↑	↑
NL	↑	→

Seasons (month no.)		Early period 1987/88-1994/95	Late period 1999/00-2006/07	% of flyway population 1999/00-2006/07
		mean of 3 maximum estimates		
Breeding:	--			
Moult:	--			
Autumn:	(7, 8, 9)	7,143	11,045	7.4
Winter:	(10, 11, 12, 1)	6,319	7,007	4.7
Spring:	(4, 5)	8,832	8,439	5.6

For details see species account Cormorant.

Population

Two Ruddy Turnstone populations pass the Wadden Sea on migration. Both are breeding in the high Arctic. One population, counting 100,000-200,000 birds, breeds in North-East Canada and North and North-East Greenland and winters in coastal Western Europe, North-West Africa and to a small extend in Western Africa. The other population of 45,000-120,000 birds breeds in Fennoscandia and North-West Russia and winters in North, West and South Africa. Both populations are decreasing (Wetlands International, 2006; Delany *et al.*, 2009).

Ecology

In the Wadden Sea Ruddy Turnstones forage on sandy and muddy sediment as well as on salt marshes and dikes, on 'rocky' shores as harbours, shell ridges and they feed on small crustaceans (Corophium, Gammarus, Carcinus) (Smit and Wolff, 1983). During high tide they roost in small flocks, often at artificial constructions such as breakwaters in harbours and on dikes, beaches and sand flats (Koffijberg *et al.*, 2003).

Phenology

On the southward migration, the first Turnstones appear in mid July. They are probably adults from Fennoscandia, and are followed by Nearctic adults in late July and early August. The juveniles from both populations arrive in August and September (Meltofte *et al.*, 1994), but peak numbers occur in early August (Blew *et al.*, 2005a).

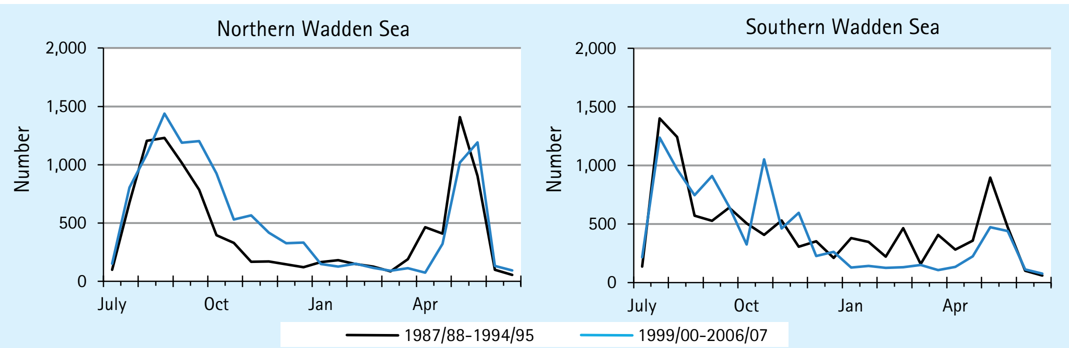


Figure 5.81
Phenology of Ruddy Turnstone (mean bi-monthly number) in the Northern and the Southern Wadden Sea during the periods 1987/88-1994/95 and 1999/00-2006/07. Counted numbers from spring-tide-counting sites, no gap-filling.

Numbers decrease gradually during the following months to a winter minimum in February or early March. A steep spring peak builds up in late April-early May formed by both populations heading for the breeding grounds. There is a division of the two populations in the Wadden Sea; the Nearctic birds dominate in The Netherlands and Niedersachsen and the Fennoscandian birds in Schleswig-Holstein and Denmark (Meltofte *et al.*, 1994).

The phenology had changed in the Northern Wadden Sea such that autumn peak numbers occur somewhat later but birds also stay longer during the late as compared to the early period (Fig. 5.81). The spring peak number in the Northern Wadden Sea has changed slightly from early May in the early period to late May in the late period. In the Southern Wadden Sea no clear changes can be revealed.

Distribution

The Turnstone has a rather scattered distributed in the Wadden Sea, due to its specific habitat preferences (Fig. 5.82). Only small changes occurred between 1987/88-1994/95 and 1999/00-2006/07. In Schleswig-Holstein increasing numbers were recorded in two sub-areas with one being statistically significant.

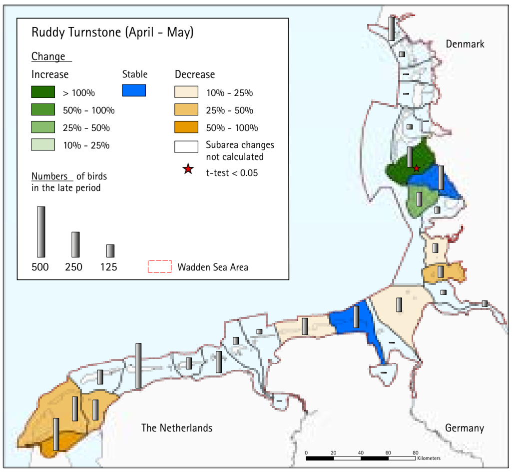


Figure 5.82 Distribution of Ruddy Turnstone in the Wadden Sea during spring (April-May) for the periods1987/88-1994/95 and 1999/00-2006/07. Changes between the two periods are indicated (colours) and numbers are given for the late period (bars). Asterisks indicate statistical, significant differences in numbers (P <0.05).

Photo: Gundolf Reichert

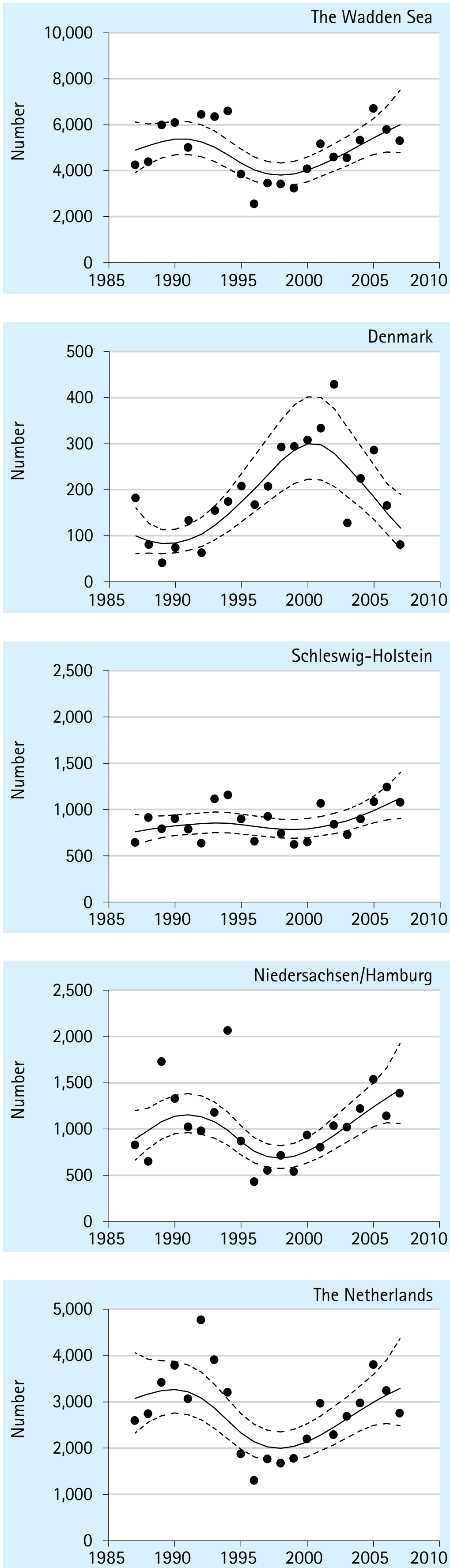


Figure 5.83
Trends of Ruddy Turnstone in the International Wadden Sea (WS) and the four regions 1987/1988-2007/2008; dots represent annual averages; trendline calculated by Trendspotter (solid line) together with the ± 95 % confidence limits (dotted line).

Numbers

Ruddy Turnstones' numbers in the Wadden Sea are small, with maximum autumn estimates being some 7,000 in the early and 11,000 in the late period, increasing mainly in The Netherlands (Appendix 1). Winter and spring estimates sum up to some 6,000 to 8,000 in the entire Wadden Sea with half of those in The Netherlands and very few in Denmark. Locally high numbers of Turnstones were recorded during autumn and spring in Ameland-Friese Kust Oost, NL (1,450; 610), Kop van Balgzand-Wieringen, NL (480; 440), and during autumn in Innere Halligen-Festland, SH (330) and in Langli-Ho Bight, DK (320), based on average numbers recorded.

The overall trend in the Turnstones' number is stable during the long term (21 years), and increasing during the short term (10 years), steadily from 1999 on (Fig. 5.83). The Netherlands numbers dominate these trends, whereas the recent increase is registered in all regions, except for a decline in Denmark.

Summary

The overall trend for Turnstone is stable or increasing, with similar results in most Wadden Sea regions. However, the species is poorly covered by the Trilateral Monitoring Programme, and therefore the results should be taken with caution. Recent counts show increasing trends in The Netherlands and fluctuating trends in Germany (Blew *et al.*, 2005b; van Roomen *et al.*, 2007).

5.31 Common Black-headed Gull

Larus ridibundus

DK: Hættemåge D: Lachmöwe NL: Kokmeeuw 05820

Flyway population:	3,700,000-4,800,000
Breeding range:	North and Western Europe, South Greenland
1%:	20,000
Status:	Decreasing

Region	Overall trends	
	short-term 10 years	long-term 21 years
WS	↓	↓
DK	↓	↓
SH	↓	↓
NDS/HH	↓	↓
NL	→	→

Seasons (month no.)		Early period 1987/88-1994/95	Late period 1999/00-2006/07	% of flyway population 1999/00-2006/07
		mean of 3 maximum estimates		
Breeding:	(5, 6)	184,819	153,822	3.6
Moult:	--			
Autumn:	(7, 8, 9, 10)	349,251	461,136	10.9
Winter:	(11, 12, 1, 2)	55,939	46,536	1.1
Spring:	(3, 4)	98,522	152,839	3.6

For details see species account Cormorant.

Population

The total population of 3,700,000-4,800,000 birds is decreasing. They breed in West-Central Europe and in South-East Greenland and winter in Western and Southern Europe (Wetlands International, 2006). The breeding numbers in the Wadden Sea have increased from 128,300 pairs in 1991 to 155,400 pairs in 2001 (Koffijberg *et al.*, 2006).

Ecology

In the Wadden Sea Black-headed Gulls feed extensively on the intertidal mudflats, but also inland on pastures or arable fields; others frequent the offshore zone (Koffijberg *et al.*, 2003). On the tidal flats they feed on crustaceans like shrimps (*Crangon crangon*), polychaetes such as ragworms (*Nereis diversicolor*) and molluscs such as the Baltic Tellins (*Macoma balthica*) (Dernedde, 1993; Kubetzki and Garthe, 2003). Inland they take earthworms and insects, and offshore they forage on fish like smelt (*Osmerus sp.*), sprat (*Sprattus sp.*) and herring (*Clupeida sp.*) (Smit and Wolff, 1983). During high tide Black-headed Gulls roost on salt marshes, sand flats, beaches and inland sites. Birds from the inland often move to the coast to roost at night (Koffijberg *et al.*, 2003).

Phenology

During late June and July local breeders initiate the moult in the Wadden Sea, probably joined by a large number of adults from the northern breeding range; during August the juveniles arrive and together they form a peak number in

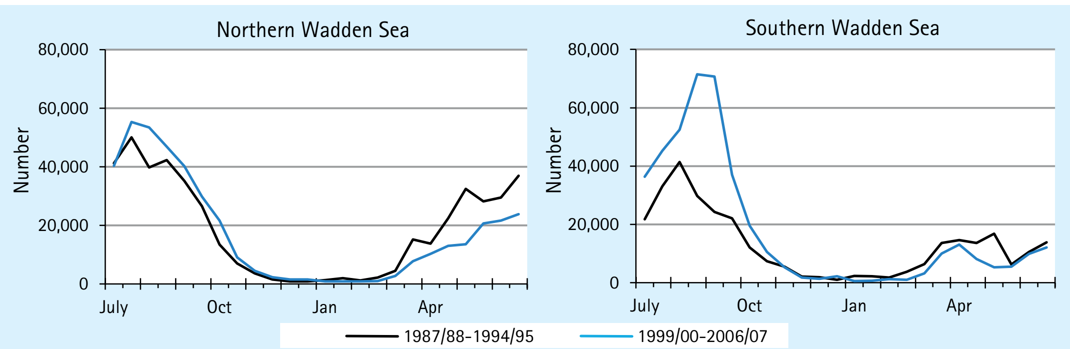
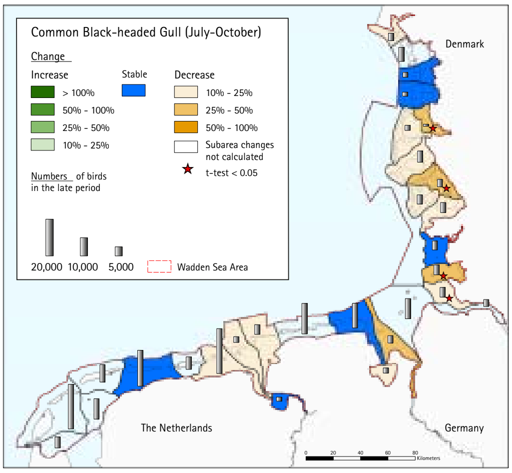
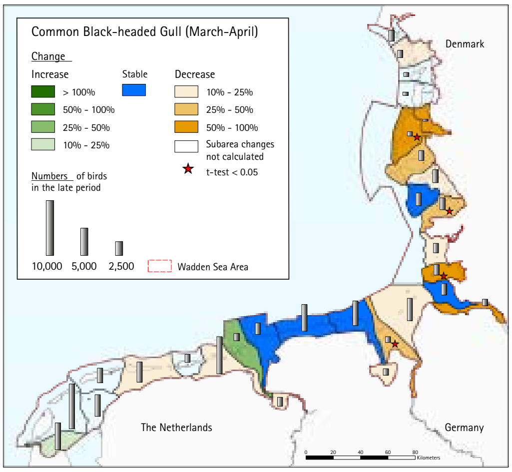


Figure 5.84 Phenology of Common Black-headed Gull (mean bi-monthly number) in the Northern and the Southern Wadden Sea during the periods 1987/88-1994/95 and 1999/00-2006/07. Counted numbers from spring-tide-counting sites, no gap-filling.

Figure 5.85
Distribution of Common Black-headed Gull in the Wadden Sea during autumn (July-October) and spring (March-April) for the periods1987/88-1994/95 and 1999/00-2006/07. Changes between the two periods are indicated (colours) and numbers are given for the late period (bars). Asterisks indicate statistical significant differences in numbers (P <0.05).





July-August (Blew *et al.*, 2005a; Meltofte *et al.*, 1994). During September a large part of the birds leave for winter areas further south and west in Europe. During winter only small numbers stay in the Wadden Sea; however, those numbers are probably underestimated because some birds occur inland or at sea, where they are poorly covered by the counts. In March, spring migration starts and numbers increase up to early April; thereafter the numbers are stable and overall much smaller than during autumn. Counted spring numbers are smaller than the breeding numbers, thus it is assumed that only some local breeders and non-breeding individuals are covered by the counts, while *e.g.* birds already present in the breeding colonies are missed.

Phenology changes had occurred during autumn in the Southern Wadden Sea with a delay of the peak numbers from August to September between 1987/88-1994/95 and 1999/00-2006/07 (Fig. 5.84); other changes are not apparent.

Distribution

Black-headed Gull is distributed all over the Wadden Sea, with highest numbers in Niedersachsen and The Netherlands (Fig. 5.85). Decreases occurred between 1987/88-1994/95 and 1999/00-2006/07 especially in Denmark and Schleswig-Holstein. Here, during autumn, decreasing numbers were recorded in nine and during spring in eight sub-areas and in three and four of these the decreases were significant in both seasons. Stable or increasing numbers were found in Niedersachsen and The Netherlands, although none were statistically significant.

Photo: Gundolf Reichert

Numbers

During autumn in the Northern Wadden Sea, peak numbers of 140,000 birds occurred during 1999/00-2006/07 and only 125,000 during 1987/88-1994/95. Larger numbers were recorded in the Southern Wadden Sea during recent years with 359,000 birds present and only 249,000 during the former period (Appendix 1). The numbers decrease considerably during winter, however. In mild winters up to 12,000 individuals may be present in the Northern and some 45,000 in the Southern Wadden Sea. During spring the numbers increase continuously to 50,000 birds in the Northern and 97,000 in the Southern Wadden Sea. Locally, large numbers of Black-headed Gulls were recorded during autumn and spring in Groningse Kust-Rottum, NL (34,700 and 9,500), Texel-Vlieland, NL (34,600 and 11,400), Friese Kust Oost-Ameland, NL (27,700 and 5,100) and in Mittlere Ostfriesische Inseln und Küste, NDS (23,300 and 6,700), based on average numbers recorded.

The overall trend is decreasing for the Black-headed Gull's numbers in the Wadden Sea during both the long (21 years) and the short term (10 years) (Fig. 5.86). The same trend is found for both periods in Schleswig-Holstein; in the other regions of the Wadden Sea, numbers fluctuate more, but trends are stable.

Summary

The Trilateral counts cover a large part of the Black-headed Gull numbers actually using the Wadden Sea, at least during autumn. However, some of the birds occur offshore, inland, at harbours or landfills where they are not counted. During spring, birds in breeding colonies are also not covered. However, for the 10% of the population that can be recorded in the Wadden Sea, the overall trend is decreasing for both the short and the long term. Recent surveys reports stable numbers in Denmark, fluctuations in Germany, and decreasing numbers in The Netherlands (Laursen and Frikke, 2006: Blew *et al.*, 2005b; van Roomen *et al.*, 2007).

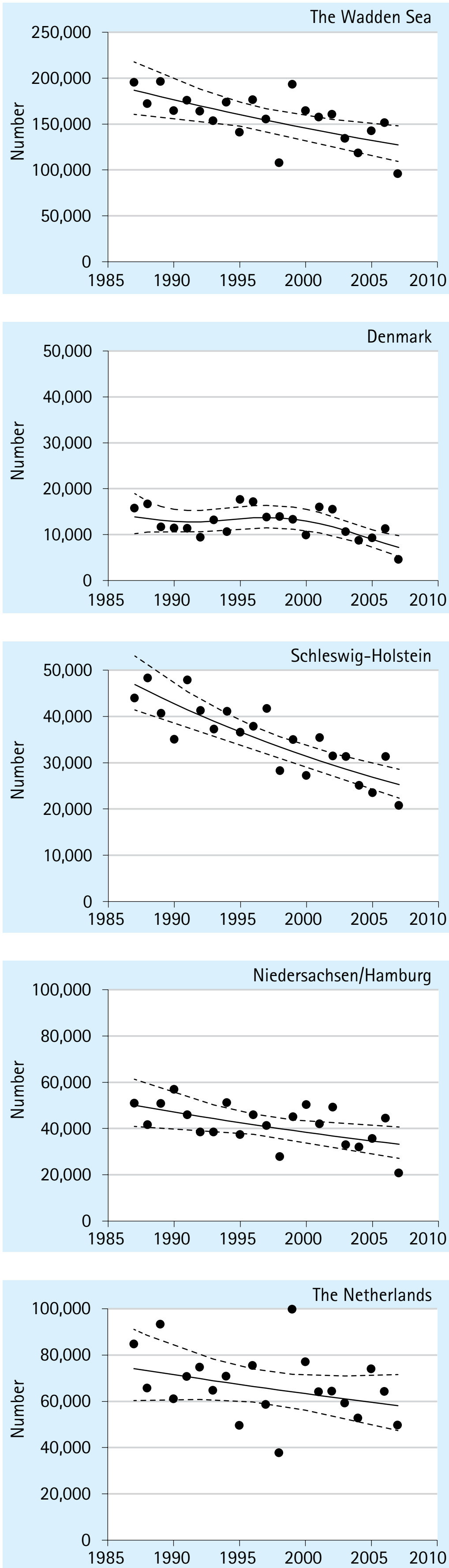


Figure 5.86
Trends of Common Black-headed Gull in the International Wadden Sea (WS) and the four regions 1987/1988-2007/2008; dots represent annual averages; trendline calculated by Trendspotter (solid line) together with the ± 95 % confidence limits (dotted line).

5.32 Common Gull

Larus canus

05900

DK: Stormmåge D: Sturmmöwe NL: Stormmeeuw

Flyway population:	1,200,000-2,250,000
Breeding range:	North Europe (Iceland to White Sea)
1%:	20,000
Status:	Decreasing?

Region	Overall trends	
	short-term 10 years	long-term 21 years
WS	↓	→
DK	→	→
SH	↓	↓
NDS/HH	↓	→
NL	↓	↑

Seasons (month no.)		Early period 1987/88-1994/95	Late period 1999/00-2006/07	% of flyway population 1999/00-2006/07
		mean of 3 maximum estimates		
Breeding:	(5, 6, 7)	21,475	81,687	4.8
Moult:	--			
Autumn:	(8, 9, 10)	121,614	225,017	13.2
Winter:	(11, 12, 1, 2)	84,194	105,907	6.2
Spring:	(3, 4)	89,024	61,603	3.6

For details see species account Cormorant.

Population

Common Gulls breed in North Europe from Iceland to the White Sea, and winter in Europe to North Africa. The population counts 1,200,000-2,250,000 birds and is probably decreasing (Wetlands International, 2006). About 13,800 pairs breed in the Wadden Sea in 2001, and the number had doubled since 1991 (Koffijberg *et al.*, 2006).

Ecology

Only up to 13% of the Common Gull population uses the Wadden Sea (Blew *et al.*, 2007). However, a larger part of the population may use the regions of the Wadden, but the birds occur inland and offshore and are therefore not included in the counts. Common Gulls feed in the intertidal zone, taking molluscs, crustaceans and polychaetes (Dernedde, 1993; Kubetzki and Garthe, 2003) but may also frequent agricultural areas. Occasionally, they steal food from other species, *e.g.* Black-headed Gull, Lapwing and Golden Plover. Common Gulls are not as common in harbours, at sewage plants and landfills as the other gull species (Smit and Wolff, 1983). During high tide they roost on beaches, high sands and along the outer edges of salt marshes. Inland birds also roost in the Wadden Sea during night.

Phenology

Adult birds from local colonies and breeding areas in Scandinavia and the Baltic arrive in the Wadden Sea in July and peak numbers occur in August when the juveniles arrive (Blew *et al.*, 2005a; Meltofte *et al.*, 1994). Thereafter the

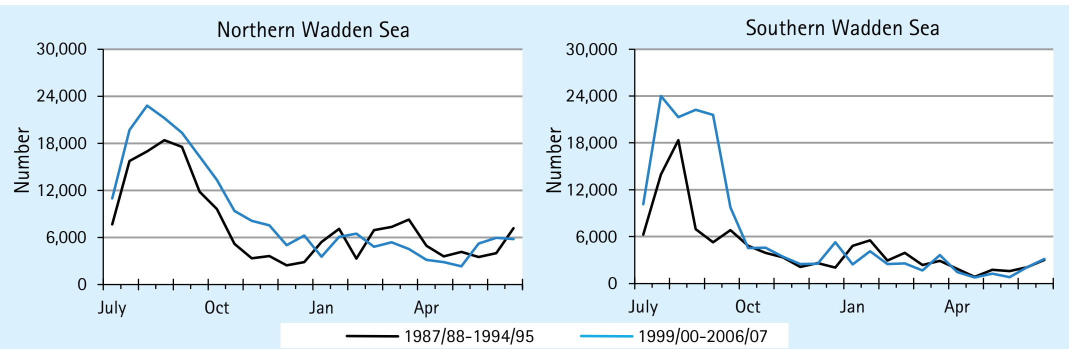


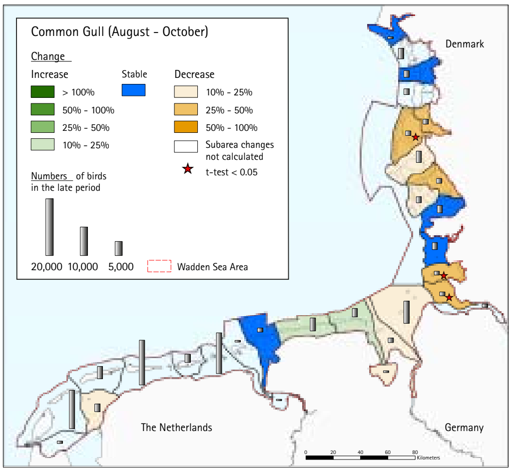
Figure 5.87
Phenology of Common Gull (mean bi-monthly number) in the Northern and the Southern Wadden Sea during the periods 1987/88-1994/95 and 1999/00-2006/07. Counted numbers from spring-tide-counting sites, no gap-filling.

numbers decrease, although considerable migration still occurs through Denmark and the Baltic during October and November. These are birds which apparently do not stage in the Wadden Sea, but only pass it en route to more westerly wintering grounds. Numbers in the Wadden Sea increase towards January, probably due to influxes of inland birds, leaving arable fields during cold periods (Meltofte *et al.*, 1994). The spring migration takes place from late February on, and birds leave for the Scandinavian breeding grounds in the second half of March and April. Numbers are low in spring compared to autumn, partly due to a large proportion of birds feeding inland while moulting their body feathers (Meltofte *et al.*, 1994).

In both the Northern and especially in Southern Wadden Sea the Common Gulls autumn peak occurred earlier in the 1999/00-2006/07 period compared to the early period 1987/88-1994/95 (Fig. 5.87), and birds also stayed longer during autumn in the late compared to the early period. However, during spring there are no clear differences in phenology between the periods.

Distribution

The Common Gull is distributed in almost all Wadden Sea sub-areas, and especially large numbers are recorded in The Netherlands during autumn (August-October), while during spring the distribution is somewhat more even (March-April) (Fig. 5.88). However, changes occurred between 1987/88-1994/95 and 1999/00-2006/07: during autumn a few, not significant, increases occurred in Niedersachsen, and decreases are recorded in six sub-areas in Schleswig-Holstein of which three are significant. During spring, increases occur in five sub-areas, and one of these, in The Netherlands, is significant. Of decreases found in three sub-areas, one is significant and situated in Schleswig-Holstein.



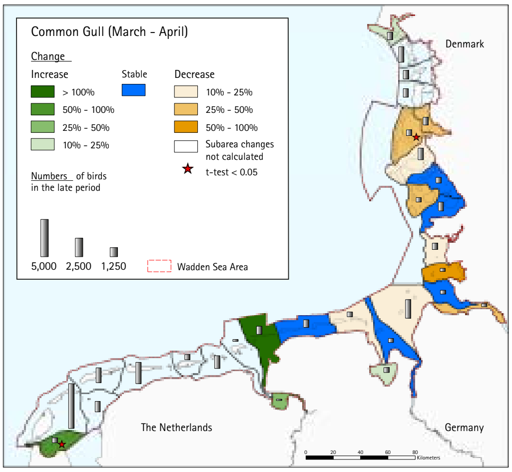


Figure 5.88 Distribution of Common Gull in the Wadden Sea during autumn (August-October) and spring (March-April) for the periods1987/88-1994/95 and 1999/00-2006/07. Changes between the two periods are indicated (colours) and numbers are given for the late period (bars). Asterisks indicate statistical significant differences in numbers (P <0.05).

Photo: Gundolf Reichert

Numbers

The autumn mean peak number of Common Gulls is 63,000-65,000 birds in both the Northern and Southern Wadden Sea during the early period. In the Southern Wadden Sea those numbers increase to some 180,000 in the late period mainly on account of The Netherlands (Appendix 1). The numbers decrease to 30,000 during winter in the Northern Wadden Sea and further decrease towards spring, while in the Southern Wadden Sea winter numbers are still as high as 86,000, considerably decreasing to some 34,000 in spring. Sub-areas with large numbers of Common Gulls were during autumn and spring Texel-Vlieland, NL (19,00 and 8,500), and during autumn in Friese Kust Oost-Ameland, NL (22,200) and Groningse Kust-Rottum, NL (20,200), based on average numbers recorded.

The overall trend in Common Gull numbers is stable during both the long (21 years) and the short term (10 years) (Fig. 5.89). However, the trends vary between the four Wadden Sea parts and between periods. For both periods, trends decrease in Schleswig-Holstein and are stable in Denmark. However, in The Netherlands the long-term trend increases, while the short-term trend is stable.

Summary

Some 13% of the population of Common Gull uses the Wadden Sea, but the counts do not cover the species properly because a large part of the birds feed inland and only roost in the Wadden Sea at night and are therefore not completely covered by the counts. The overall trend is stable for both the short and long term. Reports show increasing trends in The Netherlands and in Denmark, but decreasing trend in Germany (Laursen and Frikke, 2006; Blew *et al.*, 2005b; van Roomen *et al.*, 2007).

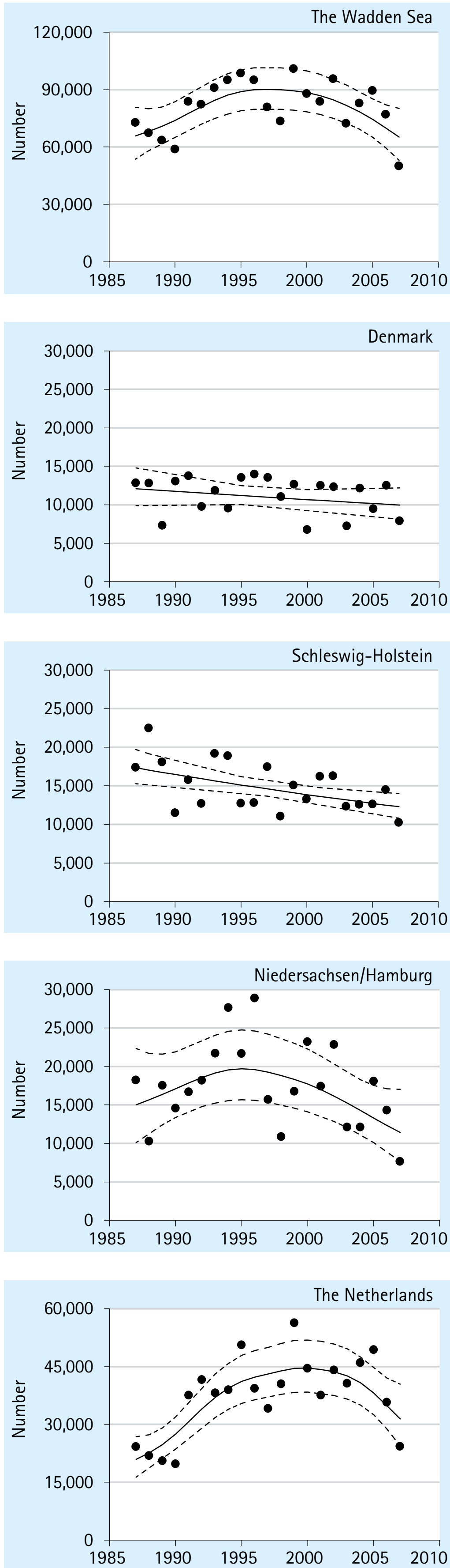


Figure 5.89
Trends of Common Gull in the International Wadden Sea (WS) and the four regions 1987/1988-2007/2008; dots represent annual averages; trendline calculated by Trendspotter (solid line) together with the ± 95 % confidence limits (dotted line).

5.33 Herring Gull

Larus argentatus

DK: Sølvmåge D: Silbermöwe NL: Zilvermeeuw

05920

Flyway population:	*Larus a. argentatus*: 1,700,000-3,600,000 *Larus. a. argenteus*: 560,000-620,000
Breeding range:	*Larus a. argentatus*: Denmark and Scandinavia to Kola Peninsula *Larus. a. argenteus*: North Atlantic Sea (Iceland to NW France)
1%:	*Larus a. argentatus*: 20,000 *Larus. a. argenteus*: 20,000
Status:	*Larus a. argentatus*: Increasing *Larus. a. argenteus*: Decreasing

Region	Overall trends	
	short-term 10 years	long-term 21 years
WS	↓	↓
DK	→	→
SH	↓	↓
NDS/HH	↓	↓
NL	↓	↓

Seasons (month no.)	Early period 1987/88-1994/95	Late period 1999/00-2006/07	% of flyway population 1999/00-2006/07
	mean of 3 maximum estimates		
Breeding: (5, 6)	167,512	86,286	3.3
Moult: --			
Autumn: (7, 8, 9, 10)	238,933	154,810	7.3
Winter: (11, 12, 1, 2)	167,512	154,810	5.8
Spring: (3, 4)		113,584	4.3

For details see species account Cormorant.

Population

Two populations of Herring Gulls breed in Europe, one (*L. a. argentatus*) in the northern part in Denmark, Fennoscandia and Northern Russia to Kola Peninsula and the other one (*L. a. argenteus*) in the north-western part from Iceland, Ireland, Britain and Germany to North-Western France. According to Wahl *et al.* (2007), *L. l. argentatus* are breeding in Eastern Germany and *L. l. argenteus* in Western Germany. Thus *L. l. argenteus* is the sub-species that is breeding in the Wadden Sea, but it is not clear whether this also includes the Danish part. The northern population counts 1.7-3.6 million birds and is increasing. It winters in Northern and Western Europe. The north-western population is smaller, 560,000-620,000 birds and is decreasing. It winters in North-Western Europe south to Northern Iberia (Wetlands International, 2006). The breeding population in the Wadden Sea in 2001 was 78,700 pairs, which decreased from 89,500 pairs in 1991 (Koffijberg *et al.*, 2006).

Ecology

A small proportion of the Herring Gulls forage in natural habitats in the Wadden Sea, such as beaches, outer parts of the tidal flats along the borders of gullies and creeks. The main proportion feeds on waste from commercial fishery, landfills and on garbage in cities and harbours. They also feed inland on arable fields. The main food items are marine invertebrates such as Mytilus, Carcinus and Asterias, together with fish

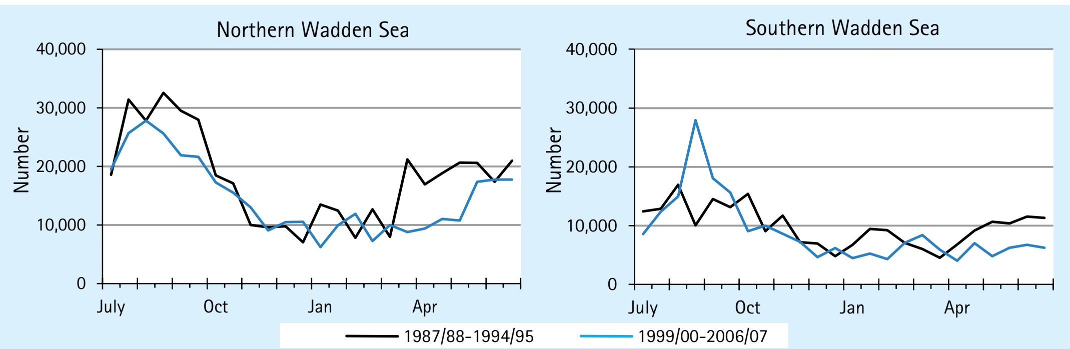


Figure 5.90
Phenology of Herring Gull (mean bi-monthly number) in the Northern and the Southern Wadden Sea during the periods 1987/88-1994/95 and 1999/00-2006/07. Counted numbers from spring-tide-counting sites, no gap-filling.

such as Clupeids, Gadids and flatfish (Dernedde, 1993; Kubetzki and Garthe, 2003). The Herring Gulls roost during high tide on beaches and high sands. Birds from both offshore and inland fly to the Wadden Sea to roost during night (Smit and Wolff, 1983).

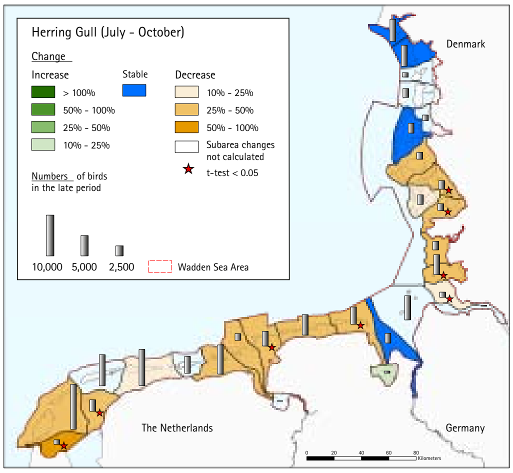
Phenology

Autumn migration through the Wadden Sea takes place during July to October (Blew *et al.*, 2005a). In July the local breeders mix with large numbers of immigrants from Scandinavia and from the Baltic during August-September. Numbers decrease until December, and the winter numbers are pretty stable. However, during severe winters numbers in the Danish Wadden Sea decrease while those in The Netherlands increase (Meltofte *et al.*, 1994). Spring migration starts in March; thereafter numbers are rather stable from April to June, representing the local breeders and immature birds.

The Herring Gull shows some changes in phenology during autumn; in the Northern Wadden Sea the autumn peak occurred earlier and the birds stayed somewhat longer in the 1987/88-1994/95 compared to 1999/00-2006/07. In the Southern Wadden Sea, a short autumn peak occurs in the late period which did not exist during the early period (Fig. 5.90). During spring, peak numbers in the Northern Wadden Sea were earlier during the first compared to the late period, when the increase only takes place in late April. Thus in the Northern Wadden Sea the Herring Gulls' staying time during the whole year has decreased from the early to the late period, while no clear changes had occurred in the Southern Wadden Sea (more birds during autumn and less during spring).

Distribution

Herring Gulls are distributed in almost all parts of the Wadden Sea, with most birds in autumn and spring in The Netherlands, Niedersachsen and Denmark (Fig. 5.91). Marked decreases had occurred in distribution between 1987/88-1994/95 and 1999/00-2006/07 with decreasing numbers in autumn and spring in 16 sub-areas of which eight were significant in autumn and four in spring. These sub-areas were situated in The Netherlands, Niedersachsen and Schleswig-Holstein (Fig. 5.91). Stable or increasing numbers were found in three and five sub-areas, although neither of these was statistically significant.



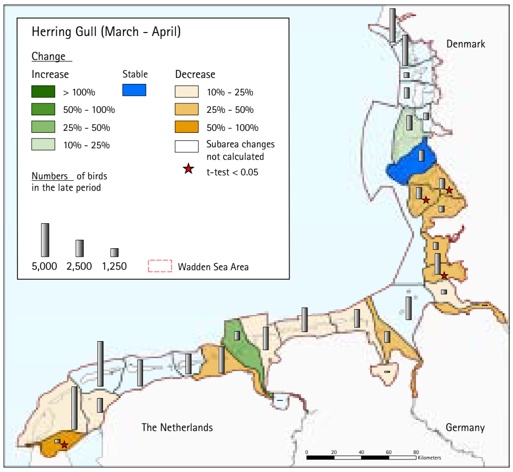


Figure 5.91
Distribution of Herring Gull in the Wadden Sea during autumn (July-October) and spring (March-April) for the periods1987/88-1994/95 and 1999/00-2006/07. Changes between the two periods are indicated (colours) and numbers are given for the late period (bars). Asterisks indicate statistical significant differences in numbers (P <0.05).

Photo: Gundolf Reichert

Numbers

During autumn some 83,000 Herring Gulls were recorded in the early period in the Northern Wadden Sea decreasing to 67,000 in the late period, while in the Southern Wadden Sea almost 150,000 are recorded in both periods (Appendix 1). Maximum numbers decrease towards spring when 43,000 are recorded in the Northern and 48,000 in the Southern Wadden Sea in the late period. Locally, large Herring Gulls numbers were recorded during autumn and spring in Texel-Vlieland, NL (15,400 and 9,000), Terschelling, NL (10,700 and 9,400) and during spring in Langli-Ho Bight, DK (7,100) and Fanø-Sneum, DK (6,400), based on average numbers.

The overall trend for the Herring Gull's numbers is decreasing during both the long (21 years) and the short term (10 years) (Fig. 5.92). These overall trends are compositions of stable trends in Denmark in both periods and decreasing trends in the other Wadden Sea regions.

Summary

Up to 8% of the Herring Gull population is covered by the counts in the Wadden Sea. However, a much higher part of the population uses the Wadden Sea but is not covered by the surveys because birds either feed offshore or inland *e.g.* at landfills. The overall trend is decreasing, which is also supported by recent counts in Germany and The Netherlands, but stable in Denmark (Blew *et al.*, 2005b; Laursen and Frikke, 2006; van Roomen *et al.*, 2007).

Photo: Gundolf Reichert

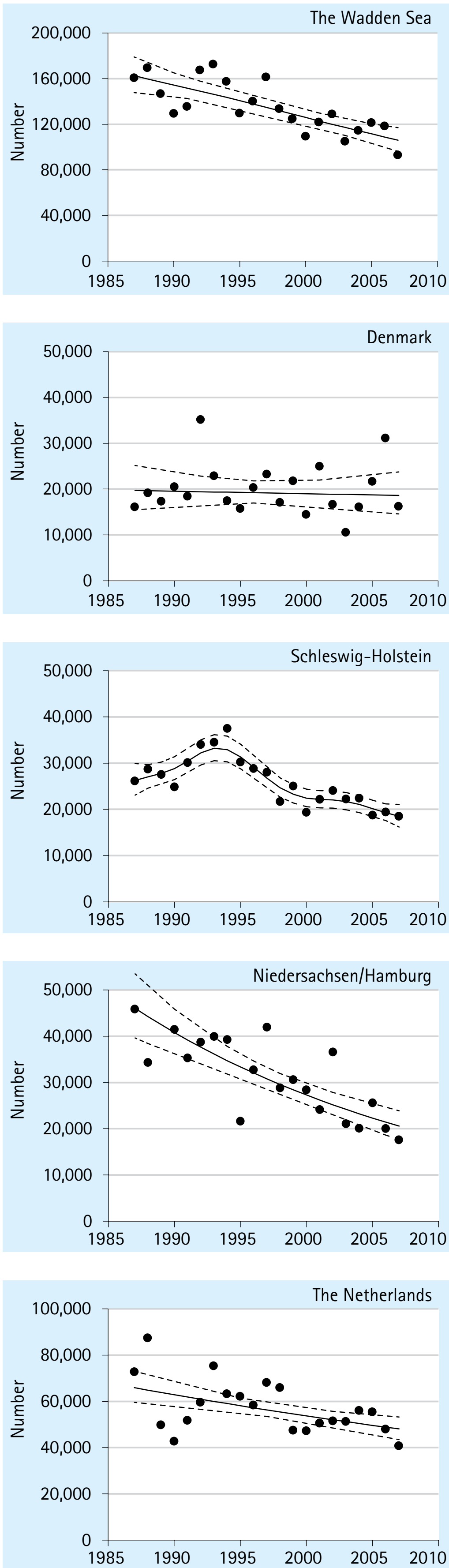


Figure 5.92
Trends of Herring Gull in the International Wadden Sea (WS) and the four regions 1987/1988-2007/2008; dots represent annual averages; trendline calculated by Trendspotter (solid line) together with the ± 95 % confidence limits (dotted line).

5.34 Great Black-backed Gull

Larus marinus

06000

DK: Svartbag D: Mantelmöwe NL: Mantelmeeuw

Flyway population:	330,000-540,000
Breeding range:	North East Atlantic (Iceland east to the White Sea and south to NW France)
1%:	4,400
Status:	Increasing

Region	Overall trends	
	short-term 10 years	long-term 21 years
WS	↓	–
DK	–	→
SH	↓	↓
NDS/HH	↓	↓
NL	–	→

Seasons (month no.)		Early period 1987/88-1994/95	Late period 1999/00-2006/07	% of flyway population 1999/00-2006/07
		mean of 3 maximum estimates		
Breeding:	(6,7)	2,051	3,673	0.8
Moult:	--			
Autumn:	(8, 9, 10)	12,651	11,627	2.6
Winter:	(11, 12, 1, 2)	9,070	10,659	2.4
Spring:	(3, 4, 5)	7,570	12,622	2.9

For details see species account Cormorant.

Population

The Great Black-backed Gull breeds along the coasts of countries bordering the North-Eastern Atlantic Ocean, and winters in the same range south to the Iberian Peninsula. The population counts 330,000-540,000 birds and is increasing (Wetlands International, 2006). Only 27 pairs bred in the Wadden Sea in 2001 (Koffijberg *et al.*, 2006).

Ecology

The Great Black-backed Gull mostly uses the Wadden Sea for roosting on beaches, high sands in the outer parts of the Wadden Sea and on some occasions also on inland areas (Koffijberg *et al.*, 2003). They forage offshore to a considerable degree by taking discharge from fishing boats (Kubetzki and Garthe, 2003). They also feed in harbours and at landfills, taking fish and garbage respectively.

Phenology

Numbers in the Wadden Sea start to increase in July, but the autumn peak occurs between September and November when both adult and juvenile birds arrive from North Scandinavia and Russia. They moult from July until November-December whereafter they depart to stay offshore or move to more westerly winter quarters (*e.g.* the British Isles) (Blew *et al.*, 2005a; Meltofte *et al.*, 1994). Relatively high numbers of birds winter in the Wadden Sea, and a peak of birds occurs in January-February; by March they have left for the breeding grounds. During the following months over-summering non-breeders remain

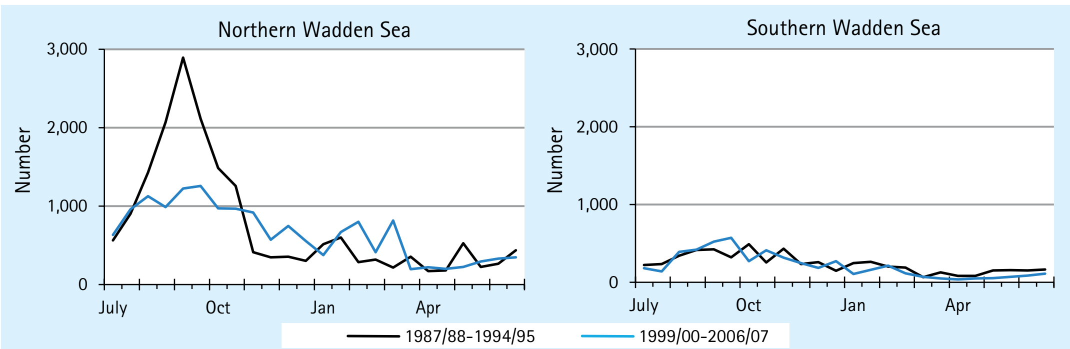


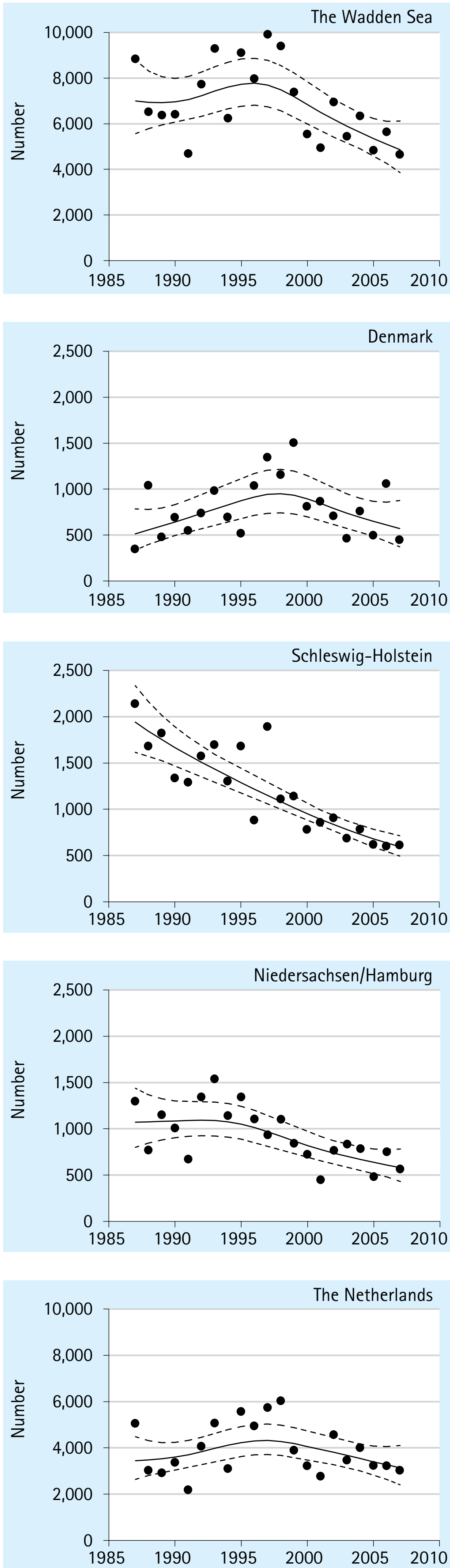
Figure 5.93
Phenology of Great Black-backed Gull (mean bi-monthly number) in the Northern and the Southern Wadden Sea during the periods 1987/88-1994/95 and 1999/00-2006/07. Counted numbers from spring-tide-counting sites, no gap-filling.

and numbers are low and stable.

In 1987/88-1994/95 in the Northern Wadden Sea the Great Black-backed Gulls had a pronounced peak during autumn after which numbers decreased continuously; during 1999/00-2006/07 the peak more or less disappeared but birds stay longer during autumn and winter (Fig. 5.93). In the Southern Wadden Sea, no clear changes had occurred.

Photo: Thorsten Krüger

Figure 5.94
Trends of Great Black-backed Gull in the International Wadden Sea (WS) and the four regions 1987/1988-2007/2008; dots represent annual averages; trendline calculated by Trendspotter (solid line) together with the ± 95 % confidence limits (dotted line).



Numbers

Of all gull species, the Great Black-backed Gulls have the lowest numbers in the Wadden Sea. During autumn, the peak occurrences were 5,900 in the Northern and 8,300 in the Southern Wadden Sea (Appendix 1). While those numbers continuously decrease in the Northern Wadden Sea towards spring, they stay at a relatively high level in the Southern parts, sometimes with up to 7,100 individuals in winter and 10,400 in spring. Local sub-areas with most birds were Texel-Vlieland, NL (2,200), Terschelling, NL (1,200) and Fanø-Sneum, DK (700), based on average numbers.

The overall trends are decreasing during the long (21 years) and short term (10 years) (Fig. 5.94). These trends were also found in the Schleswig-Holstein and Niedersachsen Wadden Sea, but in The Netherlands and Danish parts they were fluctuating and stable during the long and short term respectively.

Summary

The waterbird counts only include a small part of the Great Black-backed Gulls, since many birds use harbours and offshore areas not covered by the counts. The trends are decreasing or stable, a result which is supported by results from both Germany and The Netherlands (Blew *et al.*, 2005b; van Roomen *et al.*, 2007).

6. Overviews on Trends and Changes in Distribution or Phenology

6.1 Trends over 21 years

Trends are calculated for 34 migratory species; although data from the Common Eiders obtained from aerial counts during winter are only available since 1993 (for the last 16 years), they are included for completeness (Table 6.1). The trend information is given for the entire Wadden Sea and also for the four Wadden Sea regions for both the 21 year (long-term) and the 10 year (short-term) period. In the species account chapters, all the trends for the four Wadden Sea parts are presented, thus here we will only give a summary of the trends for the entire Wadden Sea.

For the 21 year period in the Wadden Sea, three species show strong increases, five species moderate increases, 12 species are stable, 12 species show moderate decreases and one species a strong decrease (Eider excluded). For the 10 year period, one species shows a strong increase, seven species moderate increases, 14 species were stable, 11 species show moderate and one species strong decreases.

	21 years trends					10 years trends				
Species	WS	DK	SH	LS	NL	WS	DK	SH	LS	NL
Great Cormorant	++	++	++	++	++	0	F	+	+	0
Spoonbill	++	++	++	++	++	++	++	++	++	++
Barnacle Goose	++	++	++	+	++	+	+	+	F	+
Brent Goose	0	0	-	-	0	0	F	0	-	0
Shelduck	-	+	-	-	0	0	++	-	--	0
Wigeon	0	+	0	0	-	0	+	0	-	-
Teal	-	0	0	-	F	0	+	0	F	F
Mallard	-	-	-	--	-	-	+	0	--	-
Pintail	+	F	0	0	+	+	+	+	F	+
Shoveler	0	++	+	-	0	0	++	+	-	0
Common Eider*						-	-	F	F	-
Oystercatcher	-	+	-	-	-	-	0	-	-	-
Avocet	-	-	-	-	-	-	F	0	-	-
Ringed Plover	+	0	+	-	+	+	--	+	-	+
Kentish Plover	-	--	0	--	-	-	--	0	--	F
Golden Plover	-	-	-	-	0	-	-	-	-	-
Grey Plover	0	+	0	-	+	0	0	0	-	+
Lapwing	0	0	0	0	+	0	0	0	0	F
Knot	0	+	-	0	0	0	++	-	+	0
Sanderling	+	+	0	0	++	+	+	F	0	++
Curlew Sandpiper	+	F	+	-	F	+	F	+	-	F
Dunlin	0	-	-	0	+	0	-	-	0	+
Ruff	--	--	--	--	0	--	--	--	--	0
Bar-tailed Godwit	+	0	-	0	+	+	+	-	0	+
Whimbrel	-	-	0	-	+	0	-	0	-	F
Curlew	0	++	-	0	+	0	++	-	0	+
Spotted Redshank	-	F	-	0	--	-	F	-	0	--
Redshank	0	0	-	-	+	0	F	0	-	+
Greenshank	0	0	-	0	+	0	-	-	0	F
Turnstone	0	0	+	+	0	+	-	+	+	+
Black-headed Gull	-	-	-	-	0	-	-	-	-	0
Common Gull	0	0	-	0	+	-	0	-	-	-
European Herring Gull	-	0	-	-	-	-	0	-	-	-
Great Black-backed Gull	-	0	-	-	0	-	F	-	-	F

Table 6.1
Trends for 34 waterbird species for the Wadden Sea and its four regions (Denmark, Schleswig-Holstein, Niedersachsen and The Netherlands) for 21 years and 10 years.
++ Strong increase,
+ moderate increase,
0 stable,
- moderate decrease,
-- strong decrease
(see methods).
*Covered only after 1993.

6.2 Change in geographical distribution

For 27 species, changes in distribution are presented between the periods 1987/88-1994/95 and 1999/00-2006/07; detailed descriptions are to be found in the species accounts. For the seven remaining species no maps are shown, either because of the small numbers of these species or because no trilateral data are available (*e.g.* Common Eider). For the 27 species, maps are given for the seasons with highest numbers, and for the most numerous species maps are also added for other seasons.

To get an overview of the distribution changes, the number of species showing significant increases or decreases between 1987/88-1994/95 and 1999/00-2006/07 are aggregated for the following species or species groups: Cormorant, geese together with Shelduck, dabbling ducks, waders and gulls (Table 6.2). The result shows that Cormorant increases at all parts. For geese and Shelduck (3 species) all species are decreasing in Schleswig-Holstein and Niedersachsen, increasing and decreasing species was found in the Danish and only increasing species in the Dutch parts. For dabbling ducks (5 species) in The Netherlands and in the Danish parts, more species are increasing than decreasing. But all species are decreasing in Schleswig-Holstein and Niedersachsen. This result, with all species decreasing both in Schleswig-Holstein and Niedersachsen, is also more pronounced with regard to the numerous wader species (19 species). For the gulls (3 species), decreases dominate in all four parts of the Wadden Sea (Table 6.2). Two species were excluded from this analysis, the Spoonbill due to small numbers (except for The Nether-

Table 6.2
Number of species showing significant increases or decreases in each sub-area (no. 1-29) in the Wadden Sea between 1987/88-1994/95 and 1999/00-2006/07. The species' preferred feeding habitat is indicated as follows: sea, tidal flat (tid), saltmarsh (sal)), together with the tidal amplitude for each sub-area. (light blue 1-2 m, medium blue 2-3 m, dark blue 3-4m).

		Denmark					Schleswig-Holstein								Niedersachsen/Hamburg									The Netherlands						
Sub-area no.	Habitat	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Cormorant	Sea	1	1						1				1				1		1	1	1									1
Bar. Goose	Sat					1																	1		1					
Brent Goose	Tid/Sal	-1	-1								-1									-1										
Shellduck	Tid	1				-1	-1	-1	-1	-1	-1																	1		
Wigeon	Tid								-1		-1				-1															1
Teal	Tid/Sal						-1								-1					-1										
Mallard	Tid/Sal					-1	-1		-1		-1				-1		-1		-1											
Pintail	Tid/Sal	1					-1																			1				1
Shoveler	Tid/Sal					1	-1		-1																					
Oystercatcher	Tid		1				-1	-1	-1	-1	-1		-1				-1		-1	-1	-1									-1
Pied Avocet	Tidl					-1		-1			-1								-1	-1								1		
Ring. Plover	Tid																													
Golden Plover	Tid					-1	-1		-1								-1		-1											
Grey Plover	Tid					1							-1						-1	-1										
Lapwing	Tid																-1		-1											
Red Knut	Tid			1						-1	-1	-1	-1															-1		
Sanderling	Tid		1										-1											1						
Dunlin	Tid			-1			-1		-1	-1	-1		-1				-1													
Bar-t. Godwit	Tid										-1	-1	-1	-1																
Curlew	Tid	1				1			-1		-1		-1																	
Spot. Redshank	Tid/Sal								1																					
Redshank	Tid						-1		-1		-1		-1					-1	-1	-1			-1							1
Greenshank	Tid	1				1							-1	-1																
Turnstone	Tid							1																						
Black-h. Gull	Tid					-1			-1				-1	-1																
Common Gull	Tid						-1						-1	-1																
Herring Gull	Tid								-1		-1		-1	-1					-1		-1							-1		-1
Total sums	Sea	1	1						1				1				1		1	1	1									1
	Tidal	3	1			-1	-10	-2	-10	-4	-12	-2	-12	-5	-3		-5	-1	-8	-6	-2		-1	1		1				1
	Saltm		-1			1	-4		-1		-1				-2		-1		-1	-2			1		1	1				1

lands), and the Common Eider, since it was only counted for part of the period.

6.3 Change in phenology

In the species account chapter, changes in phenology between period 1987/88-1994/95 and 1999/00-2006/07 are presented for each species. For an overview, here the median date for all species (>1,000 individuals) is estimated. The median date is the date that 50% of the individuals of a species (in a season) are counted, and to calculate that date, 1 July is set as day number one during the autumn, and likewise 1 January is day one of the spring season. The median date is estimated for autumn and spring and for the Northern and Southern Wadden Sea, respectively (Table 6.3).

An overview for changes in phenology for all species is shown in Table 6.3. For species that consist of only one population, these changes can be considered as reliable changes that are caused by an earlier or later passage of the species' individuals in the Wadden Sea. But for species that consist of two or more sub-populations these changes are not necessarily caused by phenology changes. They can be due to an increase or decrease in one or both of the sub-populations. To avoid drawing wrong conclusions, we only consider the species which have one population passing the Wadden Sea. In addition we only comment on species showing changes of three days (arbiter chooses) or more between the first (1987/88-1994/95) and late (1999/00-2006/07) period.

During autumn in the Northern and Southern Wadden Sea six and eight species respectively show a later median date for their passage when the early period is compared to the late period (Table 6.3). For the same periods 11 and eight spe-

Table 6.3
Median date and differences (number of days) for 30 waterbird species during autumn and spring in the Northern and Southern Wadden Sea between1987/88-1994/95 and 1999/00-2006/07. Results are also shown for species showing changes of three days or more. * P<0.05 (Kolmogorov-Smirnov two-sample test).

		Autumn						Spring					
		Northern Wadden Sea			Southern Wadden Sea			Northern Wadden Sea			Southern Wadden Sea		
	No Sub-pop.	87/88-93/94	99/00-05/06	Diff.	87/88-93/94	99/00-05/06	Diff.	87/88-93/94	99/00-05/06	Diff.	87/88-93/94	99/00-05/06	Diff.
Great Cormorant	1	59.4	52.9	-6.5*	42.0	57.7	15.7*	149.8	155.6	5.8*	154.1	154.9	0.8
Barnacle Goose	1	121.6	121.3	-0.3	132.9	132.4	-0.5	70.4	107.1	36.7*	75.6	86.4	10.8*
Dark-B. Brent Goose	1	109.9	111.9	2.0*	118.8	119.6	0.8*	111.1	109.5	-1.6*	107.2	104.2	-3.0*
Common Shelduck	1	67.0	95.6	28.6*	104.1	110.5	6.4*	38.4	43.7	5.3*	48.3	53.8	5.5*
Eurasian Wigeon	1	118.7	116.8	-1.9*	131.3	133.2	1.89*	46.5	49.6	3.1*	39.1	39.9	0.8
Common Teal	1	104.1	101.3	-2.9*	103.5	122	18.5*	75.7	83.9	8.2*	75.5	79.2	3.7*
Mallard	1	112.5	108.5	-4.0*	124.9	126.1	1.2*	30.5	47.3	16.8*	32.1	41.7	9.6*
Northern Pintail	1	102.7	106.6	3.9*	117.3	122.7	5.4*	49.8	66.5	16.7*	59.7	53.5	-6.2*
Northern Shoveler	1	102.2	105.6	3.4*	74.0	109.6	35.6*	93.8	114.3	20.5*	110.8	99.1	-11.7*
Oystercatcher	1	88.5	94.6	6.1*	100.5	91.9	-8.6*	65.6	66.1	0.5	54.9	55.5	0.6
Pied Avocet	1	49.8	41.8	-8.0*	95.4	90.4	-5.0*	115.7	140.1	24.4*	99.9	103.2	3.3*
Great Ringed Plover	3	58.7	58.7	0.0	66.1	61.3	-4.8*	135.1	141.1	6.0*	125.7	141.1	15.4*
Golden Plover	3	91.2	99.3	8.1*	118.7	110.9	-7.8*	100.0	88.9	-11.1*	84.7	79.2	-5.5*
Grey Plover	1	72.1	86.3	14.2*	92.8	81	-11.8*	120.4	126.3	5.9*	121.2	124.6	3.4*
Northern Lapwing	1	89.7	101.8	12.1*	104.5	117.8	13.3*	86.7	91.0	4.3*	60.4	64.7	4.3*
Red Knot	2	64.1	54.9	-9.2*	111.7	74.9	-36.8*	104.3	115.8	11.5*	91.7	106.6	14.9*
Sanderling	1	73.8	88.9	15.1*	45.4	73	27.6*	136.2	134.3	-1.9*	134.0	140.1	6.1*
Curlew Sandpiper	1	44.2	40	-4.2*									
Dunlin	1	78.1	77.3	-0.8*	91.7	86.1	-5.6*	107.6	106.2	-1.4*	107.0	101.2	-5.8*
Ruff	1	36.2	43.6	7.4*				127.5	127.8	0.3			
Bar-tailed Godwit	2	71.1	62.5	-8.6*	57.7	56.6	-1.1*	114.0	127.0	13.0*	124.1	123.0	-1.1*
Eurasian Curlew	1	66.2	81.4	15.2*	82.4	76.7	-5.7*	62.9	61.3	-1.6*	58.8	64.7	5.9*
Spotted redshank	1	55.1	44.8	-10.3*	31.4	22.5	-8.9*	130.8	158.1	27.3*	130.5	132.0	1.5*
Common Redshank	4	55	47.9	-7.1*	64.8	52	-12.8*	99.3	117.1	17.8*	94.1	109.4	15.3*
Common Greenshank	1	42.5	38.5	-4.0*	47.0	39.3	-7.7*	126.8	127.5	0.7	126.9	128.0	1.1*
Ruddy Turnstone	2	61.4	74.6	13.2*	63.7	72.8	9.1*	123.7	129.5	5.8*	95.2	118.7	23.5*
Black-headed Gull	1	46.1	47.4	1.3*	48.6	55.6	7.0*	135.0	141.0	6.9*	114.2	115.4	1.2*
Common Gull	1	61	66.1	5.1*	45.7	53.6	7.9*	79.3	80.2	0.9	57.6	73.1	15.5*
Herring Gull	2	66.8	69.1	2.3*	77.9	68.5	-9.4*	107.4	112.6	5.2*	107.7	89.6	-18.1*
Great Black-b. Gull	1	72.9	83.3	10.4*				79.1	62.5	-16.6*			
All species													
Median data ealier (-)				12			13			6			7
Median date later (+)				16			13			19			17
No change				2			1			4			3
Species with one poulation and changes ≥ 3 days													
Medial data ealier (-)				6			8			1			4
Medial date later (+)				11			8			12			10

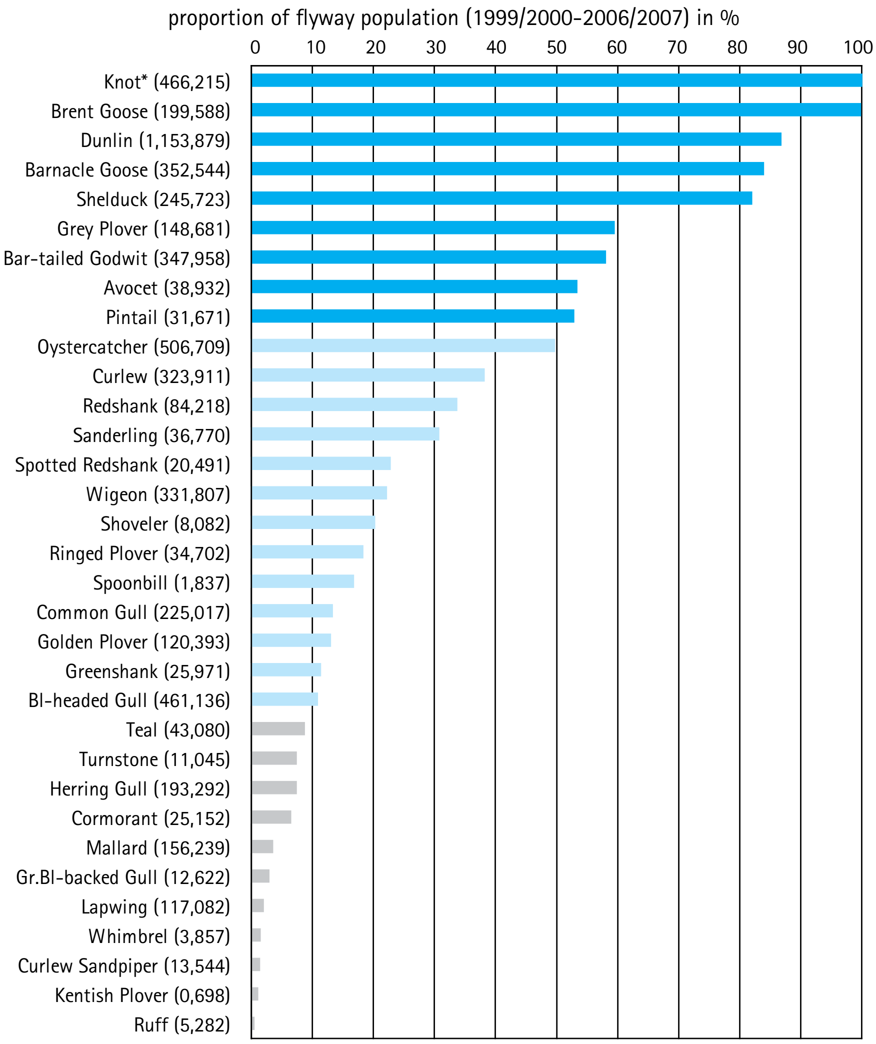
cies, respectively, pass earlier in the late period. These changes are not considered to represent a general trend in the species passage through the Wadden Sea since the number of species showing earlier and later passage is about the same size. During spring in the Northern and Southern Wadden Sea the median date of one and four species, respectively, shows an earlier passage in the late compared to the early period. However, twelve and ten species respectively show a later passage through the Wadden Sea during the same periods. Thus during spring more species in the Southern and Northern Wadden Sea pass later through the area in the late period than in the early period (in total 5 observations versus 22 observations).

6.4 Numbers in relation to flyway numbers

Importance of the Wadden Sea

Nine of 34 species utilize the Wadden Sea with more than 50% of their total population at some time in the yearly cycle. For an additional 13 species, between 10% and 50% of their flyway populations are present. Of the remaining 11 species, all but the Ruff fulfil the 1% criterion of international importance (Fig. 6.1).

The following discussion pursues a broad approach. It takes a look at the patterns of numbers and trends of waterbirds using the international Wadden Sea and presents an assessment of the



* For the Knot maximum numbers may be composed of two biogeographical populations and thus exceed the proportion if only related to the larger population (Ramsar Convention Bureau 1988)

Figure 6.1
Proportions of flyway populations with regard to estimated numbers (Wetlands International 2006).

reliability of the results. The question is, whether the current monitoring program plus the data exchange and analyses performed well enough to document the population development of the migratory waterbirds in the international Wadden Sea in a way which will finally contribute to a better understanding of the species' occurrence and their protection.

7.1 Trends

When analysing the bird numbers using the trends as a calculation tool, it should be mentioned that the numbers used in the calculation are a summation of monthly bird numbers over the entire year and not of peak numbers during autumn or spring. This has the advantage that trend results are not based on a small set of data, *e.g.* an autumn peak number that could have been influenced by poor weather conditions during some years. On the other hand, it could indicate that a species has an overall declining trend if its numbers and trends during autumn are stable, but its numbers in spring are low during recent years simply because – as seen for some North European species – parts of the population seem to overfly the Wadden Sea during spring without any staging period. Another example could be that a species simply shortens its staging time in the Wadden Sea. In both these examples a species can have a decreasing trend, but

1. the species numbers have not necessarily decreased;
2. the decreasing numbers have not necessarily anything to do with the Wadden Sea's habitat or food quality; and
3. the decreasing numbers do not correspond to a lower population size for the entire flyway population.

In conclusion, the trend analyses have to be used with some caution, and the species maximum numbers for autumn and spring should also be taken into account.

Species trends in the entire Wadden Sea and in its four regions are shown in Table 6.1.
From this it appears that for the entire Wadden Sea and for the 21 years period (Eider excluded) 8 species show strong or moderate increases: Great Cormorant, Eurasian Spoonbill, Barnacle Goose, Northern Pintail, Great Ringed Plover, Bar-tailed Godwit, Sanderling and Curlew Sandpiper; 12 species are stable: Brent Goose, Eurasian Wigeon, Northern Shoveler, Northern Lapwing, Red Knot, Dunlin, Grey Plover, Eurasian Curlew, Common Redshank, Common Greenshank, Ruddy Turnstone and Common Gull; and 13 species show – mostly moderate – decreases: Common Shelduck, Common Teal, Mallard, Eurasian Oystercatcher, Pied Avocet, Kentish Plover, European Golden Plover, Ruff, Whimbrel, Spotted Redshank, Black-headed Gull, European Herring Gull and Great Black-backed Gull.

When focusing on the species that show the same long-term trend in the entire Wadden Sea and in all parts of it, 3 species show increases, even mostly strong increases: Great Cormorant, Eurasian Spoonbill, Barnacle Goose; while 2 species show decreases: Mallard and Pied Avocet. For all the other species (28 out of 33) different trends exist in the different regions of the Wadden Sea compared to the entire Wadden Sea. If we firstly consider those species that have three or four similar trends in the Wadden Sea and its different parts, two have mostly increasing trends in all parts (including the entire Wadden Sea): Great Ringed Plover and Sanderling; six species have mostly stable trends: Eurasian Wigeon, Northern Lapwing, Red Knot, Common Greenshank, Ruddy Turnstone and Common Gull. Nine species have mostly decreasing trends. For all these 9 species the trends for the entire Wadden Sea is also decreasing and these species are already mentioned. In total 11 species show at least three different trends in the four Wadden Sea parts and for seven of those species the overall trend for the entire Wadden Sea is estimated as stable.

These results show that the trends in the Wadden Sea are consistent for only a few species, and for most species the overall Wadden Sea trend is composed of a mixture of different regional trends. To gain a better understanding of the differences between the Wadden Sea regions we have looked at the trends for the two time series (21 years versus the 10 recent years), because if there are differences between the two time series, the trends for the 10 years period will represent the indications of recent changes.

21 year versus 10 year trends

Considering the entire Wadden Sea, comparing trends for 21 against those for 10 years reveals only a few changes. Nevertheless, seven species change trend categories and five of these changes from a lower to a higher trend level: Common Shelduck, Teal and Whimbrel change from decreasing to stable numbers, and Brent Goose and Ruddy Turnstone from stable to increasing numbers. Two species change to a lower level; those are Great Cormorant from increasing to stable numbers and Common Gull from stable to decreasing numbers. Thus more species have experienced a positive trend shift than a negative one.

Trends compared to species biology and ecology

In the following we analyse the species trends in relation to some selected parameters. These include the species population trends on breeding and wintering grounds, numbers in the Wadden Sea, their preferred habitats and their favoured food items (see table 3.3).

Total flyway population trends versus Wadden Sea trends

Wetlands International estimates the number of geographical waterbird populations on a regular basis and assesses their trend status (*e.g.* Wetlands International 2002, Wetlands International, 2006). These estimations are mainly based on results from the International mid-winter count of waterbirds in January. When comparing these flyway population trends with the long-term Wadden Sea trends, one should be aware that for some species the numbers counted in the Wadden Sea can make up a large part of the flyway population and may thus have a large influence on the species flyway trend status.

Comparing these two assessments, 17 species show identical trends (5 increasing, 6 stable and 6 decreasing trends). For an additional 17 species the two trends are antagonistic: for 9 species the flyway populations are assessed as decreasing and their Wadden Sea trends are increasing; and for another 8 species the opposite situation was found. Since these latter 8 species decrease in the Wadden Sea but not on the flyway level, they can be important (together with the species decreasing in both assessments) when trying to identify potential negative developments in the Wadden Sea. These 8 species are: Shelduck, Teal, Avocet, Golden Plover, Whimbrel, Spotted Redshank, Herring Gull and Great Black-backed Gull. Species decreasing in both assessments are: Mallard, Common Eider, Oystercatcher, Kentish Plover, Ruff and Black-headed Gull. Most of these decreasing species are numerous and widely distributed in the Wadden Sea. Also, most of these decreasing species are connected to soft bottom sediment types, mussel beds and polder areas inland (see below), and also most of them breed in Northern Europe (see below).

Trends related to population size

The species flyway population sizes vary largely from European Spoonbill with 11,300 individuals to Northern Lapwing with 5-8 Million individuals (see species account chapter). Dividing the species into three groups with nearly the same number of species in each group (taking only those geographical populations that have their main occurrence in the Wadden Sea) we get 11 species with populations <210,000 individuals, 12 species populations between 210,000-880,000 individuals and 11 species with populations >870,000 individuals. Results show that, for species with populations below 210,000 individuals, for 3 species the long-term trends are decreasing and for 8 species they are stable and increasing (73%) (Table 7.1). For the species with populations between 210,000- 880,000 individuals, 6 species have decreasing trends compared to 6 species with stable and increasing trends (50 %). For the species with populations larger than 880,000 individuals, 5 species are decreasing compared to 6 species that are either stable or increasing (46%). There is some indication that the species with small population size (<210,000 individuals) are more likely to demonstrate increasing trends, than those species having larger population sizes.

Trends related to breeding grounds

The species staging in the Wadden Sea can be allocated to three main breeding areas: the Arctic, Northern Europe and Central/Western Europe (see Table 3.3). The species were grouped into their breeding grounds and using their 21-year trend results, it shows that 3 species (23%) from the Arctic breeding grounds are decreasing compared to 10 species with stable or increasing trends (Table 7.1); 6 species (55%) are decreasing breeding in Northern Europe compared to 5 species that are stable or increasing; and 5 species (50%) are decreasing from the Central/Western European breeding areas, compared to 5 species with stable or increasing trends. This reveals that only few Arctic breeders show decreases, but that more of the species breeding in North Europe and Central/Western European are decreasing.

	Long-term trend				
	increas-ing	stable	decreas-ing	Sum	% decrease
Total population size					
< 210,000	4	4	3	11	27.3
210,000-880,000	3	3	6	12	50.0
> 880,000	1	5	5	11	45.5
Breeding Grounds					
Arctic	5	5	3	13	23.1
N. Europe	1	4	6	11	54.5
Europe/Central Europe	2	3	5	10	50.0
Wintering grounds					
Trop. Afri.	2	1	3	6	50.0
Trop Afri./Med.	1	0	2	3	66.7
Trop Afri./West Euro.	2	4	0	6	0.0
West Euro. /Med.	3	7	9	19	47.4
Numbers in the Wadden Sea					
< 33,000	3	3	5	11	45.5
33,000-225,000	3	4	5	12	41.7
> 225,000	2	5	4	11	36.4
Feeding habitat in the Wadden Sea					
saltmarsh/polder/fresh water	1	1	2	4	50.0
mudflats/Eelgrass	2	6	5	13	38.5
sandflats/mixed flats	3	5	3	11	27.3
mussel beds	0	0	3	3	100.0
beaches/gullies/deeps/offshore	2	0	1	3	33.3

Table 7.1. Number of species that have increasing, stable or deceasing trends in the Wadden Sea in relation to their population size, breeding and wintering grounds, numbers occuring and their feeding habitat within the Wadden Sea. Results from the 21 years trend analyses are used.

Trends related to wintering grounds

For this analysis we have combined the wintering grounds into four categories, knowing that this is a rough generalisation, because different geographical populations are using different parts of the wintering grounds. It appears that among those species wintering in tropical Africa, 3 species (50%) are declining and 3 species are stable or increasing; 2 species (67%) wintering in tropical Africa/the Mediterranean show declining trends, while 1 species is increasing; no species (0%) wintering in the Tropical Africa/Western Europe registers a decline, compared to 6 species that are stable or increasing; and 9 species (47%) wintering in Western Europe/ the Mediterranean are declining compared to 10 species that are stable or increasing (Table 7.1). These results indicate that a large proportion of the species wintering in tropical Africa/the Mediterranean have declining populations, followed by those wintering in West Europe/Mediterranean, while those wintering in tropical Africa/West Europe are least affected.

Trends related to numbers in the Wadden Sea

Maximum estimates in the Wadden Sea vary between Kentish Plover with less than 600 to Dunlin with more than 1 Million (Table 3.3). Advantages and disadvantages exist for small and large populations alike, thus we examine the species population size in the Wadden Sea in relation to the species' trend. Dividing the species into three groups of nearly the same size in accordance to their appearance in the Wadden Sea, 11 species have populations below 33,000 individuals, 12 species between 33,000-225,000 individuals and 11 species >225,000 individuals (Table 7.1). Comparing the numbers of species with declining trends between the groups, 5 species are declining in the group with small population sizes, 5 species in the intermediate group, and 4 in the group with large population sizes. This means that 45%, 42% and 36% of the species in the three groups had declining trends. This result does not indicate that declining trends are related to the species' population size in the Wadden Sea.

Trends related to habitat use

Most species use several habitats when staying in the Wadden Sea. They can use one or two habitats for feeding during low tide and a third and a fourth for roosting during high tide. An assessment of habitat types for the species is thus a compromise of choosing between several habitat types and we assume that habitats used for feeding are more important than those used as high tide roosting sites (Table 3.3). The Wadden Sea is grouped into five habitat types (Table 7.1). Looking at the large group of species feeding on mudflats/eelgrass, sandflats/mixed flats and beaches/gullies/deeps/offshore, 18 of 27 species (67%) have stable or increasing trends. In contrast, of the seven species feeding in salt marsh/polder areas/freshwater ponds and on mussel beds, five species (71%) show decreasing trends. Those are Ruff and Golden Plover (feeding in polder areas) and Common Eiders, Oystercatcher and Herring Gull (feeding on mussel beds).

Trends related to food items

The bird species can take a large number of different food items in the Wadden Sea and when one food source is at a low level they can shift to other more abundant food types. Despite species flexibility, we have selected six groups of food items that we assume are important (Table 3.3). Of 19 species feeding on eelgrass, crayfish/worms/snails and fish, 14 species (74%) show stable or increasing trends. Of 15 species that take garbage/refuse, earthworms/arthropods, seed/grass and mussels/cockles 9 species (60%) show a decreasing trend. Amongst the decreasing species in the last groups are Ruff, Golden Plover, Whimbrel, Teal, Mallard, Shelduck, Common Eider, Oystercatcher and Herring Gull. Clearly, a close relationship exists between the food categories and utilized habitat categories, thus these two analyses are not independent of each other, and we will only show the results for the habitat types in Table 7.1.

Combining the species characteristics and trends

Considering the species' 21 years trends, we try to find common attributes for species showing the same trends to identify features in the Wadden Sea or on population level, which could have caused these trends (see also Ens *et al.* 2010). Three species show strong increases in the Wadden Sea and their flyway populations are also increasing (Wetlands International, 2006). Of these, the Cormorant and the Spoonbill are fish eaters, while the Barnacle Goose is an herbivore feeding on grass. These three species differ in almost all other aspects, such as breeding and wintering grounds, total flyway numbers, proportion in the Wadden Sea and feeding habitat.

Five species show moderate increasing trends in the Wadden Sea (Pintail, Ringed Plover, Sanderling, Curlew Sandpiper and Bar-tailed Godwit). All species except Pintail are similar in wintering in tropical Africa with parts of their winter populations in Western Europe and the Mediterranean, and breed in the Arctic. Most of them have small population sizes and they feed on tidal flats where they take crayfish together with worms.

Twelve species have stable numbers in the Wadden Sea, and six of them also have stable flyway population numbers (Wigeon, Shoveler, Lapwing, Dunlin, Redshank and Greenshank). About half of these species are either breeding in Northern Europe/Europe or in the Arctic, and the same proportion holds for their wintering grounds, which are either in the tropical Africa or in Europe. Their numbers in the Wadden Sea and the proportions of their flyway populations are highly variable, and so are the habitats they use.

Fourteen species are declining in the Wadden Sea. Of these five are also decreasing on the flyway level (Mallard, Common Eider, Oystercatcher, Ruff and Black-headed Gull). Four of the 14 species have stable flyway populations, although two of them are uncertain, (Wetlands International, 2006) (Shelduck, Pied Avocet, Golden Plover, Whimbrel and Spotted Redshank). Of another four species decreasing in the Wadden Sea, the flyway populations are increasing (Teal, Kentish Plover, Herring Gull and Great Black-backed Gull).

Eleven of the 14 species declining in the Wadden Sea are breeding in North, Central, Western Europe; of these, eight also winter in these regions, and another five winter in tropical Africa and tropical Africa/Mediterranean. With regards to total numbers in the Wadden Sea and proportion of the flyway populations, no obvious differences exist between decreasing species and those with increasing and stable trends. Considering feeding habitats and food items no particular trend categories dominate. However, all species that prefer blue mussels (Eider, Oystercatcher, Herring Gull) are decreasing.

Summary

The species showing strong increases in the Wadden Sea also show increases in the flyway populations. For those with moderate increases in the Wadden Sea those with wintering grounds in tropical Africa prevail, together with those breeding in the Arctic. Of those species that have stable numbers in the Wadden Sea, some 50% also have stable flyway numbers; all of these species have their breeding and wintering grounds in Arctic/Europe and tropical Africa/Europe. The species that decline in the Wadden Sea are dominated by species breeding in North, Central, Western Europe, and a large proportion of these species also spend the winter there.

7.2. Numbers and direct and indirect effects of climate changes

Changes in climate conditions

Climate has a large influence on birds' reproduction and survival. Precipitation before and during the breeding season favours the outcome for many wetland breeding species, and during winter, mild climate conditions increase the survival for most species. The results show that for 27 species the summed annual bird numbers in the Wadden Sea were statistically significant correlated with either the NAO winter index or the April water temperature in the Wadden Sea in the primary model (all four variables), and that three more species became significantly correlated with one of the climate variables in a modified model (Table 7.2). The four species that did not show any correlations with climate variables in the two types of models are: Shelduck, Redshank, Turnstone and Common Gull. The climate variable that shows the largest number of correlations with bird numbers is the April water temperature in the Wadden Sea, and the number of species that are correlated with this variable is 25 for period t and 24 for period t-1 (see methods). In the following, only species numbers showing significant correlation with NAO winter index and water temperature in April during period t are further commented. Species which annual numbers are positively correlated with the NAO winter index, increase in numbers in the Wadden Sea when the NAO index increases, *e.g.* their numbers increase when winters are getting milder and the precipitation increases. Among these species are Brent Goose, Common Shelduck, Common Eider and Eurasian Oystercatcher. Opposite of these are the species whose numbers are negatively correlated to the NAO-index. These species increase when the winter climate is getting colder and drier. Among these species are Great Cormorant, Barnacle Goose, Northern Lapwing and Bar-tailed Godwit.

Species whose numbers are positively correlated to water temperature in April increase in numbers when the spring water temperature increases. Some of these species are Great Cormorant, Barnacle Goose, Northern Lapwing and Curlew. Species whose numbers are negatively correlated with water temperature in April are Brent Goose, Common Eider and Eurasian Oystercatcher.

There seems to be a connection between the water temperature in April in the Wadden Sea and the long term trend numbers found for the species (see Table 6.1). 17 out of 25 species show the same sign (positive or negative) for both the water temperature and the trend directions. Thus, if any of these 17 species is positively correlated to water temperature in April, they also show a positive trend for their numbers in the Wadden Sea. For the NAO winter index, only two (Kentish Plover and Curlew) out of 23 species show the same sign as for the trend analyses. The result for the water temperature could indicate that species that benefit from warmer water temperature in April (*e.g.* from high food stocks) will show an increase in numbers during the next year. But our assumption for the NAO winter index, that milder winter climate (high NAO index) should increase the numbers during the next year (through lower winter mortality and thus higher breeding number) was not supported. Thus, of the two examined climate parameters the water temperature in April is probably the best climate parameter to indicate bird numbers in the following year.

From Table 7.2 it appears that there is a negative relationship between the NAO winter index and the water temperature in April in the Wadden Sea. How this relation is connected is not clear.

In total we found significant correlations for 30 out of 34 species between their numbers and one or more climate variables, and an indication that spring water temperature is related to the species trend number in the Wadden Sea.

Table 7.2
Relationship between the annual summed numbers of 34 waterbird species in the Wadden Sea and the North Atlantic Oscillation index during winter, December-March (NAO DJFM) and the water temperature in April in Marsdiep in The Netherlands' Wadden Sea (Wadden Sea April) in period t: 1988/89-2007/08 and period t-1: 1987/88-2006/07. P <0.05 (*) and P <0.01 (**); a: slope of correlation line. For species' names in italic a modified model was used for the statistical test (see method).

	NAO JFM_{t-1}		NAO $DJFM_t$		Wadden Sea $April_{t-1}$		Wadden Sea $April_t$	
Species	a	P	a	P	a	P	a	P
Great Cormorant			-	*	+	***	+	*
Spoonbill	-	*	-	**	+	**	+	**
Barnacle Goose			-	*	+	**	+	**
Brent Goose	+	*	+	**	-	**	-	*
Shelduck								
Wigeon	+	*	+	**				
Teal					-	*		
Mallard							-	*
Pintail							+	*
Shoveler	-	*	-	**	+	**	+	**
Common Eider			+	**	-	*	-	**
Oystercatcher	+	*	+	**	-	**	-	**
Avocet	+	*	+	**	-	**	-	**
Ringed Plover	+	*	+	**	-	**	-	**
Kentish Plover			+	*	-	**	-	**
Golden Plover	+	*	+	**	-	**	-	**
Grey Plover	+	*						
Lapwing	-	*	-	**	+	**	+	**
Knot			+	*	-	*		
Sanderling					+	**	+	*
Curlew Sandpiper	-	*	-	**	+	**	+	**
Dunlin	+	*	+	**	-	**	-	**
Ruff	+	*	+	*	-	**	-	**
Bar-tailed Godwit			-	*			+	**
Whimbrel	+	*	+	**	-	**	-	**
Curlew	-	*	-	**	+	**	+	**
Spotted Redshank	+	*	+	**	-	**	-	**
Redshank								
Greenshank					+	*		
Turnstone								
Black-headed Gull	+	*	+	**	-	**	-	**
Common Gull								
Herring Gull	+	*	+	**	-	**	-	**
Great Black-backed Gull							-	*

Changes in sediment composition

In this report we found large scale geographical changes in the migratory bird distributions in sub-areas throughout the Wadden Sea. These changes show general increasing numbers in The Netherlands and Denmark, and decreases in Schleswig-Holstein and (parts of) Niedersachsen. The results in the QSR report (Marencic and de Vlas., 2009) offer no large scale spatial pattern with regard to human activities, eutrophication, salt marsh vegetation, macrozoobenthos etc., that could fit these changes found for the migratory birds. There seems to be one exception that is the geographical extension of tidal amplitude (Wiersma *et al.*, 2009). The tidal current is responsible for the main sediment transport in the Wadden Sea and even small changes of the current can affect the sediments. By the same token, the effect of an increase in water temperatures on settling and resuspension rates of sediment may lead to a shift in timing of sediment redistribution and stabilization. This may have consequences for the pelagic and benthic biomass and production (Philippart and Epping, 2009). In addition, climate studies in The Netherlands show that westerly winds during winter and early spring had increased during recent years, but the number of storms had not changed (Oost *et al.* 2009). On the other hand, the storm corridors in Europe have moved to the north and the frequency of storms in Schleswig-Holstein had increased during recent years, but the wind speed had not increased (Oost *et al.*, 2009). Thus, on the one hand, a change in temperature might be able to change the tidal current's capacity to transport sediment and on the other hand changes in wind regimes might influence where and when the sediment can be deposited. Thus, yet another hypothesis to those mentioned above could be that the observed changes in bird distributions are driven by changes in sediment composition which again are related to changes in climate conditions.

We have analysed the observed changes in bird distribution in sub-areas in the Wadden Sea between 1987/88-1994/95 and 1999/00-2006/07 in relation to the tidal amplitude, which is low in The Netherlands and Denmark and high in Schleswig-Holstein and parts of Niedersachsen (see Table 6.2). In the analyses we only included statistically significant changes in bird numbers in the sub-areas presented in the species account chapter, and we also assume that those species that feed on the tidal flats are more influenced by changes in sediment than those species feeding on the salt marshes. The number of species showing significant changes in each sub-area (number of increasing species minus the numbers of decreasing species) is shown in Table 6.2, and we analysed the species that depend on tidal flats and those that depend on salt marshes separately. The results shows (Fig. 7.1) that for the species that feed on the tidal flats the number of species that increase or decrease for each sub-area is a statistically significant correlated with the height of the tidal amplitude ($P < 0.0001$, $R^2 = 0.42$; $N = 29$. Linear regression analysis). Thus, in sub-areas with small tidal amplitude few changes in bird numbers had occurred from the early to the late period. In turn, in sub-areas with large tidal amplitudes large changes in bird numbers had occurred between the two periods. For the species feeding on the salt marshes, no significant correlations were found between the tidal amplitude and the number of species with changes in numbers (P = 0.402, R^2 = 0.03, N = 29. Linear regression analysis). Thus, changes in species numbers are most pronounced for species feeding on the tidal flats compared to those feeding on the salt marshes.

Based on these considerations, it can be concluded, that the observed decreases of some of the migratory bird species throughout the Wadden Sea could be connected to changes in sediment composition. It must be stressed, that this analysis only suggests a correlation, and further studies must be performed to confirm and understand the mechanism behind it.

The results of relationships between the changes in species numbers in the Wadden Sea and the climate condition show that climate change could have an effect on the changing numbers that stage in the Wadden Sea. In addition we found that there could be a relationship between variables (climate related and other variables) connected to tidal amplitude in the Wadden Sea and changes in bird numbers.

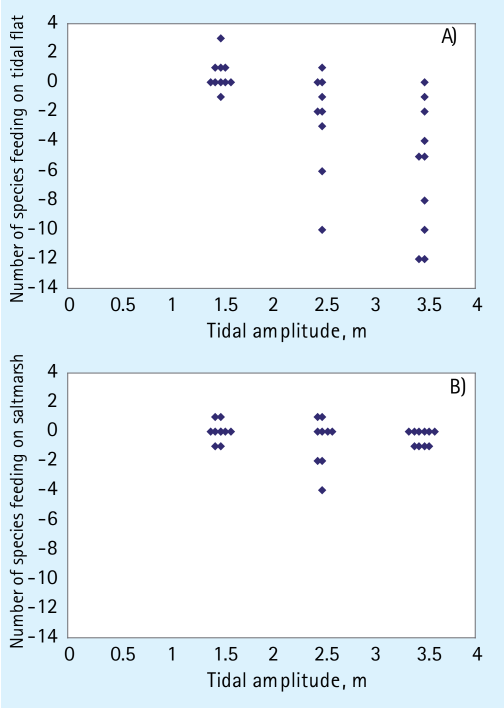


Figure 7.1
Relationships between the number of species in the sub-areas showing significant changes (increases or decreases) for the periods 1987/88-1994/95 and 1999/00-2006/07 and the sub-areas' tidal amplitude. Only statistically significant changes in bird numbers in the sub-areas between the two periods are used. A) shows the relationships for species feeding on the tidal flat (20 species of waders, gulls and the Brent Goose, Wigeon and Shelduck), and B) for species feeding on saltmarshes (6 species of geese, dabbling ducks and Spotted Redshank). Each dot represents the number of increasing minus the number of decreasing species for a sub-area (*e.g.* for the tidal species, the dot at the upper left in figure A) represent sub-area no. 1 (Langli-Ho Bugt) with 4 increasing and 1 decreasing species resulting in 3 increasing species for this sub-area. And the dot at the bottom to the right in figure A) representing sub-area no. 12 (Trischen - Meldorfer Bucht) where 12 species had decreased in numbers and 0 species had increased resulting in 12 decreasing species for that sub-area.

7.3 The Wadden Sea in perspective

The results show that eight bird species had increasing trends, 12 had stable and 13 had decreasing trends during the last 21 years. In addition we found that the trends are different in different Wadden Sea regions. Assessing these trends, we found that numbers decreased for those bird species that feed on mussel beds and on garbage dumps and for a relatively large part of those species that breed in Northern Europe. Analysing the geographical changes between 1987/88-1994/95 and 1999/00-2006/07, we found that some species decreased in the Wadden Sea sites in Schleswig-Holstein and in Niedersachsen, and increased in Denmark and The Netherlands, a remarkable spatial pattern. Analysing the phenology of the species, the results showed that several species had prolonged their stay in the Wadden Sea during autumn from the early to the late period; we found that some European breeders left the Wadden Sea earlier during spring and did not show a spring peak in the recent period, and that several species tend to stay longer during spring in recent years than in the former period. These species include both some European (*e.g.* Shelduck and Lapwing) and Arctic breeding species (*e.g.* Barnacle Goose and Grey Plover) although the Arctic breeding species are very depending on an early or well-timed arrival to their breeding grounds (Meltofte *et al.*, 2997, 2008). A reason for a longer stay in the Wadden Sea during spring could be that milder winters during recent years had initiated an earlier growth of vegetation and macrozoobenthos (Madsen *et al.* 2005).

In addition the results also show regional changes in bird numbers and these have been analysed by Ens *et al.* (2009) from the assumptions that they are caused by variables from inside the Wadden Sea. Thus the regional changes have been analysed in relation to winter severity, eutrophication, cockle and mussel fishery, macrozoobenthos and salt marsh vegetation; but it was not possible to identify variables that explain the species' contrasting numbers in the four regions of the Wadden Sea (Ens *et al.*, 2009). However, this does not mean that there are no connections between these variables and the changes in bird numbers, but only that it was not possible to find these. It is suggested that this may be due to differences in monitoring scales for the variables and the birds. Some variables important for migratory birds' presence are generally monitored on a rather small scale (*e.g.* some specific squares on a salt marsh, or transects for macrozoobenthos). Ens *et al.*, 2009, conclude that more intensive studies are necessary to find explanations on the birds' distribution and trends. A detailed case study was conducted in The Netherlands Wadden Sea. The density of cockles and the Red Knot numbers showed a close correlation and suggested that the carrying capacity for Red Knots has been reached in the western parts of The Netherlands Wadden Sea due to shell fish fishery (Kraan *et al.* 2009). This may explain why we have found increasing numbers of Red Knot in other regions of the Wadden Sea (*e.g.* Niedersachsen and Denmark) in recent years.

No obvious features in the QSR report (Marencic and de Vlas, 2009) for salt marshes and macrozoobenthos show large scale geographical changes. However, the general tidal range across the Wadden Sea shows high amplitudes in the centre of the German Bight covering Schleswig-Holstein and parts of Niedersachsen, and small amplitude in The Netherlands and Denmark. The tidal amplitude can change over years (Ingvardsen, 2006), but in the context examined here we don't think that these small changes are relevant. However, tidal amplitude in combination with warmer climate and changes in wind direction (Oost *et al.*, 2009, Philippart and Epping 2009, both within the QSR - Marencic and de Vlas, 2009) might have changed the sediment composition under influence of the general tidal amplitude. For the Danish Wadden Sea it is shown that large amounts of silts are imported and models reveal that this will continue in the future (Lumborg, 2004). Looking at the species that increase in numbers in the Danish Wadden Sea, some of these are connected to soft sediments: Shelduck, Shoveler, Grey Plover, Curlew, Redshank and Greenshank. Thus a relevant hypothesis for the future could be that changes in bird numbers inside the Wadden Sea can be caused by changes in sediment composition due to change in weather conditions since it appears that tidal amplitude together with coastal streams and coastal exposure could change sediment composition in different parts of the Wadden Sea.

On the other hand, the bird numbers in the Wadden Sea not only depend on the conditions inside the area, but also on conditions outside, for example the ecological conditions on the wintering grounds, the weather during migration and the conditions on the breeding grounds, to mention some. For waders, Engelmoer (2008) demonstrated a close connection between specific breeding grounds in the Arctic and regions in the Wadden Sea where these birds stage and moult. The autumn number in West Europe of juveniles of the Arctic breeding Dark-bellied Brent Goose reflects the annually breeding success, which again depends on the weather condition and the predation pressure in the Arctic (Ebbinge, 1989). Also the annual breeding condition of the boreal breeding species such as Teal and Pintail are reflected in their autumn numbers in the Wadden Sea (Laursen and Frikke, 2006). A 20-year study in the Danish Wadden Sea, including 17 water bird species, shows that for nine species the annual variation in numbers could be explained by parameters governed by conditions from outside the Wadden Sea, *e.g.* breeding success and flyway population numbers. Changes on the species wintering grounds also influence the numbers in the Wadden Sea. Teals that used to spend the winter in the Camargue (Southern France) belonging to the Mediterranean flyway have recently changed their wintering quarters to the North and thus have merged winter quarters with the North-Western European flyway population, which involves the Wadden Sea area (Guillemain *et al.*, 2005). It is also known that the Greylag Geese has shifted its winter sites from southern Spain to The Netherlands (Madsen *et al.* 1999). These changes are not directly analysed in relation to climate change, but they do include direct and indirect climate effects. A direct relationship between climate change and species shift in winter distribution had been demonstrated by MacLean *et al.* (2008), including a European dataset that incorporated the Wadden Sea data. In that study, seven out of nine common wader species had shifted winter distribution from southern Britain about 130 km north-eastwards, also including birds from the Wadden Sea area. Another study in Britain demonstrated a general shift in waders distribution from south-western parts to south-eastern parts, caused by climate changes. This particularly involved small sized waders that are especially vulnerable to temperature change (Austin *et al.*, 2000).

All these studies demonstrate that a large number of species and birds in the Wadden Sea are not only affected by local changes (*e.g.* the effects of shellfish fishery, or changes in sediment composition) but by factors from outside the Wadden Sea in wider Western Europe. Indeed, some sediment composition changes are due to external factors.

Further studies must acknowledge the influence that multiple internal and external factors can exert on population developments. As different factors may work on different levels, it is not easy to produce a simple message or even identify management implications.

Further diligent monitoring of migratory bird species in the International Wadden Sea will continue to produce the data necessary to fuel further analyses through which a better understanding of the complex Wadden Sea ecosystem can be built. It is essential that more connections are also made to data and studies in the wider world, since over the course of a year many Wadden Sea bird species use areas as diverse and distant as the high Arctic and South Africa. With the support and coordination of the CWSS, continued trilateral cooperation and extended cooperations with others, a more comprehensive and therefore more valuable picture can be built of conditions that affect the worldwide migratory patterns of the vast bird community that depends on the Wadden Sea for its survival. These species in turn form an indispensible part of the Wadden Sea ecosystem.

Photo: Bo Lassen Christiansen

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Appendix 1

Maximum estimates (counted and imputed) in geographical regions of the Wadden Sea 1987/1988-2006/2007 during moult, autumn, winter, spring and breeding seasons. For season definition see Table 3.4. The regions are: DK (Denmark), SH (Schleswig-Holstein), NDS (Niedersachsen/Hamburg), NL (The Netherlands), NW (Northern Wadden Sea, north of the river Elbe), SW (Southern-Western Wadden Sea, southwest of the river Elbe) and WS (the Wadden Sea). Given are the arithmetic mean of the three maximum estimates per season and region, using only estimates with less than 50% imputed; cells are empty when maximum estimates could not be given due to more than 50% imputed. For details, see method description.

			Period 1987/1988-1994/1995					Period 1999/2000-2006/2007				
Area	Euring	Name	MOULT	AUTUMN	WINTER	SPRING	BREED	MOULT	AUTUMN	WINTER	SPRING	BREED
DK	00720	Great Cormorant		3,471	25	12	462		4,828	122	35	3,318
SH	00720	Great Cormorant		1,844	17	10	952		4,306	258	378	3,543
NDS	00720	Great Cormorant		1,886	188	122	1,133		4,870	470	350	3,408
NL	00720	Great Cormorant		3,267	587	508	2,498		11,975	3,196	3,021	8,675
NW	00720	Great Cormorant		5,125	33	22	659		11,177	376	406	7,817
SW	00720	Great Cormorant		5,450	738	603	3,248		15,662	3,335	2,800	10,771
WS	00720	Great Cormorant		11,420	708	681	3,804		25,152	3,535	3,049	15,684
DK	01440	Eurasian Spoonbill		0		0	0		2		0	6
SH	01440	Eurasian Spoonbill		1		0	4		164		20	83
NDS	01440	Eurasian Spoonbill		11		0	2		341		77	140
NL	01440	Eurasian Spoonbill		322			161		1,574		358	768
NW	01440	Eurasian Spoonbill		1		0	4		173		20	84
SW	01440	Eurasian Spoonbill		323			161		1,740		391	889
WS	01440	Eurasian Spoonbill		323			163		1,837		405	938
DK	01670	Barnacle Goose		13,896	12,201	50,873			46,721	21,745	61,913	
SH	01670	Barnacle Goose		80,077	31,098	50,682			81,753	28,868	112,138	
NDS	01670	Barnacle Goose		42,237	39,064	49,283			56,016	47,966	73,954	
NL	01670	Barnacle Goose		85,988	60,592	74,901			85,250	78,871	149,512	
NW	01670	Barnacle Goose		95,613	38,876	75,018			114,446	50,764	168,972	
SW	01670	Barnacle Goose		124,430	86,858	115,380			133,360	114,872	213,432	
WS	01670	Barnacle Goose		191,545	115,573	206,459			238,671	155,626	352,544	
DK	01680	Dark-bellied Brent Goose		14,426	2,898	14,763			11,704	1,809	18,573	
SH	01680	Dark-bellied Brent Goose		43,203	10,588	131,319			36,533	7,936	87,604	
NDS	01680	Dark-bellied Brent Goose		10,482	6,092	24,255			16,030	5,184	19,970	
NL	01680	Dark-bellied Brent Goose		35,176	40,151	105,302			30,650	31,344	92,380	
NW	01680	Dark-bellied Brent Goose		55,885	10,650	156,233			45,769	9,621	97,801	
SW	01680	Dark-bellied Brent Goose		43,831	43,924	127,433			42,414	34,831	117,722	
WS	01680	Dark-bellied Brent Goose		95,123	53,141	279,453			83,269	38,808	199,588	
DK	01730	Common Shelduck	4,670	29,059	27,609	11,340	6,565	12,158	48,110	28,138	13,817	3,023
SH	01730	Common Shelduck	146,647	82,675	82,884	21,761	31,845	95,550	79,307	70,761	48,242	21,758
NDS	01730	Common Shelduck	20,928	86,070	66,689	50,083	12,926	22,376	93,089	65,900	39,288	14,369
NL	01730	Common Shelduck		64,533	49,501	17,693	16,559	58,190	75,960	48,468	26,416	46,322
NW	01730	Common Shelduck	151,852	107,714	102,649		38,313	101,211	100,361	93,292	69,045	29,086
SW	01730	Common Shelduck	34,128	153,432	115,091	46,775	25,228	74,092	159,292	108,583	63,718	55,640
WS	01730	Common Shelduck	197,097	252,824	205,533	89,754	47,564	151,268	245,723	201,345	131,509	74,963
DK	01790	Eurasian Wigeon		50,186	10,897	8,169			63,031	15,672	10,753	
SH	01790	Eurasian Wigeon		201,301	154,912	94,335			174,973	99,543	60,791	
NDS	01790	Eurasian Wigeon		49,277	46,032	25,611			47,640	31,391	21,825	
NL	01790	Eurasian Wigeon		67,018	102,971	2,589			132,608	90,957	8,379	
NW	01790	Eurasian Wigeon		253,355	164,256	94,148			229,538	112,232	77,676	
SW	01790	Eurasian Wigeon		115,062	142,291	9,065			178,110	115,586	21,800	
WS	01790	Eurasian Wigeon		327,525	273,117	94,972			331,807	259,479	124,623	

			Period 1987/1988-1994/1995					Period 1999/2000-2006/2007				
Area	Euring	Name	MOULT	AUTUMN	WINTER	SPRING	BREED	MOULT	AUTUMN	WINTER	SPRING	BREED
DK	01840	Common Teal	2,151	10,628	1,498	2,425		1,659	6,097	3,800	1,887	
SH	01840	Common Teal	5,532	19,267	8,286	6,555		4,150	14,745	8,419	7,472	
NDS	01840	Common Teal	2,596	18,899	11,656	6,805			7,727	3,298	3,511	
NL	01840	Common Teal	1,561	19,927	8,959	3,319		2,551	20,067	13,278	5,865	
NW	01840	Common Teal	6,995	22,943	9,164	5,383		5,668	20,300	10,055	9,299	
SW	01840	Common Teal	3,457	33,397	17,155	11,026		4,417	26,963	16,257	8,975	
WS	01840	Common Teal	8,904	48,154	22,828	17,502		10,454	43,080	24,626	18,170	
DK	01860	Mallard	2,154	10,330	21,047	14,664	452	2,346	5,387	10,667	7,499	384
SH	01860	Mallard	29,726	41,410	66,913		3,340	19,611	32,587	39,324	39,985	4,317
NDS	01860	Mallard	11,672	52,516	69,876	41,338	3,519	17,821	33,601	52,559	35,038	3,405
NL	01860	Mallard	6,532	36,488	56,248	25,425	2,497	15,285	46,368	60,531	23,104	4,439
NW	01860	Mallard	31,453	57,243	83,921		3,760	21,972	38,534	49,737	48,590	4,678
SW	01860	Mallard		77,797	112,715	46,872	5,640	28,197	83,536	115,263	50,108	7,603
WS	01860	Mallard	53,879	126,257	179,562	58,455	9,373	57,702	111,616	156,239	102,407	11,760
DK	01890	Northern Pintail		7,483	4,934	2,132			10,137	7,056	3,707	
SH	01890	Northern Pintail		10,371	3,678	4,585			9,895	5,031	4,491	
NDS	01890	Northern Pintail		2,830	3,141	4,557			4,453	6,507	4,440	
NL	01890	Northern Pintail		7,177	8,034				16,063	16,357	9,215	
NW	01890	Northern Pintail		13,404	7,490	6,845			16,650	9,682	7,760	
SW	01890	Northern Pintail		9,228	9,917	5,602			18,854	20,275	14,433	
WS	01890	Northern Pintail		18,587	15,787	12,832			31,671	27,856	22,184	
DK	01940	Northern Shoveler	56	783	68	31	68	100	1,618	540	271	136
SH	01940	Northern Shoveler	1,543	3,969	1,237	717	908	1,180	4,456	2,004	1,544	839
NDS	01940	Northern Shoveler	1,664	1,209	268	648	1,534	1,303	1,250	637	993	218
NL	01940	Northern Shoveler	602	2,483	1,910	1,218	186	385	3,353	1,294	569	274
NW	01940	Northern Shoveler	1,579	4,045	1,293	809	933	1,408	4,745	2,212	1,742	984
SW	01940	Northern Shoveler	2,013	2,864	2,120	1,096	1,362	1,351	4,081	1,786	1,426	479
WS	01940	Northern Shoveler	3,155	5,655	3,040	1,805	2,153	2,144	8,082	3,761	3,128	1,591
DK	04500	Eurasian Oystercatcher		39,005	43,891	21,111	13,320		42,323	42,774	29,907	17,094
SH	04500	Eurasian Oystercatcher		187,968	146,424	100,039	73,727		122,703	116,924	101,186	59,509
NDS	04500	Eurasian Oystercatcher		232,716	230,384	159,356	69,604		150,836	163,833	124,493	54,565
NL	04500	Eurasian Oystercatcher		283,625	285,341		55,334		203,965	192,028	95,105	62,053
NW	04500	Eurasian Oystercatcher		219,359	186,552		86,038		160,551	154,781	133,719	72,995
SW	04500	Eurasian Oystercatcher		463,448	495,726	172,865	117,455		349,643	334,788	214,654	136,078
WS	04500	Eurasian Oystercatcher		653,829	664,231	267,202	181,113		506,709	472,190	351,988	210,854
DK	04560	Pied Avocet	5,445	8,902		920	3,096	3,157	3,107		1,145	1,414
SH	04560	Pied Avocet	7,963	8,691		1,702	6,864	7,709	4,553		7,680	5,844
NDS	04560	Pied Avocet	10,431	31,520		4,711	2,772	4,696	22,401		3,520	1,908
NL	04560	Pied Avocet	9,496	16,973		5,961	7,712	13,044	18,174		8,110	5,928
NW	04560	Pied Avocet	15,140	16,556			9,276	10,672	8,633		8,524	6,968
SW	04560	Pied Avocet	16,288	49,128		10,439	9,876	17,888	35,086		11,270	7,864
WS	04560	Pied Avocet	20,364	53,874		11,979	19,003	27,217	38,932		18,651	14,561
DK	04700	Great Ringed Plover		488		429			2,563		843	
SH	04700	Great Ringed Plover		16,996		7,783			15,644		16,936	
NDS	04700	Great Ringed Plover		6,533		2,890			10,819		2,802	
NL	04700	Great Ringed Plover		1,443		2,050			10,966		6,597	
NW	04700	Great Ringed Plover		15,560		8,116			18,070		17,538	
SW	04700	Great Ringed Plover		10,605		4,939			19,450		8,740	
WS	04700	Great Ringed Plover		20,394		12,583			34,702		24,306	
DK	04770	Kentish Plover		16		4	55		30		20	44
SH	04770	Kentish Plover		405		85	396		534		77	319
NDS	04770	Kentish Plover		309		209	205		193		20	20
NL	04770	Kentish Plover		79			26		67		19	20
NW	04770	Kentish Plover		438		52	414		545		94	360
SW	04770	Kentish Plover		252		200	135		253		32	35
WS	04770	Kentish Plover		655		228	536		698		101	385

			Period 1987/1988-1994/1995					Period 1999/2000-2006/2007				
Area	Euring	Name	MOULT	AUTUMN	WINTER	SPRING	BREED	MOULT	AUTUMN	WINTER	SPRING	BREED
DK	04850	Eurasian Golden Plover		62,015		36,425			36,215		20,718	
SH	04850	Eurasian Golden Plover		68,561		50,735			28,307		29,858	
NDS	04850	Eurasian Golden Plover		24,622		29,655			26,648		10,022	
NL	04850	Eurasian Golden Plover		27,054		15,634			54,271		29,280	
NW	04850	Eurasian Golden Plover		121,189		55,297			55,486		43,412	
SW	04850	Eurasian Golden Plover		51,092		51,855			72,862		51,371	
WS	04850	Eurasian Golden Plover		148,108					120,393		84,885	
DK	04860	Grey Plover		3,162	1,039	5,508			6,157	1,497	5,521	
SH	04860	Grey Plover		59,670	12,233	49,039			25,979	11,581	33,305	
NDS	04860	Grey Plover		36,085	17,928	56,374			31,973	26,042	42,305	
NL	04860	Grey Plover		25,886	19,354	52,694			57,001	21,674	72,026	
NW	04860	Grey Plover		62,202	13,043	54,049			30,513	12,269	36,683	
SW	04860	Grey Plover		52,211	33,384	109,006			80,765	41,667	114,395	
WS	04860	Grey Plover		119,909	47,966	157,168			104,140	51,107	148,681	
DK	04930	Northern Lapwing		14,808	2,326	17,099	1,971		14,338	27,154	7,905	1,814
SH	04930	Northern Lapwing		46,737	16,999	10,950	3,510		25,647	19,524	7,673	6,803
NDS	04930	Northern Lapwing		29,959	20,399	15,035	2,530		30,032	26,580	8,225	3,529
NL	04930	Northern Lapwing		12,776	12,580	16,350	1,755		39,901	43,823	12,913	3,959
NW	04930	Northern Lapwing		59,856	2,720	37,309	5,051		41,880	46,678	14,642	8,900
SW	04930	Northern Lapwing		42,422	52,378	20,312	4,407		64,881	70,404	19,530	6,692
WS	04930	Northern Lapwing		99,862	68,380	36,524	9,475		98,757	117,082	36,212	13,496
DK	04960	Red Knot		9,685	10,927	58,704			82,190	24,756	115,671	
SH	04960	Red Knot		253,911	89,508	406,078			125,146	60,590	214,326	
NDS	04960	Red Knot		57,927	no imputing possible				no imputing possible			
NL	04960	Red Knot		89,419	150,170	58,648			131,117	109,432	34,459	
NW	04960	Red Knot		271,521	92,827	426,894			178,215	71,854	294,265	
SW	04960	Red Knot		161,277	168,162	NN			213,015	123,825	66,833	
WS	04960	Red Knot		396,198	194,160	501,018			358,710	165,893	466,215	
DK	04970	Sanderling		926	2,157	2,548			2,475	1,724	4,001	
SH	04970	Sanderling		8,043	2,145	12,955			5,495	1,735	11,254	
NDS	04970	Sanderling		4,552	3,199	3,329			5,655	3,890	2,777	
NL	04970	Sanderling		3,864	3,532	2,902			13,290	9,432	15,781	
NW	04970	Sanderling		8,938	3,619	15,799			7,679	3,044	14,557	
SW	04970	Sanderling		7,330	6,325	4,965			17,681	12,527	17,524	
WS	04970	Sanderling		14,801	7,535	21,429			24,875	16,462	36,770	
DK	05090	Curlew Sandpiper		108		32			265		10	
SH	05090	Curlew Sandpiper		8,965		26			12,057		1,332	
NDS	05090	Curlew Sandpiper		337		29			227		191	
NL	05090	Curlew Sandpiper		1,370		131			5,155		251	
NW	05090	Curlew Sandpiper		8,965		26			12,136		1,344	
SW	05090	Curlew Sandpiper		1,559		206			5,173		442	
WS	05090	Curlew Sandpiper		10,812		105			13,544		1,656	
DK	05120	Dunlin		307,873	57,610	224,354			238,673	37,705	190,087	
SH	05120	Dunlin		566,513	95,850	421,555			335,054	82,137	275,271	
NDS	05120	Dunlin		271,411	87,399	282,473			320,277	114,273	249,156	
NL	05120	Dunlin		232,243	117,993	228,995			407,322	198,240	370,983	
NW	05120	Dunlin		721,951	135,490	616,676			557,595	112,022	431,958	
SW	05120	Dunlin		493,280	179,238	483,275			641,144	292,575	596,904	
WS	05120	Dunlin		1,236,333	299,121	1,073,707			1,153,879	390,001	946,807	
DK	05170	Ruff		163		14,202			357		407	
SH	05170	Ruff		3,579		4,929			4,406		1,514	
NDS	05170	Ruff		1,042		1,156			421		104	
NL	05170	Ruff		533		184			610		127	
NW	05170	Ruff		3,614		18,383			4,654		2,036	
SW	05170	Ruff		1,802		1,245			846		154	
WS	05170	Ruff		5,507		19,045			5,282		2,318	

			Period 1987/1988-1994/1995					Period 1999/2000-2006/2007				
Area	Euring	Name	MOULT	AUTUMN	WINTER	SPRING	BREED	MOULT	AUTUMN	WINTER	SPRING	BREED
DK	05340	Bar-tailed Godwit		23,022	15,024	45,770			17,301	5,585	28,629	
SH	05340	Bar-tailed Godwit		69,840	25,275	143,134			43,128	16,695	87,277	
NDS	05340	Bar-tailed Godwit		36,102	4,073	64,812			28,921	10,298	81,074	
NL	05340	Bar-tailed Godwit		38,990	27,906	121,425			90,138	64,733	173,487	
NW	05340	Bar-tailed Godwit		87,060	36,920	188,904			61,871	22,812	117,358	
SW	05340	Bar-tailed Godwit		50,448	30,272	205,929			112,807	68,724	245,834	
WS	05340	Bar-tailed Godwit		126,709	52,564	367,066			151,762	85,713	347,958	
DK	05380	Whimbrel		333		502			422		79	
SH	05380	Whimbrel		647		182			830		120	
NDS	05380	Whimbrel		1,994		502			729		117	
NL	05380	Whimbrel		451		507			2,792		1,217	
NW	05380	Whimbrel		982		658			1,081		180	
SW	05380	Whimbrel		1,758		851			3,241		1,270	
WS	05380	Whimbrel		2,210		1,389			3,857		1,336	
DK	05410	Eurasian Curlew		3,689	5,234	1,462	960		10,261	14,255	7,922	1,925
SH	05410	Eurasian Curlew		73,571	52,159	41,064	10,464		48,291	44,569	32,927	9,097
NDS	05410	Eurasian Curlew		95,851	99,819	79,271	16,017		116,528	75,882	78,603	17,041
NL	05410	Eurasian Curlew		137,469	122,366		9,819		174,092	131,884	115,678	27,379
NW	05410	Eurasian Curlew		77,686	55,289	42,901	11,160		57,205	54,247	39,495	10,717
SW	05410	Eurasian Curlew		213,379	215,042		24,978		270,297	195,884	187,789	41,940
WS	05410	Eurasian Curlew		282,886	270,468	225,893	31,513		323,911	240,876	222,648	48,535
DK	05450	Spotted Redshank		765		1,964			1,383		512	
SH	05450	Spotted Redshank		13,953		10,658			9,095		3,963	
NDS	05450	Spotted Redshank		2,498		6,386			4,861		3,699	
NL	05450	Spotted Redshank		5,525		5,557			6,834		2,436	
NW	05450	Spotted Redshank		9,975		11,497			10,238		4,439	
SW	05450	Spotted Redshank		7,872		10,800			11,810		6,358	
WS	05450	Spotted Redshank		19,660		20,884			20,491		9,874	
DK	05460	Common Redshank		3,035	1,927	424	1,577		7,905	1,798	1,234	1,817
SH	05460	Common Redshank		36,322	5,787		5,577		18,434	4,660	4,762	4,355
NDS	05460	Common Redshank		20,992	6,861	10,975	9,133		19,302	4,792	6,833	4,877
NL	05460	Common Redshank		15,882	11,333	11,515	10,425		46,321	14,500	14,562	17,236
NW	05460	Common Redshank		39,293	7,036		7,083		24,437	5,903	6,253	6,096
SW	05460	Common Redshank		38,514	18,097	22,911	19,672		62,494	19,184	20,308	21,146
WS	05460	Common Redshank		56,860	24,386	25,283	26,267		84,218	24,145	26,085	25,967
DK	05480	Common Greenshank		2,132		1,657			5,745		1,221	
SH	05480	Common Greenshank		8,431		1,042			5,816		942	
NDS	05480	Common Greenshank		5,653		3,437			5,900		3,576	
NL	05480	Common Greenshank		2,506		1,595			8,894		1,921	
NW	05480	Common Greenshank		9,460		2,583			11,376		2,087	
SW	05480	Common Greenshank		8,018		4,839			13,902		5,326	
WS	05480	Common Greenshank		12,489		7,299			25,971		6,844	
DK	05610	Ruddy Turnstone		147	54	718			843	343	303	
SH	05610	Ruddy Turnstone		2,443	1,098	2,549			2,687	1,890	3,022	
NDS	05610	Ruddy Turnstone		1,979	2,376	2,297			1,963	1,752	1,762	
NL	05610	Ruddy Turnstone		4,325	3,170	3,759			6,439	3,815	3,635	
NW	05610	Ruddy Turnstone		2,617	1,209	3,258			3,250	2,055	3,542	
SW	05610	Ruddy Turnstone			5,215	5,682			7,677	5,382	5,097	
WS	05610	Ruddy Turnstone		7,143	6,319	8,832			11,045	7,007	8,439	
DK	05820	Common Black-headed Gull		38,659	7,162	9,455	19,369		42,945	3,033	12,722	9,438
SH	05820	Common Black-headed Gull		106,725	6,951	29,576	76,608		92,806	7,169	35,842	51,371
NDS	05820	Common Black-headed Gull		136,057	29,674	44,389	34,901		153,978	15,994	46,493	37,122
NL	05820	Common Black-headed Gull		92,474	21,255		88,537		234,639	23,238	58,185	34,168
NW	05820	Common Black-headed Gull		124,962	12,194	25,610	103,704		139,699	9,931	49,982	66,292
SW	05820	Common Black-headed Gull		249,321	46,305	74,022	112,330		359,081	37,464	97,020	74,907
WS	05820	Common Black-headed Gull		349,251	55,939	98,522	184,819		461,136	46,536	152,839	153,822

			Period 1987/1988-1994/1995					Period 1999/2000-2006/2007				
Area	Euring	Name	MOULT	AUTUMN	WINTER	SPRING	BREED	MOULT	AUTUMN	WINTER	SPRING	BREED
DK	05900	Common Gull		28,806	17,346	12,072	13,868		23,032	18,821	9,110	18,117
SH	05900	Common Gull		48,985	16,256	20,409	14,191		38,630	15,544	13,578	29,892
NDS	05900	Common Gull		51,539	29,658	19,959	20,132		51,569	30,749	15,354	31,323
NL	05900	Common Gull		39,946	34,147		5,994		135,302	61,074	24,925	33,156
NW	05900	Common Gull		65,494	28,061	39,174	22,194		62,795	30,673	22,184	46,581
SW	05900	Common Gull		69,686	63,498		9,327		179,945	85,512	34,032	48,527
WS	05900	Common Gull		121,614	84,194	89,024	21,475		225,017	105,907	61,603	81,687
DK	05920	Herring Gull		23,436	50,639	13,949	20,467		33,671	40,070	25,002	10,243
SH	05920	Herring Gull		61,879	28,351	35,602	40,218		36,694	24,032	23,378	27,238
NDS	05920	Herring Gull		63,518	58,003	44,125	27,605		58,956	34,586	35,733	27,403
NL	05920	Herring Gull		96,338	75,516		34,469		97,883	89,473	44,422	26,585
NW	05920	Herring Gull		82,520	71,951	36,011	54,611		67,081	61,227	46,636	43,347
SW	05920	Herring Gull		150,976	120,114		64,236		147,307	114,686	77,435	48,296
WS	05920	Herring Gull		238,933	167,512		115,679		193,292	154,810	113,584	86,286
DK	06000	Great Black-backed Gull		1,346	1,195	1,771	790		1,669	3,276	1,519	1,459
SH	06000	Great Black-backed Gull		5,185	626	425	1,293		2,132	1,960	370	1,028
NDS	06000	Great Black-backed Gull		2,666	2,211	1,809	798		2,590	1,577	1,254	213
NL	06000	Great Black-backed Gull		6,203	5,018	4,517			7,583	6,324	9,104	1,308
NW	06000	Great Black-backed Gull		5,889	2,683	1,531	2,016		3,553	4,525	1,978	2,359
SW	06000	Great Black-backed Gull		8,313	6,911	5,353	1,457		8,991	7,148	10,410	1,528
WS	06000	Great Black-backed Gull		12,651	9,070	7,570	2,051		11,627	10,659	12,622	3,673

Acknowledgements

This report would not have been possible without the help of a large number of people. First of all we want to mention the immense effort by the hundreds of ornithologists who participated in the waterbird counts in the Wadden Sea in the past decades. Many of them are volunteers and without their knowledgeable help, the production of a report of this kind would have been impossible. We hope that this report encourages all observers to keep up their valuable census work!

We would also like to thank all the people who participated in the production of this report. Help during various stages of data processing and writing, English spelling and grammer check, draft-reading was received from Seabury Salmon and Gerold Lüerßen.

Kees Koffijberg (SOVON, The Netherlands) and members of the JMBB group provided numbers and comments regarding the breeding bird species in the Wadden Sea. Erik van Winden (SOVON, The Netherlands) performed the UINDEX and TrendSpotter operations to calculate trends and to provide the imputed numbers for the calculation of maximum estimates and distributions.

Gerold Lüerßen layouted and produced all the maps within the report.

Financial support to produce this report was received from Environmental Center Ribe under the Danish Ministry of the Environment.

The Common Wadden Sea Secretariat provided the necessary framework for the JMMB group. We would especially like to thank Gerold Lüerßen for his support during all stages of this report.

In Denmark the counts were carried out by the National Environmental Research Institute (NERI); Lars Maltha Rasmussen was the national co-ordinator from 1994 to 2002 and was followed by Karsten Laursen. Ole Thorup, Kim Fischer, Jens Peder Hounisen, Lars Maltha Rasmussen and Jens Ryge Petersen carried out a large part of the counts. Aerial counts were carried out by NERI up to 1992, and during the years after they were organized through collaboration between NERI and Ribe County and performed together with John Frikke. The counters were Ole Amstrup, Mogens Bak, Keld Bakken, Sven Bødker, Henrik Brandt, Kurt B. Christensen, Michael Clausen, John Frikke, Jens Hjerrild Hansen, Thor Bue Hansen, Thomas Eske Holm, Martin Iversen, Bent Jakobsen, Michael Johansen, Niels Knudsen, Karsten Laursen, Susanne O. Petersen, Stefan Pihl, Svend Rønnest, Michael Schwalbe, Henning Simonsen, Carl Schenider, Ole Therkildsen and Niels Vedel.

In Schleswig-Holstein the Monitoring of Migratory Waterbirds in the Wadden Sea was - for the period covered by this report - coordinated by the WWF-Projektbüro Wattenmeer in Husum. The responsible persons were Hans-Ulrich Rösner (until 1996) and Klaus Günther (since then). The monitoring was funded by the Landesamt für den Nationalpark Schleswig-Holsteinisches Wattenmeer, Tönning, and during the first period until 1994 as part of an ecosystem research project also funded by the Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit. The aerial surveys of Common Eider and Shelduck were carried out by G. Nehls, J. Meißner, N. Kempf and G. Scheiffarth and also financed by the Landesamt für den Nationalpark Schleswig-Holsteinisches Wattenmeer. In Schleswig-Holstein, thanks also go out to several organizations (NGOs) and institutions which cooperated in and supported the monitoring over many years and provided thousands of counts, in particular Schutzstation Wattenmeer, Verein Jordsand, Naturschutzbund Deutschland, Naturschutzgesellschaft Sylt, Öömrang Ferian, Amt für Ländliche Räume, FTZ Büsum (University of Kiel) and the Nationalpark Service of Schleswig-Holstein. The counts were mainly conducted by young people doing their one year national service (Zivildienst) or 'Freiwilliges Ökologisches Jahr (FÖJ)' at the different NGOs and since 1996 also by rangers of the Nationalpark Service. Most of the data input was done by volunteers doing their FÖJ at the WWF-Projektbüro Wattenmeer and Schutzstation Wattenmeer, to whom we say our special thanks.

Counters were in alphabetical order: C. Abraham, P. Ackermann, S. Adler, S. Adolph, M. Adrion, S. Ahlborn, U. Ahlborn, A. Ahrends, E. Ahrens, J. Aichroth, T. Albath, A. Albert, O. Albrecht, T. Alfert, A. Allgaier, A. Altmaier, B. Andresen, H. Andresen, N. Andresen, S. Arbeiter, K. Arndt, S. Arndt, H. Arp, T. Arp, A. Arsenijevic, S. Backsen, A. Baer, U. Bähker, M. Bahrenberg, V. Baiser, H. Bartels, M. Bartels, F. Barthel, B. Baschek, M. Basen, D. Baumann Vogel, F. Baumgardt, C. Bausch, P. Becher, A. Beck, T. Beck, B. Becker, L. Becker, M. Becker, T. Becker, P. Bedall, F. Behnam, P. Behre, F. Behrendt, A. Behrens, J. Behrs, S. Berg, S. Berger, J. Berghold, L. Bergmann, A. Berkan, J. Berndt, S. Bernieck, C. Beuter, M. Beverungen, N. Beyer, M. Bickel, J. Bieberich, S. Biermann, F. Bindrich, K. Birlenbach, P. Blei, B. Bley, E. Block, W. Block, M. Blockhaus, V. Blome, C. Blum, S. Blume, D. Blümel, N. Blüthgen, T. Bockelmann, I. Bode, M. Bogdahn, V. Bohle, I. Böhling, A. Böhm, N. Böhm, C. Böhmer, S. Bohnet, H. Boldt, A. Boll, C. Bömer, E. Bone, T. Bonn, F. Borchard, R. Borcherding, C. Borchers, A. Börner, K. Börtitz, S. Borwieck, L. Bossert, H. Böttcher, S. Böttger, L. Boyens, F. Bracht, K. Brandstädter, R. Brauer, J. Breffke, T. Brehm, C. Breithaupt, T. Bretten, T. Breyer, C. Brinken, S. Brooks, H. Brose, T. Brummund, H. Brunckhorst, A. Brunken, J. Brunkert, H. Bruns, K. Bühlke, K. Bulling, T. Bungardt, S. Buntrock, V. Buntrock, D. Burger, S. Burger, S. Burkhard, A. Burkowitz, A. Burmester, G. Busche, M. Buschmann, H. Büttger, F. Carius, V. Carstens, U. Caspary, N. Christensen, J. Christiansen, T. Christophersen, S. Claßen, G. Clausen, S. Clorius, P. Coldwell, S. Conrad, M. Creutziger, S. Crome, M. Dabelstein, F. Dähne, R. Dannenberg, F. Dannenburg, H. Danner, J. Darda, R. Dauer, A. De Walmont, G. Dechert, T. Degenhardt, C. Dengler, K. Denker, S. Dennenmoser, G. Detzler, F. Deuschle, H. Diecks, A. Diederichs, D. Diehl, B. Diener, P. Dierichsweiler, P. Dierkes, J. Dierschke, V. Dierschke, F. Dießelberg, S. Dietrich, A. Dircks, T. Disselhoff, H. Dittmann, T. Dittmann, R. Domin, N. Donner, J. Doppe, T. Dörges, M. Dornieden, D. Dornig, M. Dorsch, C. Dorsch , K. Drenseck, M. Dreyer, C. Drum, S. Duhm, J. Dunkel, K. Durek, J. Düsterhöft, J. Dütting, A. Dyck, J. Eberlein, L. Ebert, J. Eckle, S. Eggers, H. Ehlers, H. Ehrbeck, M. Eichberger, M. Eichner, O. Ekelöf, R. Endler, C. Engelhardt, R. Engels, G. Erichsen, A. Ette, J. Etzold, A. Evers, F. Exner, P. Falk, F. Fechner, P. Felsch, D. Felzmann, R. Femmer, S. Feuerstein, L. Fey, M. Fichtler, U. Fiedler, G. Fiedrich, M. Finkel, B. Fischer, P. Fischer, S. Fischer, M. Fischl, D. Fleet, K. Fleeth, C. Flieger, K. Flockau, A. Floren, A. Förster, F. Förster, J. Förster, W. Förster-Hahn, H. Freier, T. Fresemann, M. Freter, G. Friedrich, M. Friedrich, T. Friedrich, D. Fröhlich, D. Frohnmaier, N. Frohse, S. Fronczek, L. Fröse, S. Früh, F. Fuchs, O. Fuchs, T. Fusenig, J. Fuß, C. Gahrau, M. Gaiser, F. Gäng, M. Gänß, B. Ganter, S. Garthe, C. Gathmann, W. Gaul, F. Gauly, S. Gaus, T. Gefken, M. Geilhufe, R. Gentzmann, R. Gerhard, D. Gerhardt, H. Gerlach, S. Gerling, F. Gerspach, T. Gezork, P. Gienapp, P. Gimmini, B. Glatzle, P. Gleisenstein, R. Gliedstein, P. Gloe, O. Glomb, N. Gockel, B. Goebel, J. Gollisch, M. Gorke, C. Göttsche, C. Götz, N. Grabow, C. Grabowski, E. Graf, G. Graf, L. Graf, K. Graff, G. Grah, I. Gram, S. Grauthoff, T. Greule, C. Grober, A. Großert, M. Großmann, U. Groth, S. Gruber, A. Grund, C. Grüneberg, F. Grünewald, M. Grüninger, T. Guischard, P. Gundel, K. Günther, L. Güntner, B. Guse, G. Gust, M. Haacks, H. Haag, N. Haass, A. Haberer, U. Hagenlocher, J. Hagge, M. Hallinger, B. Hälterlein, P. Hampel, I. Hanke, B. Hannapel, B. Hansen, H. Hansen, J. Hansen, J. Hansen, O. Hansen, J. Hansmann, M. Hantke, M. Harder, O. Harjes, A. Härtel, A. Hauschild, D. Hawellek, L. Haywood, M. Heck, C. Heidt , B. Heimann, H. Heinz, M. Heinz, F. Heiser, I. Heiser, J. Helbig, U. Helbing, F. Henge, A. Hengsberger, T. Henning, A.

Hensel, G. Henze, C. Herden, D. Herlemann, F. Herrmann, P. Herrmann, I. Hertzler, U. Hesse, C. Hech, S. Hetsch, V. Heubel, C. Heuck, P. Heumann, J. Hildebrand, R. Hill, J. Hingst, S. Hinkel, M. Hirschnitz, T. Hirzel, M. Hoch, F. Hoedt, F. Hofeditz, M. Hoffmann, B. Hofmann, M. Hohlbein, L. Höhn, C. Höhne, C. Holeksa, J. Holm, U. Holst, A. Holtmann , H. Holzapfel, S. Hone, C. Honnens, H. Hötker, S. Hotlen, T. Hubert, J. Hübner, J. Hucker, R. Hummels, C. Humrich, P. Hunke, N. Hutter, M. Hüttner, M. Hüttner, G. Huwald, J. Ingerowski, H. Jacobi, J. Jäger, E. Jahn, A. Jährling, F. Jährling, M. Jansen, M. Jansen, L. Jaspersen, U. Jauert, D. Jauss, J. Jekat, H. Jensen, S. Jensen, A. Jeß, A. Joch, T. Jochum, H. Johannsen, T. John, T. John, M. Johst, K. Jost, S. Jung, O. Junge, M. Junghänel, A. Jungk, J. Junior, A. Jurzok, S. Kaack, G. Kaboth, T. Kabus, J. Kahl, T. Kaiser, D. Kalisch, B. Kaluza, L. Kaminske, R. Kammann, J. Kamp, M. Kampp, S. Kapell, T. Kaphengst, M. Kappmeyer, K. Karkow, B. Katharina, J. Katzenberger, A. Keller, P. Keller, N. Kempen, N. Kempf, M. Kerschensteiner, I. Kessler, A. Keßler, K. Ketelsen, K. Kiebitz, B. Kiehl, A. Kielborn, S. Kindt, M. Kirsch, T. Kissinger, D. Kißling, A. Kivi, M. Klabunde, F. Klappenbach, O. Klausing, J. Kleeb, J. Kleebaum, J. Klein, L. Klein, A. Klemm, S. Klemp, S. Klinge, E. Klinke, M. Klisch, M. Klöck, J. Klose, S. Klug, R. Knapp, M. Knauer, H. Knaut, P. Kneitz, U. Knief, W. Knief, B. Knierim, T. Knitter, V. Knoke, U. Knoll, C. Knorr, M. Koblofsky, C. Koch, F. Koch, M. Koch, C. Koch , F. Köhl, G. Kohla, A. Köhler, G. Kölsch, G. Körber, J. Körber, M. Körfer, J. Korte, L. Kortschack, G. Kotsch, C. Kowalski, D. Kramer, M. Krämer, R. Krapp, F. Kräusche, A. Krause, S. Krause, F. Krebs, J. Kreling, T. Kress, B. Kreuels, M. Kreutzfeldt, W. Kröber, M. Krome, C. Kruggel, A. Kruse, G. Kuhlencord, P. Kühlke, A. Kühn, M. Kühn, S. Kühn, O. Kühnapfel, J. Kühnemund, H. Kuhrt, D. Kükenshöner, N. Kumbruck, P. Kumkar, H. Kümmel, J. Kunath, T. Künnemann, H. Kunze, A. Küper, L. Kurth, H. Kuschert, J. Laber, C. Ladenburger, M. Lampe, J. Landschoff, A. Lang, C. Lang, H. Langbehn, T. Langbehn, M. Lange, O. Lange, M. Langer, E. Langner, L. Laux, D. Lehmann, M. Lehmann, K. Lehn, M. Lehnert, D. Leiberger, F. Leiß, A. Leistikow, H. Lemke, S. Lenz, T. Lenz, P. Leo, P. Leopold, B. Lind, D. Lindemann, J. Lindemann, J. Lippert, S. Lischka, S. Lisovski, J. Loebell, B. Lohse, H. Lorenz, F. Lornsen, B. Lucchesi, A. Lücking, N. Luckner, A. Lüdtke, B. Ludz, M. Lung, L. Luthy, E. Lutz, F. Lutz, G. Mackensen-Neitzke, I. Mahler, A. Maichel, K. Maier, M. Maier, R. Manderla, K. Markgraf, I. Martiensen, R. Martin, T. Marx, N. Marxen, M. Matheis, S. Matheis, C. Mathia, T. Mattes, G. Matthiesen, H. Matthiesen, J. Maurer, J. Maurer, P. May, A. Meerbott, T. Meinrenken, M. Meißner, P. Meister, H. Mercker, B. Merkel, J. Merz, J. Meurer, R. Mey, D. Meyer, D. Michel, H. Michel, H. Michel, J. Mikosch, M. Miorin-Bellermann, A. Mitschke, K. Mock, T. Molitor, I. Möller, N. Möller, B. Moreth, M. Morgenroth, A. Morgenstern, C. Moskaliuk, M. Muckenthaler, L. Mühle, J. Muhr, A. Müller, D. Müller, H. Müller, K. Müller, R. Müller, P. Müller-Kronberg, M. Münnich, S. Mußbach, Y. Nadolny, F. Nägele, I. Narberhaus, F. Närmann, K. Nast, N. Nausch, F. Nebelung, T. Neckermann, J. Neff, G. Nehls, C. Neß, J. Nettelstroth, M. Neubauer, A. Neumann, A. Neumann, J. Neumann, D. Nickelsen, F. Noack, C. Nöh, N. Nolte, H. Nopper, J. Oberheim, A. Ochs, C. Ochs, J. Olberding, A. Olearius, S. Oppel, F. Orthuber, V. Orthuber, M. Osterkamp, A. Ostrowski, L. Ott, J. Otterbach, J. Overbeck, T. Paechnatz, S. Pahl, A. Paisler, L. Pass, C. Pätz, B. Paulsen, J. Pempeit, E. Penssler, S. Peper, A. Peschel, J. Peters, A. Petersen, B. Petersen, W. Petersen-Andresen, W. Petzl, E. Peus, C. Pfannkuchen, H. Pfeiffer, B. Philipps, M. Pickel, C. Piening, J. Piepgras, A. Pissin, H. Pix, O. Plambeck, A. Poloczek, A. Port, C. Portofée, T. Posset, A. Postel, K. Preisner, N. Prior, N. Prior, H. Prix, F. Prohm, P. Prokosch, H. Prüter, A. Püschel, D. Pust, J. Quintus, M. Raasch, L. Rabenstein, A. Rach, M. Rackl, J. Raether, L. Raether, G. Rahmlow, F. Rajsic, J. Ratayczak, S. Rehfeuter, R. Rehm, C. Reichelt, M. Reimann, T. Reincke, N. Reinecke, A. Reinhardt, P. Reinhardt, M. Reinmann, T. Reinwald, L. Reisel, A. Repp, S. Reß, W. Retzlaff, P. Reufsteck, N. Reupke, U. Reuther, J. Revermann, R. Revermann, F. Richter, F. Richter, P. Rickert, T. Riedel, M. Risse, A. Ritschel, C. Rixen, M. Röbig, T. Röder, J. Rogalla, B. Rohkemper, U. Rolfs, T. Romanski, A. Rösch, J. Rösch, J. Rosenow, H. Rösner, T. Roßberg, O. Rößler, T. Rötting, D. Roy, R. Rubröder, T. Rusche, G. Rust, T. Sacher, E. Sachtleber, U. Sack, T. Salewski, V. Salewski, D. Sanders, G. Sanders, P. Sarge, U. Saß, D. Sauter, D. Schaefer, J. Schäfer, R. Scharfenberg, G. Scharnweber, T. Schaub, U. Schauser, F. Schawaller, E. Scheiber, G. Scheiffarth, K. Schiele, H. Schielzeth, M. Schiff-Francois, D. Schikorra, A. Schirmel, K. Schleicher, F. Schleusener, H. Schlöder, M. Schlorf, G. Schlosser, M. Schlüter, P. Schmeling, M. Schmelzer , J. Schmelzle, C. Schmid, M. Schmid, A. Schmidt, D. Schmidt, H. Schmidt, J. Schmidt, M. Schmidt, O. Schmidt, T. Schnau, A. Schneider, C. Schneider, D. Schneider, S. Schneider, C. Schnorr, K. Schollenbruch, K. Scholz, H. Schönberger, J. Schöne-Warnefeld, J. Schöning, M. Schönke, S. Schönleben, H. Schott, S. Schrader, J. Schreiber, A. Schrimpf, R. Schritt, J. Schröder, O. Schröder, R. Schulz, G. Schulze-Althoff, K. Schünemann, G. Schüssler, L. Schützler, R. Schwaier, F. Schwarz, S. Schwarz, R. Schweizer, P. Schwemmer, T. Seekamp, A. Segebade, M. Seibel, S. Seibert, F. Seitz, C. Sell, U. Sieberg, A. Siebert, G. Siedenschnur, S. Sieslack, N. Sinnecker, J. Sirker, M. Sixt, C. Söder, J. Sohler, E. Sohlström, T. Sonntag, J. Spalke, S. Stadtmann, B. Stahl, A. Stark, W. Stefano, T. Stegmann, A. Steinbeck, B. Steinborn, H. Steiner, N. Steiner, U. Steiner, I. Steinhagen, J. Stieg, M. Stock, M. Stöck, C. Stolz, F. Stracke, B. Strauß, A. Ströh, N. Stromer, P. Strunk, W. Stubenrauch, F. Stumpe, D. Sturm, M. Sturm, I. Stützle, R. Suppe, F. Tavan, G. Teenck, J. Tetens, O. Thaßler, F. Theis, N. Thiele, F. Thiermann, H. Thiessen, L. Thoms, L. Thomsen, J. Thormählen, R. Tiedemann, T. Tiedemann, S. Tielesch, S. Tilesch, S. Tkocz, P. Todt, D. Treichel, M. Trenkler, I. Treusch, B. Trötschler, P. Trumpf, S. Twietmeyer, G. Uhlmann, S. Ulrichs, I. Umbach, M. Unger, S. Unger, T. Valdiek, J. Vasbender, K. Velarde, T. Verleger, J. Vermehren, V. Verron, C. Vlasak, D. Vogel, J. Vogel, C. Vogel-Baumann, A. Vogelpohl, H. Voigt, H. Volmer, H. Von Bodelschwingh, P. Von Bothmer, G. Von Gosen, M. Von Roeder, D. Von Rönn, M. Vondey, T. Vorhaben, M. Walburg, J. Waldmann, J. Walter, P. Walter, M. Walther , N. Warburg, L. Weber, S. Weber, S. Weber, J. Weck, M. Wegner, H. Wehebrink, B. Wehnsen, S. Weiel, T. Weilkiens, M. Weinkauf, C. Weinmann, F. Weiß, S. Weiß, S. Weißbach, H. Weitkamp, J. Welcker, T. Wels, H. Wendel, C. Wenning, S. Wenzel, A. Wepner, M. Werner, T. Werner, R. Westphal, M. Weyland, A. Wichmann, B. Wiggering, S. Wilken, V. Wille, L. Willem, M. Winterhoff, J. Wischnath, A. Wochele, D. Wohlgemuth, M. Wojach, H. Wolf, S. Wolf, S. Wolf, S. Wolff, S. Wolfrum, T. Wulf, S. Zankl, S. Zechlin, O. Zeiske, J. Zellfelder, C. Zepf, F. Zeyns, S. Zieger, R. Ziegler, A. Zimmermann, M. Zimmermann, D. Zopf, S. Zuther, J. Zwar, N. Zydek,

In Niedersachsen / Niedersachsen the counts were organized by the Staatliche Vogelschutzwarte – – Niedersächsischer Landesbetrieb für Wasserwirtschaft, Küsten- und Naturschutz (NLWKN). Most counts were organized by local or regional organizations and institutions, in particular the Niedersächsische Landesbetrieb für Wasserwirtschaft , Küsten und Naturschutz in Norden, Der Mellumrat in Varel, the Wissenschaftliche Arbeitsgemeinschaft für Natur- und Umweltschutz (WAU) in Jever, the Ornithologische Arbeitsgemeinschaft Oldenburg (OAO) in Oldenburg, Verein Jordsand in Ahrensburg, Landkreis Stade, Zählergruppe Osnabrück, Zählergruppe Dollart.

Counters not mentioned in the list below may belong either to those young people doing their one year national service or "Freiwilliges Ökologisches Jahr (FÖJ)" in Niedersachsen.

The aerial surveys of Common Eider were carried out by G. Nehls, B.-O. Flore and G. Scheiffarth including additional

counters (see below) and financed by the National Park Administration, Niedersachsen. Counters from 1987 to 2007 werein alphabetical order: S. Abrahamczyk, L. Achilles, J. Adams, K. Adler, L. Adorf, S. Ahlers, T. Ahlsdorf, M. Akkermann, O. Albert, S. Albert, J. Albrecht, J. Albrecht, M. Andreas, U. Andreas, H. Andretzke, U. Appel, W. Arndt, K. August, R. Aumüller, W. Avenhaus, L. Bach, F. Bachmann, H. Backenköhler, D. Backes, I. Bahr, R. Baier, K. Bär, S. Barthold, M. Bauer, M. Baum, R. Baum, A. Baumann, M. Baumann, A. Baumbach, F. Bechinger, C. Becker, E. Becker, J. Becker, P. Becker, T. Becker, B. Beckers, R. Beckmann, R. Behlert, V. Behnen, N. Behrmann, W. Beisenherz, J. Bemmelburg, A. Benninghofen, B. Berg, G. Berg, M. Bergmann, P. Bernholt, H. Besemann, B. Beyer, C. Bieck, N.-S. Biehler, F. Bierkamp, P. Blaszyk, J. Blatt, S. Blatt, F. Blaukat, J. Bless, R. Bless, J. Bliedung, H. Blindow, V. Blüml, J. Bocher, C. Bock, F. Bock, W. Böckelmann, H. Bödecker, M. Bödecker, C. Bodenstein, T. Böhme, V. Bohnet, C. Boiteau, A. Boll, H. Böllger, N. Borgerding, K. Börgmann, C. Borrek, P. Börsch-Supan, H.-G. Boyken, U. Bradter, S. Bräger, E. Brahms, I. Brake, J. Bramsiepe, S. Brandt, S. Braun, C. Braunroth, K. Brechensbauer, H. Breckmann, B. Breden, L. C. Brenner, H. Brombach, B. Bronnert, R. von Brook, I. Brüning, G. Brunow, N. Bruns, T. Brunzendorf, J. Bruzinski, C. Buch, D. Bühler, K. Buke, F. Bumm, P. Burkhardt, G. Buss, H. Büttger, R. Carstens, D. Carstensen, A. Cervencl, G. Cihlars, T. Clemens, H. Clodius, B. Conrad, A. Cornelius, J. Cramer, G. Császári, H. Culmsee, B. Daehne, G. Dahms, A. Dalenz, K. Dallmann, U. Dammann, J. Dannemann, E. Darge, M. Dauber, J. de Leeuw, Y. de Soye, U. de Vries, A. Degen, T. Deinert, M. Deinhardt, K. Dettmann, M. Deutsch, U. Dick, W. Dick, A. Diederichs, S. Diekhoff, A. Diekmann, M. Diekmann, S. Diers, J. Dierschke, K. Dietrich, K. Dingerkus, T. Dittmann, J. Djuren, W. Dobers, J. Dörrie, M. Dorsch, M. Dreidax, T. Drewer, J. Driebold, R. Dröschmeister, F. Droz, J. Dübedat, H. Duden, B. Duhm, S. Eckardt, M. Eggert, D. Ehlert, K. Ehlert, P. Eichner, I. Eikhorst, W. Eikhorst, G. Eilers, H. Elburn, F. Ellerbrock, P. Ellner, K. Elvers, I. Engel, D. Engelhard, S. Engling, W. Epple, H.-O. Erhorn, G. Ernst, H. Eschenbacher-Knoop, F. Esser, W. Esser, D. Eulberg, H. Evers, B. Evert, J. Everts, F. Everwien, K.-M. Exo, K. Falk, V. Falke, C. Fehrenbacher, I. Feldmann, J. Feldmann, U. Feldmann, M. Fetz, M. Feuersenger, F. Fiederling, T. Fiene, J. Figgener, A. Fischer, C. Fischer, D. Fischer, W. Fischer, A. Fleck, J. Fleig, B.-O. Flore, F. Födisch, H. Foken, M. Folkerts, M. Fooken, D. Frank, R. Frank, F. Franke, E. Fredrich, K. R. Freitag, T. Frenzel, L. Frers, T. Fresemann, D. Friedrichs, H. Fritze, J. Fröhling, C. Froitzhuber, M. Füchtemeier, E. Fuhrken, K. Fuhrmann, M. Füller, H. Funda, S. Funk, L. Gaedicke, J. Garcia, M. Garcia, H. Garrelts, S. Gärtner, E. Garve, V. Gäth, J. Gebauer, A. Gehring, C. Geibel, J. Geipel, J. Genser, E. Gentsch, K. Gerdes, K. Gerland, R. Germer, N. Geveke, P. Gienapp, M. Giercke, E. Giese, T. Giese, B. Gießing, K. Gießing, A. Glinka, S. Gödderz, C. Gondert, H. van Göns, J. González-Solis, L. Görth, K. Goslar, C. Gottfried, R. Gotthard, W. Göttmann, M. Gottschling, F. Grantz, S. Greißl, C. Grohn, K. Großberger, G. Großkopf, B. Großmann, R. Grossmann, D. Grote, M. Grüner, J. Grünig, T. Grünkorn, H. Gruska, J. Grützmann, D. Gueffroy, D. Guicking, M. Günther, A. Guse, T. Gutmann, V. Gutsmiedl, J. Haar, B. Haas, T. Haase, C. Habelt, R. Hadjitarkhani, D. Haese, U. Haesihus, I. Hagemann, P. Hagemann, T. Hail, A. Haken, N. Halbach, A. Halpap, P. Halve, D. Hammerich, A. Hampe, N. Hampel, M. Hanauer, K. Handke, U. Handke, F. Händler, E. Hanewinkel, H. Hansel, G. Hardekopf, H.E. Harken, U. Harrjus, S. Hartig, S. Hartlaub, J. A. Hartmann, E. Hartwig, O. Hartwig, T. Hasse, R. Haupt, A. Hausmann, E. Hausmann, S. Hausten, L. Havermeier, H. Hayen, C. Hays-Brauscheid, A. Heckroth, M. Heckroth, S. Heer, K.-E. Heers, S. Heidemann, T. Heiden v.d., D. Heidenreich, P. Heimlich, H. Heinemeyer, K. Heinrich, G. M. Heinze, S. Heinze, A. Helge, L. Hellbernd, N. Helmstorf, U. Hemmerling, H.-R. Henneberg, M. Hennemann, V. Hennig, A. Hergenhahn, B. Herhaus, M. Herhaus, F. Hericks, H. Herlyn, M. Hermann, J. Herrling, N. Hersacher, I. Herzler, T. Hetsch, A. Hettinger van, C. Heuermann, M. Heunemann, B. Heyen, E. Hicken, B. Hielen, S. Hielscher, G. Hilgerloh, H. Hille, J. Hinck, H. Hinrichs, M. Hintze, S. Hirch, J. Hitsch, H. Hobbensiefken, S. Hochgesand, E. Hoffmann, T. Hoffmann, K. Höffmann, S. Hoks, A. Holl, D. Holl, J. Hollmann, M. Hölscher, M. Holzweg, U. Honecker, T. Hönisch, F. Hopf, H.-W. Hoppe, A. Horst, C. Horst, B. Horstmann, J. Horstmann, A. Hückelheim, J. Hückelheim, A. Huesmann, F. Hüffner, A. Hugo, S. Hülse, I. Hülsebusch, A. Hummel, C. Hüsing, J. Husmann, J. Ihnen, A. Jacob, A. Jacob, C. Jacob, M. Jacob, H. Jacobs, R. H. Jaekel, J. Jaene, M. Jagszent, E. Jähme, J. James, F. Janich, K. Jankowski, R. Janning, S. Janowski, A. Janssen, C. Janßen, H. Janßen, W. Janßen, C. Jauch, T. Jaworek, E. Jereczek, R. Joest, C. Jones, M. Joost, V. Jordsand e.V., B. Jürgens, K. Jürgens, A. Jütterbock, A. Kade, V. Kahlert, H.-J. Kalisch, R. Kamman, C. Kammel, J. Kamp, H. Karthäuser, K. Kasper, W. Kassemedt, R. Kasten, U. Kasten, T. Kausch, M. Kellermann, L. Kempener, N. Kempf, P. Kerber, A. Keßler, P. Keßler, C. Ketzenberg, S. Kiel, S. Kieß, H. Kilian, M. Kilian, F. Kipkeew, D. Kirsch, K.-W. Kirsch, J. Kleebaum, T. Kleemann, M. Klein, F. Kleinschroth, C. Klemp, T. Kling, M. Klingenhardt, T. Klinner, H.-W. Klose, S. Klose, T. Klose, M. Knake, S. Knäuper, D. Knobloch, J. Knödel, L. Knödl, R. Knorr, M. Koch, C. Koepff, A. Köhler, I. Kolaschnik, M. Kolbe, D. Köllmann, R. Kölmel, D. Kolthoff, G. Könecke, U. Könecke, A. König, N. Könitz, O. Kopetz, B. Köpke, B. Koppe, D. Koppisch, M. Korn, A. Korsch, A. Korsten, C. Koß, T. Köster, F. Kösters, J. Kotte, M. Kramer, J.-C. Kranefeld, C. Kraus, G. Kraus, J. Kraus, H. Krause, M.-P. Krause, P. Krause, P. Krech, S. Kreft, R. Kreja, H. Krethe, I. Kreusel, S. Kreusel, J.-O. Kriegs, M. Kriewen, W. Kröger, O. Krome, M. Kromer, H. Kruckenberg, C. Krüger, R. Krüger, T. Krüger, T. Krüger, J. Krumnow, K. Kubaczynski, R. Kubica, B. Kücking, C. Kühn, M. Kühnel, K. Kukatz, S. Kükelhahn, V. Kullik, D. Kunz, H. Kunze, B. Kurtz, T. Kuske, S. Lambertz, I. Latendorf, G. Latzel, R. Lau, T. Lauer, V. Lautenbach, V. Lazovic, D. Legler, T. Lehmberg, J. Lehmhus, R. Leicht, K. Lemb, J. Lempert, M. Lepetit, M. Lessing, J. Leyrer, M. Liedvogel, A. Lilje, B. Limmer, N. Lindemeier, B. Linden, K. Lindenberg, N. Lindner, M. Linhart, T. Lissner, S. Löber, T. Lobinger, D. Logemann, H.-J. van Loh, J. Lopau, H. Löschen, R. Lottmann, D. Lübsen , R. Lucht, D. Lück, J. Lücker, E. Ludwig, J. Ludwig, P. Ludwig, J.-D. Ludwigs, L. Lüers, J. Lugert, R. Lühken, R. Lühlen, M. Lüllmann, S. Lux, K. Maatz, I. Maggini, I. Mahler, M. Mansard-Veken, C. Mansfeld, M. Markowski, M. Martinez Benito, C. Mayer, L. Mayer, H. Mayerhöfer, M. Meenken, T. Meenken, R. Meinel, D. Meisel, J. Meißner, J. Melter, W. Menger, K. Menke, W. Menke, T. Mennebäck, A. Mensching, M. Merker, L. Merswolke-Fay, T. Merten, M. Mertens, B. Metzger, G. Meyenburg, B. C. Meyer, H. Meyer, J. Meyer, U. Meyer, B. Metzger, A. Michalik, D. J. Mikolajweski, A. Mitschke, H. Mitschke, F. Mohr, M. Mölleken, H.-J. Möller, S. Möller, M. Möller-Holtkamp, A. Monroy, I. Montag, S. Moseberg, H. Muhle, D. Müller, F. Müller, F.-O. Müller, H. Müller, M. Müller, N. Müller, N. Müller, P. Müller, S. Müller, S. Müller, U. Müller, M. Mundus, T. Munk, J. Muoz-Cifuentes, J. Mürdel, W. Nachtigall, R. Nagel, D. Nannen, F. Nannen, T. Napirata, T. Naue, P. Nehmer, H. Neubert, C. Neumann, M. Neumann, M. Neumann, R. Neumann , J. Nickel, N. Niedernostheide, H. Niehus, D. Niemeyer, G. Nikolaus, S. Nikoleizig, C. Nilsson, L. Nilsson, A. Noack, S. Nobile, U. Nolting, K. Nottmeyer-Linden, H. Obendorf, N. Oberdiek, C. Odendahl, M. Odenkirchen, K. Oehler, S. Oeler, O. Oetken, D. Olbrich, H. Oldekamp, D. Oldenburg, J. Oldenettel, E. Oldewurtel, S. Olearius, M. Olthoff, S. Oltmann, B. Oltmanns, F. Oltmanns, S. Oltrop, J. Onnen, S. Oppel, R. Opreé, K. Osburg, G. Ostendorf, R. Osterthun, K. Otten, B. Paap, J. Pagel, M. Paland, E. Paleit, J. Paleit, L. Paleit, W. Pappel, E. Pasch, M. Pattmann, F. Pega, H. Pegel, T. Penkert, E. Peplow, M. Petermann, S. Petermann, F. Peters, W. Peters, B. Petersen, D. Petersen, R. Petri, B. Petrus, M. Petzold, T. Peyrat, H. Pichler, M.

Piepenschneider, K. Pierstorff, F. Plaisier, S. Pleines, M. Plötz, H. Poeschel, T. Poeschel, T. Pollak, P. Polley, C. Pott, P. Pott, H. Prange, P. Prokosch, S. Pröls, A. Puchta, J. Rabe, F. Rabenstein, B. Rackoll, E. Raddatz, G. Rademacher, K.-H. Rademacher, M. Rahders, V. Rahn, U. Rahr, J. Rasch, F. Rasche, B. Rau, H. Reepmeyer, J. Rehders, M. Reichenbach, G. Reichert, W. Reiher, C. Reim, G. Reinders, S. Reinders, H. Reiner, H. H. Reinsch, H. Reipöller, A. Reise, D. Renken, W. Rettberg, J. Rettemeier, K. Rettig, M. Reuter, R.de Reuter, F. Rheindt, A. Richter, C. Richter, J. S. Richter, K. Richter, M. Richter, F. Ricke, P. Rickert, L. Rieke, F. Rieken, U. Ritter, H. Röbken, M. Röbken, M. Rohloff, J. Rohwedder, M. Roitsch, A. Roock, H.-J. Ropers, A. Rose, C. Rose, A. Rösler, C. Roß, P. Ross, R. Roth, L. Rother, A. Rothert, D.-H. Rückamp, K. Rückl, A. Rudolph, K. B. Rüller, B. Rupprecht, C. Rusack, M. Saathoff, I. Saez, H. Sagkop, V. Salewski, A. Sanders, R. Sandfort, T. Sänger, U. Sartorius, M. Saß, C. Sauer, D. Schabelreiter, E. Schaeg, M. Schäfer, J. Schalajda, J. Scharienhorst, K. Schartler, J. Scheck, U. Schede, M. Scheding, G. Scheiffarth, F. Scherbarth, W. Schießberg, T. Schikore, J. Schirmel, B. Schiwon, E. Schlegel, T. Schlegel, H. Schmäing, G. Schmal, P. Schmal, A. Schmidt, C. Schmidt, C. Schmidt, E. Schmidt, F. Schmidt, M. Schmidt, S. Schmidt, V. Schmidt, S. Schmitt, C. Schmittwilken, U. Schneider, J. Schnick, A. Schniederkötter, M. Scholl, D. Scholz, G. Scholz, M. Scholze, S. Schönecker, R. Schopf, C. Schopfer, W. Schott, S. Schrader, A. Schramm, J. Schramm, U. Schramm, J. Schreiber, J. Schreiber, M. Schreiber, A. Schrimpf, B. Schröder, H. Schröder, J. Schröder, K. Schröder, T. Schröder, A. Schubert, A. Schulz, T. Schulz, F. Schulze, M. Schulze-Diekhoff, B. Schumacher, H.-G. Schumacher, H.-K. Schumacher, R. Schumacher, S. Schumacher, T. Schumacher, A. Schütt, A. Schüttler, C. Schütz, K. Schwaab, J. Schwandner, D. Schwarz, K. Schwarz, V. Schwarz, H. Schwarze, G. Schweizer, S. Schwenk, C. Schwennesen, W. Seedorff, F. Seeger-Harbers, J. Seehausen, J.-F. Segger-Harbers, H. Seifert, N. Seifert, H. Seithe, J. Seitz, T. Severin, F. Seydel, U. Siebolds, D. Siebolts, K. Siedler, R. Sieverding, F. Simon, R. Sinning, U. Smock, V. Sohni, M. Sommerfeld, J. Sondermann, H. Sonnenburg, S. Sorger, J. Spalke, R. Specht, D. Sperl, V. Spitta, M. Spittel, S. Sprenzel, J. Springer, U. Stampa, G. Stauch, B. Steffen, H. Steffens, P. J. Stegmann, S. Steinbrenner, H. Steinert, A. Steinmetz, E. Steinmetz, F. Sterregaard, L. Stetter, S. Stiegeler, N. Stöber, C. Stocksieker, P. Stoddard, S. Stoepper, A. Stollenwerk, A. Stornes, S. Stosiek, H. Strathmann, L. Strauch, A. Strecker, D. Sturm, M. Stüve, F. Sudendey, J.-J. Sültmann, S. Sülzle, J. Sünkel, J. Sutherland, A. Szczesinski, M. Szwierczynski, E. Täger, A. Tapp, K. Taux, L. Taylor, H. Tebart, G. Teenk, J. Teerling, M. Temme, D. Ternes, M. Teten, C. Teuber, M. Teuscher, E. Tewes, J. Theilmann, N. Theißen , G. Thesing, M. Thiel, B. Thomas, M. Thomas, K. Thon, A. Thorenmeier, C. Thorenmeier, E. Thünte, S. Thyen, M. Tiaden, B. Tiemann, J. Tiemann, V. Tiemeyer, A. Till, H. Timmermann, K. Timmermann, P. Tolkens, E. von Toll, M. Tolske, K. Tornow, A.-M. Trede, B. Trede, D. Trede, M. Treiber, T. Treiber, Y. Treis, M. Trobitz, N. Trusch, O. Tschetsch, M. Tuma, A. Twardy, S. Uhlmann, J. Umland, N. Unger, J. Utikal, K. Utrecht, D. Uttich, A. v. Hettinga, L. van der Giessen, A. van Ohlen, K. Veentjer, M. Villbrandt, S. Vlotho, M. Volpers, F. von Berger, G. von Bronsart, M. von den Driesch, A. von der Linden, E. Voß, J. Voß, T. Voßhage, G. Wagenknecht, A. Wagner, C. Wagner, D. Wagner, P. Wagner, S. Wagner, R. Wahlhäuser, S. Wahls, S. Walentowitz, S. Walker, M. Wall, B. Walter, S. Warth, A. Weber, D. Wegener, F.-W. Wegener, J. Wegge, N. Wehkamp, R. Wehking, J. Weigelt, B. Weinbecker, B. Weinbecker, J. Weinbecker, U. Weinhold, C. Weiss, S. Weiß, U. Weiß, F. Weiß , C. Weitzel, J. Welle, A. Welz, H. Wemhoff-de Groot, D. Wendt, S. Wenzel, A. Wesling, D. Westphal, C. Wiedemeyer, T. Wiegand, M. Wiemann, H. Wienekamp, P. Wiersma, W. Wieting, O. Wiggers, A. van Wijk, G. Wilken, A. Wilkens, H. Wilkens, M. Wilkens, S. Wilkens, M. Williams, H. Willmann, A. Wilms, K. Wilson, C. Winter, N. Winterscheid, J. Wißmann, A. Witt, B. Witt, H. Witte, J. Wittmann, A. Witzke, B. Wolf, C. Wolf, K. Wolf, S. Wolf, D. Wolff, I. Wolff, S. Wolff, C. Wolter, H. Wördemann, V. Wörner, I. Wrazidlo, B. Wrede, J. Wübbenhorst, S. Wulkau, J. Wunderlich, S. Würzer, G. Wustig, R. Zacharzewski, R. Zander, T. Zerner, A. Zickuhr, H. Ziebel, H. Zimmermann, N. Zimmermann, J. Zöller.

For the Hamburg part of the Wadden Sea Cooperation area Peter Körber, Ministry of Urban Development and Environment / National Park Administration Wadden Sea of Hamburg, took the job to validate the count data since 2001 and to forward them to the Niedersächsischen Landesbetrieb für Wasserwirtschaft und Küstenschutz (NLWK) / Staatliche Vogelschutzwarte ; in former times this was done by the Verein Jordsand.

The counts are organized and carried out by the staff of the Verein Jordsand. Apart from regular employees this work is done by young people during their national service (Zivildienst) or 'Freiwilliges Ökologisches Jahr (FÖJ)' or working as trainees partly financed by sponsoring of the Commerzbank. Counters are listed in alphabetical order: U. Albrecht-Rose, W. Andresen, B. Athmer, H. Backhaus, J. Baer, C. Bailly, R. Barth, V. Bayer, N. Becker, R. Bedürftig, S. Berks, V. Blietschau, M. Böhm, I. Bormann, C. Brand, N. Braun, S. Brinkrolf, M. Brodde, J. Brügmann, M. Bulla, G. Busch, U. Busch, A. Christophersen, F. Deinhard, M. Draeger, S. Dubberke, S. Dudek, R. Enderlein, A. Fehling, M. Fichtler, K. Fischer, K. Gläser, A. Götkens, E. Graf, K. Grebe, W. Hachmann, J. Haupt, K. Heitland, U. Hellwig, Y. Henkel, S. Hille, C. Hof, N. Hofbauer, G. Holighaus, M. Iden, E. Jeanrond, A. Jeß, D. Johann, T. Junghans, B. Kaeding, R. Kallenborn, L. Kamleiter, K. Kay, G. Klauberg , A. Klemmer, F. Kleuker, M. Korsch, A. Kramer, T. Krause, S. Lamm, B. Lehner, W. Lemke, G. Liedtke, A. Linz, K. Lohse, A. Ludwig, L. Maciolek, J. Makatsch, J. Meyer, B. Meyer, S. Michel, M. Müller, H. Müller, C. Neumann, T. Niebert, V. Olry, H. Osterndorff, J. Otto, T. Overmans , H. Parpaix, I. Paschen, M. Petersen, D. Pietzsch, C. Pinnecke, D. Pohlner, I. Prader, A. Rausch, M. Rose, R. Röw, M. Schädlich, N. Schaks, A. Scheibner, C. Schmid, S. Schoneberg, I. Schrey, E. Schubert, S. Schulze, M. Seehausen, A. Seelemann, D. Seredynska, A. Sieben, T. Sieben, L. Sötje, A. Spitschak, B. Steinborn, E. Steinborn, W. Steinborn, S. Stübing, F. Stühmer, M. Templin, P. Thalmann, M. Timmermann, A. Tran Van Loc, B. Tschech, N. Ullrich, T. Vahldiek, A. Vey, T. von der Heiden, M. von Glahn, A. Vrcic, R. Wegener, C. Wegst, N. Weiß, H. Wendel, R. Werner, F. Wiese, S. Winkler, D. Wissman, H. Zahlauer, J. Zwar.

The waterbird counts in the Dutch Wadden Sea are coordinated by SOVON Dutch Centre for Field Ornithology, in the framework of the National Ecological Monitoring programme (NEM), a cooperation between the Ministry of Water Management and Public Works, Vogelbescherming Nederland (BirdLife The Netherlands), the Ministry of Agriculture, Nature and Food Quality (Gegevensautoriteit Natuur, Ministerie van Landbouw, Natuur en Voedselkwaliteit), Statistics The Netherlands (CBS) and SOVON. The counts were coordinated by Romke Kleefstra (SOVON), the data was processed and supplied by Erik van Winden (SOVON). The regional coordination of counts was taken care of by J. van Dijk and B. Feij (Noorderhaaks), C.J. Smit (Texel), P. de Boer (Vlieland), B.J. Koks (Richel), M. van Roomen (Terschelling), J. De Jong (Blauwe Balg), K. van Scharenburg (Ameland), H. Smit (Engelsmanplaat), K. van Dijk (Schiermonnikoog), V. van de Boon (Simonszand), N. de Vries and B. Corté (Rottumerplaat en Rottumeroog), J. Veen (Griend), H. de Boer (Dollard), M. Brijker (mainland coast Groningen), S. Boersma mainland coast Friesland), P. Zomerdijk (Afsluitdijk), T. Mulder and W. Tijsen (Wieringen), J. Zijp (Balgzand) and C. De Graaf (Den Helder). The aerial surveys of Common Eider were carried out under the responsibility of the National Institute for Coastal and Marine Management (RWS Waterdienst).

Counters are in alphabetical order: J. van Ardenne, J. Baalbergen, A. Baas, T. Baas, Y. Baas-Beatrixst, P. Bakker, S. Bakker, T. Bakker, J. Beerling, K. van der Bij, J. Bijma, A. Binsbergen, M. Birkenhäger, H. Blijlevens, D. Blok, P. de Boer, S. Boersma, S. Boersma, M. Boon, V. van de Boon, E. Boot, G. Boot, M. ten Bosch, F. Bosman, A. Bosscher, L. Bot, A. Bouman, W. Braaksma, J. Bredenbeek, N. van Brederode, I. Brijker, M. Brijker, H. van den Brink, P. Brouwer, J. van Bruggen, E. van Bruggen, M. Bügel, M. Bunskoek, E. Bunskoeke, J. Cremer, I. Czickos, L. Daalder, H. Dalmeijer, J. Degenaar, S. Deuzeman, A. van Dijk, J. van Dijk, K. van Dijk, L. Dijksen, A. Dijksen, A. Dijkstra, B. Dijkstra, G. Dijkstra, J. Dirks, E. Douwma, R. Drent, J. Driehuis, P. Driessen, G. van Duin, P. Duin, M. van Eerden, J. Ellens, H. Engelmoer, M. Engelmoer, B. Ens, A. Erens, J. Feddema, B. Fey, B. Fey, D. Fey, T. van Gent, H. Gerdez, B. Giskes, H. Glorie, J. de Gooijer, E. Goutbeek, C. de Graaf, P. de Graaf, M. Graauw, J. Groen, M. Haan, K. de Haan, R. Hammer, J. Hanenburg, G. Hazenhoek, M. Heegstra, W. v.d. Heide, F. Helmig, R. Hemmelder, L. Hemrica, L. Heykoop, D. Hiemstra, H. Hiemstra, B. Hoentjen, L. Hofstee, M. Hoksberg, T. Hopkes, H. Horn, J. ten Horn, P. van Horssen, H. Horstman, R. Hovinga, J. Huizinga, J. Hulscher, H. Hut, D. Imhoff, T. Jager, W. Jager, I. Jager, R. Jalving, L. Jellinek-Moormann, M. de Jong, J. de Jong, M. de Jong, B. Jonge Poerink, M. Kaales, G. Kasemir, R. Kats, S. Kazimier, L. Kelder, K. Kempen, K. Kempen, M. Kersten, M. Keursten, R. Kleefstra, M. Klemann, A. van Klinken, E. Klunder, K. Köller, J. Kok, B. Koks, G. Kool, L. van Kooten, F. Koster, S. Krap, J. Kuiken, B. Kuiken, D. Kuiken, D. Kuiper, H. Kuiper, E. van de Laan, H. de Lange, D. Lap, M. v.d. Lee, O. van der Lee, F. van Leeuwen, F. van Leeuwen, P. van Leeuwen, R. van de Leij, B. Loos, J. Louwe Kooijmans, D. Lutterop, D. Maas, F. Majoor, J. van Meegen, J. van der Meer, J. Meindertsma, E. Menkveld, G. Mensink, R. Mes, H. Miedema, H. Mulder, G. Molenaar, J. Mosselaar, E. Mulder, F. Mulder, M. Muller, J. Musch, G. Nieuwland, B. Nijhof, R. Noordhuis, T. Oenema, D. Olsthoorn, A. Oosterdijk, R. Oosterhuis, L. Oudman, A. Ouwerkerk, W. Penning, P. Pepers, L. Peters, K. Pietersma, H. Plat, M. v.d. Pol, J. Poortstra, J. Postma, M. Postma, A. Pot, B. Prak, J. Prins, J. Prop, W. Put, C. Rappoldt, K. Rappoldt, J. Ravesteijn, J. Reneerkens, T. Roersma, M. van Roomen, T. Roosjen, W. Ruitenbeek, W. de Ruiter, W. de Ruiter, S. van der Schaaf, C. van Scharenburg, C. Scharringa, H. Schekkerman, D. Schermer, L. Schilperoord, M. Schmitz, L. Scholtens, E. Schothorst, H. Schouten, H. Sieben, C. Smit, H. Smit, I. Snijders, B. Spaans, E. van der Spek, L. Steen, E. Stolwijk, M. van Straaten, R. Strietman, J. Taal, M. Tamminga, P. Tepper, W. Tijsen, G. Timmer, L. Tinga, J. Tuinhof, I. Tulp, C. van Turnhout, L. v. d. Vaart, J. Veen, T. Veen, D. Veenendaal, G. Veenstra, K. Veldkamp, H. Verdaat, A. Veurman, J. Vink, G. Visch, A. Visser, G. Visser, K. Vledder, A. van der Vliet, J. Vochtelo, R. Vogel, H. Vonk, R. Vos, D. Vreugdenhil, C. de Vries, J. de Vries, M. de Vries, N. de Vries, O. de Vries, K. van der Wal, T. Walda, A. Wassink, B. Weel, A. Weeseman, M. van der Weide, J. Werkman, J. van Werz, J. van Wetten, W. Weyman, F. Willems, J. Willems, E. van Winden, A. de Winter, G. Witte, H. Witte, M. Witte, W. Witte, B. Woets, E. Wolters, M. Wondergem, W. Woudman, M. Zekhuis, M. Zijm, J. Zijp, A. van der Zijpp, P. Zomerdijk, C. Zuhorn, P. Zumkehr, A. Zwart, F. Zwart.

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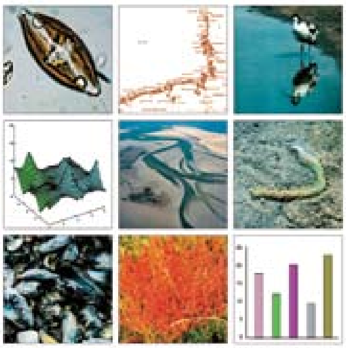

The Trilateral Monitoring and Assessment Program (TMAP)

Common Wadden Sea Secretariat
Virchowstrasse 1
D - 26382 Wilhelmshaven
info@waddensea-secretariat.org
www.waddensea-secretariat.org

ISSN 0946-896X