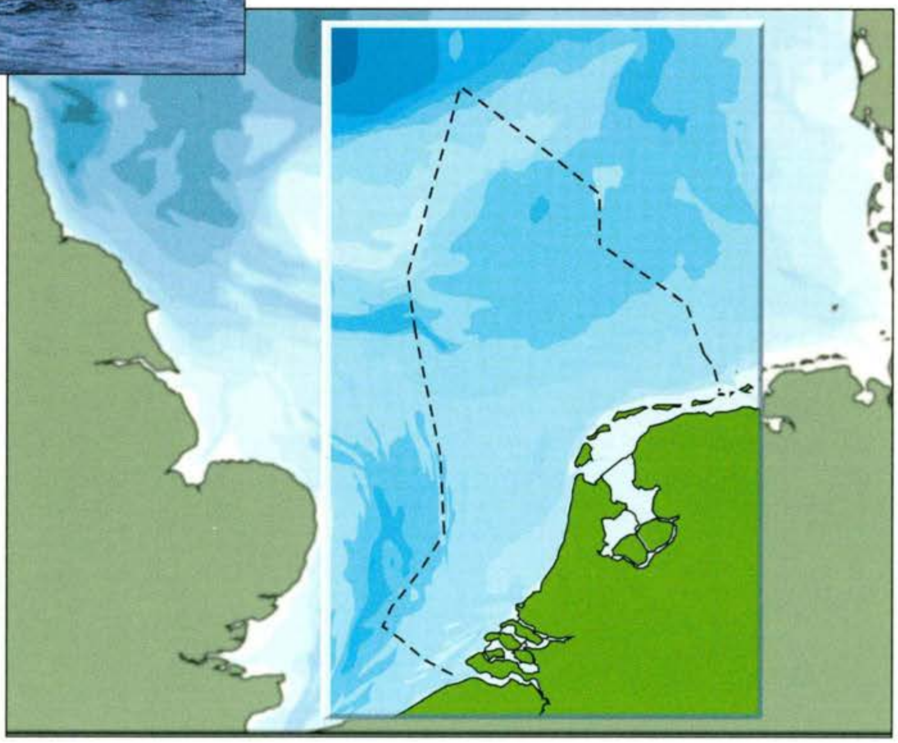
IBN RESEARCH REPORT 94 / 6
NIOZ-REPORT 1994 - 8

ATLAS OF SEABIRDS IN THE SOUTHERN NORTH SEA

C.J. Camphuysen, M.F. Leopold



ibn - dlo

NZG

Institute for Forestry and Nature Research (IBN-DLO)
Dutch Seabird Group (NZG)
Netherlands Institute for Sea Research (NIOZ)

Institute for Forestry and Nature Research (IBN-DLO)
P.O. Box 167, 1790 AD Den Burg,
Texel, The Netherlands

Netherlands Institute for Sea Research (NIOZ)
P.O. Box 59, 1790 AB Den Burg,
Texel, The Netherlands

Dutch Seabird Group (NZG)
Driebergseweg 16c, 3708 JB Zeist
The Netherlands

North Sea Directorate (DNZ)
Ministry of Transport and Public Works
P.O. Box 5807, 2280 HV Rijswijk
The Netherlands

This report should be cited as follows: Camphuysen C.J. & M.F. Leopold 1994. Atlas of seabirds in the southern North Sea. IBN Research Report 94/6, NIOZ-Report 1994-8, Institute for Forestry and Nature Research, Dutch Seabird Group and Netherlands Institute for Sea Research, Texel, 1-126 pp

ISSN 0923 - 3210

Cover design: Henk Hobbelink
Cover photo: Guillemots *Uria aalge* (Kees Camphuysen)

ATLAS OF SEABIRDS IN THE SOUTHERN NORTH SEA

C.J. Camphuysen[2, 3], M.F. Leopold [1, 2, 3]

This atlas was commissioned
by the North Sea Directorate / DNZ
and the National Institute for Coastal and Marine Management / RIKZ
of the Ministry of Transport, Public Works and Water Management

[1] **INSTITUTE FOR FORESTRY AND NATURE RESEARCH (IBN-DLO)**
[2] **DUTCH SEABIRD GROUP (NZG)**
[3] **NETHERLANDS INSTITUTE FOR SEA RESEARCH (NIOZ)**

IBN RESEARCH REPORT 94/6
NIOZ-RAPPORT 1994-8

PREFACE

The Dutch sector of the southern North Sea covers a larger area than the terrestrial part of The Netherlands. Notwithstanding this, the North Sea has been neglected by Dutch conservationists until quite recently. Probably, this was largely caused by lack of knowledge. It was only in the 1970s that ship-based surveys of seabirds (and usually also marine mammals) in the Dutch sector of the North Sea commenced. Aerial surveys started in 1984. Both types of surveys have now resulted in a large amount of data on occurrence and distribution of birds and mammals.

Any survey method has its advantages and limitations, as everybody involved in these types of censuses is well aware. So it is very adequate that, after the results of the airborne censuses had been summarized by Baptist & Wolf in 1993, the North Sea Directorate and the National Institute of Coastal and Marine Management of the Dutch Ministry of Transport, Public Works and Water Management commissioned the DLO-Institute of Forestry and Nature Research to prepare a comparable report on ship-based counts of seabirds. The present report was produced in close co-operation with the Dutch Seabird Group and the Netherlands Institute for Sea Research, which together provided most of the data.

The authors have done much more than required. They were asked to give a description of the occurrence and distribution of seabirds in the southern North Sea, as appears from ship-based counts. However, the present report goes in much more detail and, moreover, it embarks on a series of comparisons between their data and other sources of information.

A final word has to be devoted to the volunteer birdwatchers who made this report possible and without whom future studies cannot be carried out. The census data analysed have been collected to a large extent by these volunteers. Thanks to their efforts in freezing gales and burning sun the larger part of the data have been collected. It would be an appropriate way to thank them if this report could lead to an improved conservation of their beloved seabirds.

Prof. Dr. Wim J. Wolff, head of department of Aquatic Ecology, DLO - Institute of Forestry and Nature Research (IBN-DLO)

Drs. Jan Andries van Franeker secretary, Dutch Seabird Group (NZG)

Dr. Han J. Lindeboom head of department of Applied Marine Ecology, Netherlands Institute for Sea Research (NIOZ)

1. INTRODUCTION

History

The Netherlands are not particularly rich in nesting seabirds. Its sandy beaches and crowded shores leave little space for breeding birds and are totally unsuitable for cliff-breeding or burrow nesting seabirds. Although important colonies of gulls and terns are found in our country, more pelagic species such as petrels and auks are mainly known as (scarce) passage migrants, winter visitors, victims of oil pollution or storm driven casualties on beaches. Beached seabirds have attracted attention since the beginning of this century, because strandings provided evidence that several species of seabirds, although rarely observed alive, did occur in the southern North Sea (Haverschmidt 1930, Diesch 1932, Enkelaar 1934, Zweeres 1935, Duiven 1974). Allready in the first half of this century, several keen observers reported large flocks of seaduck and divers along our coast (Brouwer & Verwey 1919, 1922, De Graaf 1930), but "seawatching" did not become a more regular passtime until the late 1950s (Van den Oord & Swaab 1964, Buurma & De Miranda 1968, Tekke 1971). Seabird passage along the coast was studied on a systematic basis after the foundation of the '*Club van Zeetrekwaarnemers*' (CvZ, currently a working group of the *Dutch Seabird Group*, NZG) in 1972 (Van Dijk & Buurma 1973, Camphuysen & Van Dijk 1983). Hence, studies of seabirds in the southern North Sea were traditionally land-based. Occasional reports of intriguing species of seabirds at sea by ornithologists joining cargo vessels, ferries, trawlers or light-vessels (*cf.* Traanberg 1923, Van Blerkom *et al.* 1936, Van der Heide 1938, Jespersen 1949, Boer 1971, Oliver 1976), did at first not lead to a significant increase in the interest in seabirds at sea. However, in the 1970s, the first steps towards sea-based studies of seabirds in the southern North Sea were made (Joiris 1972, Engelsman & Hulsman 1974, Swennen 1978, Joiris 1983). The Voordelta was the first area which was studied in a systematic manner, while using an aircraft (Baptist & Meininger 1984). In 1978, the CvZ started systematic 'offshore' seawatches on *Meetpost Noordwijk*, a research platform in the coastal zone off mainland Zuid-Holland (Camphuysen 1979a) and launched ideas for further work on gas production platforms and ship-based studies in Dutch coastal waters (Camphuysen 1979b). The results of seawatches at Meetpost Noordwijk between 1978 and 1982 (Camphuysen *et al.* 1982, Den Ouden & Camphuysen 1983, Den Ouden & Van der Ham 1988, Van der Ham 1988), results of observations on gas production platforms K7-FA-1 and K8-FA-1 further offshore in 1984/85 (Platteeuw *et al.* 1985), but particularly the first reports of the '*Seabirds at Sea Team*' (SAST) in Aberdeen (Mitchell *et al.* 1980, 1981, Blake *et al.* 1984), engendered considerable interest in seabirds at sea and particularly in the possibilities for ship-based studies of seabird distribution in our waters.

A literature search resulted in the conclusion that little was known about the presence, abundance, timing and spatial distribution of seabirds in the southern North sea (Camphuysen 1984). Aerial surveys for seabirds on the Dutch sector of the continental shelf, commenced in December 1984, organised by Henk Baptist (Deltadienst Milieuonderzoek of the Ministry of Transport, Public Works and Water Management; later named Tidal Waters Division (DGW), currently named National Institute for Coastal and Marine Management (RIKZ)). This programme comprised monthly surveys between December 1984 and December 1987, occasional trips in 1988, and bimonthly flights between August 1989 and the present (Baptist & Wolf 1993). In the mid-1980s, several students based at the Netherlands Institute for Sea Research (NIOZ), under supervision of Kees Swennen, launched research projects in which the backgrounds of seabird distribution in the southern North Sea, particularly in the Frisian Front area, were studied (Leopold 1987, Van der Niet unpubl. data). Methods of these ship-based surveys were different from 'North Sea standards' proposed by Tasker *et al.* 1984 and therefore currently of little use. In March 1987, CvZ volunteers, in close co-operation with DGW (H. Baptist) and the North Sea Directorate (DNZ), were able to start regular systematic surveys onboard RV *Holland*. From NIOZ, a new series of cruises was organised, also on platforms of opportunity and mainly using students and volunteers as observers, under supervision of Mardik Leopold. SAST methods were now adopted both by ornithologists based at NIOZ and by CvZ (see chapter 3). RV *Holland* could be frequently manned with ornithologists between 1987 and 1990. Cruises organised by NIOZ covered the whole North Sea, and even extended towards the Bay of Biscay, the Celtic Sea, the Channel, and the Orkney and Shetland Islands, particularly when using fisheries research vessels in co-operation with the Netherlands Institute for Fisheries Research (RIVO-DLO).

These trips subsequently became more popular, so that it became difficult to find volunteers for trips onboard RV *Holland*. Since 1993, ship-based surveys are organised by the Institute for Forestry and Nature Research (IBN-DLO) and financially supported by the Ministry of Agriculture, Nature and Fisheries. Although in recent years several trips of dedicated vessels were organised, most cruises were and still are on platforms of opportunity. In the mid- and late 1980s, also research institutes in Denmark, Germany and Belgium set up ship-based surveys in the North Sea, basically following methods developed by SAST in Aberdeen, which finally led to a joint database (including data from aerial surveys). This joined database is the so-called European Seabirds at Sea Database (ESAS), which is maintained in Aberdeen by the Joint Nature Conservation Committee (Tasker 1991a, Stone *et al. in press*).

Recent publications
Since 1984 and 1987, the years in which respectively aerial and ship-based surveys of seabirds in the southern North Sea organised from Dutch organisations and institutions commenced, several short papers and preliminary reports were published. In the case of aerial surveys, publications often focussed on methods or discussed the statistical validity of the collected information (Baptist & Camphuysen 1987, Baptist 1988, Baptist 1990, Baptist & Wolf 1991, 1992). From ship-based surveys, a series of short notes and preliminary reports were published covering a variety of topics (Baptist & Camphuysen 1987, Leopold 1988ab, Camphuysen & Platteeuw 1988, Platteeuw 1988, Leopold 1989, Leopold *et al.* 1990, Camphuysen 1991, Offringa & Leopold 1991, Van Katwijk & Camphuysen 1993, Leopold 1993, Offringa 1993). Besides, data were used for studies of certain regions within the North Sea (Leopold 1988c, Bergman *et al.* 1991, Leopold 1991, Bergman & Leopold 1992, Camphuysen *et al.* 1992, Leopold *et al.* 1993, Van Leeuwen *et al.* 1994). NIOZ students produced several (unpublished) internal reports (Witte & Camps 1989, Geertsma 1990, Offringa 1991, Geertsma 1992, Den Hollander 1993). Results of ship-based surveys (and occasionally also results of aerial surveys) were quarterly summarized in *Recent Reports* in *Sula*, the journal of the Dutch Seabird Group. In 1993 an atlas of the seabirds in the southern North Sea was published, based on the results of aerial surveys (Baptist & Wolf 1993), providing the first overview focussing on the distribution and abundance of seabirds in the Dutch sector of the North Sea.

This report
To enable comparison of the results of aerial surveys with those obtained in ship-based surveys the North Sea Directorate asked for a compilation of data from ships similar to the atlas mentioned above. Moreover, the conservation use of such data became more and more obvious (Tasker 1991b, Camphuysen *et al.* 1992). Future monitoring has to be planned and comparisons between the results of aerial and ship-based surveys are needed. Both methods have obvious advantages and disadvantages. Aerial surveys provide less accurate information on the species level in several groups of seabirds, whereas the systematic approach and fixed routes followed by the aircraft were never achieved by ship. This atlas is meant to compile the results of ship-based surveys conducted since 1987 in the Dutch sector of the southern North Sea. Only data were used of surveys in which methods as proposed by Tasker *et al.* 1984 were adopted. Results of surveys organised onboard RV *Holland*, data of cruises organised by NIOZ and IBN-DLO during 1987-93 were combined. Added were data collected by others during 1985-93 within the study area, as available in the ESAS database. With this atlas, base-line data are provided which can be compared to results obtained by aerial surveys. In order to put the results in a broader context, we made a comparison with seawatching results and strandings data, in an attempt to achieve a more complete review of the status of seabirds in Dutch North Sea waters throughout the year.

Acknowledgements
We would like to thank captains and crews of all vessels used for ship-based surveys: *Aurelia*, *Breeveertien*, *Holland*, *KW 34*, *Navicula*, *Pelagia*, *Solo*, *Tridens I* & *II* and *Tyro*. Our sincere thanks are to the numerous observers who participated in these projects: Johan Apperloo, Marc Argeloo, Casper van Baarle, Hans van den Berg, Hans van Berkel, Erik Bos, Klaus Brass, Leo Bruinzeel, Lo Camps, Bram Couperus, Philipp Derks, Jelle van Dijk, Rijer Dijker, Frank Dorel, Andre Duiven, Ton Eggenhuizen, Albert van den Ende, Frank van den Ende, Jan Andries van Franeker, Marten Geertsma, Bert v.d. Geest, Tibor Gras, Stefan Groenewold, Nick v.d. Ham, Rob Hammer, Henk Hin, Mark Hoekstein, Gert Hogerwerf, Joslyn Hooijmeijer, Ron van Houwelingen, Frans Hovenkamp,

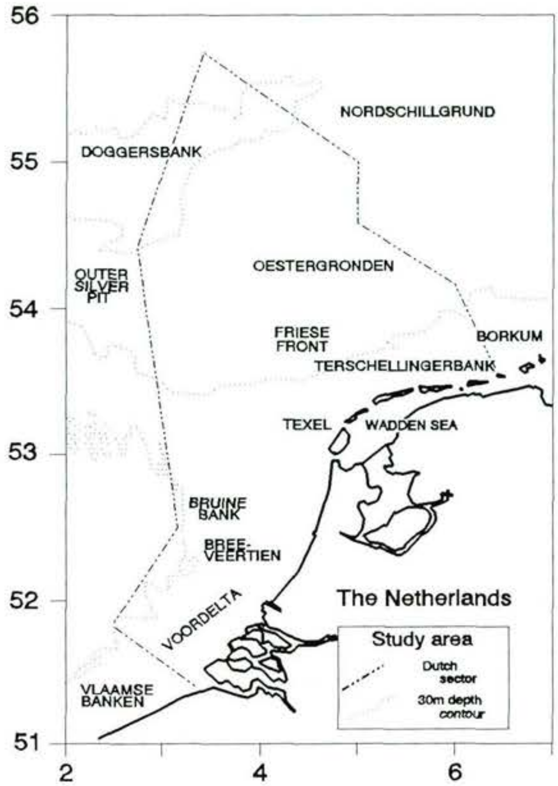


Figure 2.1a Study area and offshore names used in this report

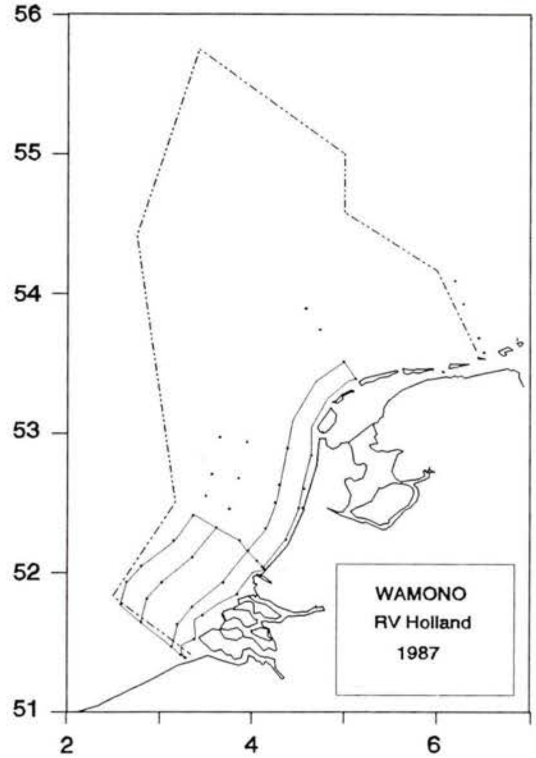
Figure 2.1b Study area and coastal names used in this report

Quinten van Katwijk, Guido Keyl, Ben Knegtering, Bert Knegtering, Jurren Koerts, Marcel Kok, Willem Koomen, Eduard Koopman, Rene Kriek, Sander Lagerveld, Marcel Laks, Willy van Lanen, Bob Loos, Michiel Michiels, Koos Minnaar, Kees Mostert, Cor Mozes, Jaap Mulder, Anja van der Niet, Joost Nijkamp, Ruurd Noordhuis, Henk Offringa, Jan den Ouden, Ferd Oyen, Katja Philippart, Maarten Platteeuw, Martin Poot, Theo Postma, Dick Schermer, Ted Sluyter, Leo Stegeman, Andre Sterk, Michelle Talsma, Professor H. Veldkamp, Michiel Versluys, Chris v.d. Vliet, John v.d. Voorn, Marcus Werner, Lyda Wessels, Rombout de Wijs, Chris Winter, George Wintermans, Rob Witbaard, Louis Witte, Hans Witte, Richard Witte, Pim Wolf, Peter v.d. Wolff. We thank Jan Durinck and Henrik Skov (Ornis Consult, Denmark), Ommo Hüppop and Stefan Garthe (Inselstation Vogelwarte Helgoland, Germany), Patrick Meire (Instituut voor Natuurbehoud, Belgium), Mark Tasker and Andy Webb (Joint Nature Conservation Committee, Scotland) for the use of their data stored in the ESAS Database. James Williams wrote the essential bits of software which we used to produce distribution maps and he and Andy Webb provided the essential backup for unexpected situations in the database. Henk Offringa contributed significantly to the development of the computerized database and was of great help during the first analyses of data. Chris Winter prepared many of the distribution maps in this atlas. Henk Hobbelink competently prepared the cover of this atlas and organised the printing of the report. The North Sea Directorate and National Institute for Coastal and Marine Management of the Ministry of Transport, Public Works and Water Management are gratefully acknowledged for the financial support in the RV *Holland* programme, for enabling the temporarily employment of CJC to computer process the *Holland* data, and for sponsoring the production of this report. We want to thank Jakob Asjes, North Sea Directorate, for making the impossible possible and for making us to work on this atlas, and particularly for his encouraging comments during planning and writing. Ies de Vries, Henk Baptist, Jelle van Dijk, Bart Ebbinge, Jan Andries van Franeker, Norbert Dankers and Wanda Zevenboom commented on a draft of this report.

2. STUDY AREA, OBSERVER EFFORT

The material used for this atlas was collected during ship-based surveys on board a variety of vessels between 51° and 56°N, 02° and 07°E (figure 2.1a), an area which will simply be called the *southern North Sea*. This area includes some of the British, Belgian, German and Danish parts of the continental shelf plus the entire *Dutch* *sector* (figure 2.1a, 3.2). In the south, from the Vlaamse Banken to 53°N, this area is often referred to as the *'Southern Bight'*. Part of the *Doggersbank*, *Nordschillgrund* and the German Bight form the other borders of the study area. The Dutch coast is often divided into three major parts: the *Voordelta* in the south, the *mainland coast* of *Noord-* and *Zuid-Holland* in the middle, and the *Wadden Sea islands* in the north (figure 2.1b). The *Wadden Sea* itself was not normally included in our surveys, although some observers continued with observations when their vessel left the North Sea and entered these waters.

The southern North Sea is shallow and reaches a maximum depth of just over 80m in the Outer Silver Pit (figure 2.1a). The 30m depth contour runs approximately 45 km north of the Wadden Sea islands and some 90 km to the west of the mainland coast and the Delta area. The Voordelta is very shallow in places and new sand banks are currently developing which are exposed most of the time. Residual currents run from southwest to northeast in the Southern Bight, transporting Channel water mixed with riverine input along the mainland coast. Channel water is relatively saline and clear, but poor in nutrients and organic suspended matter compared to the riverine input. Central North Sea water comes in from NW and mixes with Channel water and Continental coastal water (the mixture of Channel water and water from the large rivers Schelde, Maas and Rijn) in the *Oestergronden* region (Laevastu 1963, De Gee *et al.* 1991). Bottom sediments are basically sand, mud and gravel (Veenstra 1970). Narrow sand ridges occur just to the south of *Outer Silver Pit*, off the English east coast, in the Voordelta (*Zeeuwse Banken*) and off Belgium (*Vlaamse Banken*) (Eisma *et al.* 1979). Large muddy areas are found in the Oestergronden, SE of the Doggersbank and in the Nordschillgrund region. Bottom sediments in the Southern Bight are mainly sand with occasional gravel patches. At the transition between 25m deep Southern Bight water and Oestergronden (50 m depth), the maximum tidal current velocity drops below a critical value, resulting in deposition of mud and detritus on the bottom. Between the 30 and 40m contours, the sediment has a high mud and organic (carbon) content, and contains an abundant



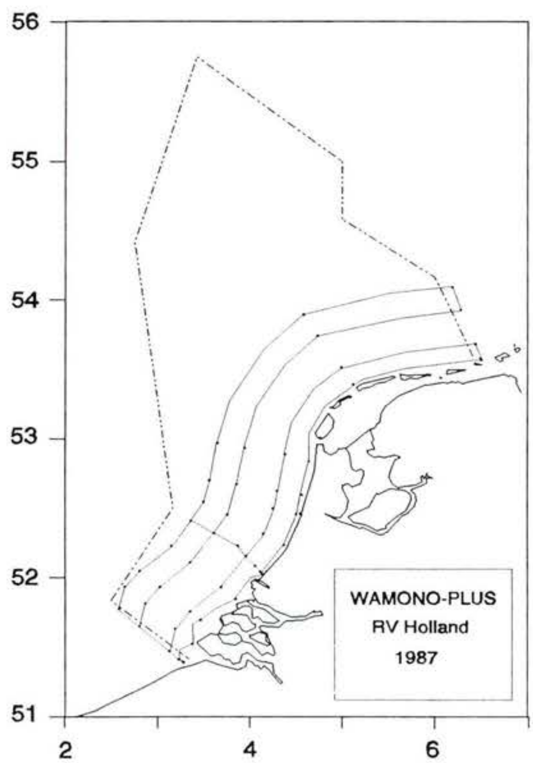
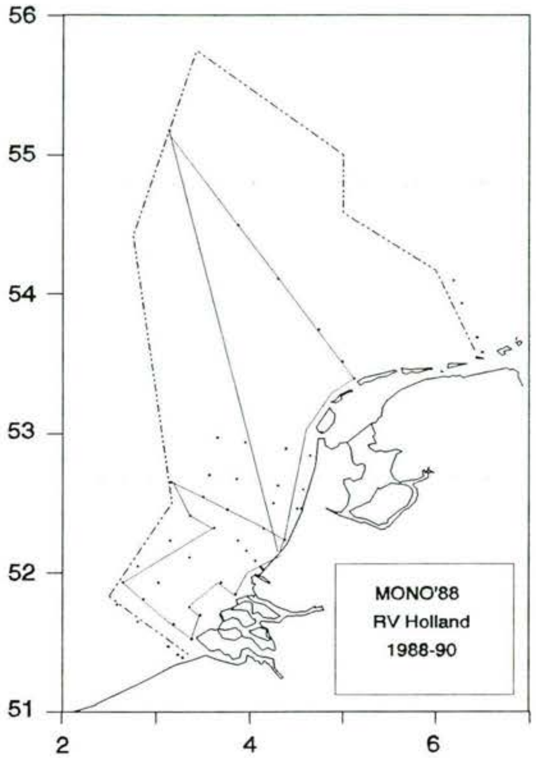
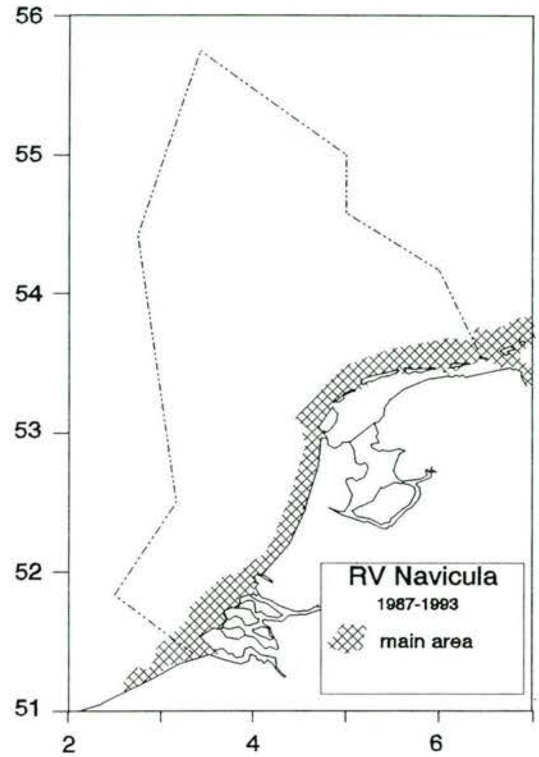


Figure 2.2 Route MV Holland for water quality monitoring WAMONO in 1987

Figure 2.3 Route MV Holland for water quality monitoring WAMONO-plus in 1987





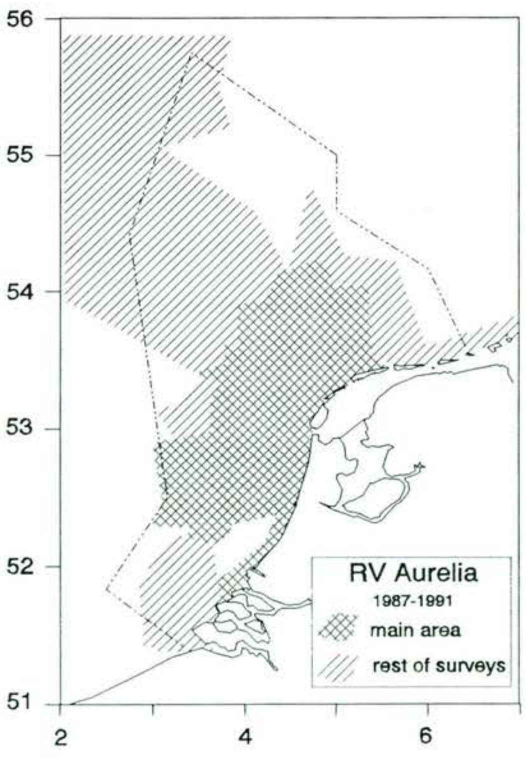


Figure 2.4 Route MV Holland for water quality monitoring MONO'88 since 1988

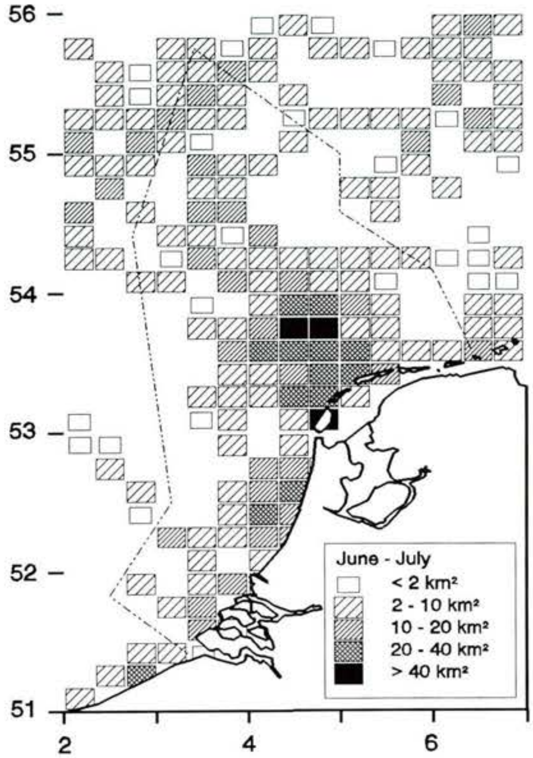
Figure 2.5 Main working area of RV Aurelia, 1987-91

Figure 2.6 Main working area of RV Navicula, 1987-93

fauna. This enriched zone is called the *Friese Front* and is located approximately between 53° 30'N, 4°E and 54°N, 5°E (De Gee *et al.* 1991). In the Friese Front area, spring development of zooplankton is more pronounced than in surrounding areas. In summer, acoustic recordings showed high concentrations of pelagic fish shools above the enriched zone, mainly consisting of sprat *Sprattus sprattus* and immature herring *Clupea harengus* (Sprong *et al.* 1990).

Ship-based surveys included counts of birds near the coast as well as offshore and were usually carried out on ships of opportunity rather than on dedicated vessels (ships that specifically set out to sea for seabird surveys). Important contributions were cruises onboard RV *Holland* (5311 ten-minute counts), when volunteers of the Dutch Seabird Group joined the water quality monitoring trips for the North Sea Directorate, named 'WAMONO, WAMONO-PLUS (both only in 1987; figure 2.2 and 2.3) and MONO'88 (1988-90; figure 2.4). These trips were on fixed routes, but since the ship steamed day and night there were differences in overall coverage of the route each trip.

Extensive surveys were carried out on the research vessel *Aurelia* (5165 counts), particularly in the Friese Front area and around the Bruine Bank (figure 2.5). Coastal surveys were conducted onboard the research vessel *Navicula* (3920 counts; figure 2.6), which mainly aimed to map divers, seaduck and other coastal seabirds. Extensively used by volunteer ornithologists were the fisheries research vessels *Tridens I* (2395 counts, 1987-1990) and *Tridens II* (2067 counts, 1990-1993). Several other vessels were used less frequently, including MVs *Solo* (410 counts), *Breeveertien* (352 counts), *Pelagia* (95 counts), *Tyro* (49 counts), and fishing vessel KW 34 (Rosemarie; 26 counts). These surveys were conducted under supervision of the Netherlands Institute for Sea Research (NIOZ) as part of several research programmes. Since 1992, the organisation of this kind of surveys is in the hands of the Institute of Forestry and Nature Research (IBN-DLO). Additional information was obtained from the ESAS Database from British (Joint Nature Conservation Committee), Danish (Ornis Consult Ltd), German (Inselstation Vogelwarte Helgoland) and Belgian (Instituut voor Natuurbehoud) observers (table 2.1). Bi-monthly observer effort, arranged per 10x20' square and in terms of area (km²) surveyed, is presented in figures 2.7-2.12. It is obvious that, despite the fact that overall coverage was not the main intention, most of the study area was visited during ship-based surveys. The only exception is the poor mid-winter coverage of waters north of 54°N (December-January, figure 2.10).



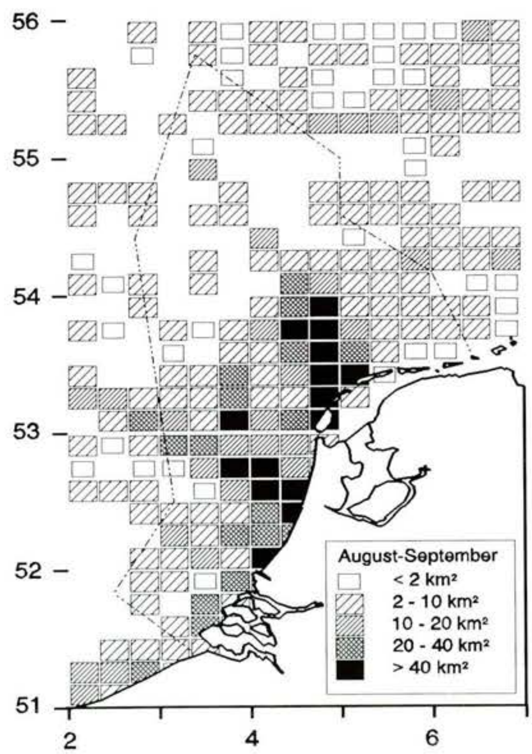
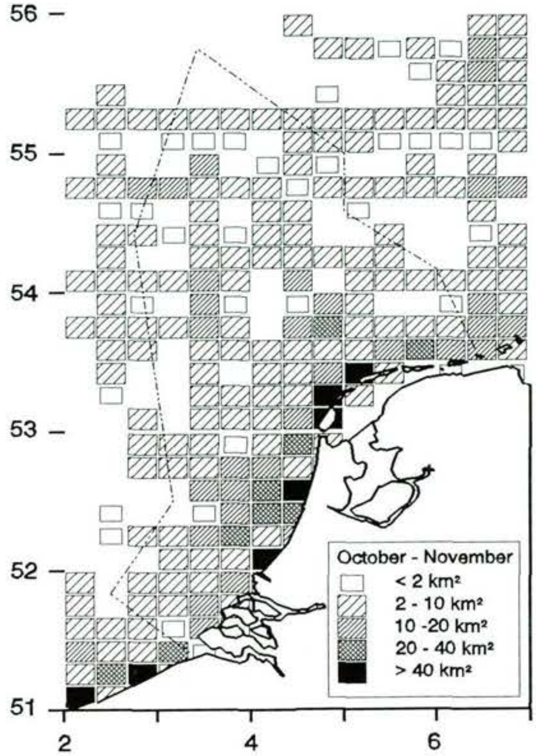
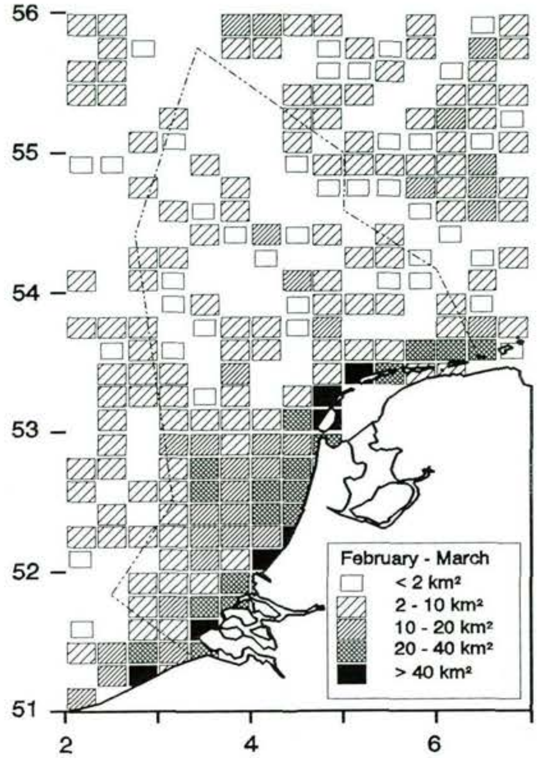
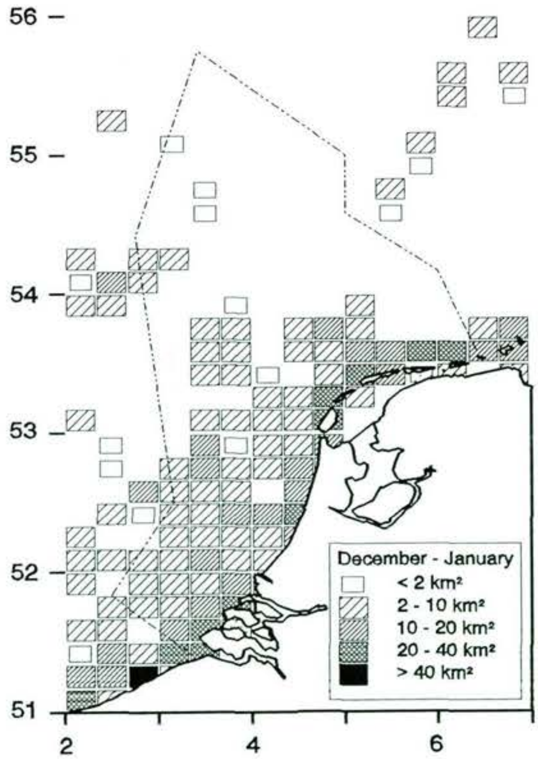


Figure 2.7-2.12 Observer effort (km² surveyed), 1985-93, June-July (3049 km²), August-September (4864 km²), October-November (3912 km²), December-January (2156 km²), February-March (4163 km²), April-May (3302 km²)


56
55
54
53
52
51
2
4
6
October - November
< 2 km²
2 - 10 km²
10 -20 km²
20 - 40 km²
> 40 km²


56
55
54
53
52
51
2
4
6
February - March
< 2 km²
2 - 10 km²
10 - 20 km²
20 - 40 km²
> 40 km²


56
55
54
53
52
51
2
4
6
December - January
< 2 km²
2 - 10 km²
10 - 20 km²
20 - 40 km²
> 40 km²

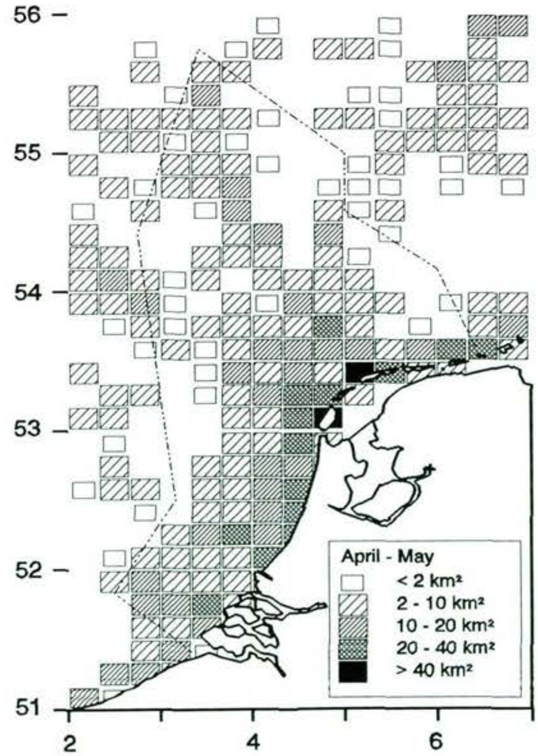

56
55
54
53
52
51
2
4
6
April - May
< 2 km²
2 - 10 km²
10 - 20 km²
20 - 40 km²
> 40 km²

Table 2.1 Origin of data used in this atlas, expressed as km² surveyed per year (rounded).
Tabel 2.1 Herkomst van gegevens gebruikt in deze atlas, uitgedrukt in onderzochte oppervlakte (km²) per jaar (afgerond).

Year	JNCC	NIOZ	IBN	INB	NZG/RWS	Ornis	VWH	other	Total
1985	1376	-	-	-	-	-	-	-	1376
1986	414	-	-	-	-	140	-	-	554
1987	191	3193	-	-	1577	202	-	-	5163
1988	15	1726	-	-	1698	207	-	-	3646
1989	24	1431	-	-	843	290	-	-	2588
1990	48	994	-	-	769	33	-	-	1844
1991	112	1340	-	-	-	-	-	360	1812
1992	44	931	-	485	-	22	-	-	1482
1993	197	790	795	962	28	-	208	-	2980
Totals	2420	10,405	795	1447	4915	894	208	360	21,445
%	11.3	48.5	3.7	6.7	22.9	4.2	1.0	1.7	

JNCC = Joint Nature Conservation Committee, Aberdeen, U.K.; NIOZ = Netherlands Institute for Sea Research, Texel, the Netherlands; IBN = Institute for Forestry and Nature Research, Texel, the Netherlands; INB = Instituut voor Natuurbehoud, Hasselt, Belgium; NZG/RWS = Dutch Seabird Group, Zeist, in co-operation with Tidal Waters Division and North Sea Directorate, the Netherlands; Ornis = Ornis Consult Ltd, Copenhagen, Denmark; VWH = Inselstation Vogelwarte Helgoland, Helgoland, Germany.

3. METHODS

Counting birds at sea

Traditionally, observers of seabirds in the North Sea just recorded all birds seen along the ship's course line, or within a 360° radius on stations (Boer 1971, Joiris 1972, Engelsman & Hulsmann 1974, Joiris 1976, Bourne 1976, Joiris 1978, 1983ab, Leopold 1987, Joiris 1989). This had the advantage that larger samples were obtained, providing a good basis for distribution patterns, but as the area observed is not known, densities cannot be calculated. The 'effective strip width' varies greatly between weather conditions (it is less wide in windy or foggy conditions) and between different observers. Ship-based surveys used for this report were conducted using **strip-transect counts**, which were developed as a standard for the North Sea (*cf.* Tasker *et al.* 1984). Counts were usually conducted from the top-deck or, on small vessels, the bridge. During steaming, from one to three observers counted birds in a strip-transect on one side and ahead of the ship. Birds were normally discovered with the naked eye and if necessary identified by using binoculars. Standard counting units were ten-minute-periods and the transect width was preferably 300m (less wide in poor conditions or on small vessels). All swimming birds or birds touching the water (diving, dipping or plunge-diving) present within the strip designated as the transect were recorded as 'in transect', whereas for flying birds a 'snap-shot' was taken at regular intervals (see Tasker *et al.* 1984 for details). Occasionally, particularly in flat calm conditions and with sufficient observers onboard, two transects, one on either side of the ship, were observed simultaneously. Only birds recorded in transect (swimming or within snapshot) were used for calculations of densities (number of birds per km² sea surface; n/km²) and to produce spatial distribution patterns on the basis of densities for the more common species. Simultaneously, a **180° scan** of the area ahead of the ship was used to record scarcer species of birds, conform methods described in Tasker *et al.* (1984). Within this scan, all birds normally detectable with the naked eye ahead of the ship were recorded (hence, including birds in transect). Particularly for rare species of seabirds, these recordings are valuable in order to produce informative distribution maps. The chance to detect rarer species of seabirds, particularly for those with an aerial lifestyle such as shearwaters and storm petrels, in the strip transect counts is remote. Obviously, birds recorded in the scan which were not within the transect cannot be used to calculate densities (n/km²). Scan sightings are therefore usually effort corrected by calculating total numbers per unit distance travelled (*e.g.* n/km). In this atlas, for scarce seabirds and waterfowl, sightings were simply plotted on maps to show the spatial distribution of records. All birds recorded within the scan (which includes birds in transect) were used for a monthly analysis of species composition (divers, terns), age (Gannet, gulls), plumage (auks) or colour phase (Fulmar). Total numbers of birds recorded at sea, and observer effort expressed as distance travelled, are listed in Appendix 1. Groups of birds associated with fishing vessels, marine mammals, other obvious objects (platforms, buoys, *etcetera*) or other peculiarities in the sea such as tidal current lines, rubbish, oil, sand banks or ice were labelled in a 'notes' column. However, if such flocks happened to be within the transect strip, these birds were treated as all other individual birds or groups and used for calculations of densities. Birds associated with or obviously attracted by the own vessel were listed separately and not used for calculations of densities. The advantage of using internationally accepted standard procedures for seabird work at sea is obvious. With teams from all North Sea countries using the same strip transect method, it has been relatively easy to use data gathered by others. In the ESAS database the work of several different teams has been amalgamated (table 2.1), and this database provided us with important additions to our own data.

Correction for birds not seen

Before densities were calculated, numbers of animals observed in the counting strips had to be corrected for individuals apparently overlooked by the observers at sea. According to line transect theory (Burnham *et al.* 1980) the probability of missing a target increases with distance to the observer. The chance of missing a seabird in transect is largest for dark-backed birds (divers, grebes, petrels, cormorants and auks) and for the smaller, light-mantled and intermediately coloured birds (Fulmar, skuas, the smaller gull species, terns). The problem is particularly important for swimming birds, as birds in the air are much more conspicuous. In order to estimate the proportion missed, the strip under observation was subdivided into sections of 100 m wide and each observed swimming seabird or group of birds was designated to the appropriate section. Thus, for the 200 and 300 meter bands, 2 and 3 sub-sections were used respectively. For each set of counts, the number of observations should be statistically equal for each sub-strip. The proportions of birds seen in each sub-strip were calculated and compared to the null-hypothesis of equal numbers. The distribution of the sightings for the first group of species differed from the desired equality in most cases. We assumed, that all birds present in the nearest 100 m are detected. Using this assumption, the numbers overlooked in the more distant strata were calculated and the numbers present in the total band were accordingly corrected. The correction was smoothed over the entire area where animals of the species under consideration were found. In order to achieve this, numbers of each observation were multiplied by the same correction factor, derived from the proportions of animals in each sub-strip. This method ensures that no animals 'appear' in areas where the species was not observed. Further smoothing occurs through grouping of the counts into the 10x20' squares (see below). Although the precise distribution patterns may be slightly disfigured by this procedure, both the large-scale distribution is mapped correctly and the total numbers of animals present in the area are estimated best. For the larger gulls (Herring, Lesser and Great Black-backed Gulls and for Gannet) no correction was considered necessary. These spend a lot of time in flight anyway, and when swimming often occur

Table 3.1 Correction factors used to compensate for swimming birds missed in the counting strips. The smaller gulls (Little, Black-headed, Common Gull and Kittiwake) all had the same detection curves.

Tabel 3.1 Correctie factoren die gebruikt zijn om de gemiste fractie van zwemmende zeevogels in de transecten te berekenen. De ontdekkingskansen voor de kleinere meeuwensoorten (Dwerg-, Kok-, Storm- en Drieteenmeeuw) waren gelijk.

	Strip Width	
Species	150 and 200 m	300 m
divers	1.2	1.3
Great Crested Grebe	1.2	1.3
Fulmar	1.1	1.1
Great Skua	1.1	1.3
smaller gulls	1.2	1.4
terns	1.3	1.7
Guillemot	1.2	1.4
Razorbill	1.2	1.5
Little Auk	1.5	1.9
Puffin	1.2	1.5

in large aggregations, in response to fishing vessel activity, making accurate distance determinations difficult. As for several species the sample sizes were rather small, and may have been unduly influenced by particular observers or cruises, we used the larger European Seabirds At Sea (ESAS)-database (*cf.* Stone *et al. in prep.*). Correction factors for the different species, for different total strip widths are given in table 3.1. Note that corrections were only applied to swimming birds of the species listed in table 4.1, and therefore not to birds that were seen in the air. Flying birds were thus assumed to be always detected within the counting strips. Corrections were also not used for scarcer species for which no densities or total numbers present were calculated.

Distribution maps

Densities are mapped in different shadings in 10' latitude x 20' longitude squares (so-called *'Mijnbouwvakken'*, used in Dutch offshore mining and management activities) per two-months period (June-July to April-May), if at least 10 birds were seen within the strips covered in that period. The lowest density class (in the legends: 0.1-0.9 birds per km²) in fact includes all densities < 1/km². Sample sizes given with the distribution maps indicate the total number of birds that were seen in transect, and used for calculations of densities, but do not indicate the total number of birds at sea that time of year. Overall coverage or observer effort, in terms of km² surveyed, is given separately in distribution maps on the same scale (figures 2.7-2.12), while squares with limited effort (<2 km² surveyed) were indicated on all maps by a slightly smaller size. All other birds (not being in transect) were recorded but have not been used for calculations of overall numbers or distribution patterns on the basis of densities. Of rare seabirds, all recorded individuals, whether in transect or not, were plotted on maps to show all sightings. Proportions of age classes, plumages or species identifications in groups of common species which are hard to identify (*e.g.* divers) in certain areas or periods were calculated on the basis of all birds observed (*i.e.* scan results plus strip-transect) rather than the often much smaller sample of birds observed in transect.

Map interpretation

In the presentation of results in distribution maps, the results have simply been lumped into squares of 10x20 geographical minutes. Three associated problems with this approach need to be addressed. Firstly, differences between years in the numbers of seabirds in the southern North Sea cannot be recognised, and one 'special' year with many more sightings than average will unduely influence the maps. An example of this problem are the relatively numerous sightings of Great Skuas in autumn 1987 (over 50% of all records). Secondly, important differences in effort between years occurred. Data in the Friese Front area have mainly been gathered in 1987-90, those on the Bruine Bank mainly in 1989-91, while dedicated surveys for divers and seaduck in the coastal zone took place in 1990-93. The *Holland* programme, in which a regular coverage was achieved over much of the Dutch sector, was restricted to 1987-90 and the Doggersbank region was only visited under MONO'88 with the *Holland* (figure 2.4) and later by research vessels *Aurelia*, *Tyro* and *Tridens*. Differences in distribution patterns between years which were caused by differences in coverage will not show up in the maps, which are composites over 1985-93. Thirdly, apparent differences between neighbouring squares may well be the result of chance, especially in ship-following birds. Large numbers of gulls and Fulmars may be found associated with trawlers. With average densities of usually less than 10 birds per km², a single count of hundreds of birds of a given species within the counting strip will designate the highest density class to that particular square. Such counts happen regularly in the southern North Sea, as trawlers with associated seabirds are frequently met (Camphuysen 1993a). With larger numbers of counts, such 'short-lived' high densities would level out, but in the present database the amount of data is often not large enough to make this happen.

Estimates of total numbers

Estimates of total numbers of birds at sea in the southern North Sea (51°-56°N, 2°-7°E) were made on the basis of 30'Nx1°E squares (so-called 'ICES-squares') and summarized for a coastal zone of 10 (parts of) ICES squares and an offshore zone of 33 such squares (figure 3.1). Estimates of total numbers of birds within the southern North Sea per 2 month period were calculated and are presented in table 4.2. Peak numbers of common species occurring within the study area were assessed and compared with recent estimates of NW European or world populations (table 4.3; *cf.* Evans 1984, Lloyd *et al.* 1991, Rose & Scott 1994). The *Ramsar Convention* (Convention on Wetlands of International Impor-

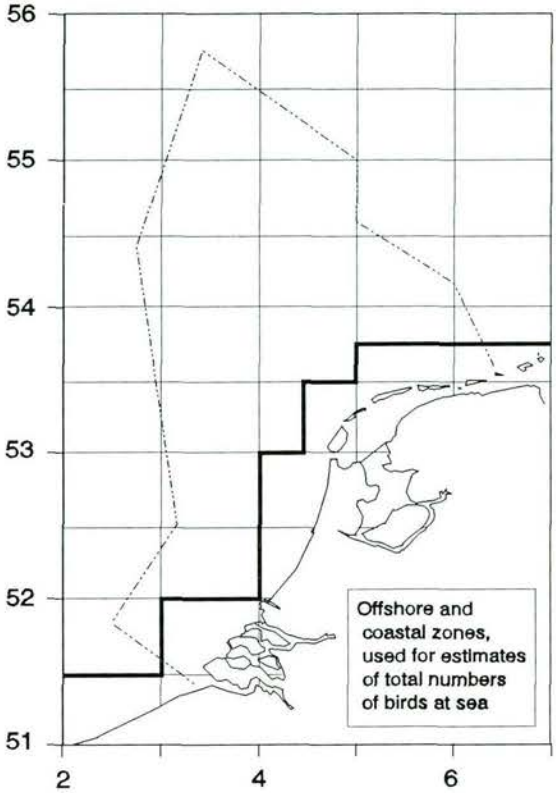


Figure 3.1 ICES squares (0.5°N x 1°E rectangles) and the border between an offshore and a coastal zone (solid line) used for estimating total numbers of birds

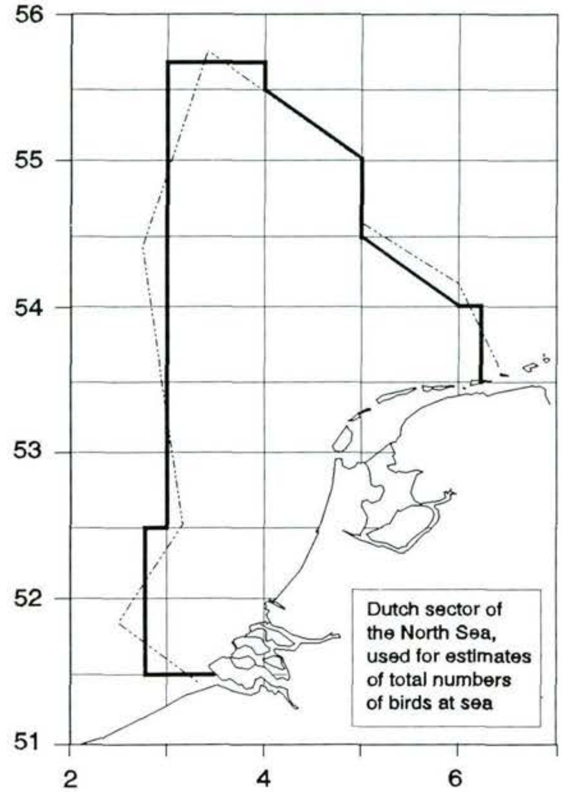


Figure 3.2 ICES squares (0.5°N x 1°E rectangles) used for estimates of total numbers of birds within the Dutch sector of the southern North Sea (solid line)

tance, especially as Waterfowl Habitat) uses a set of criteria by which internationally important wetlands can be identified for designation to the Ramsar list. A wetland is identified as being of international importance if it regularly supports 1% of the individuals in a population of one species or subspecies of waterfowl. For the interpretation of data presented in this atlas, it is important to realize that the 'coastal zone' defined earlier covers an area of approximately 16,000 km², whereas the 'offshore zone' covers a total area of approximately 114,000 km², both much larger than average 'wetlands'. To apply the criterion it is necessary to know the numeric size and geographical limits of the populations of waterfowl species occurring in each wetland. For many species the numeric size and geographical limits are indicated by Rose & Scott (1994). Peak numbers occurring in the southern North Sea were listed and expressed as proportions of the total population estimates, using the geographical limits from Rose & Scott (1994) or the North Sea breeding population.

The Dutch sector of the North Sea, although an arbitrary unit in itself, is used for management and conservation of the marine environment under jurisdiction of the Netherlands. Hence, estimates of total numbers within this sector were made separately and mentioned in the species accounts. Estimates of total numbers of birds at sea in the Dutch sector were also made on the basis of (parts of) ICES-squares (figure 3.2). Estimates of total numbers of birds within the Dutch sector per 2 month period were calculated and presented in table 4.4. In this same table, peak numbers of common species occurring within this area were listed and compared with recent estimates of NW European or world populations (*cf.* Evans 1984, Lloyd *et al.* 1991, Rose & Scott 1994)

It must be clear that the abundance estimates derived from extrapolations of densities over larger areas are very crude. Hence, the estimated numbers should be considered rough indications of total numbers.

Comparisons with other data
Distribution patterns derived from ship-based surveys, on the basis of densities at sea, were compared with similar data published as results of aerial surveys (Baptist & Wolf 1993). Only the general distribution patterns were compared, not the densities square by square. Timing, species composition within certain groups of birds and spatial distribution of seabirds observed from seawatching sites along the Dutch coast (*cf.* Camphuysen & Van Dijk 1983, Platteeuw *et al.* 1994) were compared with similar results obtained in coastal waters during ship-based surveys. The timing of (mass-) strandings, trends through the years and indications of the vulnerability to oil pollution of seabirds in Dutch waters are indicated for each species (mainly derived from Camphuysen 1989, 1992, Camphuysen & Van Franeker 1992). Finally, in an overall discussion, the findings in this atlas are compared with results of similar surveys in other parts of the North Sea, the Delta area and Wadden Sea, and adjoining seas, the Baltic and eastern Atlantic. A bibliography at the end of this report aims at giving a complete overview of historic and recent studies of seabird distribution, seabird migration and seabird strandings in this part of the North Sea. To avoid lengthy references in the text, comparisons with aerial surveys (Baptist & Wolf 1993), beached bird surveys (Camphuysen 1989), and seawatching results (1974-79, Camphuysen & Van Dijk 1983; 1980-89, Platteeuw *et al.* 1994), will be referred to as #1, #2, #3, and #4 respectively ('**key references**').

4. RESULTS

Seabirds observed during ship-based surveys are discussed per taxonomic group of birds (divers-auks), on the species level if possible. Land-birds such as raptors and passerines are excluded. Land-birds are frequently observed at sea, particularly during spring- and autumn migration, but these have no link with the marine environment. Records of swans, geese, dabbling duck, most diving duck, rails and waders will be treated only briefly.

For common seabirds (table 4.1), distribution maps are presented on the basis of strip-transect counts, showing mean densities of birds per 10'x20' square. Data are presented in bi-monthly periods. Maps with densities are only given if at least 10 birds were observed in transect in that period. The sample size given with these maps indicates the number of birds seen in transect in that period (*cf.* table 4.1). Overall densities are given in table 4.1 to show the seasonal pattern of common seabirds in the southern North Sea. Distribution maps are briefly discussed and compared with the corresponding maps from aerial surveys. Several seabirds have colour phases (*e.g.* Fulmar), summer versus winter plumages (*e.g.* auks) or can be aged using plumage characteristics (*e.g.* Gannet, gulls). The seasonal pattern in the frequency of these plumage types is given per month in tables with each species. Abundance estimates were made for an offshore zone and a coastal zone in the southern North Sea (figure 3.1, table 4.2; see chapter 3) and for the Dutch sector (figure 3.2, table 4.4). Peak numbers of each species were compared with recent information on the NW European population and the proportion which was maximally found within these areas was assessed (Evans 1984, Lloyd et al. 1991, Rose & Scott 1994; tables 4.3, 4.4). Seasonal and spatial patterns derived from ship-based data were compared with aerial data, seawatching results (#3, #4) and strandings data (#2, Camphuysen & Van Franeker 1992). Conclusions are drawn on the relative importance of the southern North Sea for each species (compared to the NW European population), potential threats, and possible conservation measures. Records of scarce species are plotted on maps showing all individual sightings throughout the year or for shorter periods. Sample sizes given with these maps indicate the total number of birds seen, within or outside transect (*cf.* Appendix 1). Rare seabirds are only briefly discussed.

Table 4.1 Seasonal pattern of common seabirds in the southern North Sea (birds in transect, corrected for individuals missed; conform Stone et al. *in press), 1985-93. Top half: observer effort (km² surveyed) and total number of birds seen in transect; bottom half: mean densities (n/km²). Eider and Common Scoter, which occurred highly aggregated, were not included.*

Tabel 4.1 Seizoenpatroon van veel voorkomende zeevogels in de zuidelijke Noordzee (vogels binnen het transect, gecorrigeerd voor gemiste vogels conform Stone et al. *in press), 1985-93. Bovenste helft: waarnemingsinspanning (km² onderzocht) en totaal aantal waargenomen vogels in het transect; onderste helft: gemiddelde dichtheden (n/km²). Gegevens van Eidereend en Zwarte Zeeëend, soorten die een sterk geconcentreerd voorkomen hebben, zijn niet opgenomen.*

	Jun-Jul	Aug-Sep	Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Mean
Km² surveyed	3049	4864	3860	2156	4088	3302	21320
Divers			214	834	927	35	2010
Great Cr. Grebe		2	108	1156	1876	5	3147
Fulmar	2950	5197	1703	730	3992	1954	16526
Gannet	133	874	1367	98	525	142	3139
Cormorant	46	14	9	86	22	99	276
Great Skua	15	173	41	8	8	6	251
Little Gull		37	1209	320	415	693	2674
Black-headed Gull	104	182	1750	1608	1754	118	5516
Common Gull	176	108	3529	5974	4925	494	15206
Lesser Bl.-b. Gul	2414	2769	1587	70	670	4662	12172
Herring Gull	1250	599	5021	10679	9253	3816	30618
Great Bl.-b. Gull	24	1132	3614	3111	1830	227	9938
Kittiwake	526	910	4050	2643	3866	1105	13100
Sandwich Tern	456	140	1	1	40	667	1305
"commic" terns	173	947	1		2	509	1632
Guillemot	925	2185	6990	3788	4406	1565	19859
Razorbill	2	8	982	417	1296	214	2919
	Jun-Jul	**Aug-Sep**	**Oct-Nov**	**Dec-Jan**	**Feb-Mar**	**Apr-May**	**Totals**
Divers	0	0	0.06	0.39	0.23	0.01	0.09
Great Cr. Grebe	0	0.00	0.03	0.54	0.46	0.00	0.15
Fulmar	0.97	1.07	0.44	0.34	0.98	0.59	0.78
Gannet	0.04	0.18	0.35	0.05	0.13	0.04	0.15
Cormorant	0.02	0.00	0.00	0.04	0.01	0.03	0.01
Great Skua	0.00	0.04	0.01	0.00	0.00	0.00	0.01
Little Gull	0	0.01	0.31	0.15	0.10	0.21	0.13
Black-headed Gull	0.03	0.04	0.45	0.75	0.43	0.04	0.26
Common Gull	0.06	0.02	0.91	2.77	1.20	0.15	0.71
Lesser Bl.-b. Gul	0.79	0.57	0.41	0.03	0.16	1.41	0.57
Herring Gull	0.41	0.12	1.30	4.95	2.26	1.16	1.44
Great Bl.-b. Gull	0.01	0.23	0.94	1.44	0.45	0.07	0.47
Kittiwake	0.17	0.19	1.05	1.23	0.95	0.33	0.61
Sandwich Tern	0.15	0.03	0.00	0.00	0.01	0.20	0.06
"commic" terns	0.06	0.19	0.00	0	0.00	0.15	0.08
Guillemot	0.30	0.45	1.81	1.76	1.08	0.47	0.93
Razorbill	0.00	0.00	0.25	0.19	0.32	0.06	0.14

Table 4.2 Estimates of (average) total numbers of birds in the southern North Sea (derived from birds in transect, corrected for individuals missed; see figure 3.1). Estimates for seaduck and Eider were not calculated on the basis of densities, but based on counts of groups (see chapter 4.6).

Tabel 4.2 Schatting van het (gemiddeld) aantal zeevogels in de zuidelijke Noordzee (alleen vogels binnen het transect, gecorrigeerd voor gemiste individuen; zie figuur 3.1). Schattingen voor zee- en Eider-eenden zijn niet gebaseerd op dichtheden, maar op getelde groepen (zie tekst hoofdstuk 4.6).

	Coastal zone (16,000 km²)						Offshore zone (114,000 km²)*					
	Jun-Jul	Aug-Sep	Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Oct-Nov	Dec-Jan	Feb-Mar	Apr-May
Divers	0	0	1800	9400	6100	200	0	0	400	800	3000	700
GrC Grebe	0	10	3600	17800	21100	80	0	0	20	30	30	0
Fulmar	3000	1300	500	3300	5000	1600	121800	227200	86300	28600	176800	111700
Gannet	340	3000	7200	600	600	200	4700	13700	28700	3100	18200	7000
Cormorant	700	200	100	700	100	400	0	0	0	0	0	50
Eider	250	20	440	16800	16800	370	0	0	10	0	0	0
Com Scoter	1700	2300	2100	58000	60000	53000	0	20	2900	0	510	580
Velvet Scoter	30	10	90	24	2300	500	0	0	0	10	10	0
Arctic Skua	50	200	80	0	0	10	0	1000	200	0	0	300
Great Skua	100	300	100	30	10	10	400	2600	1200	200	300	300
Little Gull	0	500	11200	3900	2900	7300	0	0	3000	600	100	40
BHh Gull	1000	800	23500	11200	9800	600	1400	900	1400	500	1300	3200
Com Gull	1300	300	29200	55300	34300	4800	800	1900	5900	25100	7100	400
LBb Gull	20200	16200	19600	700	2800	29800	37200	18600	4900	500	9800	53100
Herr Gull	14500	3800	46300	108800	55100	35800	1600	3000	28000	62500	75900	9500
GBb Gull	200	5000	22300	23100	6200	1000	900	4100	41200	70400	36000	7400
Kittiwake	1200	1100	21800	19500	9200	200	12500	22000	127700	54200	112200	103600
SandwTern	4700	1000	10	10	200	5700	100	100	0	0	80	1300
"comm" t	1700	10500	10	0	10	4300	2200	1100	0	0	0	2100
Guillem/Razorb	100	1400	28400	33800	13800	1100	50600	92500	241900	121000	198400	128600
- Guillemot	100	1400	23700	30400	9900	900	45500	92100	211300	93000	150400	116700
- Razorbill	0	0	4200	2700	3500	200	70	300	22600	23200	40800	11300
Little Auk	0	0	20	40	30	0	0	0	2200	18000	17700	200
Puffin	0	0	0	30	20	0	80	200	5000	3900	7000	4600
All birds	69900	54410	251850	330480	205580	117200	210750	380400	534800	313030	588800	412540

*) Extrapolations were made per 30'Nx1°E rectangle (ICES-squares). Due to poor coverage north of 54°N in mid-winter, the offshore area for which the number of birds was calculated in December-January was only 82,000 km² (*ca.* 70% of the total area).

Table 4.3 Peak numbers of common seabirds in the southern North Sea, estimated from ship-based surveys, compared with recent estimates of the NE Atlantic populations and the percent level for use in Ramsar Convention criterion 3c (cf. Rose & Scott 1994). Maximum estimates were derived from table 4.2, except in seaduck and Eider where the maximum number located in Dutch waters is given (see chapter 4.6).

Tabel 4.3 Maximale aantallen van algemene zeevogels in de zuidelijke Noordzee op grond van schatting en aan de hand van scheepstellingen en vergelijkingen met recente schattingen van de NW Europese populaties en het percentage van deze populaties voor gebruik bij Ramsar Conventie criterum 3c (cf. Rose & Scott 1994). Maximum schattingen zijn afgeleid van tabel 4.2, behalve voor zee- en Eidereenden waar de hoogste gevonden aantallen zijn weergegeven (zie tekst hoofdstuk 4.6).

Species / group	Maximum estimate	period	NE Atlantic	ref	%
Red-throated Diver	9,800	Dec-Jan	75,000	(1)	13.1
Black-throated Diver	400	Dec-Jan	120,000	(1)	0.3
Great Crested Grebe	21,100	Feb-Mar	100,000	(1)	21.1
Fulmar	228,500	Aug-Sep	10,000,000	(2)	2.3
Gannet	35,900	Oct-Nov	892,000	(3)	4.0
Cormorant	700	Jun-Jul	320,000	(4)	0.2
Eider	105,000	Jan-Feb'93	3,000,000	(1)	3.5
Common Scoter	135,000	Jan-Feb'93	1,300,000	(5)	10.4
Velvet Scoter	13,000	Jan-Feb'92	1,000,000	(5)	1.3
Arctic Skua	1,200	Aug-Sep	55,000	(6)	2.2
Great Skua	2,900	Aug-Sep	27,200	(6)	10.7
Little Gull	14,200	Oct-Nov	75,000	(1)	18.9
Black-headed Gull	24,900	Oct-Nov	5,000,000	(1)	0.5
Common Gull	80,400	Dec-Jan	1,600,000	(1)	5.0
Lesser Black-backed Gull	82,900	Apr-May	450,000	(1)	18.4
Herring Gull	171,300	Dec-Jan	1,400,000	(1)	12.2
Great Black-backed Gull	63,500	Oct-Nov	480,000	(1)	13.2
Kittiwake	149,500	Oct-Nov	8,400,000	(1)	1.8
Sandwich Tern	7,000	Apr-May	150,000	(1)	4.7
Common Tern	10,600	Aug-Sep	180,000	(6)	5.9
Arctic Tern	1,000	Aug-Sep	> 1,000,000	(1)	< 0.1
Guillemot	242,400	Oct-Nov	8,000,000	(7)	3.0
Razorbill	44,000	Feb-Mar	2,400,000	(8)	1.8
Little Auk	18,000	Dec-Jan	> 1,000,000	(9)	< 1.8
Puffin	7,000	Feb-Mar	>12,000,000	(2)	< 0.1

References:

(1) Rose & Scott 1994, NW European population
(2) NE Atlantic; rough estimate, using figures in Lloyd *et al.* 1991
(3) Lloyd *et al.* 1991, East Atlantic breeding population plus same number immatures
(4) Rose & Scott 1994, *P.c.carbo* NW Europe + *P.c.sinensis* N/C Europe
(5) Durinck *et al.* 1994, NW European winter population
(6) Lloyd *et al.* 1991, NW Europe breeding population
(7) NE Atlantic, breeding adults and equal number immatures; Jensen 1993 In: Durinck *et al.* 1994
(8) N Atlantic, breeding adults and equal number immatures; Lloyd *et al.* 1991
(9) Evans 1984, NE Atlantic breeding population

Table 4.4 Estimates of total numbers of seabirds in the Dutch sector of the North Sea from ship-based surveys, 1985-93 (see figure 3.2), compared with recent estimates of the NE Atlantic populations and the percent level for use in Ramsar Convention criterion 3c (cf. Rose & Scott 1994; see table 4.3). In seaduck and Eider where the maximum number located in the Dutch sector is given (see chapter 4.6).

Tabel 4.4 Schattingen van de aantallen zeevogels op het Nederlandse deel van de Noordzee aan de hand van scheepstellingen, 1985-93 (zie figuur 3.2), en vergelijkingen met recente schattingen van de NW Europese populaties en het percentage van deze populaties voor gebruik bij Ramsar Conventie criterum 3c (cf. Rose & Scott 1994; zie tabel 4.3). Voor zee- en Eidereenden zijn de hoogste gevonden aantallen weergegeven (zie tekst hoofdstuk 4.6).

	Jun-Jul	Aug-Sep	Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Maximum		%
Divers	0	0	2000	7400	5800	700	7400	Dec-Jan	[1]9.5
Grebes	0	10	3200	8900	13700	50	13700	Feb-Mar	13.7
Fulmar	58600	114100	43400	15300	110800	44300	114100	Aug-Sep	1.1
Gannet	2700	9500	19900	1600	12300	3600	19900	Oct-Nov	2.2
Eider	250	20	400	16000	16800	190	100000	Feb 1993	3.3
Com Scoter	1700	2300	4900	50000	55000	47500	135000	Feb 1993	10.4
Velv Scot	20	10	80	20	2300	450	13000	Feb 1992	1.3
Arct Skua	20	600	300	0	0	10	600	Aug-Sep	1.1
Great Skua	400	2000	800	200	200	100	2000	Aug-Sep	7.4
Little Gull	0	50	10700	3800	2200	4900	10700	Oct-Nov	14.3
Bl-h Gull	800	1100	21900	10300	10000	3100	21900	Oct-Nov	0.4
Comm Gull	1700	400	29900	60800	29100	3400	60800	Dec-Jan	3.8
L Blb Gull	36800	24600	15300	800	9300	57900	57900	Apr-May	12.9
Herr Gull	14700	5000	51900	117700	101300	39700	117700	Dec-Jan	8.4
Gr Blb Gull	700	6900	35300	71500	32800	5600	(71500	Dec-Jan)	[2]7.4
Kittiwake	7100	6400	53100	32900	74600	16900	74600	Feb-Mar	0.9
Sandw Tern	3500	900	10	10	300	5900	5900	Apr-May	3.9
'commic' tern	1200	10100	10	0	10	4000	10100	Aug-Sep	[3]5.1
Razorbill	0	100	13500	18900	21900	3100	21900	Feb-Mar	0.9
Guillemot	15500	39500	133800	80700	87100	47800	133800	Oct-Nov	1.7
Razor/Guill	15500	39600	147300	99600	109000	50900			
Little Auk	0	0	700	900	4000	200	4000	Feb-Mar	0.4
Puffin	0	100	700	100	3500	800	3500	Feb-Mar	0.0
	145700	223700	441800	497800	574100	290200	574100	Feb-Mar	

[1] Calculated for Red-throated Diver, 96.2% of all divers

[2] Calculated for estimate over October-November (35,300)

[3] Calculated for Common Tern, 91.4% of all 'commic' terns

4.1 DIVERS

In the southern North Sea, divers are passage migrants and winter visitors of coastal waters. Four species of divers have been observed. Red-throated Diver and Black-throated Diver, further referred to here as 'small divers' were common. Unfortunately, winter-plumage individuals are often difficult to identify to species (60.6% identified; n= 3828, appendix 1). Distribution maps were prepared in which results for both species were combined, but the proportions of Red- and Black-throated Divers were assessed by using the relative abundance of each species whenever this was considered appropriate.

Red-throated Diver *Gavia stellata*
Black-throated Diver *Gavia arctica*

In summer and early autumn (June-September) small divers were rare (6 individuals observed; no maps), but between October and May both Red-throated Divers and Black-throated Divers were frequently observed in inshore waters, particularly off the Wadden Sea islands and in the Voordelta. Numbers in coastal waters peaked in December-January (estimated at 10,200 individuals). Small divers were comparatively numerous further offshore during early spring migration (February-March, estimated at 3000 individuals; table 4.2).

In **October-November**, low densities were found (figure 4.1). Most sightings were near the shore, but further offshore, small numbers occurred, indicating that migration also occurs across the North Sea, rather than just along the eastern seaboard. Highest densities were recorded off the Wadden Sea islands and in the Voordelta. Of 288 small divers identified to species in October-November, only 8 individuals were Black-throated Divers (2.8%). Distribution patterns are well in accordance with those from aerial surveys in these months (#1), but estimates of total numbers in the Dutch sector (2000 from ship-based surveys, 500 from aerial surveys) were quite different.

In early winter, more divers have arrived from the northerly breeding grounds. The highest densities in **December-January** were found along the Wadden Sea islands and in the Voordelta (figure 4.2). Substantial numbers occurred at the Vlaamse Banken (*cf.* Seys 1993). Of 945 small divers which were identified, 3.7% were Black-throated

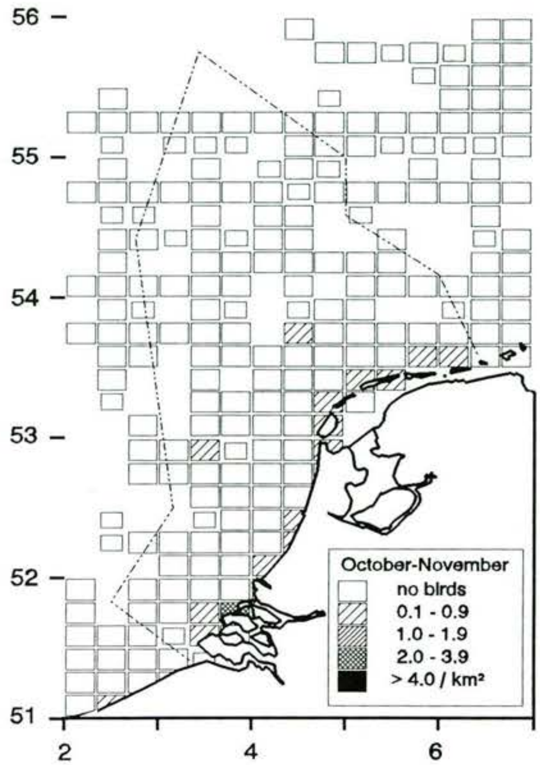


Figure 4.1 Distribution of small divers, October-November (n= 214)

Divers. In these months, numbers in the study area were estimated at 10,100 individuals of which 9800 were Red-throated Divers (approximately 18% of the NW European population; table 4.3). An estimated 7400 small divers occurred in the Dutch sector of the North Sea (table 4.4).

The peak numbers found in these months coincide with mass movements seen from coastal sites during seawatching (#4) and high numbers of staging divers seen from the shore in the Voordelta (Ouweneel 1993a). It is generally thought that winter movements recorded during seawatching are mainly short distance flights, caused by disturbance (shipping) or a response to compensate for tidal drift, rather than migration. Ship-based surveys confirm the presence of a substantial wintering population. Results of aerial surveys suggested a considerably wider distribution off the coast, with frequent occurrences at over 10 km from the shore (#1), a result, not corroborated by ship-based surveys. Part of this difference may be related to differences in effort in the offshore

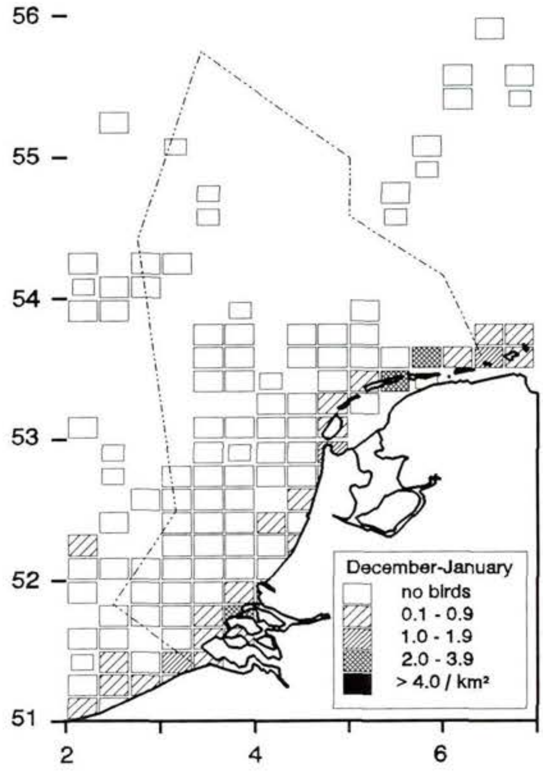


Figure 4.2 Distribution of small divers, December-January (n = 834)

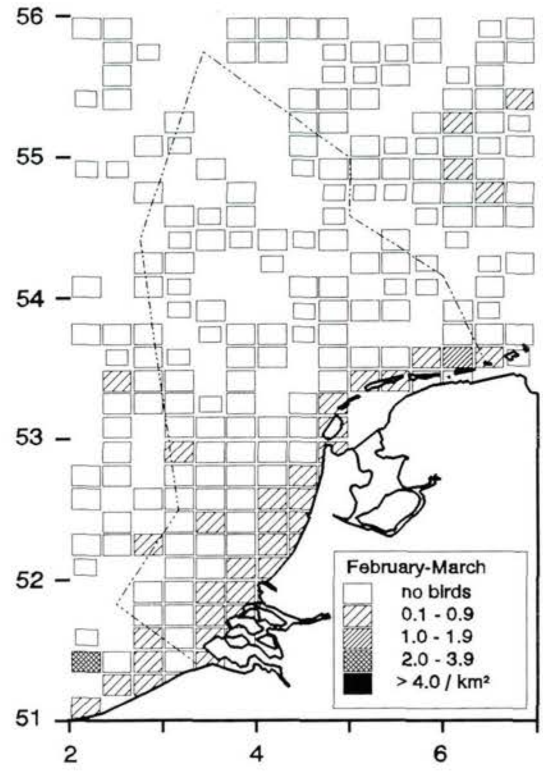


Figure 4.3 Distribution of small divers, February-March (n = 927)

Breeveertien area. With more local effort in the aerial surveys the chance of detecting very low densities are better. However, also from aerial surveys, divers appeared more equally distributed along the entire coastline, whereas ship-based surveys (and seawatching data) indicated the presence of comparatively large numbers off the Wadden Sea islands and in the Voordelta. From aerial surveys it was concluded that approximately 1900 divers occurred in Dutch waters in these months.

In **February and March**, more divers were found off the mainland coast, indicating the onset of spring migration (figure 4.3). However, highest densities were still observed in the Vlaamse Banken area and off the easternmost Wadden Sea islands (Schiermonnikoog, Rottum, Borkum). Of 1045 divers which were identified to species, 2.9% were Black-throated Divers. Seawatching data have shown that the peak of spring migration of Red-throated Divers along the Dutch coast is in these months (#4). Divers were comparatively numerous at greater distances from the coast (estimate offshore waters 3000 individuals; table 4.2). In the Dutch sector of the North Sea, 5800 small divers were estimated to occur (table 4.4). The main difference between results of aerial surveys and ship-based surveys is again a much narrower distribution pattern as derived from the latter, much more restricted to coastal waters than indicated by Baptist & Wolf (1993). This is probably partly related to higher effort in the aerial surveys (#1).

Numbers of divers in **April and May** were small. Offshore records were now comparatively frequent, while densities in inshore waters were generally very low (figure 4.4). Of 60 divers which could be identified, 8 individuals were Black-throated Divers (13.3%). Seawatching has also shown that Black-throated Divers are comparatively numerous in April and May (#3, Van der Ham 1987, #4). In these months, Black-throated

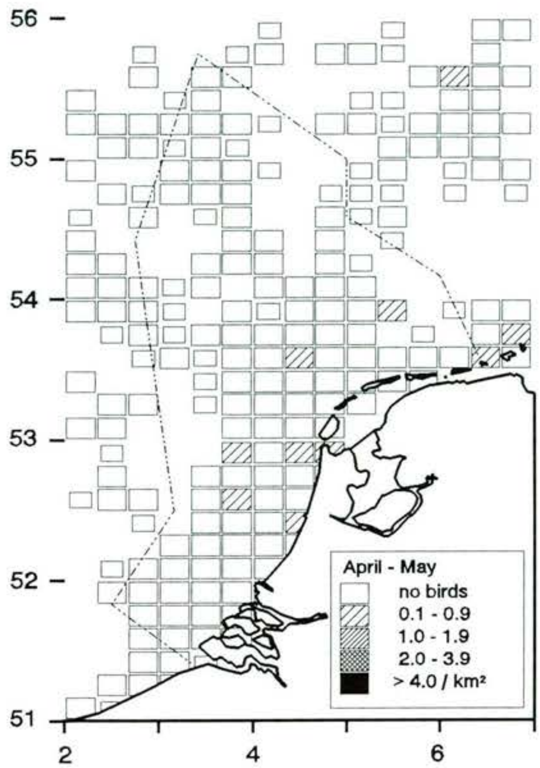


Figure 4.4 Distribution of small divers, April-May (n = 35)

Divers wintering south of the study area move towards the German Bight, where high numbers occur in late spring (Skov *et al.* 1994). Compared to results from aerial surveys, the distribution pattern of divers in April and May is equally fragmented with low densities in coastal waters. Estimates for the Dutch sector from ship-based and aerial surveys were similar (700 and 600 individuals respectively).

Discussion and conclusions The southern North Sea is an important wintering area for Red-throated Divers. Of a NW European/ Greenlandic breeding population of 75,000 Red-throated Divers (Rose & Scott 1994), as many as 18.4% were found within the study area in winter. The estimated 10,200 divers wintering in Dutch and Belgian waters are part of the very important wintering population in the southeastern North Sea, which was only recently fully appreciated (Skov *et al.* 1994). Small numbers of Black-throated Divers, Great Northern Divers and White-billed Divers were observed. Most divers occur near the shore, mainly within 20 km from the coast, and because divers are highly vulnerable to oil pollution this area requires special protection (aerial surveillance for oil slicks, clean-up operations, shipping lanes away from the coast). Divers are very shy birds which are difficult to count because they readily take off for approaching vessels and may leave the strip-transect well before being detected. The majority of our surveys in the coastal waters in winter were in fact dedicated surveys, with slightly changed methods (constant watch by binoculars ahead). This was needed to assess total wintering numbers in Dutch coastal waters more accurately (*cf.* Skov *et al.* 1994). Because divers cannot be identified on the species level from the air, aerial surveys are a less efficient tool.

Seawatching data are important to monitor annual fluctuations in numbers and appear rather accurate as a means to locate (nearshore) high density areas (Meininger 1987, #3, #4). However, specific identification is usually very difficult (1980-89 14% identified, n = 136,864; #4). Seawatching data showed that numbers of divers gradually build up from late September to mid-December, remain high up to early March, and subsequently decline. Between years, the numbers observed have fluctuated considerably. However, systematic seawatching since 1972 has demonstrated that the overall numbers in winter have increased since the early 1980s and comparisons between numbers counted during 1980-89 and during 1974-79 have shown that numbers off the Wadden Sea islands have at least doubled, and off the mainland coast have even tripled or quadrupled (#4).

Diver strandings, on the other hand, have declined since the early 1970s (and particularly since the 1950s and 1960s), despite consistently high oil rates in divers on our coasts (#2, 1992, Camphuysen & Van Franeker 1992). The decline was mainly attributed to a comparatively extensive control of coastal waters for oil pollution as compared to offshore waters. It is possible, however, that substantially larger numbers occurred in Dutch waters in the 1950s and 1960s.

Great Northern Diver *Gavia immer*
White-billed Diver *Gavia adamsii*

Great Northern Diver (13) and White-billed Diver (1) were rare (figure 4.5). Most Great Northern Divers were seen near the coast, but the number

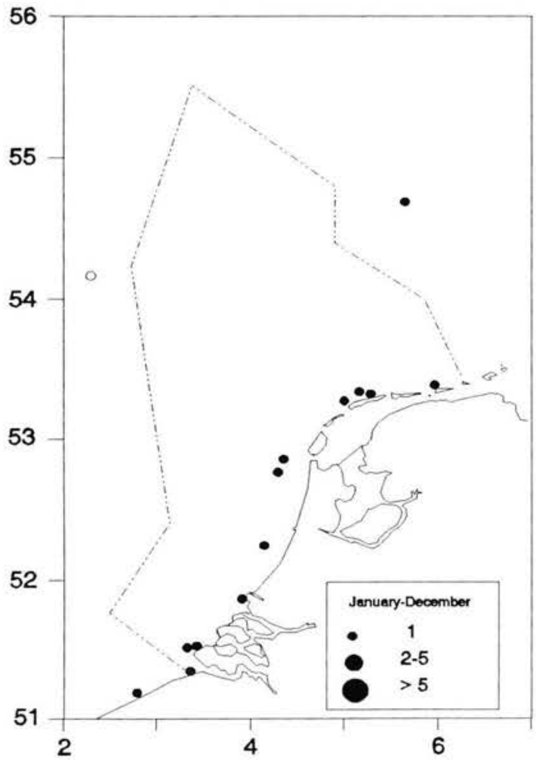


Figure 4.5 Sightings of Great Northern Divers (●, n= 13) and White-billed Divers (○, n= 1), January-December

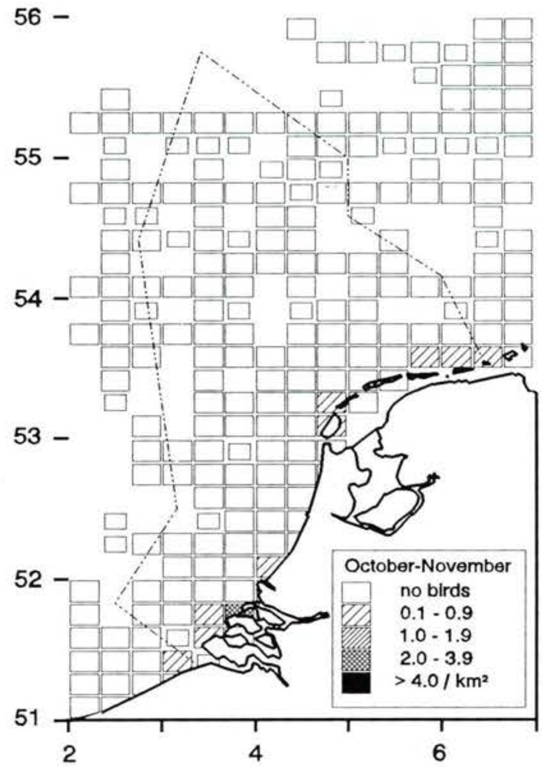


Figure 4.6 Distribution of Great Crested Grebes, October-November (n= 108)

of large divers compared to the number of small divers (0.4%, n= 3878) was considerably larger than could be expected from coastal sightings (1980-89 0.04%, n= 136,931; *cf.* #4). This could indicate that Great Northern Divers stay slightly further offshore than the small divers.

4.2 GREBES

Four species of grebes were observed during ship-based surveys in the southern North Sea, but only one, the Great Crested Grebe was numerous in coastal waters in winter. Three species of grebes breed in the Netherlands, one of which, the Little Grebe is rarely recorded at sea and not at all during surveys reported here. Breeding and non-breeding species alike, however, are mainly winter visitors of the coastal zone (mainly October-March).

Great Crested Grebe *Podiceps cristatus*

In summer and early autumn (April-September) Great Crested Grebes were rarely seen at sea (7 individuals observed; no maps). Small numbers arrived at sea in October, but high numbers were only found in the winter months (table 4.1). Between February and March as many as 21,100 Great Crested Grebes were estimated to occur in Dutch waters. All but very few were found in the coastal zone.

In autumn (**October-November**), low densities of grebes occurred off the Wadden Sea islands and the Voordelta (figure 4.6). Moderate to high densities were found closely inshore near the Brouwersdam. Along most of the mainland coast not a single grebe was found. In total, it was estimated that approximately 3600 Great Crested Grebes occurred in Dutch waters in these months. From seawatching results it is known that significant (southward) passages off the Dutch coast were

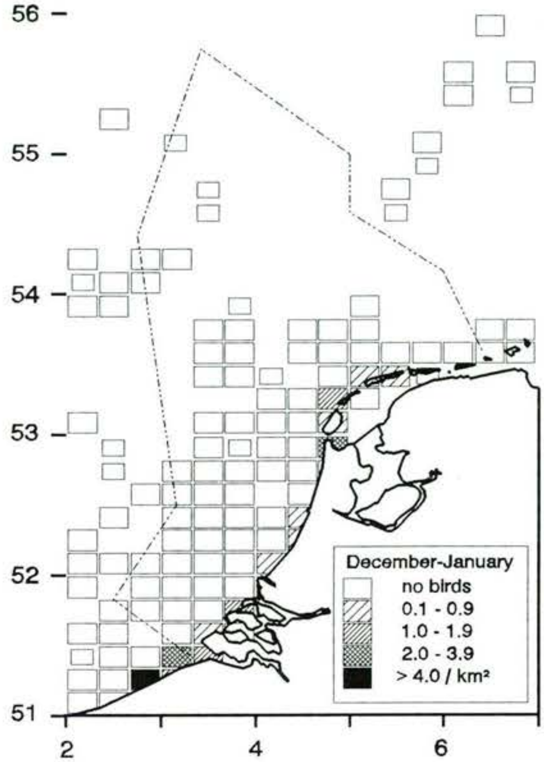


Figure 4.7 Distribution of Great Crested Grebes, December-January (n= 1156)

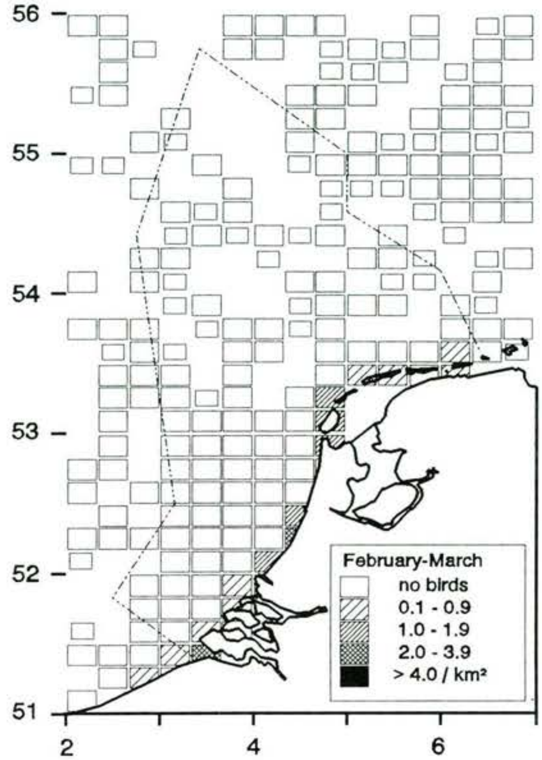


Figure 4.8 Distribution of Great Crested Grebes, February-March (n= 1876)

usually not recorded before late October (#4). Numbers seen flying by were found to increase rapidly in November, but were still small. Strandings of (oiled) grebes in autumn were rare (#2).

In the first half of winter (**December-January**), Great Crested Grebes were found closely inshore along most of the Dutch and Belgian coast, with highest densities in the southernmost regions (figure 4.7). The numbers found in these months in coastal waters, estimated 17,800 individuals (8900 of which occurred within the Dutch sector; table 4.4), are in agreement with high numbers observed from seawatching sites (#4). Large differences between years occurred, however, in response to winter conditions (Camphuysen & Derks 1989). Cold rushes and large concentrations of grebes which may occur in our waters in severe winters were not recorded during these ship-based surveys. Coastal observations indicated that wintering numbers in Dutch coastal waters can be a lot higher under extreme conditions.

In **February-March**, overall densities along the mainland coast and westernmost Wadden Sea islands were slightly higher, but numbers off Belgium and in the Voordelta appeared to have declined (figure 4.8). The estimate of total numbers in coastal waters in these months was even higher than in the previous period (21,100 individuals, 13,700 of which were found in the Dutch sector; table 4.4). Similar to the early winter months, were large differences in numbers at sea between years in response to severe weather conditions (Camphuysen & Derks 1989, #4). Great Crested Grebe strandings peaked in February and March, particularly in severe winters, and often involved substantial numbers of starved grebes (#2). Seawatching data showed that northward movements along the coast predominated in March, indicating the return of grebes to the breeding areas (#4). In accordance with seawatching data, hardly any grebes were observed at sea after March.

Discussion and conclusions The southern North Sea is of international importance as a wintering area for Great Crested Grebes, being frequented by at least 10% of the NW European wintering population (table 4.3; Rose & Scott 1994) and probably rather more than that in severe winters. In winter, substantial numbers were found in Belgian waters. A common feature of important areas for wintering Great Crested Grebes in NW Europe is the proximity of large fresh water bodies. This premise is well met by the suitably located IJsselmeer and Delta waters, both important wintering areas for grebes (Adriaensen 1993, Meininger *et al.* 1994, Skov *et al.* 1994). Wintering numbers in the Netherlands have increased in recent years, mainly because grebes breeding in NW Europe changed habits from a principally migratory species to residents (Adriaensen *et al.* 1993). Peak numbers of Great Crested Grebes wintering on fresh water in the Netherlands, approximately 18,000 individuals of which 14,000 in the Delta, were recorded in 1986 (Van den Bergh 1988). Extreme winter conditions may force all these birds to move to sea (Camphuysen & Derks 1989) and the coastal zone deserves therefore special protection in severe winters, similar to that for divers in 'normal' years. Inshore oil incidents have demonstrated the vulnerability of Great Crested Grebes for oil pollution (Camphuysen *et al.* 1988). High mortality rates were found during beached bird surveys in severe winters, such as in 1979 (#2, Camphuysen & Derks 1989), with comparatively few oiled casualties. Most of these birds are starved to death and this indicates that the coastal zone is a poor alternative for grebes wintering inland, or that cold-rushes towards the sea are sometimes carried out too late.

As in ship-based surveys, most grebes seen from the air were found near the coast (#1). A direct comparison between the two methods is impossible, because densities of Great Crested Grebes were not given from aerial surveys. The design of the aerial surveys consists of alongshore transect lines, which does not permit a valuable estimate of this nearshore species. It appears from aerial counts that rather more grebes occurred off the mainland coast than off the Delta, an aspect which is not corroborated by ship-based surveys. Results of ship-based surveys are in broad agreement with seawatching results, considering seasonal patterns, spatial distribution and relative abundance of the four species under consideration in this report. Obviously, grebes are restricted to waters very near the coast, mainly within five km from the shore. Therefore, seawatching is an important and comparatively cheap method of monitoring the presence of grebes in Dutch waters.

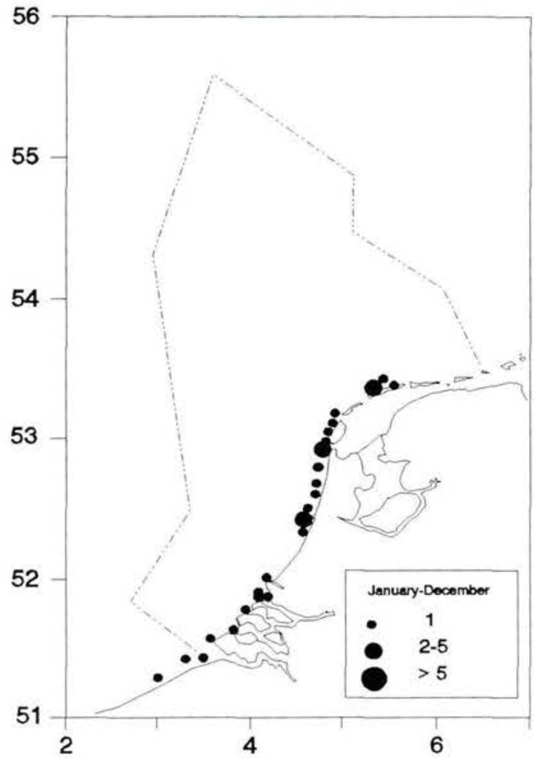


Figure 4.9 Sightings of Red-necked Grebes, January-December (•, n = 33)

Red-necked Grebe *Podiceps griseigena*

Red-necked Grebes were scarce (33 individuals recorded) and occurred mainly between November and March. This species was only observed close inshore, but on average slightly further to the north (mainland coast of Noord-Holland, Texel and Vlieland) than Great Crested Grebes (figure 4.9). From seawatching data, however, it can be concluded that the occurrence of this species in Dutch coastal waters in less a winter phenomenon than in the Great Crested Grebe (#4). These sightings confirm that Red-necked Grebes are more numerous along the mainland coast of Noord-Holland and particularly off the Wadden Sea islands than further to the south. From ship-

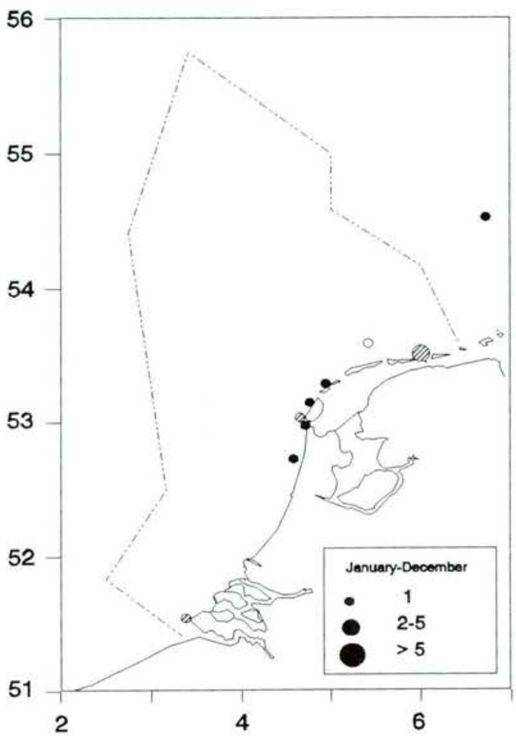


Figure 4.10 Sightings of Slavonian Grebes (•, n = 7), Black-necked Grebes (○, n = 1) and unidentified small grebes (shaded, n = 4), January-December

based surveys and seawatching data it is unlikely that more than a few hundred Red-necked Grebes occur in Dutch coastal waters at any time (less than 1% of the NW European wintering population; Rose & Scott 1994). Red-necked Grebes occur concentrated at some locations in the Delta area (Ouweneel 1985, 1990, Meininger *et al.* 1994). Clearly, Dutch North Sea coasts are not of international importance for this species. Red-necked Grebes wash ashore annually, but usually in very small numbers (#2). In severe winters, strandings occur more frequently because wintering numbers are higher (*cf.* Chandler 1981).

Slavonian Grebe *Podiceps auritus*
Black-necked Grebe *Podiceps nigricollis*

Small grebes, most of which were identified as Slavonian Grebes, were rare and mainly occured inshore between December and April (figure 4.10). Most records were off the Wadden Sea islands which is in agreement with seawatching data for Slavonian Grebes (#3, #4). A distinct peak in numbers recorded during seawatching in late April and early May, caused by spring migration and mainly found along the mainland coast of Noord-Holland, is not reflected in data from ship-based surveys. Small grebes, with two times as many Slavonian Grebes as Black-necked Grebes, wash ashore in very small numbers in the Netherlands and mainly in severe winters (#2). Slavonian and Black-necked Grebes occur concentrated at various locations in the Wadden Sea and in the Voordelta (Ouweneel 1989a, 1993b, SOVON 1987, Meininger *et al.* 1994, H. Witte pers. comm.). Considering ship-based surveys, seawatching results and beached bird surveys, it is unlikely that internationally important numbers of these small grebes winter in Dutch coastal waters at any time.

4.3 TUBENOSES

Seven species were observed during ship-based surveys of which two, Black-browed Albatross and Balearic Shearwater, only once. The only common species of this group was the Fulmar, a species which was numerous throughout the year in the offshore zone. Shearwaters and storm petrels were mainly observed in late summer and autumn.

Black-browed Albatross *Diomedea melanophris*

An adult Black-browed Albatross was observed *ca.* 12 nautical miles north of Schiermonnikoog in the German sector of the North Sea on 5 October 1988 (Offringa & Witbaard 1990). A sighting of this species was to be expected, as one has frequented colonies of Gannets on Bass Rock (Waterston 1968) and Hermaness (Shetland; Sutherland & Brooks 1979) since the late 1960s. Black-browed Albatrosses, or at least birds belonging to the genus *Diomedea*, have been reported on several other occasions in or near the study area: one off Castricum, 22 Oct 1971 (Slings 1981) and one off Camperduin (Noord-Holland) on 30 Nov 1980 (#4). Offshore records include one at the Doggersbank (photographed by a fisherman on 21 May 1988; Brit. Birds 81: 480) and one near Helgoland on 7 May 1991 (Leopold *et al. in prep*). In the North Sea at large, tens of records of this species have been made (*e.g.* Lippens & Wille

1986, Dymond *et al.* 1989). Indications that more than one individual visited NW Europe in recent years were that one was found dead in Spain (December 1987; Seabird Group Newsletter 51), and a record of two birds flying together (Dymond *et al.* 1989).

Fulmar *Fulmarus glacialis*

The Fulmar is one of the commonest seabirds in the North Sea. It is widespread and occurs year-round, particularly in the offshore zone. Generally, moderate to high densities occurred north of 53°N and in water of over 20m depth. Breeding numbers along the coast of East England and on Helgoland (German Bight) increased rapidly. Of a North Sea population of *ca.* 310,000 couples, only some 3500 pairs nest south of 56°N (Lloyd *et al.* 1991, Hüppop 1992). A dark and a light morph can be recognized in this species. Light phase birds (coded LL according to Van Franeker & Wattel 1982) were routinely separated from 'coloured' individuals (coded L, D or DD) whenever possible. 'Coloured' individuals are of arctic origin (mainly East Greenland, Svalbard, and Bear Island) and the proportion of 'coloured' birds was used to illustrate the arrival and departure of birds from outside the North Sea within the study area.

In summer, **June-July**, moderate to high densities were found off the mainland coast of Noord-Holland, in the Friese Front region and further to the NW (figure 4.11). Fulmars were most abundant in the Doggersbank area. Low densities were found at Nordschillgrund, north of the Wadden Sea islands and in the south end of the study area. 'Coloured' Fulmars were rare (0.23%, n= 11,287; table 4.5). It was estimated that some 125,000 Fulmars were present in the southern North Sea this time of year, 3000 of which were in the coastal zone (table 4.2). For the Dutch sector of the North Sea, nearly 60,000 Fulmars were estimated to occur (table 4.4). Numbers of stranded Fulmars in the Netherlands peak in this period (#2). Mid-summer mass strandings are a well known, but unexplained phenomenon in the Netherlands, usually of unoiled, starved, light phase (LL) birds. The last stranding of this kind on record was in June 1991 (NZG/NSO unpubl. data). The distribution pattern described from aerial surveys was, considering differences in observer effort and coverage, remarkably similar (#1). The estimate of total numbers in the Dutch sector from aerial surveys was *ca.* 12,000 individuals.

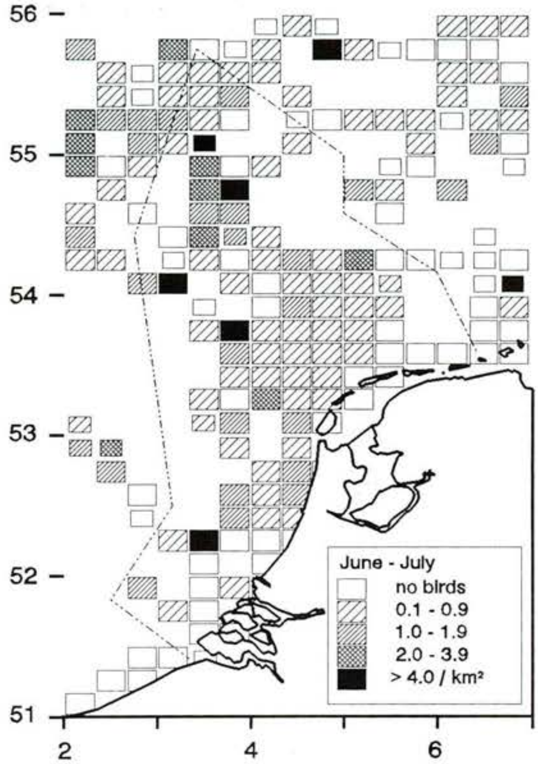


Figure 4.11 Distribution of Fulmar, June-July (n= 2950)

Numbers increased considerably in late summer (**August-September**) to nearly 230,000 individuals (table 4.2), 114,000 of which were found within the Dutch sector of the North Sea (table 4.4). High densities were now found in the Nordschillgrund area and scattered over the Dutch sector of the North Sea (figure 4.12). Moderate to high densities were recorded scattered over the Southern Bight. Low densities were found in the coastal strip, but steaming an hour away from the coast was normally sufficient to reach waters rich in Fulmars. Fulmars were rather scarce at the Vlaamse Banken and in the Voordelta and very low numbers occurred north of the Wadden Sea islands. The fraction of 'coloured' Fulmars was still very low in August, but increased gradually to 0.5% in September (table 4.5). Large groups of Fulmars were observed associated with fishing vessels in August. Of 34 trawlers studied, 32.4% were joined by over 100 Fulmars (Camphuysen 1993a). One boat, just over 100 km NW of Texel, was joined by more than 1000 Fulmars. Strong

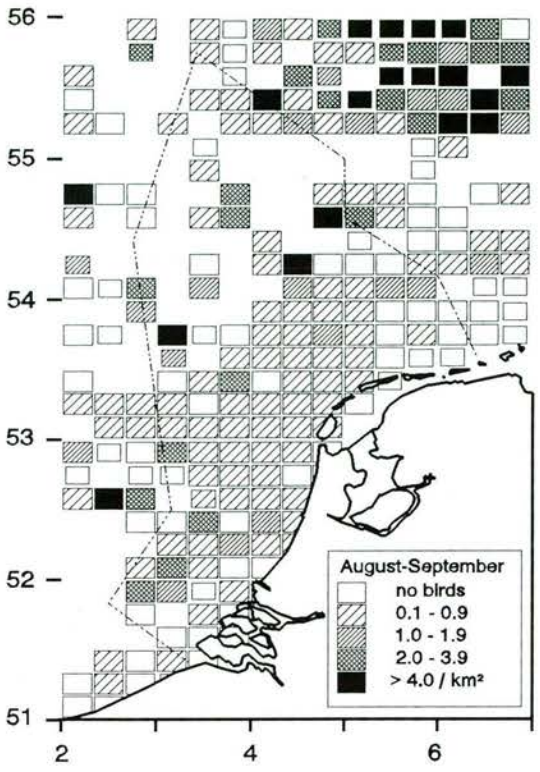


Figure 4.12 Distribution of Fulmar, August-September (n= 5197)

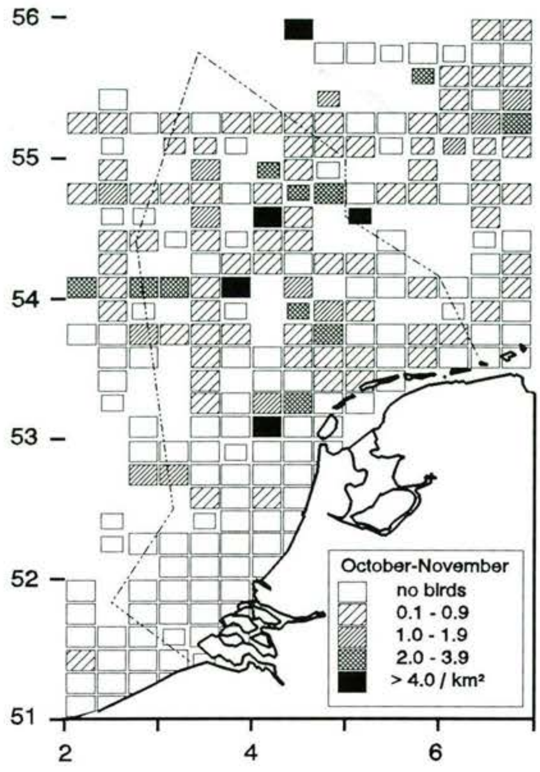


Figure 4.13 Distribution of Fulmar, October-November (n= 1703)

westerly winds in September repeatedly led to mass movements of Fulmars along the mainland coast of Noord-Holland and off the Wadden Sea islands (#4). Fulmar passage was usually insignificant near the mainland coast of Zuid-Holland and in the Voordelta. A mass stranding occurred in August 1987, when many Fulmars washed ashore at the mainland coast. The stranding coincided with a wreck of juvenile Kittiwakes, but the state of primary moult in most Fulmar casualties indicated that this crash could not be attributed to post-fledging mortality (#2). Baptist & Wolf (1993) found the highest densities of Fulmars in the Oestergronden and, similar to the results of ship-based surveys, concluded that Fulmars were scarce in the coastal strip, north of the Wadden Sea islands and in the Voordelta. It was estimated from these surveys that around 80,000 Fulmars occurred in the Dutch sector.

In **October-November**, the period when storm-riding Fulmars were most frequently seen at coastal sites in the Netherlands (#3, #4), numbers at sea had fallen dramatically. An estimated 86,800 Fulmars were present in the southern North Sea (table 4.2), the majority of which occurred north of 53°N in relatively clear Central North Sea water (figure 4.13) and only 43,400 were found in the Dutch sector of the North Sea (table 4.4). The proportion of 'coloured' Fulmars increased abruptly in this period, and the 'winter-level' of approximately 2.5-3.0% was reached in November (table 4.5). The drop in numbers at sea is less obvious in distribution patterns from aerial surveys (#1) but the estimated numbers for these months were 60% lower than those in previous months (*ca.* 33,500 individuals. Other than in ship-based surveys, Fulmars were found much further to the south in substantial numbers. Densities of stranded Fulmars are normally lowest in November (#2).

In winter, **December-January**, the offshore zone was not well studied during ship-based surveys

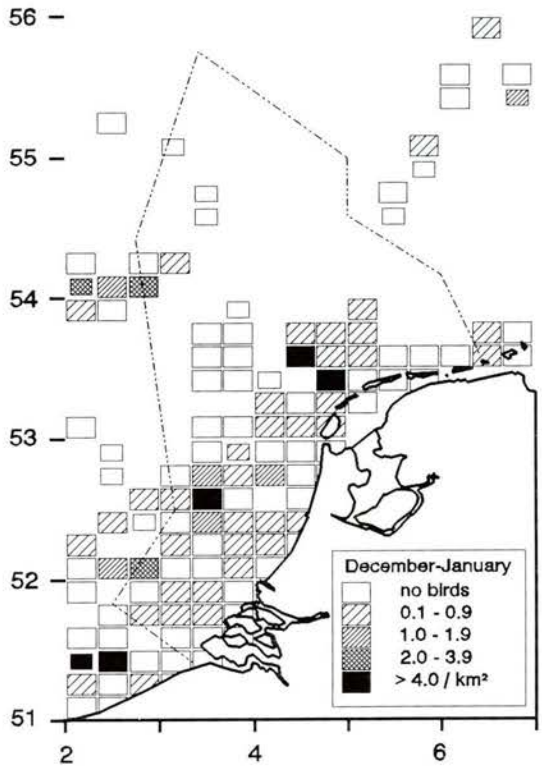


Figure 4.14 Distribution of Fulmar, December-January (n = 730)

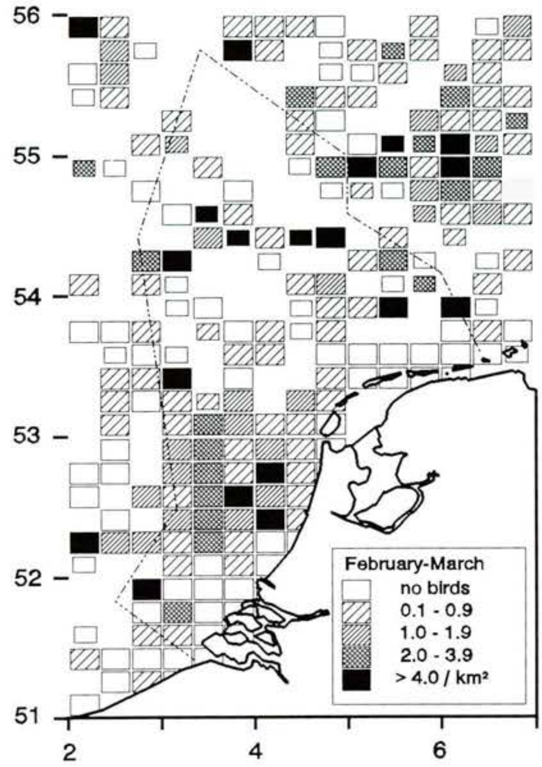


Figure 4.15 Distribution of Fulmar, February-March (n = 3992)

north of 54°N. Moderate to high densities occurred at scattered locations in the Southern Bight and even at the Vlaamse Banken substantial numbers were found (figure 4.14). As usual, the coastal zone was not particularly rich in Fulmars. The proportion of 'coloured' Fulmars peaked in December (2.9%, table 4.5) and subsequently declined. Mass movements of Fulmars along the coast occurred at this time of year, but were not very frequent (#4). Strandings are normally at a low level in winter (#2). Aerial surveys of the Dutch part of the North Sea resulted in a much the same pattern as in the previous period, with low densities near the coast, a widespread occurrence offshore and highest densities in the NW (#1).

Fulmars were again widespread, and penetrated deep into the Southern Bight, in **February-March** (figure 4.15). Around 180,000 Fulmars were estimated to be within the study area (table 4.2) and high numbers could be seen anywhere, except in the coastal strip. The Bruine Bank area, Oestergronden and Nordschillgrund were regions in which high densities occurred frequently. The Dutch sector of the North Sea accounted for *ca.* 111,000 Fulmars (table 4.4). Just over 2% of all Fulmars in February were 'coloured', but this figure dropped sharply in March (table 4.5). The entire Southern Bight was studied in February 1993 as part of an international study of scavenging seabirds in the North Sea. That year, it was estimated that 720,000 Fulmars occurred in the North Sea proper, 86,000 of which were found in the Southern Bight (51°N, 53°30'N; Camphuysen *et al.* 1993). Fulmars were abundant at trawlers, as far south as the Channel. From seawatching sites, Fulmars were only reported in substantial numbers during strong westerly winds (#4). Stranded numbers were usually very small at this time of year (#2), but a mass stranding of Fulmars on Texel, the mainland coast and the Delta, many of which were oiled, occurred late February 1988. This wreck coincided with unusually high numbers of stranded Puffins *Fratercula arctica* and Razor-

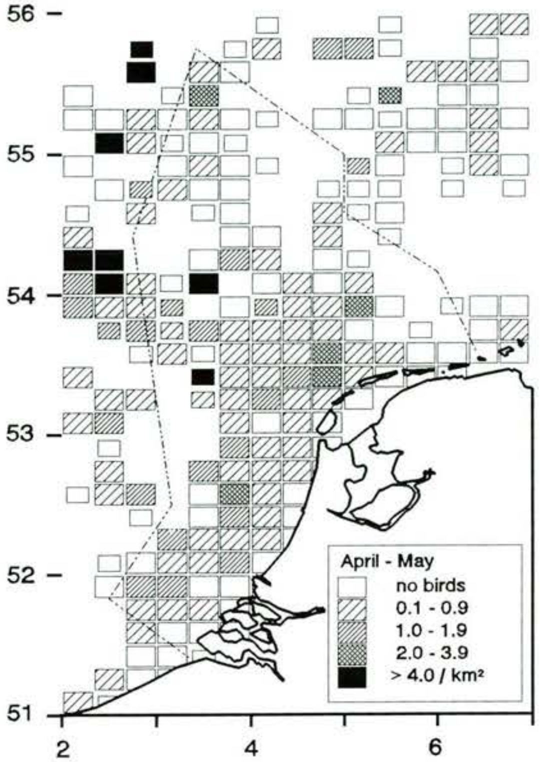


Figure 4.16 Distribution of Fulmar, April-May (n= 1954)

bills *Alca torda*. The most massive Fulmar wreck on record took place in February 1962, when nearly 2400 Fulmars washed ashore in the Netherlands (J.J.C. Tanis in Pashby & Cudworth 1969), as part of a major wreck which was witnessed in all North Sea countries. Most of these birds were unoiled but starved to death, with extremely high proportions of 'coloured' individuals in most countries (Pashby & Cudworth 1969). Fulmars were widespread during aerial surveys in the area, but were absent in a wide area along the coast (#1). The estimate of total numbers in the Dutch sector derived from this source was 27,500 individuals. Moderate to high densities were found around the Bruine Bank and north of 53°30'N.

In **April-May**, high densities occurred at the Outer Silver Pit and in places around the Doggersbank. Low densities were recorded in the Nordschillgrund and Oestergronden and moderate densities to the northwest of Texel and off the mainland coast (figure 4.16). The overall picture is one of patches of birds offshore and very low densities near the coast. Estimates of total numbers were still in the range of 120,000 Fulmars for the entire area (table 4.2), 44,300 for the Dutch sector alone (table 4.4), and the proportion of 'coloured' Fulmars was back at the summer low of 0.3% (table 4.5). Along the coast, Fulmars are often seen in small numbers as 'prospectors' (birds flying towards land in a straight line, circling over the dunes for some time and setting off to sea again; #3). Mass strandings took place frequently in April and May, usually involving unoiled, starved, light phase birds (#2). A large scale wreck was witnessed in April/May 1975, whereas large numbers of Fulmars that washed ashore in May 1985 were covered in oil. From aerial surveys it was also concluded that Fulmars were scarce in the coastal strip, with moderate to high densities at Bruine Bank, west of Noord-Holland and to the SE of the Doggersbank. The estimate of total numbers in the Dutch sector was 30,500 individuals (#1).

Table 4.5 Monthly samples and proportion of light phase (LL) and 'coloured' (L, D or DD) Fulmars in the southern North Sea, 1985-93.

Tabel 4.5 Maandelijkse steekproeven en het aandeel lichte fase (LL) en 'gekleurde' (L, D en DD) Noordse Stormvogels in de zuidelijke Noordzee, 1985-93.

Month	LL	L, D, DD	% col	sample
Jan	1590	33	2.1	1623
Feb	3186	71	2.2	3257
Mar	3244	39	1.2	3282
Apr	2624	9	0.3	2633
May	2843	9	0.3	2852
Jun	7485	20	0.3	7505
Jul	3776	6	0.2	3782
Aug	6901	14	0.2	6915
Sep	2833	16	0.5	2849
Oct	3239	40	1.2	3278
Nov	4124	108	2.6	4232
Dec	878	27	2.9	905
Totals	42,722	391	0.9	43,112

Discussion and conclusions The southern North Sea is an area with a large number of Fulmars, of which highest densities occur in relatively clear Central North Sea water, north of 53°N and west of 6°E (figures 4.11-17). Peak numbers are in the range of 230,000 individuals of which the majority belongs to the (boreal) light phase (*ca.* 97% in winter, 99.7% in summer). The contribution of birds of arctic origin is underestimated, because dark phase birds are only numerous in high arctic colonies (Van Franeker & Wattel 1982). Fulmars from West Greenland, Iceland, Faeroe and Jan Mayen cannot be recognized at sea.

Ship-based and aerial surveys alike, show that Fulmars are a common offshore species in the southern North Sea. High numbers can be seen in places, often in association with fishing vessels. The distribution and relative abundance of Fulmars were in fact quite unpredictable. At times, large areas appeared totally deserted whereas Fulmars could stream into the region without any obvious underlying reason. Observations on gas production platforms in winter 1984/85 demonstrated massive differences between consecutive days in the same area (Platteeuw *et al.* 1985). To compare distribution patterns derived from different sources in detail is therefore difficult. High densities encountered on single flights or cruises have influenced the overall pattern considerably and these patches could occur virtually everywhere (but mainly in the NW). Seawatching data had little value when predicting the relative abundance of Fulmars at sea (*cf.* #4). Fulmars could be numerous at only 5 km away from the coast while seawatching records were scarce and the reverse could also be true.

Fulmars were commonly observed as scavengers at commercial trawlers in the southern North Sea (Camphuysen 1993a, Camphuysen *et al.* 1993). Fulmars were seen scavenging throughout the year, but more frequently and in larger numbers in late summer. Most Fulmars were reported in August, when 11 trawlers in the offshore zone were followed by over 100 Fulmars (32.4% of all trawlers studied, n= 34). The largest number of Fulmars at a trawler was recorded on 23 August 1990 (1000 individuals). The overall patterns of trawler distribution and Fulmar distribution did not always match. For instance, trawler densities are usually very high near the coast, but Fulmars hardly join them here (Camphuysen 1993a). Obviously, the Fulmar is of minor importance as a scavenger behind trawlers in the coastal zone: scavenging Fulmars occurred mainly over 20km from the coast (94.6%, n= 92). As a dominating species (>50% of all scavengers observed behind a particular fishing vessel), Fulmars were mainly found in waters at over 50km from the Dutch coast. Only off Texel and Noord-Holland, Fulmars were frequently found dominating between 20 and 50km from the coast. Larger flocks of Fulmars (>50 individuals) were rather scarce off the Delta area, although scores of several tens were reported a few times.

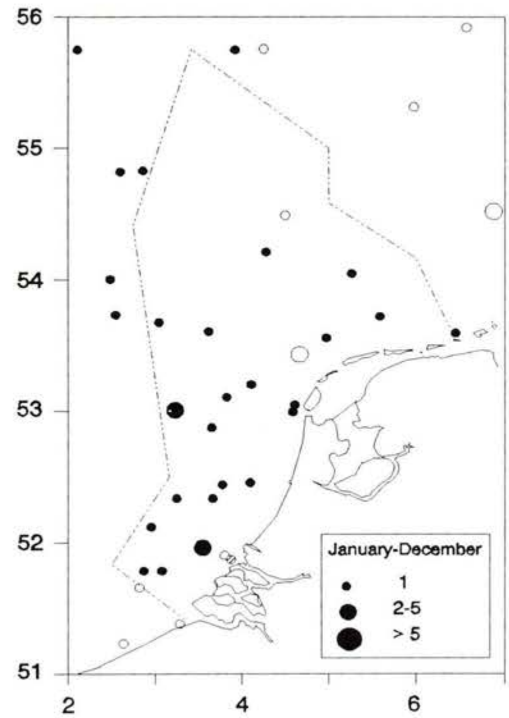


Figure 4.17 Sightings of Sooty (•, n= 29) and Manx Shearwaters (○, n= 12; Balearic Shearwater shaded), January-December

The vulnerability of Fulmars to oil pollution is usually considered rather low, mainly because of its large population size and aerial lifestyle (Carter *et al.* 1993). However, Fulmars do suffer from chronic oil pollution in the southern North Sea, with on average 68.0% of stranded birds being oil fouled (#2). Besides, mass strandings of clean, unoiled Fulmars were typical late spring and summer phenomena and these remain unexplained.

Sooty Shearwater *Puffinus griseus*

Most Sooty Shearwaters were seen in autumn (July-November), with singles in May and December. Records were scattered over the study area, but were mainly located well offshore (figure 4.17). At seawatching sites, most Sooty Shearwaters are recorded between late August and mid-November, mostly during strong westerly winds in September and October #3, #4). Aerial surveys produced only nine records: scattered sightings between 25 August and 3 November (#1). These authors suggested that most Sooty Shearwaters were associated with trawlers and suggest that individuals may have been missed among the huge numbers of Fulmars and large gulls scavenging at these boats. From ship-based surveys, however, only a single record of a Sooty Shearwater feeding at the periphery of a flock of scavengers is known. Further studies of scavengers in the North Sea have demonstrated that Sooty Shearwaters are rather timid birds at trawlers, often being severely attacked by Fulmars, large gulls or Great Skuas. Solitary Sooty Shearwaters will avoid competition with Fulmars and therefore do not join such mass-feedings deliberately (Camphuysen 1993a).

Manx Shearwater *Puffinus p. puffinus*
Balearic Shearwater *P. yelkouan mauretanicus*

Manx Shearwaters and a single Balearic Shearwater, were very scarce and mainly occurred in between June and October (figure 4.17). Two individuals were observed on 17 February in rough seas north of Borkum. At coastal sites, Manx Shearwaters were usually less numerous than Sooty Shearwaters in autumn, (#3, #4). In June, northward passage of Manx Shearwaters along seawatching sites at the mainland coast of Noord-Holland during strong westerlies is a well known phenomenon, with up to 150 individuals on a single day (#4). There were no records from boats in June within the study area, but an analysis of ESAS Database showed that Manx Shearwaters penetrate deep into the North Sea in summer (Stone *et al. in press*). Aerial surveys produced four records of Manx Shearwaters (5 individuals, July-November; #1).

Storm Petrel *Hydrobates pelagicus*

A total number of 10 Storm Petrels during ship-based surveys (figure 4.18) is a surprisingly high figure for a species which is so scarcely reported during seawatching from the coast (#3, #4). Ship-based surveys resulted in a ratio of 2.5 Leach's Petrels : 1 Storm Petrel. On the coast, some 2.75 Leach's Petrels are found stranded on

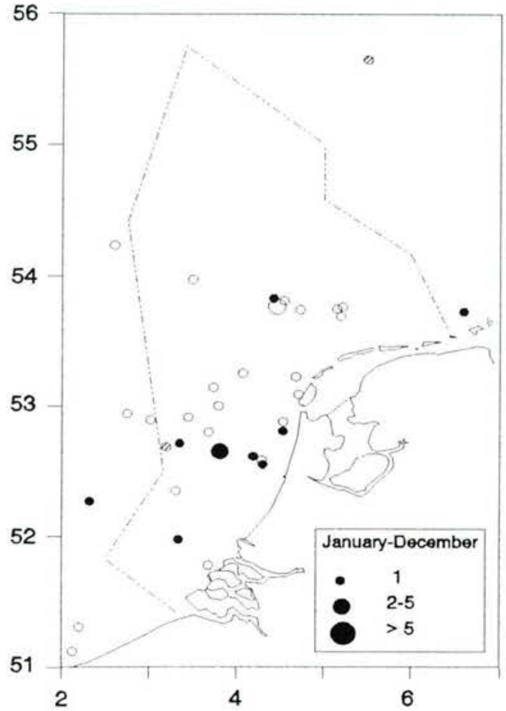
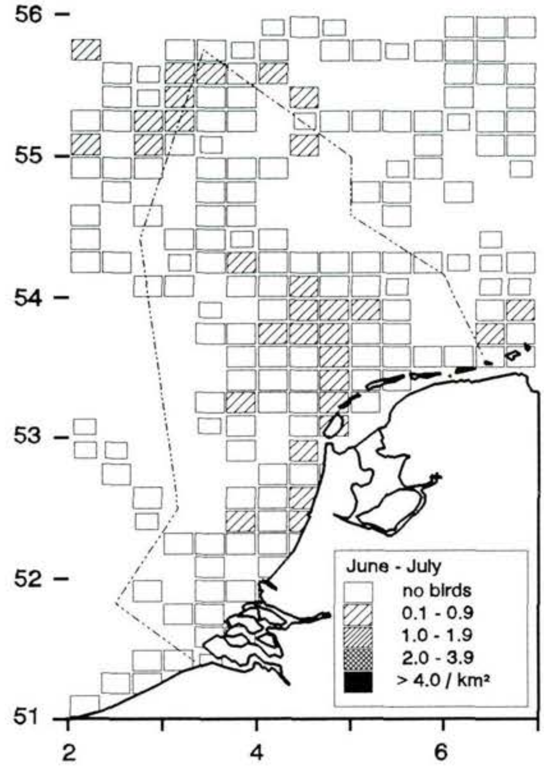


Figure 4.18 Sightings of Storm Petrels (●, n = 10) and Leach's Petrels (○, n = 25; shaded = unidentified, n = 1), January-December

each Storm Petrel (#2). In contrast, seawatching results in recent years have produced 1420 Leach's Petrels compared to only 14 Storm Petrels (1980-89, 100 : 1; #4). Most records from ships in the southern North Sea were in late autumn and early winter, which suggests that these birds originate from Norway. In Britain, Storm Petrels mainly depart from their colonies in September-November (Cramp & Simmons 1977), whereas the nesting season just starts in autumn in northern Norway (Nygård *et al.* 1987). Interestingly, most strandings in the Netherlands are also rather late in the year (#2). In contrast, of 14 Storm Petrels recorded from seawatching sites between 1980 and 1989, 13 individuals were observed during late August-early November (#4).

Leach's Petrel *Oceanodroma leucorhoa*

A total of 25 Leach's Petrels were recorded, most of which were seen in autumn (September-No-



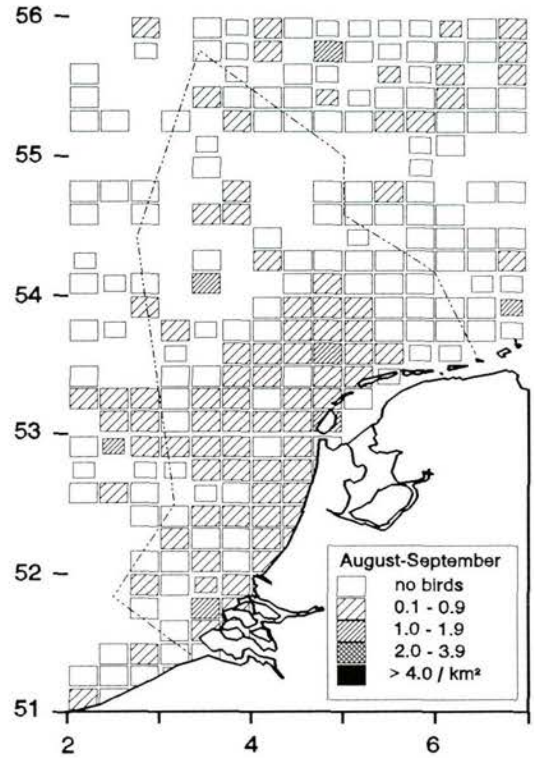


Figure 4.19 Distribution of Gannet, June-July (n= 133)

Figure 4.20 Distribution of Gannet, August-September (n= 874)

vember). Sightings were scattered over the study area, normally well offshore, but mainly south of 54°N (figure 4.18). The timing of records matches records from coastal sites, where Leach's Petrels are frequently seen during strong westerly winds in autumn (#3, #4).

4.4 GANNET

Gannet *Sula bassana*

Of Gannets, which occur throughout the year but in largest numbers in autumn in the southern North Sea, the nearest breeding colonies are found on Bempton Cliffs (East England, *ca.* 780 nests) and on Helgoland (2 pairs in 1992; Lloyd *et al.* 1991, Hüppop 1992).

In summer, **June-July**, low densities of Gannets were found in the Doggersbank region and just to the NW of the Netherlands coast (figure 4.19). An estimated 5040 individuals occurred within the study area, most of which were immatures (82.1%, n= 390; table 4.5), and including 340 individuals in the coastal zone. In the Dutch sector, *ca.* 2700 Gannets were estimated to occur. From coastal sites, Gannets are reported frequently but only in small numbers in summer (#3, #4). Most Gannets in these months are heading north, and the vast majority is immature (#3). The remaining adults were probably non-breeding individuals, because breeding Gannets seldom feed at greater distances than *ca.* 150 km from their colony (Tasker *et al.* 1985a). Aerial surveys produced a slightly more regular pattern of low densities over the Dutch sector of the North Sea, with a lower estimate of total numbers (*ca.* 1500; #1).

Numbers increased considerably in early autumn, **August-September**, and Gannets were widespread both offshore and in coastal waters (figure 4.20). Densities were generally low to moderate, but an estimated 16,700 Gannets were present in the

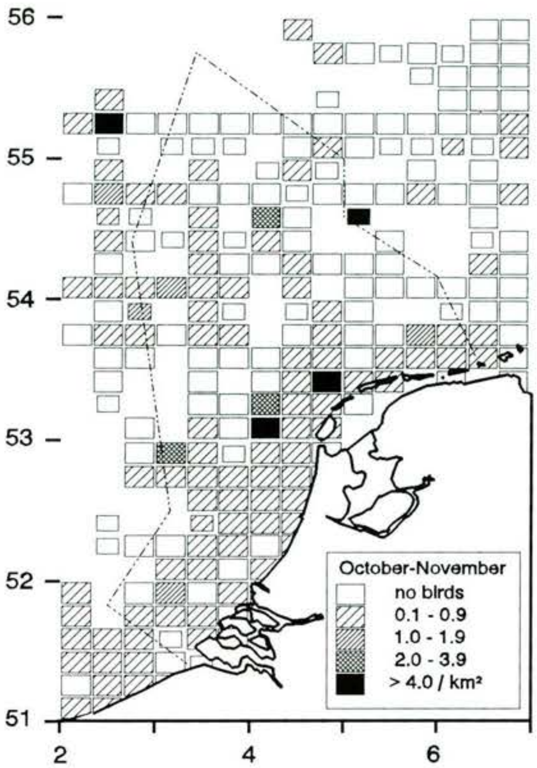


Figure 4.21 Distribution of Gannet, October-November (n= 1367)

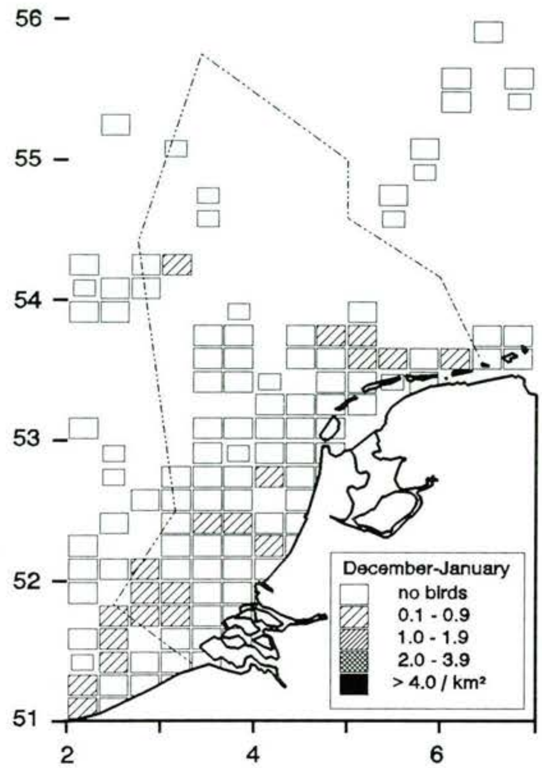


Figure 4.22 Distribution of Gannet, December-January (n= 98)

area (table 4.2), nearly 9500 of which were in the Dutch sector. Immatures predominated and juveniles occurred frequently (13.1%, n= 2233). In September, Gannets are numerous in coastal waters (#4). A majority is still heading north, but what is seen from coastal sites are probably mainly local movements of feeding individuals or corrections for wind-drift. Wind is only one factor underlying the presence of Gannets in autumn in coastal waters. Perhaps much more important, considering massive fluctuations in numbers between years, is the availability of young Herring in the upper water layers in combination with clear (calm) water (Leopold & Platteeuw 1987). Similar to ship-based surveys have sightings from the air resulted in a distribution pattern which showed low densities all over the study area, with the most distinct concentrations in the coastal zone. From aerial surveys for August-September, it was estimated that *ca.* 2250 Gannets occurred in Dutch waters (#1).

Peak numbers were found in **October-November**, when an estimated 35,900 Gannets occurred in the southern North Sea (nearly 10% of the British breeding population), 20,000 of which were found in the Dutch sector. Immatures left the southern North Sea in these months for more southerly wintering areas, and the proportion of adults increased to 55% in October and 83% in November (table 4.5). Moderate to high densities occurred in places west of Texel and in the Doggersbank area, but Gannets were widespread (figure 4.21). In the northeastern half of the study area, densities were generally quite low. October is normally a month in which large numbers of Gannets may occur in coastal waters, particularly during strong northwesterlies or in years rich in Herring (#3, Leopold & Platteeuw 1987). Similar to the results of ship-based surveys was the gradual decline of numbers of immatures observed during seawatching in autumn (#3, Leopold & Platteeuw 1987). In November, just over half the Gannets reported during seawatching were adults.

According to aerial surveys, Gannets occurred *everywhere in low densities, with scattered, small* areas with moderate or high densities (#1). The overall estimate for October-November from this source is *ca.* 14,000 individuals.

In winter, **December-January**, when the offshore zone was poorly covered, scattered low densities of Gannets were observed, most of which were adults (figure 4.22, table 4.5). Obviously, considering the distribution pattern and numbers in the Southern Bight, numbers have dropped markedly. Very closely inshore, Gannets were virtually absent, but an estimated 600 individuals still occurred in the coastal zone. At seawatching sites, numbers of Gannets fell considerably in December. Records are infrequent and numbers are generally very small (#3, #4). Similar to ship-based surveys adults formed the majority of Gannets seen in winter. Aerial surveys produced a more complete picture of Gannet distribution in the Dutch sector of the North Sea and confirmed that numbers have fallen considerably since autumn (#1). Estimates of numbers of Gannets in the Dutch sector in winter were in the range of 2500 birds from aerial surveys, 1600 individuals from ship-based surveys.

Gannets were still common in **February-March**, but there was a tendency of these birds to avoid the coastal strip nearest to the beach (figure 4.23). North of 53°30'N, occasional low densities were recorded, whereas Gannets were widespread and comparatively numerous in the Southern Bight. At coastal sites, Gannets were normally scarce in February and only very gradually 'recover' in March (#3, #4). The majority of the birds seen in these months are adults, both in ship-based surveys (table 4.5) and as seen from coastal sites. The distribution patterns derived from ship-based surveys and aerial surveys were very similar (#1). Estimates from ship-based surveys for the Dutch sector in these months are much higher (12,300 Gannets) than from aerial surveys (*ca.* 2650 individuals). A North Sea wide ship-based survey in February 1993 produced an estimate of 3500 Gannets south of 53°30'N and another 24,000 individuals between 53°30'N and 57°30'N (west of 6°E; Camphuysen *et al.* 1993).

Scattered Gannets in low densities were found in the pre-breeding season, **April-May** (figure 4.24). The proportion of adults dropped rapidly from 77% in April to 19% in May (table 4.5), indicating that birds associated with colonies now left the southern North Sea. Very low numbers occurred in coastal waters (estimated at 200 individuals). At seawatching sites, northward passage of small numbers of Gannets is normal and an increasing proportion were immatures (#3, #4). Similar to ship-based surveys were scattered low densities, mainly offshore, in the aerial surveys (#1). Estimates of total numbers at sea in April-May were around 3000 Gannets, whereas the estimate derived from ship-based surveys for the Dutch sector in April-May was a quite similar: 3600 individuals.

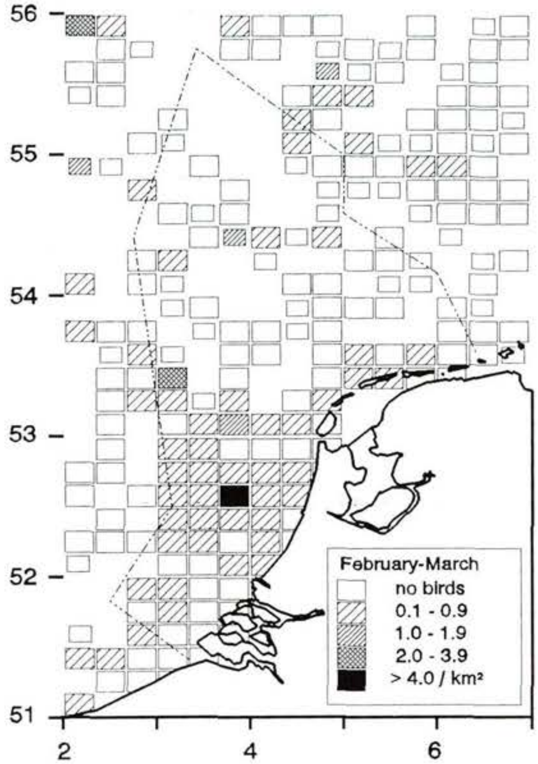


Figure 4.23 Distribution of Gannet, February-March (n = 525)

Discussion and conclusions The southern North Sea is important for Gannets during southward migration in autumn, and as a wintering area for adults. The age composition of Gannets in Dutch waters, as derived from ship-based surveys, compares well with results obtained at seawatching sites in the 1970s (#3). A numeric predominance of adults in winter (Nov-Apr) and large numbers of

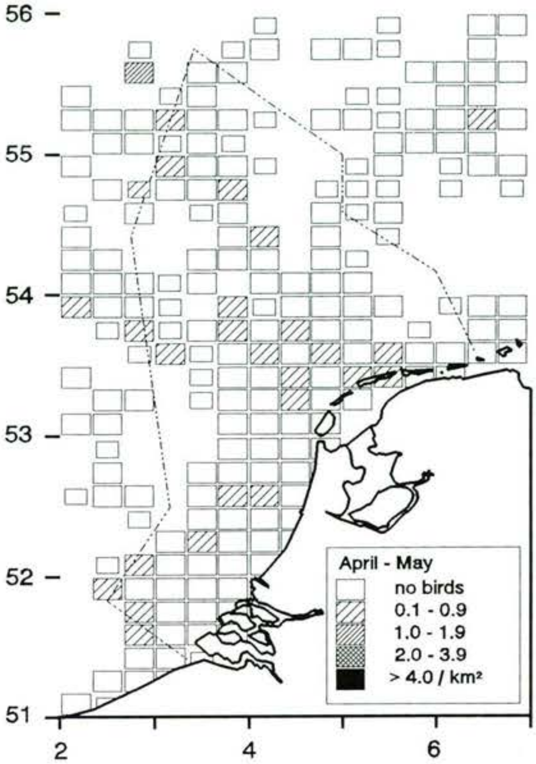


Figure 4.24 Distribution of Gannet, April-May (n= 142)

immatures in the rest of the year were major aspects of this seasonal pattern. Besides, also inconspicuous aspects, such as the return of 2nd calendar year birds in our area in May-Jun and the rather sudden appearance of juveniles in late August were the same in both schemes. In autumn, when peak numbers of Gannets were found in the southern North Sea (estimated 35,900 individuals, Oct-Nov; table 4.2), nearly 65% (*i.e.* 23,500 individuals) were adults. It is interesting to note that estimates derived from ship-based surveys were normally higher than estimates from aerial surveys. It is unlikely that from the air substantial numbers of this conspicuous, large bird are overlooked. One important reason might be the fact that wandering Gannets have a strong tendency to 'check-out' vessels for opportunities to feed. Hence, vessels will overestimate these birds because Gannets are attracted over large areas. A detailed analysis of raw data from both sources, perhaps coupled with simultaneous observations from ship and aircraft at the

Table 4.5 Monthly age composition of Gannets (adults, immature and first year birds) in the southern North Sea, 1985-93.

Tabel 4.5 Maandelijkse leeftijdsverdeling van de Jan van Gent (volwassen, onvolwassen en eerste jaars) in de zuidelijke Noordzee, 1985-93.

Month	adult	imm	first year	% adult	sample
Jan	164	8	0	95.3	172
Feb	634	44	5	92.8	683
Mar	536	113	3	82.2	652
Apr	299	82	5	77.5	386
May	23	90	9	18.9	122
Jun	24	88	9	19.8	121
Jul	46	212	11	17.1	269
Aug	231	536	101	26.6	868
Sep	345	828	192	25.3	1365
Oct	1346	859	214	55.6	2419
Nov	797	139	22	83.2	958
Dec	204	12	3	93.2	219
Totals	4649	3011	574	56.5	8234

same time at the same place could be helpful in this respect.

Gannets were regularly recorded as scavengers behind fishing vessels, but never in large numbers. Most scavenging Gannets were seen in February, September and October. The maximum number, 160 individuals, was recorded in a large mixed group of scavengers, 24 km offshore in October, in an area were a fishing fleet was operating. The Gannet is typically an offshore species as a scavenger, with most sightings of substantial numbers well over 20 km from the coast. The seasonal pattern of scavenging Gannets was not quite in accordance with fluctuations in densities at sea and numbers of Gannets in Dutch coastal waters. Apparently, scavenging was of relatively greater importance in winter, for the (few) specimens remaining in the southern North Sea (Camphuysen 1993a). Numbers of stranded Gannets showed little fluctuations through the year (#2), and the much larger numbers in the southern North Sea in autumn were not reflected in the numbers washing ashore. Many Gannets found on Dutch beaches were oiled (1969-85 86.5%, n= 561), but entanglements in fishing gear were also frequent (1979-89 5.4%, n= 624; 1990-93 5.4%, n= 205; Camphuysen 1990a, Camphuysen 1994b). In stranded Gannets, adults predominated even stronger than in ship-based surveys

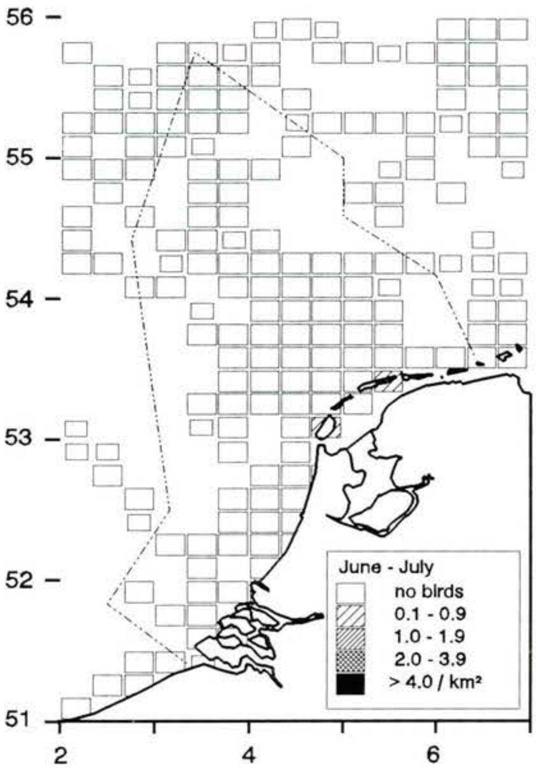


Figure 4.25 Distribution of Cormorant, June-July (n= 46)

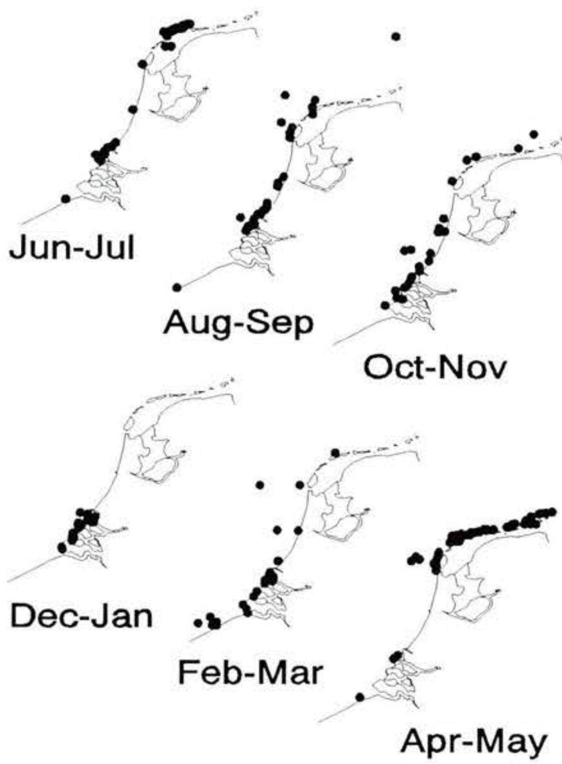


Figure 4.26 Sightings of Cormorants in bi-monthly periods, including birds outside transect (n= 945)

(68.5%, n= 391). Post-fledging mortality therefore did not contribute significantly to the numbers recorded on our beaches (3.8% juveniles, n= 391; #2). In severe winters, the oil rate was significantly lower than in mild winters, indicating some extra mortality in extreme conditions.

4.5 CORMORANT AND SHAG

Cormorants feature only shortly as rather common seabirds in Dutch waters and can be seen through the year in small numbers. Most Cormorants were seen near the shore and several roosts have been established on beaches during the last decade. Shags are rare visitors.

Cormorant *Phalacrocorax carbo*

The NW European population of Cormorants has increased enormously during the last few decades. In the Netherlands, where Cormorants were traditionally an inland species, the breeding stock increased spectacularly and new colonies were established near the coast (Rooth 1985, Bakker & Lok 1988, Zijlstra & Van Eerden 1991, Leopold & Van den Berg 1992, Costers 1993). In the 1970s, Cormorants were not uncommon during seawatching, but numbers were five to six times higher in the 1980s (#3, #4). In the Wadden Sea large roosts have developed in summer and autumn in recent years, during the post-nuptial moult, and large numbers migrate through the area (*e.g.* Keijl & Koopman 1991), and also as a winter visitor (residents?) Cormorants have increased (Beintema *et al.* 1993). In the North Sea, Cormorants were frequently observed during ship-based surveys near the coast, around the year, but in small numbers only. At several coastal sand banks and beaches substantial roosts were found. Densities at sea were always low, except closely inshore in the Voordelta and off the Wadden Sea islands.

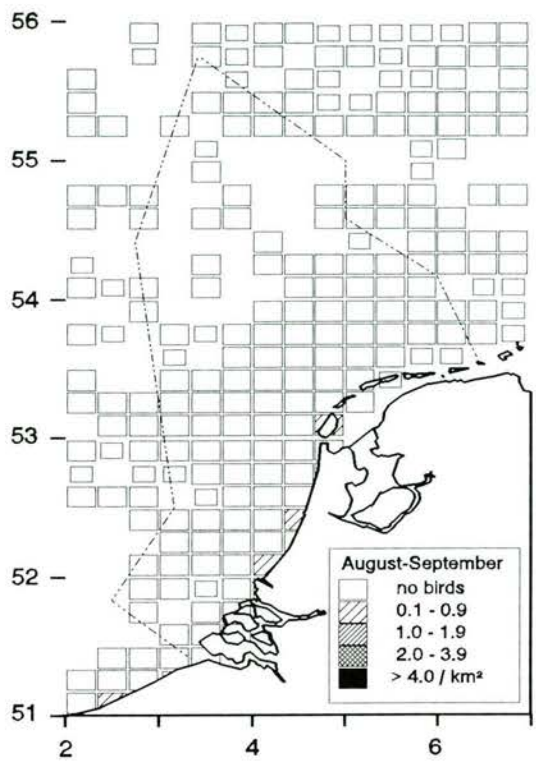


Figure 4.27 Distribution of Cormorant, August-September (n= 14)

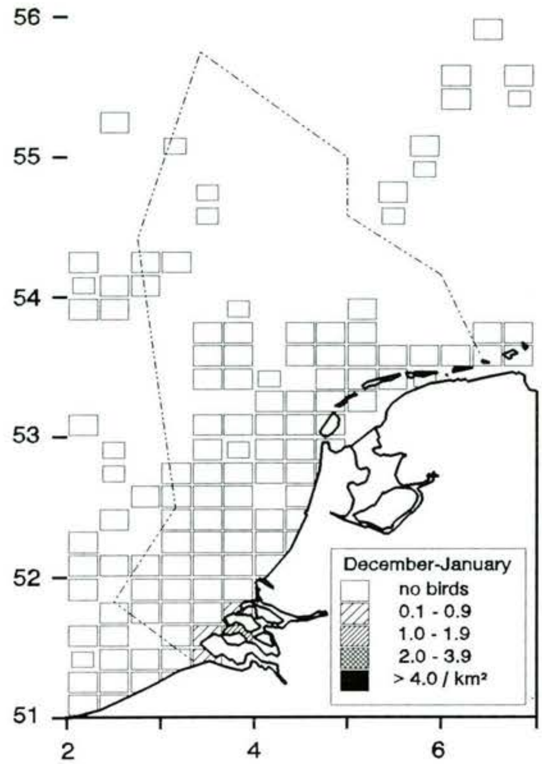


Figure 4.28 Distribution of Cormorant, December-January (n= 86)

In summer, **June-July**, Cormorants were found around Texel and Terschelling (figure 4.25). Flying Cormorants were observed frequently off Voorne and along the mainland coast of Zuid-Holland (figure 26). The birds off Voorne originated probably from the recently established colony in Brede Water at Voorne, since it was found that the majority of Cormorants breeding there feeds at sea (Bakker & Lok 1988). At this time of the year, a remarkable drop in numbers was recorded from seawatching sites, between rather high numbers in March-May (northward, spring migration) and in autumn (#4). Apparently, in summer there is little exchange between birds in the Voordelta and roosting Cormorants at the Wadden Sea islands.

In **August-September**, Cormorants were found in low densities along the mainland coast, around Texel and off Belgium (figure 4.27). Flying birds were observed more frequently along the coast, particularly off Zuid-Holland (figure 4.26). Early autumn normally produced substantial numbers at seawatching sites, mainly in Zuid-Holland (#4), and there is also a peak in strandings late summer/early autumn (#2).

Only very low densities were found in **October-November**, mainly around the Wadden Sea islands (not mapped). Flying birds were encountered frequently, both off the Wadden Sea islands and the mainland coast (figure 4.26). Not a single swimming Cormorant was seen at sea during ship-based surveys south of Texel. In accordance with these observations were frequent coastal movements recorded at seawatching sites, particularly in Zuid-Holland (#4).

Records were concentrated in the Voordelta area in winter, **December-January**, both with respect to Cormorants swimming at sea (figure 4.28) and flying birds (figure 4.26). Not a single bird was seen at sea north of Scheveningen (Zuid-Holland). Normally, at this time of year, Cormorants are

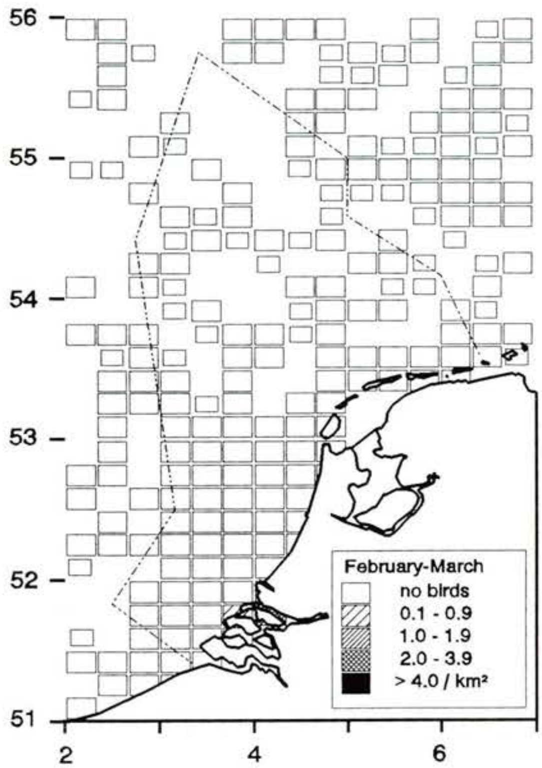


Figure 4.29 Distribution of Cormorant, February-March (n = 22)

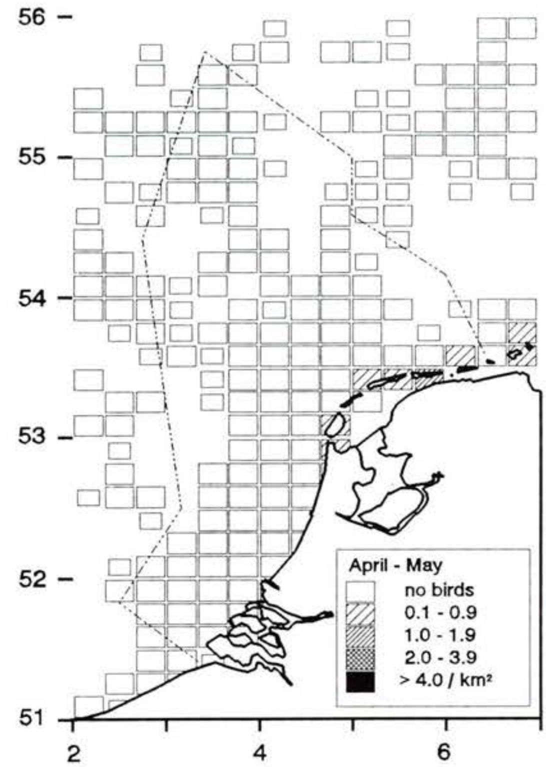


Figure 4.30 Distribution of Cormorant, April-May (n = 99)

quite scarce at coastal sites (#4) and despite much more extensive beached bird surveys in winter, rather few Cormorants are recorded at the tideline (#2).

In **February-March**, Cormorants at sea were still concentrated inshore in the Voordelta region (figure 4.29). Late March, spring migration is a feature of increasing strength at seawatching sites (#4) and groups of Cormorants moving northward were encountered frequently during ship-based surveys off the mainland coast, even at considerable distances from the shore (figure 4.26).

Cormorants were widespread, around the Wadden Sea islands in **April-May** (figure 4.30). The highest densities were found around Terschelling and these must have been non-breeding birds, not being associated with any colony. From seawatching sites along the mainland coast, northward movements are now most pronounced (#4). However, during ship-based surveys off the mainland coast only very few Cormorants were seen flying (figure 4.26).

Discussion and conclusions Cormorants occurred closely inshore and estimated numbers varied between 100 and 700 individuals (table 4.2). Important roosts occur at Texel, Terschelling and Griend (Wadden Sea) and many of these Cormorants feed in coastal waters of the North Sea. Records of swimming (feeding) Cormorants were also frequent in the Voordelta. The widespread use of the coastal strip is a relatively new aspect of Cormorants in the Netherlands and developments go rapidly. In the 1950s, Cormorants were common off De Beer and Hoek van Holland (northern part of the present Voordelta; Strijbos 1960). The Voordelta was the only sea area in which substantial numbers occurred at sea in the 1970s and early 1980s (Baptist & Meininger 1984). Cormorants passing seawatching sites on the mainland coast and the Wadden Sea islands

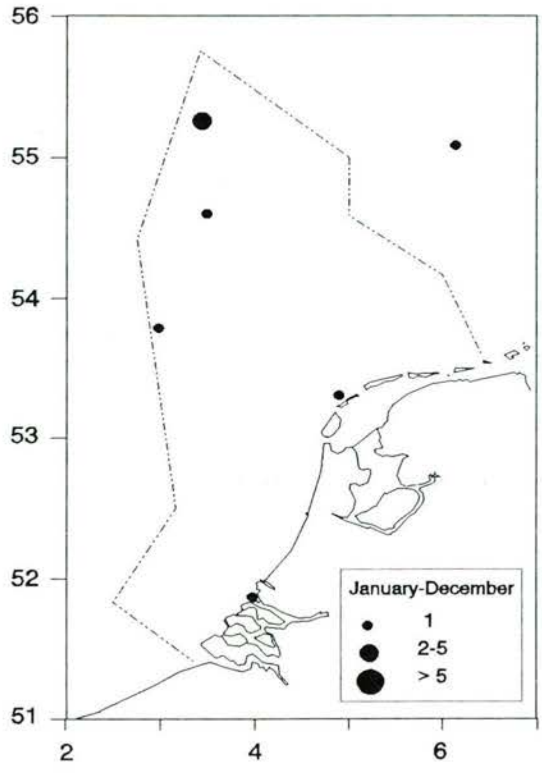


Figure 4.31 Sightings of Shags, January-December (•, n= 8)

were not particularly rare in the 1970s, but less common than nowadays (#3) and strandings of Cormorants were uncommon (#2). The establishment of colonies and roosts along the coast has led to a significant increase of Cormorants at sea, first noticed in numbers seen during seawatching (#4) and in numbers washing ashore (Camphuysen 1992a, NZG unpubl. data). Cormorants, being potentially highly vulnerable to oil pollution, did not suffer great losses from chronic oil pollution so far. They are restricted to the coastal strip which is relatively 'well-patrolled' and controlled. An inshore oil spill in the Voordelta, at any time of the year, or off Terschelling, in summer, has the greatest risk of killing substantial numbers.

Shag *Phalacrocorax aristotelis*

Shags were rarely seen at sea and most records were well offshore (figure 4.31). Sightings were scattered over the study area and over the year, indicating the incidental presence of wandering individuals of this otherwise non-migratory species. Solitary Shags, or even small groups, are frequently seen in harbours in the Netherlands, often staying for weeks or months at the same spot. In the Delta area, small numbers of Shags are known to occur as year-round residents (Baptist & Meininger 1984, Beekman *et al.* 1986). Seawatchers see most Shags in August-October (53% of all records) and mid-winter (December-January, 20% of all records, n= 232; #4). Strandings of Shags are rare (#2). As it is unlikely that a Shag can be identified with any degree of certainty from the air, it is no surprise that Baptist & Wolf (1993) noted only a single individual.

4.6 SWANS, GEESE AND DUCKS

Most waterfowl discussed in this chapter are typically inshore species which mainly occur in the marine environment under exceptional conditions (*e.g.* severe winters) or as migrants. Between Britain and mainland Europe, regular crossings of the North Sea are known as part of spring- or autumn migration (*e.g.* Bewick's Swan, Brent, Wigeon), or during moult migration (*e.g.* Shelduck). Scoters and Eider are principally salt water species which occur in our coastal waters throughout the year. These species are more abundant at sea in winter than in summer (table 4.1). Eiders are mainly found within the Wadden Sea in summer, whereas most scoters leave the southern North Sea for their Scandinavian breeding grounds.

Swans *Cygnus* spp.

Mute Swans *Cygnus olor* (6), Bewick's Swans *C. columbianus* (24), and Whooper Swans *C. cygnus* (16) were exclusively reported at sea in winter (November-March) and all sightings comprised flying individuals. Most records were in the Southern Bight. Sixteen Whooper Swans were observed flying over the Oestergronden, 25 swans flying over the Vlaamse Banken remained unidentified.

Geese *Anser* and *Branta* spp.

Geese were seen at sea in all months, except midsummer (June-July). Most records dealt with migrating geese in autumn (October-November) and early spring (February-March). Six species of geese were seen, of which Pink-footed Goose *Anser brachyrhynchus* (109), Grey-lag Goose *Anser anser* (1709) and Brent Goose *Branta bernicla*

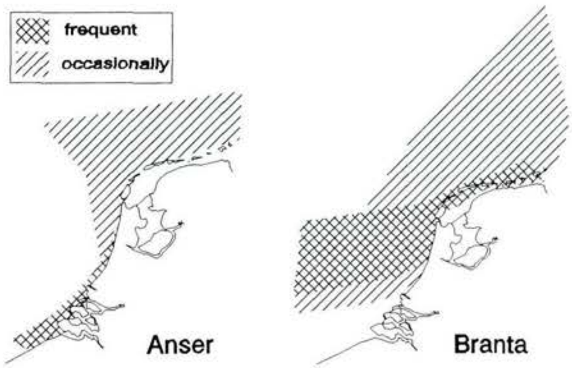


Figure 4.32 Areas with frequent and occasional sightings of migrant geese

(2140) were the most numerous. Most *Anser*-geese were seen near the coast, some were reported offshore, north of the Wadden Sea islands (Terschellingerbank). Substantial numbers were seen along the coast of Zuid-Holland, in the Voordelta and off Belgium (figure 4.32). *Branta*-geese, most of which were Brent Geese, were frequently recorded offshore between England and the mainland coast of Noord-Holland, but records were scarce south of 52°N. Several flocks were seen off the Wadden Sea islands. This flyway, where Brent reach (spring) and leave (autumn) the mainland coast mainly north of IJmuiden, is well known from seawatching results, where numbers increase from south to north (#3, #4).

Shelduck *Tadorna tadorna*

Shelduck are known for their impressive moult migration towards the German Bight in late summer (Salomonsen 1968, Platteeuw 1980). British Shelduck regularly cross the North Sea late June/early July on their way to Große Knechtsand, and even Shelduck from the Camarque in southern France have been found in the German Wadden Sea (Walmsley 1987). Although several other, smaller moulting sites have recently been discovered (Ouweneel 1988, Mulder & Swennen 1992), the German Bight holds still the most important concentration of Shelduck in western Europe (Nehls *et al.* 1992). The Shelduck is a coastal species and a common breeding species along the entire Dutch coast (Teixeira 1979). As a result of the North Sea crossings from England to the Wadden Sea, offshore records occurred frequently, and the birds used a flyway which was similar to that described for *Branta*-geese (figure 4.32). The peak of moult migration (June/-July), however, was largely missed in ship-based surveys. Otherwise, coastal sightings were frequent during ship-based surveys between the French border and Borkum. From seawatching sites, Shelduck were seen throughout the year, but peak numbers were recorded in June and July (Platteeuw 1980, #3, #4). Shelduck were not mentioned from aerial surveys (#1). Shelduck are frequently found dead on beaches (45.6% of all swans, geese, dabbling and diving duck; n= 4572) and over a quarter of these birds were oiled (28.6% oiled, n= 1268; #2). Many Shelduck were killed by oil in the *Borcea* incident in the Voordelta in 1988, showing its vulnerability to oil pollution (Camphuysen *et al.* 1988), but also its marine or at least estuarine habits in winter.

Dabbling duck *Anas* spp.

Common dabbling duck were Wigeon *Anas penelope* (2590 individuals), Mallard *Anas platyrhychos* (1232), Teal *Anas crecca* (211) and Pintail *Anas acuta* (158). A remarkable feature of Mallard was that these duck were often seen in male-female pairs at sea (≥ 51 cases). Small numbers of Gadwall *Anas strepera* (61) and Shovelers *Anas clypeata* (31) were seen. Some 71 dabbling duck were not specifically identified, of which 70 were of the size of teals or Garganey *Anas querquedula*. Most dabbling duck were seen between October and March. Both timing and species composition were roughly in agreement with seawatching results (#3, #4). Most sightings were in the coastal strip, but all species were frequently observed offshore, indicating regular crossings of the North Sea. Sightings of dabbling duck were not specified from aerial surveys (#1). In strandings of dead dabbling duck during 1969-85, Mallard (643), Wigeon (200), Pintail (93) and Teal (77) were most numerous. A minority of these birds is contaminated with oil (18-32%; #2) and most were found in severe winters.

Diving duck *Aythya* spp.

Tufted Duck *Aythya fuligula* (31 individuals) and Pochard *Aythya ferina* (78) occurred in small numbers in winter, October-March, and mainly in small groups flying along the coast. Several offshore sightings were reported for both species. Scaup *Aythya marila* were numerous at times, particularly in periods of very cold weather. The only location where larger groups of Scaup were

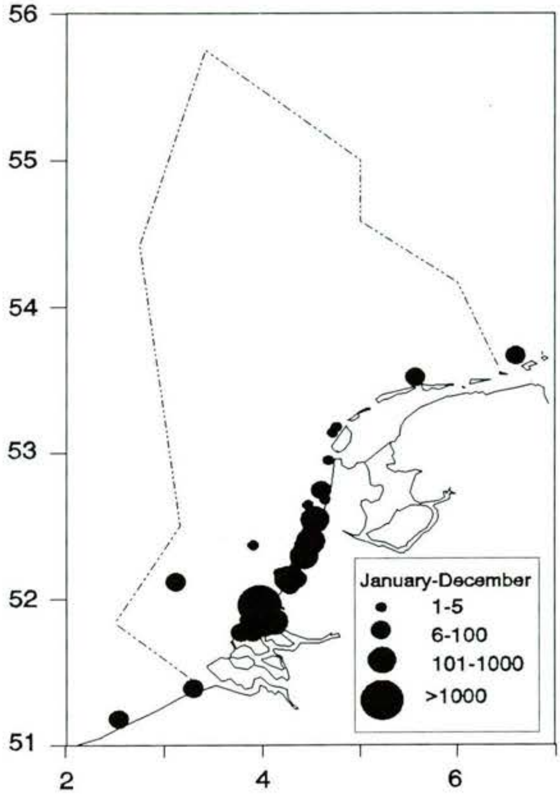


Figure 4.33 Sightings of Scaup, January-December (•, n= 5913)

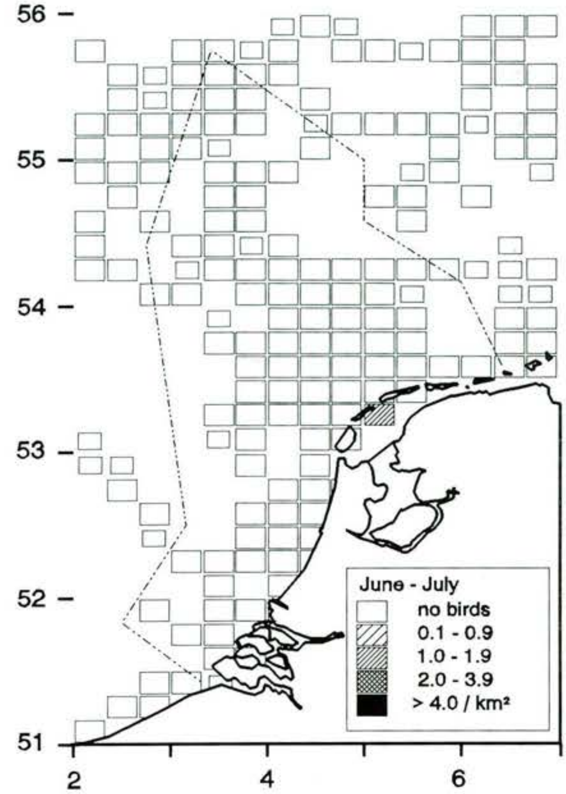


Figure 4.34 Distribution of Eider, June-July (n= 252)

found repeatedly in winter was off the 'Maasvlakte' in the Voordelta. Massive numbers of Scaup occur in the IJsselmeer and Wadden Sea and icing may force these birds to move to sea. Most sightings of Scaup under these conditions were along the mainland coast of Noord- and Zuid-Holland (figure 4.33). In all, 5913 Scaup were recorded of which the majority was seen in February 1991 (2008 individuals) and February 1993 (3616). From coastal sites, Scaup are mainly seen between October and April, with peak numbers in January and February (#3, #4). Autumn passage (southwestward) is most pronounced along the Wadden Sea islands, while winter influxes were most impressive in Noord-Holland (#4). Plots of Scaup from aerial surveys produced a rather similar picture, with highest numbers along the mainland coast and in the Voordelta (#1). Scaup are frequently found dead on beaches in the Netherlands and some 40% of these birds are oiled (#2). A massive wreck of Scaup occurred in the western Wadden Sea in the cold winter of 1986 (Leopold *et al.* 1987, #2), killing perhaps 5-10,000 Scaup. Extremely large numbers also died in the cold winters of 1985 and 1987, so that the three severe winters in succession have led to a massive extra mortality, unprecedented in the Netherlands for this species (#2).

Eider *Somateria mollissima*

Several thousands of breeding pairs of Eider are found in colonies on the Waddensea islands, (Swennen 1991b). Besides, substantial numbers of non-breeding Eiders spend the summer in the Wadden Sea.

In summer and early autumn **June-July** and **August-September** numbers of Eiders in Dutch coastal waters were very low (figures 4.34-35). The only substantial group seen in these months were 900 Eiders between Vlieland and Terschelling in June 1991. Estimates of total numbers of Eiders in these months were not made in a similar way

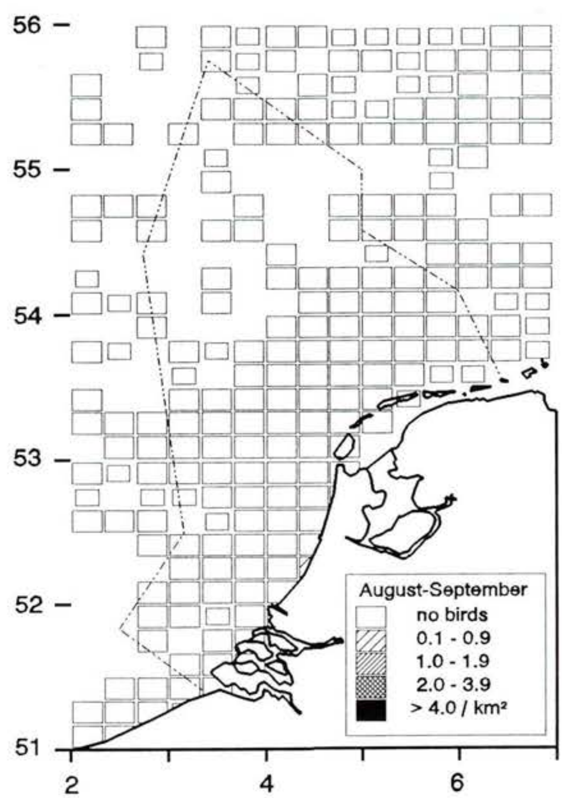


Figure 4.35 Distribution of Eider, August-September (n= 23)

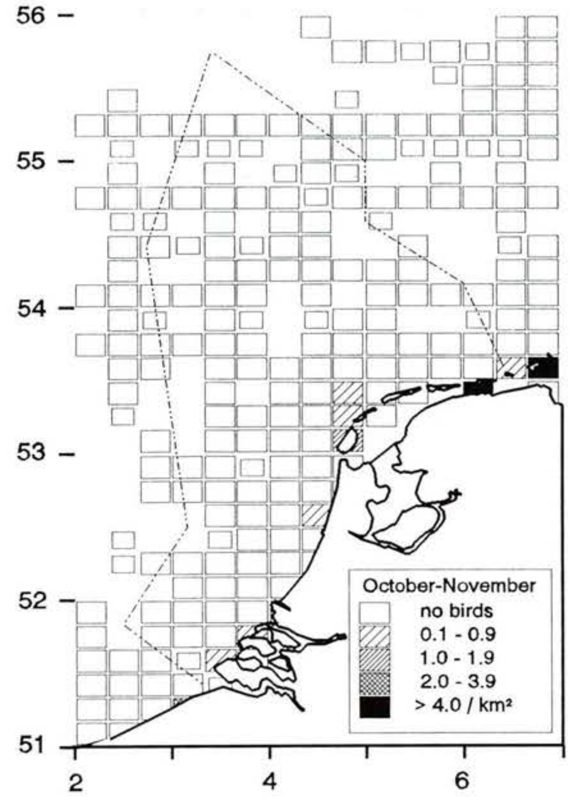


Figure 4.36 Distribution of Eider, October-November (n= 446)

as other, less clumped seabirds, but must have been in the range of a few hundreds to perhaps 1-2000 Eiders at most. Many of these were associated with breakwaters at North Sea beaches of the Wadden Sea islands, and out of reach of ordinary ship-based surveys. Aerial surveys resulted in very low densities in coastal waters in these months, slightly more widespread than ship-based surveys, and estimates derived from these counts were a few hundreds of Eiders (#1). Seawatching produced very low numbers of Eiders in these months (#3, #4). Only along the Wadden Sea islands some westward movements of (male) Eiders were recorded in August. Corpses of Eiders were found thoughout the year and, hence, also in these months. Highest numbers were always located on the Wadden Sea islands and a minority of the Eiders in summer were oiled (#2).

In **October-November**, numbers of Eiders along the coast increased slightly. Low densities were found scattered along the mainland coast and in the Voordelta, moderate to high densities were found in places around the Wadden Sea islands (figure 4.36). Large numbers have not been found in coastal waters, but a guess of total numbers in our waters would be in the range of several thousands of Eiders. Such an estimate would be in agreement with results from aerial surveys (#1). The distribution pattern resulting from these surveys was similar to that of ship-based surveys.

Highest numbers of Eiders in coastal waters were found in **December/January** and **February/March**, when moderate to high densities occurred everywhere along the Dutch coast (figures 4.37-38). A dramatic change was witnessed in the early 1990s: since 1990/91, wintering numbers in the coastal waters of the southern North Sea increased spectacularly. Off the Wadden Sea islands 4573 Eiders were counted from the air in January 1991 (Swennen 1991a). No ship-based surveys were conducted at the time however, and the event was not noticed. In February 1991, 200

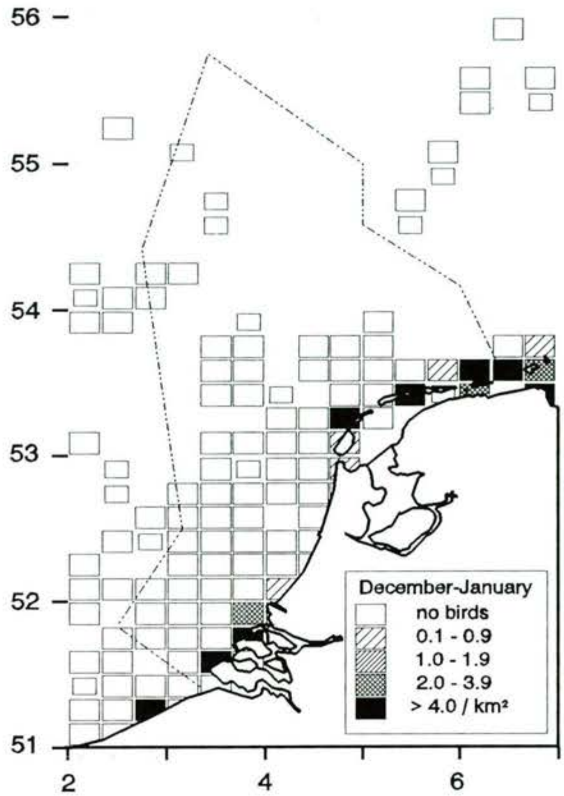


Figure 4.37 Distribution of Eider, December-January (n= 30,022)

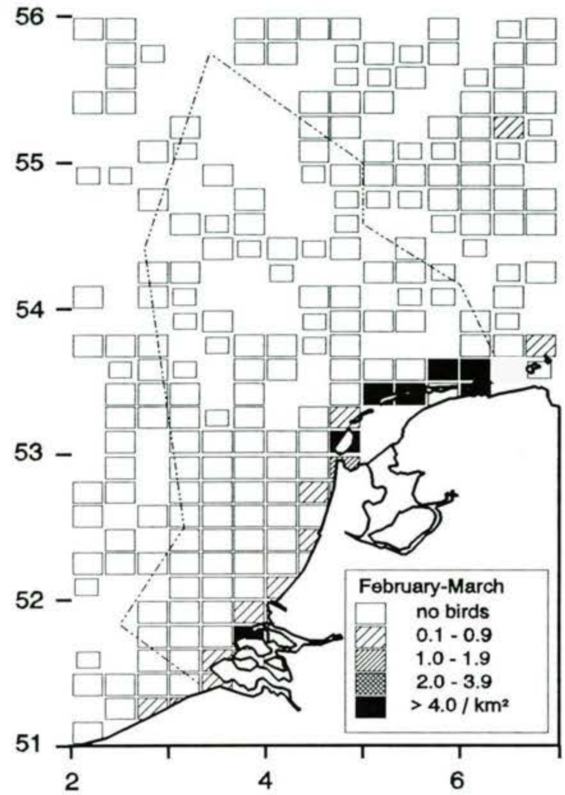


Figure 4.38 Distribution of Eider, February-March (n= 83,130)

Eiders were found off Schiermonnikoog, 2500 off Noord-Holland and another 2500 off Zuid-Holland. In March of that year, 2000 Eiders were seen off Terschelling and another 1000 off Schiermonnikoog. In January/February 1992, three groups of 10,000 or more were seen: 10,000 in the Voordelta, 15,000 off Terschelling and 10,000 of Schiermonnikoog, while several groups of over 1000 birds were scattered along the Dutch mainland coast. In January/February 1993 the numbers in the Voordelta had decreased to some 2000 birds, possibly as a result of cockle and *Spisula* fishery in the area, as these bivalves are important food sources for these ducks. Even larger numbers had been forced out of the Wadden Sea, and all time high numbers were found in the southern North Sea (Leopold 1993): 25,000 off Noord-Holland, 5000 off Texel, 60,000 off Terschelling and 10,000 off Schiermonnikoog/-Rottum. The ducks did not fare well, however. Many thousands died, from parasites picked up from crabs used for food instead of bivalves, and due to starvation (Van de Kuip 1991, Beukema 1993) and their numbers returned to almost 'normal' in the southern North Sea in February 1994 (Leopold unpubl.). The increase in numbers was also witnessed in the aerial surveys (#1). Estimates of wintering numbers of Eiders in February-/March (1989-92) came at some 50,000 individuals. The presence of moderate to high densities along most of the mainland coast, as found in aerial surveys and ship-based surveys in the early 1990s, must not be regarded as a 'normal pattern'. Numbers of Eiders at seawatching sites in these months were usually quite small (1972-89), except in 1975/76 when an influx of immature Eiders along the mainland coast and the Voordelta occurred (#3, #4). Since 1990, massive numbers have been observed at coastal sites along the mainland coast (Stegeman 1991, 1992, 1993). Eider strandings have increased accordingly in the early 1990s. Oil rates fell to levels far below the 67.3% found oiled in 1969-85 (#2), because most of these Eiders simply starved to death.

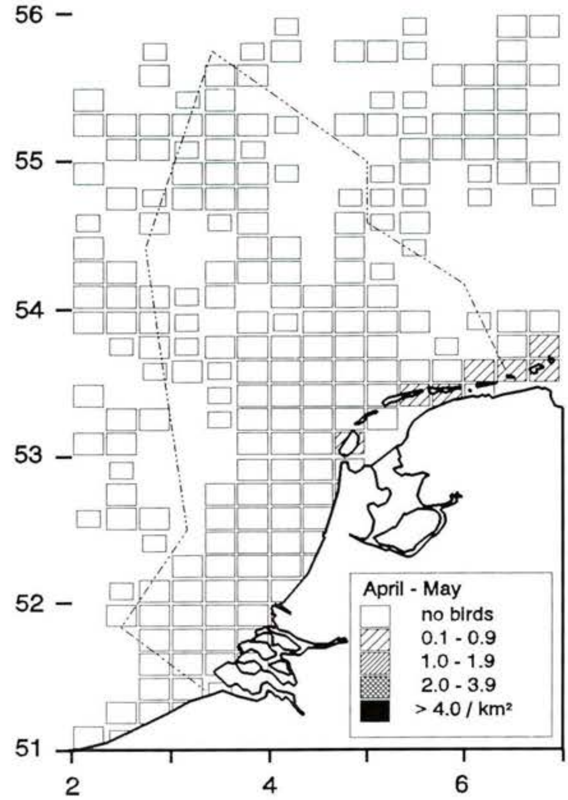


Figure 4.39 Distribution of Eider, April-May (n= 373)

Highest numbers of dead Eiders were found on the Wadden Sea islands and the northern half of mainland Noord-Holland (NZG/NSO unpubl. data).

Densities in late spring, **April-May**, were much lower, indicating that most Eiders had retreated into the Wadden Sea (figure 4.39). Along the mainland coast and in the Voordelta numbers were very small. From aerial surveys a similar distribution pattern was derived, with moderate to high densities only off the Wadden Sea islands, no birds along the mainland coast and very low densities in the Voordelta (#1). Seawatchers usually record some northward movements of Eiders along the mainland coast, again demonstrating the return to the Wadden Sea (#3, #4). Substantial numbers were seen from coastal sites on the Wadden Sea islands, but Eiders appeared to fly merely up and down the coast in this period.

Discussion and conclusions Eiders have long been a species of the Wadden Sea that was not found in large numbers elsewhere in the study area. Numbers in the Dutch Wadden Sea were largest in mid-winter and were rather stable from 1970-90 (Swennen *et al.* 1989, Swennen 1991b) with an average number in December-February of ca 115,000 birds in 1970-88 (Smit 1994). The only other places where Eiders occurred in numbers worth attention were: around the breakwaters off the North Sea beaches of the Wadden islands, particularly Terschelling, Vlieland and Texel (up to several thousands; Swennen *pers. comm.*), IJmuiden harbour (several hundreds; Geelhoed *et al.* 1989), and the Voordelta (up to 800; Meininger & Van Haperen 1988). As feeding conditions in the Wadden Sea deteriorated due to prolonged overfishing of mussels and cockles (Van de Kuip 1991, Beukema 1993), eventually tens of thousands of Eiders had to move to the adjoining North Sea. This (man-induced) movement has substantially affected the results of the ship based surveys. In the 1980s Eiders were seen merely as migrants along the coastline, mainly in winter off the Wadden Sea islands (#3, #4), the exception being a group of 850 birds off Noord-Holland in January 1989. The vulnerability to oil pollution of Eider has been demonstrated repeatedly, both within and outside our country (Swennen & Spaans 1970, Camphuysen *et al.* 1988), but the huge numbers of clean birds found dead in the early 1990s resembled mass mortality reported in the late 1960s (De Miranda 1968, #2).

Long-tailed Duck *Clangula hyemalis*

Only 28 Long-tailed Duck were observed during ship-based surveys, most of which were seen between December and March. Most sightings were near the coast, while a solitary Long-tailed Duck was seen at Nordschillgrund (figure 4.40). Most Long-tailed Duck were seen in the Voordelta, but total numbers were very small. From the air, Lomg-tailed Duck were seen in more locations and larger groups. Most Long-tailed Duck spotted from the air were found in flocks of Common and Velvet Scoters off the Wadden Sea islands (#1). Despite extensive dedicated ship-based surveys for scoters in this area, the number of sightings of Long-tailed Duck from this source was very small. Still, spotting Long-tailed Duck from ships in a large flock of other seaduck does not seem to be particularly difficult, as they are readily seen in the Wadden Sea amidst thousands of Eiders. Seawatching produced equal numbers off the Wadden Sea islands and the mainland coast of

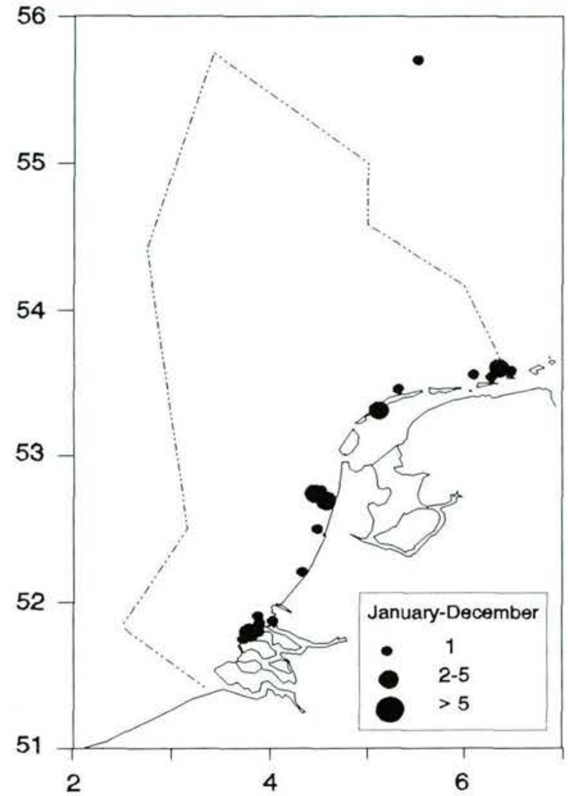


Figure 4.40 Sightings of Long-tailed Duck, January-December (●, n= 28)

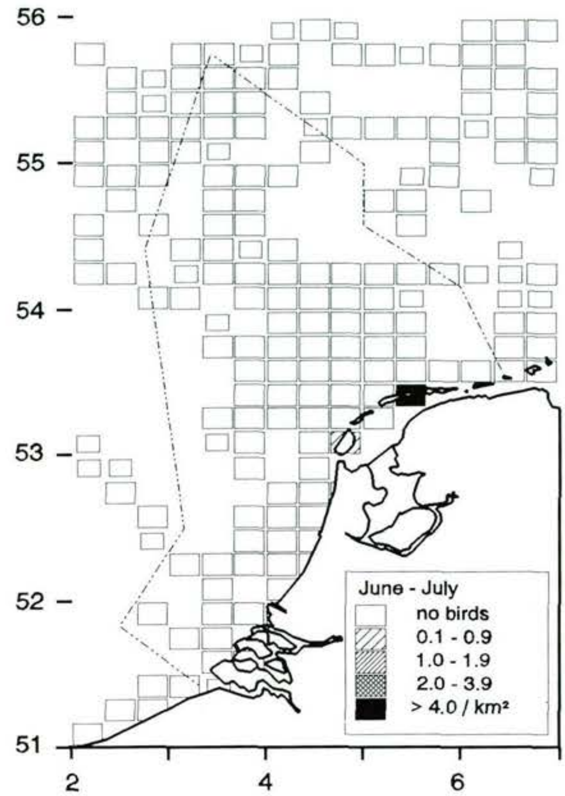


Figure 4.41 Distribution of Common Scoter, June-July (n= 8638)

Noord-Holland of this scarce species, and most Long-tailed Duck were seen between November and May (#3, #4). A few hundred of these duck per year were recorded. Strandings have been very rare in recent years, indicating that the wintering stock in Dutch coastal waters of this species, which is highly vulnerable to oil pollution, is rather insignificant (1969-85 22 Long-tailed Duck, 1.8% of all seaduck (n= 1244), 88.9% of which were oiled; #2). The only sizable concentration of Long-tailed Duck known to occur in the Netherlands (*ca.* 1000 birds) is found between October-April in the western Wadden Sea (SOVON 1987).

Common Scoter *Melanitta nigra*

Common Scoters breed in Scotland and Scandinavia, but this species was seen in all months of the year, mainly in nearshore waters. Some small groups were seen migrating through the offshore zone (*cf.* Platteeuw 1990, Offringa 1993). Common Scoters typically occur in large to very large groups in our waters, with small groups flying up and down the coast between these concentrations. This latter aspect of Common Scoter behaviour makes seawatching the prime technique for mapping temporal distribution. Common Scoters go through wing moult in summer, but normally do so further north (*e.g.* in Danish waters; Ferdinand *et al.* 1956). The highly clumped occurrence of Common Scoters makes the strip-transect a less suitable technique. Therefore, dedicated surveys were organised along the entire coast in January/February and April/May, 1990-93. Surveys were onboard RV *Navicula*, a ship that could negotiate the shallow inshore zone that is used by the scoters. During these surveys it was attempted to count every (large) group visible, whether in or outside transect (Offringa & Leopold 1991). As the precise location of the group showed considerable variation between months and years, 'densities' may best be calculated by dividing the total number present by the total surface area of the coastal zone in the study area (16,000 km²).

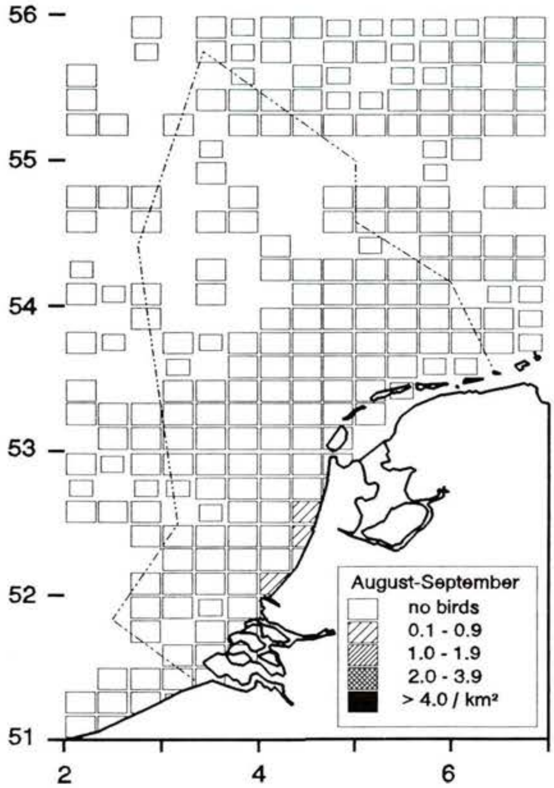


Figure 4.42 Distribution of Common Scoter, August-September (n = 71)

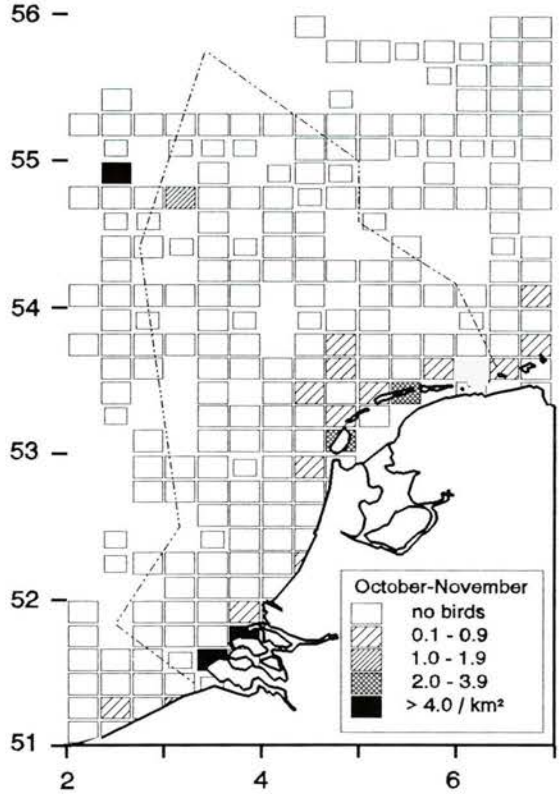


Figure 4.43 Distribution of Common Scoter, October-November (n = 7218)

Estimates of total numbers were derived from these dedicated surveys unless otherwise stated, whereas the distribution patterns given in figures 4.41-4.46 were based on standard transect counts and standard analysis (*cf.* #1).

In **June-July**, Common Scoters were quite scarce along most of the coastline (figure 4.41). In June 1991, however, a group of 13-15,000 apparently moulting Common Scoters was found off Terschelling. Coastal observations demonstrated that along the Wadden Sea islands substantial numbers moved westwards in these months, suggesting moult migration (#3, #4). Along the mainland coast, Common Scoters were always present, but generally in small numbers compared to the winter months. Considerably higher densities were reported from aerial surveys, particularly off the Wadden Sea islands where Common Scoteres appeared to be more widespread than indicated by ship-based surveys (#1). From aerial surveys, it was estimated that between 30,000 (1985-88) and 70,000 (1989-92, but this must be an error!) Common Scoters were present in Dutch waters, whereas the estimate of mean numbers in Dutch waters derived from ship-based surveys was in the range of 1700 individuals (15,000 in 1991, virtually none in other years).

Surveys in **August-September** produced low densities of Common Scoters of the mainland coast (figure 4.42), while the small numbers of scoters seen along the Wadden Sea islands and in the Voordelta were outside transect. From coastal sites on the Wadden Sea islands, a continuation of westwards movements was recorded at a level of at least 100 birds per hour of observation, particularly in September (#3, #4). Along the mainland coast, numbers were very small in August and gradually increased in September. Most passages were southbound, but birds were generally flying up and down the coast, indicating that most movements were to compensate for tidal drift or were caused by disturbance by ships.

Results of aerial surveys were complementary to the Common Scoter distribution mapped from ship-based surveys: low to moderate densities were found off the Wadden Sea islands, low densities in the Voordelta (#1). An estimate of total numbers in Dutch waters from aerial surveys came at only a few thousands.

In **October-November**, more Common Scoters returned from the breeding grounds. Moderate to high densities occurred off the Wadden Sea islands, very low densities were found along the mainland coast, and Common Scoters were numerous in patches in the Voordelta (figure 4.43). Groups at sea were rather small and rarely exceeded a few thousand birds. Substantial numbers were seen off Schiermonnikoog (1000) and in the Voordelta around 10,000 in November 1990. Seawatching showed that autumn migration was most pronounced in these months, whereas numbers flying westwards along the Wadden Sea islands were still at a level of *ca.* 100 birds/hour (#3, #4). Aerial surveys confirmed that numbers increased in autumn. Moderate to high densities were recorded off the Wadden Sea islands and Belgium, low to moderate densities were along the mainland coast (#1). It was estimated that *ca.* 6000 Common Scoters occurred in Dutch waters during 1985-88, and nearly 30,000 during 1989-92.

In **December/January** scoters have returned in larger numbers to the Netherlands (Leopold *et al. in press*). Highest densities were recorded off the Wadden Sea islands and in the Voordelta (figure 4.44). Common Scoters were frequently observed along the mainland coast, but these were mainly flying birds outside the transect. Due to lack of dedicated surveys, the supposed increase in numbers was not noticed from ships in December. In January several very large groups were found, both in Dutch and in Belgium waters. In January 1988 a group of 15,000 birds that had first been located from the air (Baptist 1988) was also seen from a ship specially set out to survey very shallow waters in the Voordelta (Leopold 1988). In January 1991, 10,000 were found off the Belgian coast, a figure that matched aerial surveys in these waters in the previous years (5-12,000 wintering Common Scoters; Maertens *et al.* 1988, 1990, Seys 1993). Further north, a very large group (100,000) was found off Schiermonnikoog, up to that moment the largest group ever recorded in the southern North Sea. From seawatching

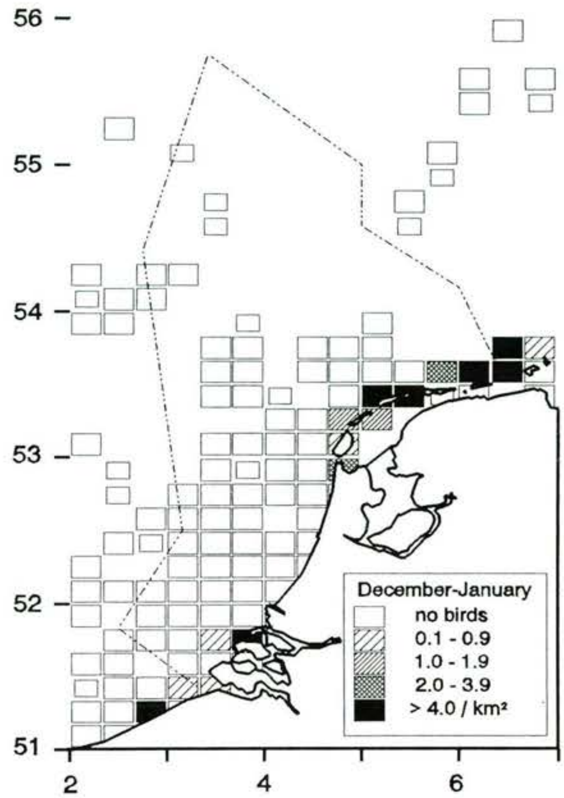


Figure 4.44 Distribution of Common Scoter, December-January (n= 183,278)

sites, very large movements were recorded in these months, but most passages were to be attributed to movements from one concentration area to the other, or to local movements to compensate for drift or caused by disturbance (#3, #4). Southbound passages predominated, however, which is in agreement with the fact that Voordelta and Belgian waters gained importance in winter. Distribution maps derived from aerial surveys show a similar picture, but with Common Scoters being more frequently seen off the mainland coast (#1). It was estimated that nearly 50,000 Common Scoters occurred in Dutch coastal waters in these months during 1989-92, which is quite similar to the 58,000 estimated on the basis of dedicated ship-based surveys.

In **February-March** the largest numbers of Common Scoters have been found in Dutch and Belgian waters. In March the scoters started performing courtship displays at sea (Offringa 1991b). The precise location of massive concentrations

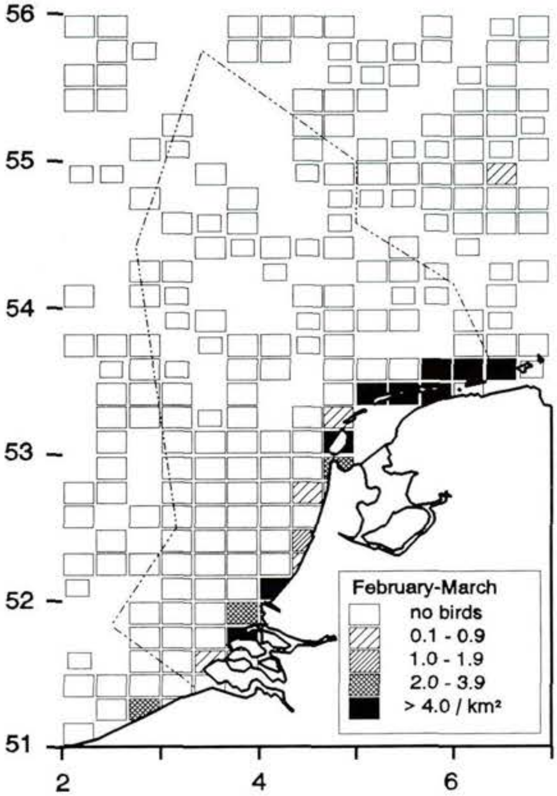


Figure 4.45 Distribution of Common Scoter, February-March (n = 235,851)

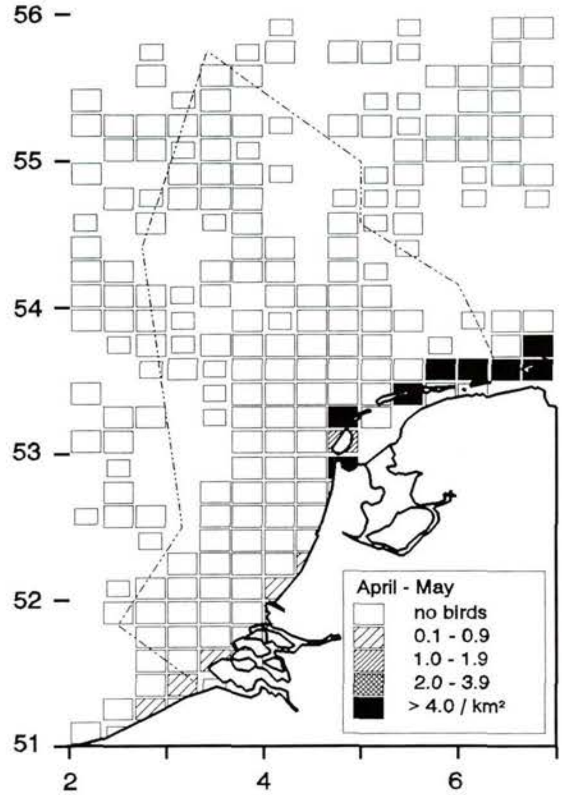


Figure 4.46 Distribution of Common Scoter, April-May (n = 110,000)

varied from year to year. High densities were encountered along the mainland coast, as well as off the Wadden Sea islands and in the Voordelta (figure 4.45), but occurred most frequently off the Wadden Sea islands. Moderate numbers were found off Belgium. In 1987, 50-60,000 wintered off the mainland coast (Baptist & Camphuysen 1987, Van Dijk 1987). In February 1992, two groups of this size were found off the Wadden Sea: 50,000 off Schiermonnikoog, and 75,000 off Terschelling. In February 1993 a new record-sized group was found: 125,000 off Terschelling, while another 10,000 were still present off Schiermonnikoog. Ship-based surveys produced 63,000 Common Scoters (of which 48,000 off Terschelling) in March 1991, but there is a land-based observation of 80,000 birds off Texel that month (Leopold *et al. in press*). In earlier years, thousands were present in the Voordelta region (#1). In March 1987 an estimated 25,000 Common Scoters were seen here from a ship, and in March 1988 22,500 Common Scoters were located in the Voordelta region. On seawatching sites, substantial numbers were recorded in February, similar to December/January, but spring migration along the mainland coasts commenced in March. In March, many thousands of birds could be seen heading north on a single day (#3, #4). Aerial surveys found distinctly higher densities of Common Scoters off the mainland coast, but otherwise the distribution patterns were rather similar (#1). Total numbers which were thought to occur in Dutch waters were estimated at *ca.* 75,000 for 1985-88 and 100,000 during 1989-92. From ship-based surveys, a mixture of dedicated surveys and ordinary strip-transect counts, a mean of 60,000 wintering scoters was calculated.

In **April-May**, Common Scoters were slightly less widespread, with high densities only off the Wadden Sea islands (figure 4.46). In April 1991, 8000 were found off Texel, and nearly 40,000 off Terschelling. Seaduck surveys in May 1991, 1992 and 1993 showed that large numbers can remain in our coastal waters up to this month. In May 1991 8000 birds were still present off Texel and 36,000 off Terschelling. In May 1992 the largest numbers were found: 15,000 off Terschelling, 50,000 off Schiermonnikoog/Rottum and another 40,000 of Borkum. In May 1993, after the fishery for *Spisula* had developed off Terschelling (Leopold 1993) the numbers had dropped substantially: none were found here, only 2500 off Schiermonnikoog/Rottum and only in German waters, off Borkum/Juist 14,200 birds were still present. Along the mainland coast, where low densities were found, massive spring migration was recorded in April, while numbers flying past rapidly declined in May (#3, #4). In April 1993, tens of thousands of Common Scoters temporarily moved to a site off Noord-Holland (Winter 1993). In the late 1970s, large flocks of birds stayed off the coast of Noord-Holland, indicating that this area can also be of significance in spring (#3). From aerial surveys it can be concluded that Common Scoters were widespread in moderate to high densities along the entire coastline, and it was estimated that between 10,000 and 20,000 Common Scoters were present in Dutch waters (#1).

Discussion and conclusions Common Scoters occur in very large groups in the coastal zone of the study area. In fact, the seaduck concentrations are unrivalled by other species, in terms of bird density. This makes these duck highly vulnerable to oil pollution, as a single spill may wipe out a large part of the birds present in the area (Swennen & Spaans 1970, Baptist 1988, Camphuysen *et al.* 1988). Beached bird surveys have shown that numbers of oiled Common Scoters were much higher in the first half of the century than at present (#2). This may indicate that the ducks were then much more widespread than today. Now, an oil slick has to be 'at the right place at the right time' in order to make casualties. Should this happen, the number of victims will be very large.

Studies of the potential benthic food sources revealed that the bivalve *Spisula subtruncata* occurred in high concentrations in all areas with large numbers of seaduck (Offringa 1991a, den Hollander 1993, Leopold 1993). The recently developing fishery for *Spisula subtruncata* is an even greater reason for concern than oil pollution, as the fishery is directly aimed at the wintering grounds of these duck. As the nearshore stocks of *Spisula* have been depleted by the fishermen in two consecutive winters, the numbers of seaduck in the region must decrease considerably (Leopold & Plat *in prep.*). Large concentrations of Common Scoters have often been located in areas beyond the range of the seawatchers' binoculars. However, as there is a lot of 'traffic' related to the presence of these groups, it is not surprising that seawatchers see high numbers of Common Scoters from December to May (#3, #4). Both ship-based and aerial surveys can be used to find these concentrations, be it that dedicated surveys are needed for both platforms to locate all groups. In the early years of the surveys, only RV *Holland* accidentally stumbled upon a very large group (February-March 1987), whereas also from the air only this group was found north of the Voordelta, that was surveyed in much more detail (#1). Only since the winter of 1989/90 was the whole coastline of the Netherlands properly surveyed for seaduck by ship. This procuded record numbers of Common Scoters (and other seaduck species; Leopold 1993) in these waters. The status of the species before this time remains uncertain, but it is likely that peak numbers have been present in the study area in recent years (Leopold et al. *in press*). The overall impression is, that aerial surveys are generally a much more efficient tool to locate and estimate total numbers of Common Scoters in Dutch coastal waters. Dedicated ship-based surveys are relatively time-consuming and since Common Scoters are highly mobile, a fast and rapid check of location and numbers may be desirable. A constant monitoring at seawatching sites, rapid searches by plane and thorough checks by ship (including food sampling) seems the best solution to obtain information on this species of which internationally important numbers occur in Dutch waters and which are currently under serious threat of food depletion.

Velvet Scoter *Melanitta fusca*

Excepting summer (July-August), Velvet Scoters were seen throughout the year, mostly in nearshore waters. The vast majority of sightings comprised small groups of birds flying up and down the coast. In autumn and early winter, groups were seen virtually anywhere along the coast (fig 4.47). Later in winter, most groups were seen off the Wadden Sea islands (figs. 4.48, 4.49). In some years a few staging groups were found: 450 in the Voordelta and 300 near IJmuiden in March 1987, 100 off Schiermonnikoog in February 1990 and again off this island 100 in March 1993. The

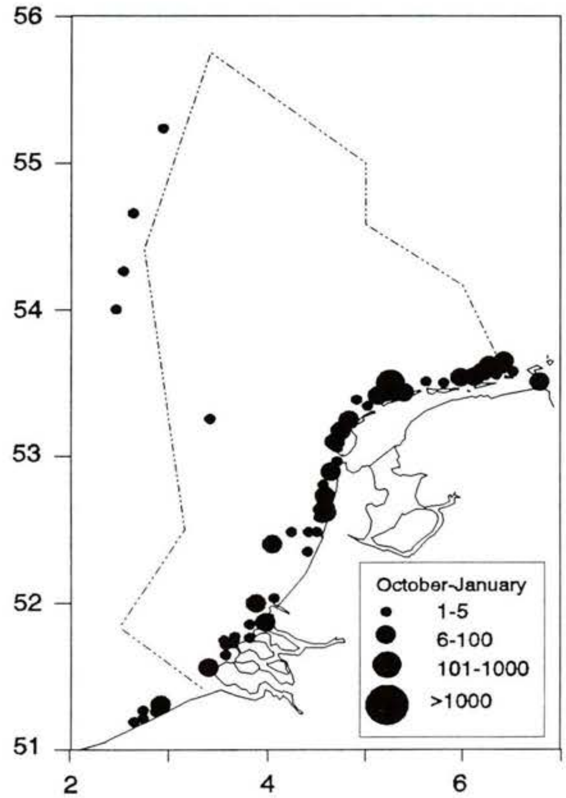


Figure 4.47 Sightings of Velvet Scoters, October-January (•, n= 738)

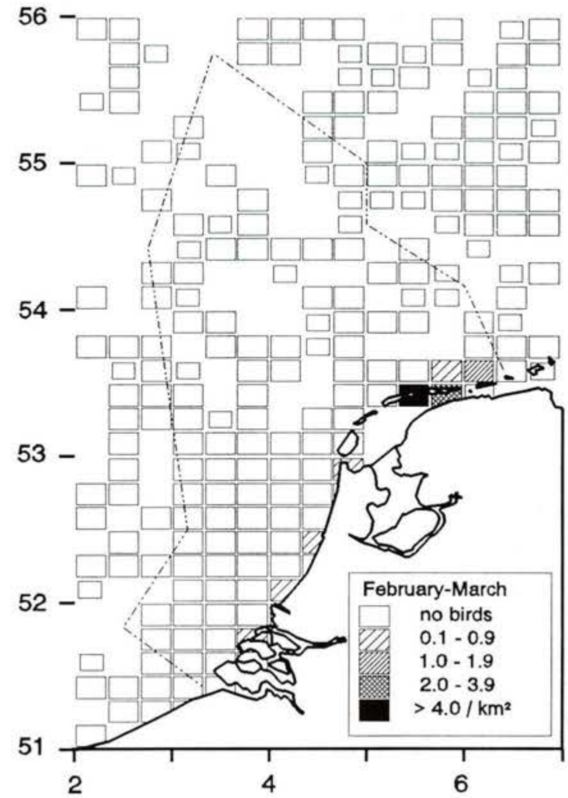


Figure 4.48 Distribution of Velvet Scoter, February-March (n= 3231)

largest groups were found in winter and spring off Terschelling, at the rim of a large concentration of Common Scoters (Leopold 1993). At this location, on a rich bank of *Spisula subtruncata* 510 birds were found in March, and 4820 in May 1991. Two groups of 1000 and 12,000 birds had joined the Common Scoters at Terschelling in February 1992. This was the largest concentration of Velvet Scoters ever located in the Netherlands. The pattern of occurrence observed in ship-based surveys agrees well with the seawatching data: few records in summer (June-September) and the majority of sightings in November to May (#3, #4). There is little evidence for large groups wintering on a regular basis in Dutch waters. Most staging groups probably remain only a short time, on spring migration, joining resident groups of Common Scoters. The most important locations in the period under consideration were the Voordelta, and the Wadden Sea islands coast, particularly off Terschelling. Aerial surveys confirmed this pattern (#1). Stranded Velvet Scoters are not normally found in large numbers in the region, reflecting the low numbers at sea compared to the Common Scoters. In cold winters numbers in our waters may be higher, as an unusual number of starved individuals (10.4% of all scoters) was found during a cold spell in 1985 (#2).

Goldeneye *Bucephala clangula*

Most Goldeneye were seen in the Voordelta, the larger groups invariably closely inshore but some solitary individuals were seen offshore in the Southern Bight. The rest were found inshore along the coast of Noord-Holland and the Wadden Sea islands (figure 4.50). A total of 336 Goldeneye were observed, all of which were seen between October and March. Goldeneye were only briefly mentioned from aerial surveys, as a species which is not rare in coastal waters but seldom seen from an aircraft (#1). Seawatchers recorded many hundreds of Goldeneye per year, particularly in cold winters, with highest numbers between

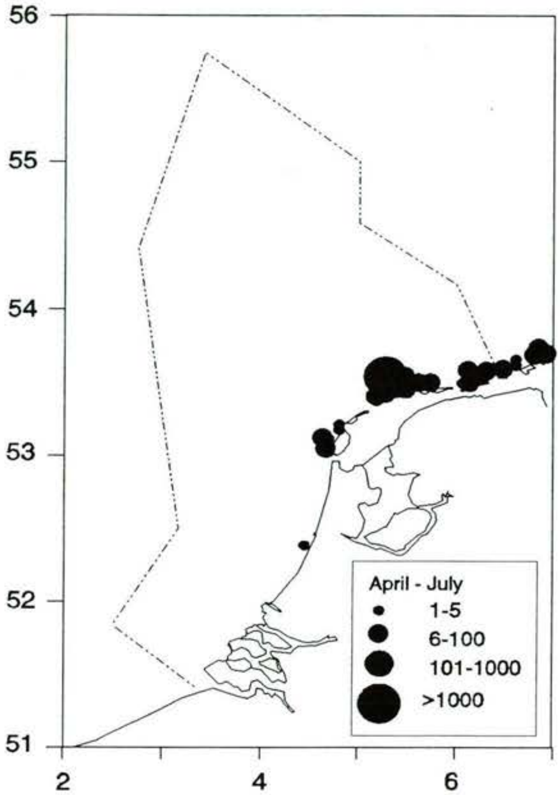


Figure 4.49 Sightings of Velvet Scoters, April-July (•, n= 5489)

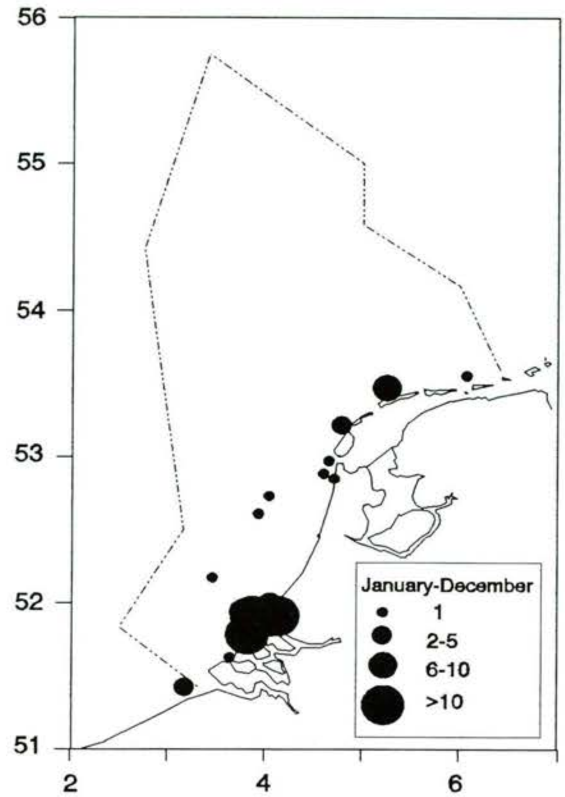


Figure 4.50 Sightings of Goldeneyes, January-December (•, n= 336)

November and April (#3, #4). Corrected for observer effort, equal numbers occurred off the Wadden Sea islands, and along the mainland coast (#4). Goldeneye are found stranded in small numbers, mainly in cold winters (#2). During 1969-85, a third of these birds were oiled (35.3%, n= 223). Hundreds of Goldeneye wrecked in the severe winter of 1986 (Leopold *et al.* 1987, #2).

Saw-bills *Mergus* spp.

Smew *Mergus albellus* were rare (2 individuals reported) and Goosander *Mergus merganser* (11) were seen in very small numbers in December-January. Red-breasted Merganser *Mergus serrator* is the most marine species in this group, with large numbers moulting and wintering in fjords of southern Norway and off western Denmark (Nygård & Røv 1985, Danielsen *et al.* 1986, Durinck *et al.* 1994). This species was seen regularly between October and March (596) and in very small numbers in early autumn (2) and late spring (14). Sightings were predominantly near the coast, with concentrations along Texel, the mainland coast of Noord-Holland, Voordelta and Belgium. Group sizes were usually small and many birds (174) were just seen flying by. Only 9 larger groups of 10-50 individuals were found on the water, all closely inshore in the Voordelta. Two exceptional offshore records were in the Doggersbank region and at Terschellingerbank. From seawatching sites, most Red-breasted Mergansers were seen between October and May, including a distinct peak of northward spring migration in late March/April (#4). A few thousands of mergansers were counted each year, while numbers per hour of observation were three times higher in late winter and spring (Jan-May) than in autumn and early winter (October-December). Cold-rushes in 1982 and 1985 produced relatively large numbers of birds flying southward along the coast. Smew and Goosander were only numerous at sea in severe winters. Substantial numbers of Smew were recorded in winter 1981/82 (1805) and winter 1984/85 (2056) and the same seasons produced large numbers of Goosander (1981/82 2331, 1984/85 3075). Massive cold-rushes of these species were observed early January 1979 (#3). Cold-rushes of these species were usually most spectacular along the coast of Zuid-Holland. From ship-based surveys it can be deduced that, in mild winters, mergansers were only commonly found in the Voordelta. From aerial surveys only Red-breasted Merganser is briefly mentioned, as a species which is not uncommon but difficult to detect from the air (#1). Beached bird surveys produced small numbers of Red-breasted Mergansers (43.0% oiled, n= 223) and very small numbers of Goosander (42.5% oiled, n= 40) every year. Larger numbers, plus very small numbers of Smew, were found in severe winters (#2).

4.7 RAILS, MOORHEN, COOT

A solitary Water Rail *Rallus aquaticus*, 2 Moorhens *Gallinula chloropus* and 15 Coot *Fulica atra* were observed during ship-based surveys. The Water Rail came onboard the ship just SE of the Doggersbank. Two solitary Moorhens were observed north of Terschellingerbank. Several sightings of Coot were made near Borkum, a single bird was encountered just off IJmuiden (mainland coast Noord-Holland), but all other sightings were of swimming birds, well offshore in the Terschellingerbank region, off the mainland coast and in the Voordelta. Coot were seen through the year, except in the middle of summer. The majority of Coot seen from coastal sites were swimming near the beach in severe winter conditions (#4). Water Rail (3) and Moorhen (1) were rarely seen during seawatching, perhaps indicating nocturnal movements. During 1969-85, 14 strandings were reported of Water Rail and 171 of Moorhen (#2). Water Rail were found in autumn and winter, but most Moorhen were recorded in severe winter conditions. Large numbers of starved Coot wash ashore in severe winters, indicating that the coastal zone is a poor alternative for the fresh water reservoirs as a wintering area. Rallidae were not reported from aerial surveys (#1).

4.8 WADERS

A total of 24 species of waders was reported at sea, with Oystercatcher *Haematopus ostralegus* (126), Lapwing *Vanellus vanellus* (1080), Dunlin *Calidris alpina* (175), Bar-tailed Godwit *Limosa lapponica* (298), Curlew *Numenius arquata* (360) being the most numerous. Most sightings were near the coast, but several species were also recorded as migrants well offshore. Of the only seabird among the waders observed, Red-necked Phalarope *Phalaropus lobatus*, 2 specimens were seen in the Doggersbank region. The relative abundance of waders seen during ship-based surveys was clearly different from seawatching results (#3, #4). A species like the Lapwing, known to migrate from the continental mainland to Britain, was frequently observed and in fact the most numerous wader on record (*cf.* #1). Several species which migrate from West Africa towards the Wadden Sea (*e.g.* Grey Plover *Pluvialis squatarola*, Knot *Calidris canutus*, and Bar-tailed Godwit, occurring in large numbers during spring migration in Dutch coastal waters), were relatively scarce at open sea. A species like the Oystercatcher, not famous as a long-distance migrant and restricted to the coast, was comparatively scarce during ship-based surveys and was exclusively reported in the coastal strip.

4.9 SKUAS

All four North Atlantic species of skuas were observed during ship-based surveys, with Great Skuas being most numerous and widespread. The nearest breeding places of Great and Arctic Skuas are found in Scotland and southern Scandinavia. Pomarine Skua is an arctic species breeding on the Taymir Peninsula (Russia), in Canada and Alaska, whereas Long-tailed Skuas breed in central Scandinavia and circumpolar, in arctic regions. Of all skuas seen at sea, only 1.2% remained unidentified (n= 1121). The great majority of all skuas was seen in autumn (August-November), when substantial numbers were wandering around in the North Sea.

Pomarine Skua *Stercorarius pomarinus*

Of 50 Pomarine Skuas seen during ship-based surveys, 34 individuals were recorded in autumn (August-November). Records were scattered over the study area and mainly comprised solitary individuals (figure 4.51). Pomarine Skuas were normaly quite scarce during seawatching, and clearly less numerous than Arctic and Great Skuas (#4). In autumn 1985, a major influx of Pomarine Skuas occurred in the North Sea, during which

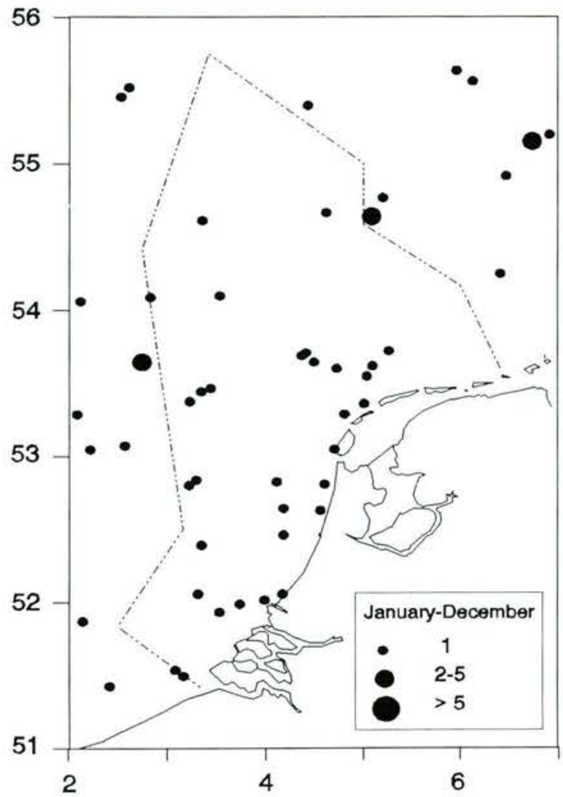


Figure 4.51 Sightings of Pomarine Skuas, January-December (•, n = 50)

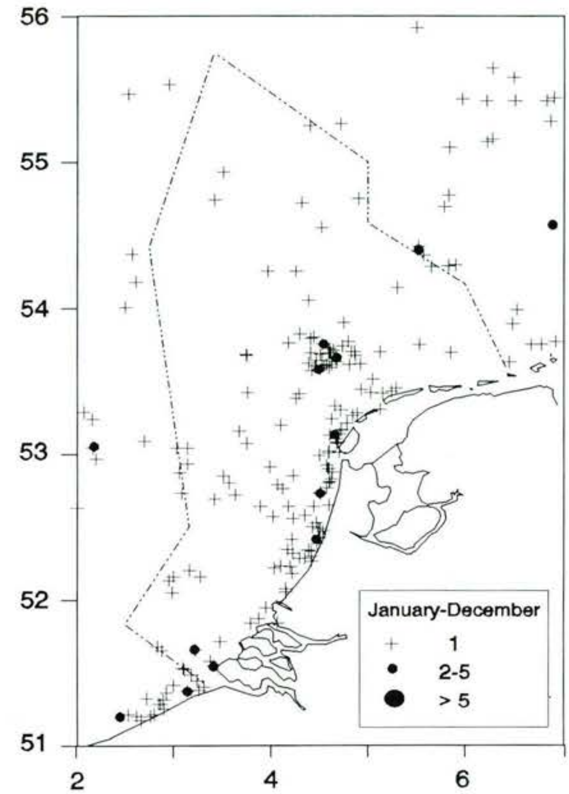


Figure 4.52 Sightings of Arctic Skuas, January-December (+/•, n = 245)

several thousands of Pomarine Skuas migrated through our coastal area. Many of these birds wrecked on Dutch and German shores (Camphuysen & Van IJzendoorn 1988ab). A detailed analysis of the occurrence of Pomarine Skuas in the (southern) North Sea during the last three decades, based on coastal sightings, produced evidence that a three-year cycle exists, with peak numbers (mainly being caused by juvenile birds) every third year. The cycle coincides with the cycle of Lemmings on Taymir (western Siberia), their main food in the breeding season, and apparently with high breeding success at these major breeding grounds (Camphuysen 1987a).

Arctic Skua *Stercorarius parasiticus*

Arctic Skuas were the second most numerous species during ship-based surveys. By far the majority were recorded in autumn and 11 individuals in April-May were the only sign of spring migration through the area. Many Arctic Skuas were reported near the coast, besides a concentration of sightings in the Friese Front area (figure 4.52). The latter is at least partly effort-related (*cf.* figures 2.8-9). Again, most records comprised solitary individuals, couples or occasional trios. During seawatching, Arctic Skuas are by far the most abundant species, of which several thousands of individuals are seen annually (#4). The majority of these birds was seen in autumn and a small but distinct peak of (adult) skuas was found during spring migration in April and May.

Long-tailed Skua *Stercorarius longicaudus*

Long-tailed Skuas were rare (4 records, figure 4.53) and all sightings were made in autumn. In autumn 1988, an influx of Long-tailed Skuas was witnessed at coastal sites in the Netherlands (Van der Ham 1989) and elsewhere in the North Sea (Dunn & Hirschfeld 1991). Long-tailed Skuas were frequently seen in the North Sea during ship-based surveys further to the north and west (Camp-

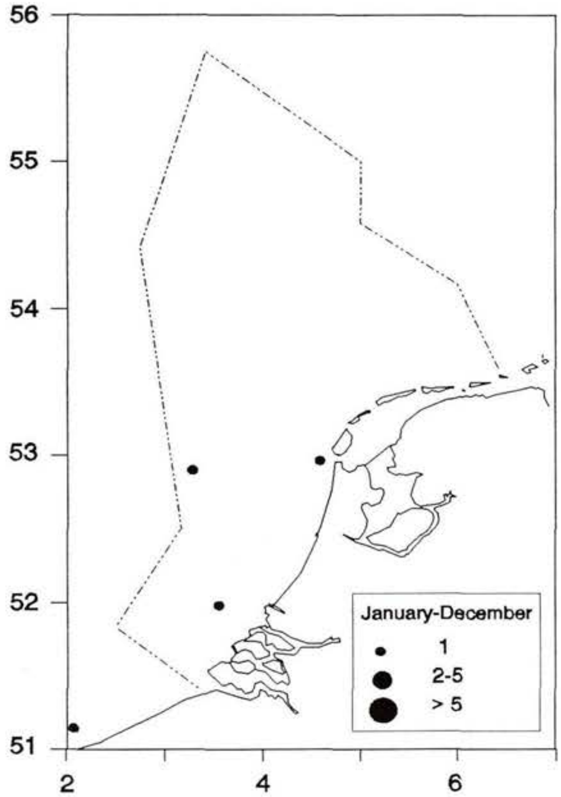


Figure 4.53 Sightings of Long-tailed Skuas, January-December (•, n = 4)

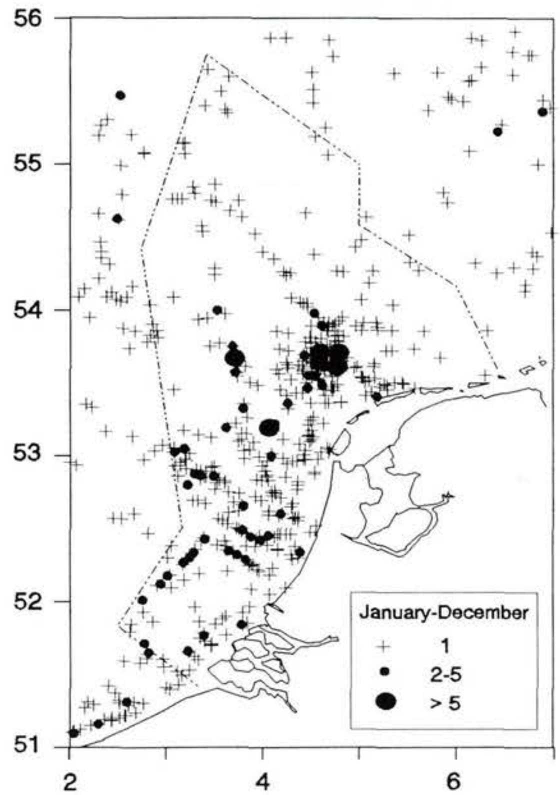


Figure 4.54 Sightings of Great Skuas, January-December (•, n = 808)

huysen & Den Ouden 1988), but only one was seen within the study area that autumn, as little survey effort was made at the right time within the study area.

Great Skua *Catharacta skua*

Great Skuas were widespread and comparatively numerous, particularly in autumn (figure 4.54). In **August-September**, low densities were found offshore in the Southern Bight, around the Friese Front and scattered in the Nordschillgrund region (figure 4.55). The distribution pattern shown is partly an artefact caused by substantial differences in oberserver effort between areas. Frequent surveys near the mainland coast of Noord-Holland and towards the Friese Front have caused that many of the Great Skuas were seen here. It was estimated that around 2900 Great Skuas occurred in the entire study area in early autumn. Great Skuas were particularly numerous in 1987 and this coincided with exceptionally high numbers at coastal sites that year (#4). The seasonal pattern recorded at seawatching sites was rather similar to that from ship-based surveys, but Great Skuas became relatively numerous along the coast in September and October rather than in August. Results from ship-based surveys indicate that Great Skuas generally tend to avoid the coastal strip. The plot of Great Skua sightings from aerial surveys provides a similar picture (#1).

Discussion and conclusions Major differences between the relative abundance of skuas in the southern North Sea were found between ship-based surveys, counts from coastal sites (seawatching; #3, #4) and birds found dead on the beach (#2). Great Skuas formed two-thirds to three quarters of all skuas reported offshore and of all skuas found dead on the beach. From seawatching sites, however, 80-90% of all skuas were Arctic Skuas (table 4.6). In August, when hardly any were seen along the coast, Great Skuas were widespread and comparatively numerous further

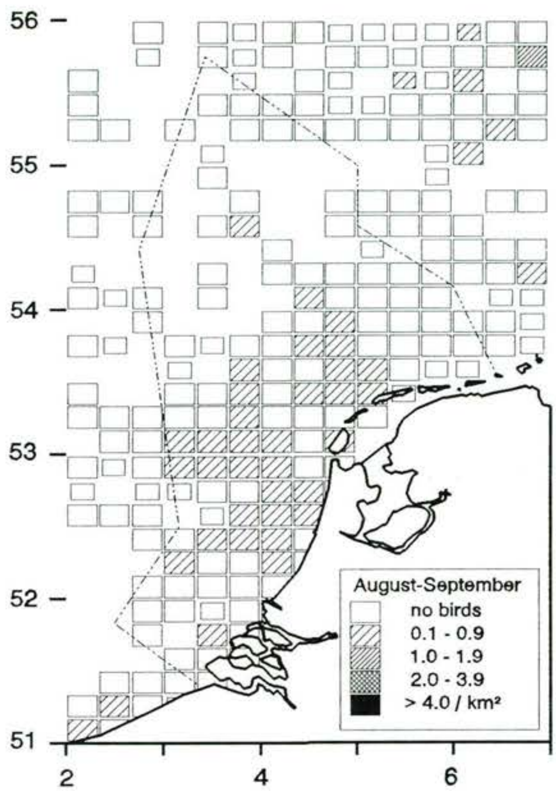


Figure 4.55 Distribution of Great Skua, August-September (n= 173)

offshore. Obviously, autumn migration of Arctic Skuas is a typically coastal phenomenon of a stream of birds funneling through the narrow southerly 'exit' of the North Sea. Great Skuas linger around for some time in the North Sea after the breeding season, entering the Skagerrak, German Bight and Southern Bight in substantial numbers (ESAS Database; Stone *et al. in press*) and do not seem to hurry on their way south (which is much less far south than that of the smaller conspecifics). Moreover, Great Skuas have a tendency to stay away from the coastal strip (compare figures 4.52 and 4.54). In early autumn, internationally important numbers of Great Skuas are found in the North Sea (table 4.2, 4.3). An important source of food for these skuas are scraps at trawlers, but Great Skuas at sea have been observed as kleptoparasites of Gannet, large gulls, Kittiwake, terns and killing and eating Kittiwakes, *Larus*-gulls and auks (only attémpts to kill Sooty Shearwaters have been observed). Of Pomarine and Long-tailed Skuas only rather small numbers are seen in the southern North Sea, indicating that autumn and spring migration mainly take place in the Atlantic Ocean, west of the British Isles (Camphuysen 1987a, Davenport 1987, 1991, Harrop 1993).

The differences between ship-based surveys and aerial surveys with respect to skua sightings are remarkable, but can generally be explained by differences in methods. The number of sightings from the aircraft were much smaller than from ship-based surveys. The main reason for this difference is the scan for birds ahead and to the side of the ship and, hence, the records of skuas outside the transect. From the air, only skuas within the transect were recorded (150m on each side of the aircraft; #1), whereas all skuas seen ahead of the ship entered the database. This factor, combined with the fact that skuas have a tendency to take a look at vessels (apparently mainly in search for ship-followers which can be attacked), will have resulted in skuas being recorded from a much wider area than just the strip-transect. Approximately 9x as many smaller skuas and 11.5x more Great Skuas were recorded during ship-based surveys than in aerial surveys. This would mean that skuas from a strip of 3000m were recorded onboard vessels, a figure which is by no means unlikely. The distribution pattern of Great Skuas is quite similar in ship-based and aerial surveys but the concentration of smaller (Arctic) skuas in the coastal strip was not noticed from

Table 4.6 Species composition (%) of skuas recorded at sea (this report), migrating along the coast (1974-79, #3; 1980-89, #4) and stranded (1969-84, #2). For coastal observations, data of 1985 were not used.

Tabel 4.6 Soortsamenstelling (%) bij jagers waar genomen op zee (dit rapport) trekkend langs de kust (1974-79, #3; 1980-89, #4) en gestrand (1969-84, #2). Van kustwaarnemingen werden gegevens van 1985 niet gebruikt.

		seawatching		
	at sea	74-79	80-89	beach
Pomarine Skua	4.5	3.8	7.2	6.9
Arctic Skua	22.1	91.6	82.3	21.8
Long-tailed Skua	0.4	0.1	0.1	9.2
Great Skua	73.0	4.6	10.4	62.1
sample	1107	14,636	20,057	87

and the ship-based survey data, Arctic Skuas the air. Considering both seawatching results (#3, #4) were quite numerous in coastal waters and this last aspect is therefore puzzling and cannot be explained by differences in detection from the two sources.

4.10 GULLS

Twelve species of gulls were observed, seven of which were common. Black-headed, Common, Lesser Black-backed and Herring Gulls are common breeding birds in the Netherlands, but the first two species were mainly winter birds at sea. The Lesser Black-backed Gull was most common in summer and the Herring Gull occurred year-round (table 4.1). Several gulls are scarce or irregular breeding species in the Netherlands: Mediterranean, Little, Yellow-legged and Great Black-backed Gull. Meditarranean and Yellow-legged Gulls were rarely encountered at sea, whereas Little Gull and Great Black-backed Gull were scarce in summer but rather common in the rest of the year. Three arctic species, Sabine's, Glaucous and Iceland Gull, were rare visitors in the southern North Sea, mainly in autumn and winter. Kittiwakes, cliff-nesting gulls which breed in large numbers along the coast of East England, were common during most of the year.

Mediterranean Gull *Larus melanocephalus*

Only 7 Mediterranean Gulls were observed during ship-based surveys, including 6 records in autumn near the coast in the Southern Bight (figure 4.56). Sightings comprised 4 adults, 1 immature and 2 juveniles. One adult was seen scavenging in a large, mixed group of birds behind a trawler at some 11 km from the coast, off the Delta area. Mediterranean Gulls have increased as breeding birds in western Europe, and recently got a firm foothold in the southern provinces of the Netherlands (Meininger & Bekhuis 1990). Most of these gulls appear to feed inland (Meininger *et al.* 1991). At seawatching sites in the Netherlands and in Belgium, Mediterranean Gulls are frequently seen in very small numbers (#3, #4, Allein *et al.* 1992). Along the Wadden Sea islands Mediterranean Gulls were scarcely reported, which is in agreement with (the few) sightings during ship-based surveys. Aerial surveys produced only two sightings, which is not surprising, for only two of the Meditteranean Gulls seen during ship-based

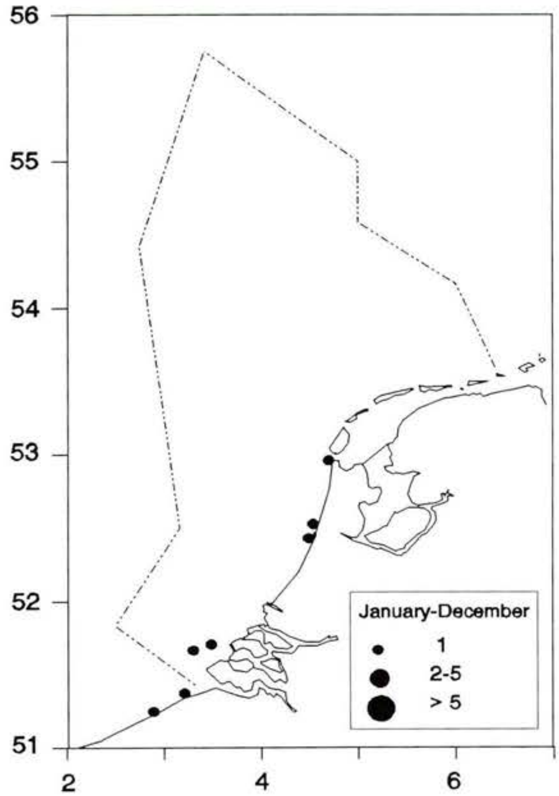


Figure 4.56 Sightings of Mediterranean Gulls, January-December (•, n= 7)

surveys were actually in transect (see also discussion in Great Skua).

Little Gull *Larus minutus*

Little Gulls breed in very small numbers in the Netherlands, but most of the gulls which are observed in the southern North Sea as migrants or winter visitors originate from colonies in Sweden, Finland, Poland and further east.

Little Gulls were seldom recorded in June and July (12 individuals, all adults, not mapped). Densities were still low in **August-September**, and of a total number of 143 Little Gulls, 37 individuals were in transect (figure 4.57). Of 135 Little Gulls the plumage was recorded, including a large percentage of juveniles (24.4%; table 4.7). The total number of Little Gulls in the southern North Sea is estimated at 500 individuals in the coastal zone and none offshore (table 4.2), only 50 of these were found in the Dutch sector. Seawatching

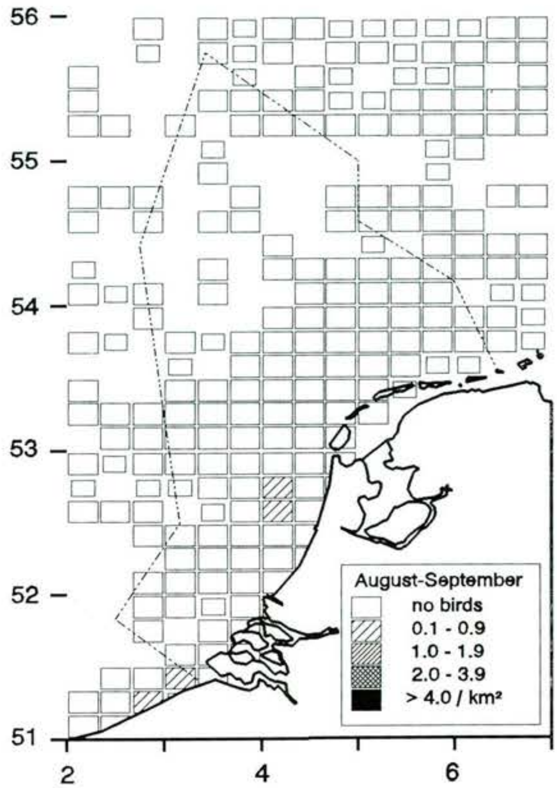


Figure 4.57 Distribution of Little Gull, August-September (n= 37)

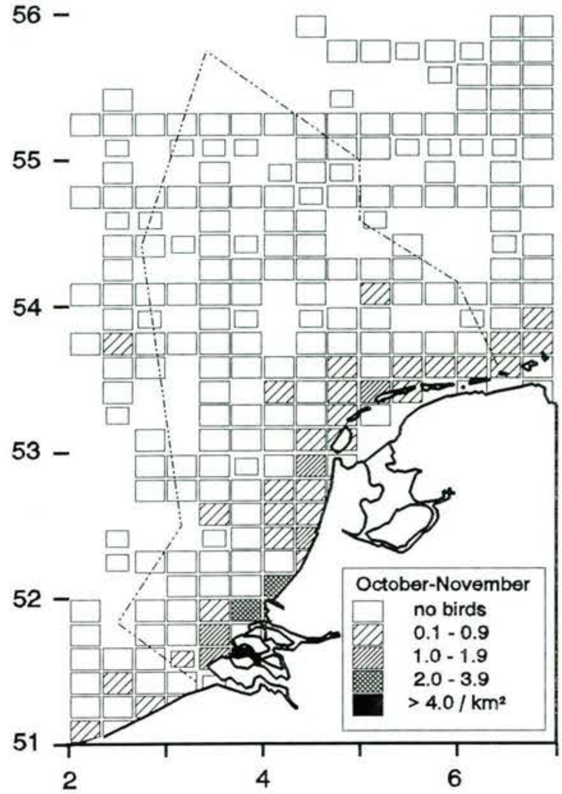


Figure 4.58 Distribution of Little Gull, October-November (n= 1209)

data show that the onset of autumn migration of this species is in late September and numbers rapidly increase from early October (#3, #4). These results are quite different from data derived from aerial surveys, from which it was concluded that Little Gulls occurred widespread in low densities offshore and in the coastal zone (#1). It was argued that the frequent sightings of Little Gulls in August-September were all just offshore (*i.e.* 'out of reach' for seawatchers), but also that from the air these small gulls are easily confused with floating skeletons of *Sepia officinalis* and "commic" terns (#1, Baptist 1991). It was concluded that Little Gulls occurred frequently offshore in these months, and the total number was estimated at around 1400 (just over 2000 during 1989-92), but it is difficult to judge with hindsight whether the differences between results of aerial and ship-based surveys were caused by accident (*e.g.* the timing of surveys) or whether mis-identifications of Little Gulls during aerial surveys are a structural problem. From a compilation of recently published seasonal patterns for Little Gulls in the (southern) North Sea, we conclude that Little Gulls are scarce in August and increase in numbers only in late September (#3, #4, Nisbet 1956, Ferdinand *et al.* 1956, Bulteel & Van der Vloet 1969, Hutchinson & Neath 1978, Oliver 1977, Rettig 1977, Bergendahl 1986, Meltofte & Faldborg 1987, Smith 1987, Temme 1989, Temme 1991, Allein *et al.* 1992, Garthe 1993, Jardine *et al.* 1993). Only in Scotland, substantial numbers of Little Gulls were recorded in July, August and early September (Bruun 1968, Hutchinson & Neath 1978).

Autumn migration of Little Gulls peaked in **October-November**, which resulted in a substantial increase in numbers present in Dutch coastal waters. Low to moderate densities occurred throughout the coastal zone, occasional patches with low densities occurred offshore (figure 4.58). Some 88.5% were adults (n= 1903; table 4.7). It was estimated that just over 11,000 Little Gulls

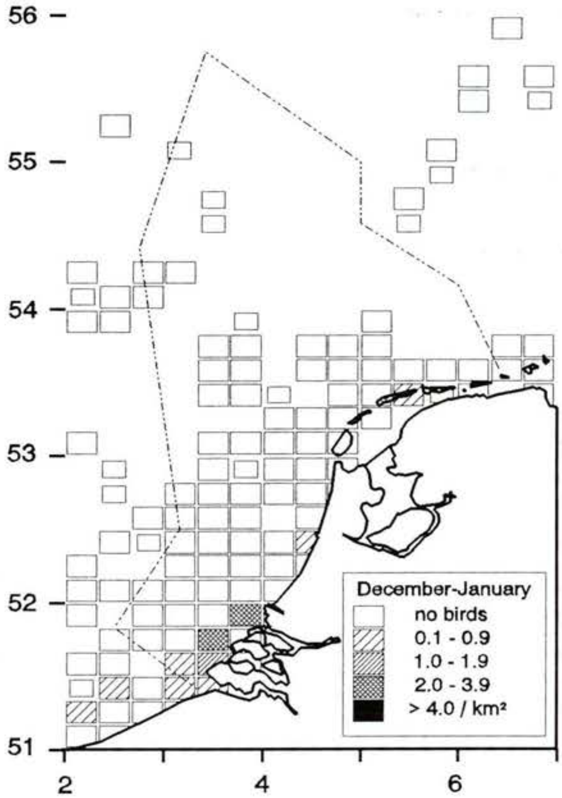


Figure 4.59 Distribution of Little Gull, December-January (n= 320)

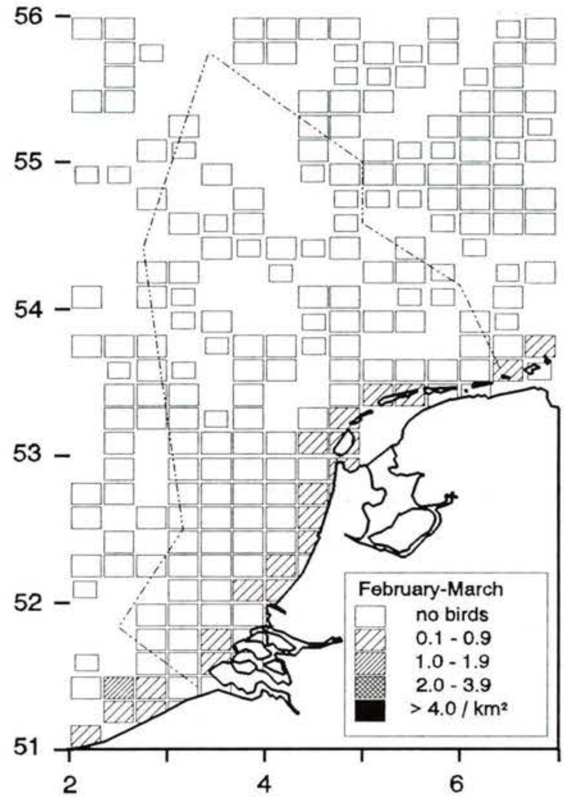


Figure 4.60 Distribution of Little Gull, February-March (n= 415)

were in the coastal zone, with another 3000 offshore in these months (table 4.2). Some 10,700 Little Gulls were estimated to occur within the Dutch sector. The timing of this increase was in agreement with seawatching results (#3, #4). Strandings of Little Gulls on Dutch beaches peak in autumn (October-November) and winter (January-February), but overall numbers are very small (#2). Aerial surveys produced a rather similar distribution pattern, but offshore sightings were more frequent (#1). Overall, densities were low during these surveys and the estimate of total numbers in our waters was only around 2650 individuals.

In winter, **December-January**, numbers of Little Gulls had declined considerably and sightings were mainly confined to the coastal waters off Belgium and in the Voordelta (figure 4.59). Virtually all Little Gulls observed in winter were adults (table 4.7). It was estimated that some 3900 Little Gulls occurred in coastal waters, with another 600 individuals offshore (table 4.2), 3800 of which occurred in the Dutch sector. From aerial surveys a much wider distribution in winter was deduced, in a broad band with low densities all along the coast, and with slightly higher densities in the Voordelta (#1). As stated earlier, this may be partly effort related. The estimate of total numbers in Dutch waters, despite the larger area covered and used for the final estimate in winter, was slightly lower (*ca.* 3050). Seawatchers recorded small numbers in December and very small numbers in January (#3, #4). Few Little Gulls stranded in December, while the increase in effort in January and February led to rather more casualties on Dutch beaches (#2). Wintering Little Gulls were often associated with feeding Razorbills, and these associations were quite strong. Razorbills that were flushed by the approaching vessel were often immediately followed by the associated Little Gulls. The reason for these frequent associations, which have been described earlier (Madge 1965, Scott 1972, Evans 1989), is unclear. Kleptoparasitism has not been observed, whereas the gulls were eagerly hovering over the Razorbills when these were submerged. When the Razorbills returned to the surface, the gulls often simply settled next to the auks. Razorbills were clearly preferred; feeding Guillemots *Uria aalge* were usually joined by Kittiwakes *Rissa tridactyla*.

In **February-March**, a regular pattern of low densities of Little Gulls was found in the coastal zone (figure 4.60), but the overall densities were slightly lower than earlier in winter (table 4.1). The estimate of total numbers of Little Gulls came at 2900 individuals for the coastal zone and antoher 100 individuals offshore (table 4.2), 2200 of which occurred in the Dutch sector. Approximately 97% of the Little Gulls were adults (table 4.7). Numbers of Little Gulls reported from seawatching sites were also very low in these months (#3, #4). The distribution pattern derived from aerial surveys was roughly similar to that from ship-based surveys, but Little Gulls seemed to occur in a wider band off the Dutch coast (#1). The estimate of total numbers from aerial surveys was considerably lower though (*ca.* 500).

In spring, **April-May**, moderate densities were found along the mainland coast and low densities scattered off the Wadden Sea islands and off Belgium (figure 4.61). Most Little Gulls were adults, although small numbers of juveniles (2nd calendar year birds) joined the mature birds towards the breeding areas (table 4.7). It was estimated that 7300 Little Gulls occurred in the coastal zone, plus another 40 offshore. Within the Dutch sector, some 4900 Little Gulls were present. The value of these figures is limited. From seawatching data it can be demonstrated that the peak of spring migration is usually extremely tight around 20 April-1 May (#3, #4, Den Ouden & Stougie 1990). Extrapolating for hours not observed, it was estimated that, in April and May, normally around 10,000 Little Gulls migrate through Dutch coastal waters, but that in some years (notably 1981, 1984 and 1985) between 20,000 and 30,000 individuals passed through the Dutch coastal zone (Den Ouden & Stougie 1990). A detailed analysis of seawatching data and the assumption that Little Gulls are able to choose between an overland route and a flyway along the coast, led to the conclusion that a predominance of 'head winds' leads to higher numbers in coastal waters during spring migration. During 1989-92, aerial surveys were twice plan-

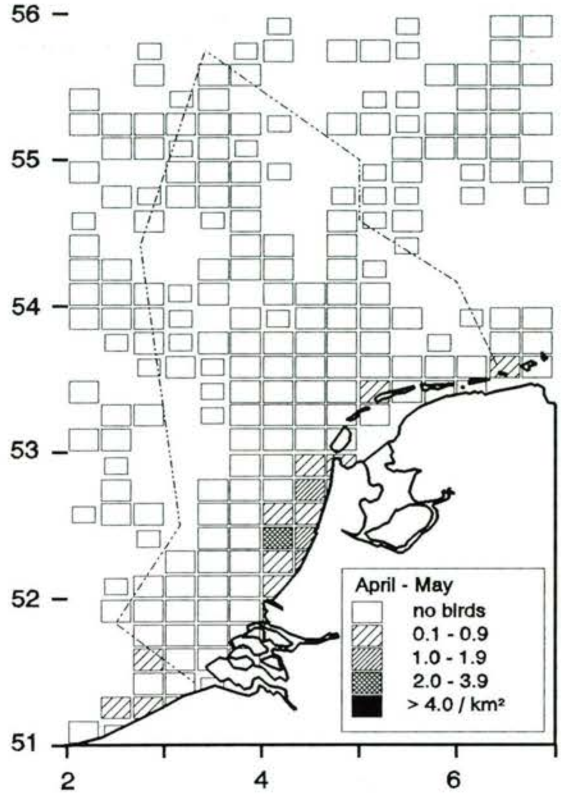


Figure 4.61 Distribution of Little Gull, April-May (n = 693)

ned at the peak of spring migration, and the estimate of total numbers was accordingly high (*ca.* 11,000 individuals, #1). Again, Little Gulls were seen over a much wider band than in ship-based surveys, but, similar as in ship-based surveys, with highest densities near the mainland coast of Noord-Holland.

Discussion and conclusions Little Gulls occurred in substantial numbers in Dutch coastal waters during autumn- (mainly October/November) and spring migration (April/May), particularly when compared to other areas in the North Sea at large (Tasker *et al.* 1987). Ship-based surveys led to peak estimates of 14,200 Little Gulls in Dutch waters (October/November, 18.9% of the central/east European breeding population; Rose & Scott 1994). For use in Ramsar (criterion 3c), a total number of 750 Little Gulls in a wetland is sufficient for a status of international importance. From seawatching results in can be shown that the estimate derived from ship-based surveys in

Table 4.7 Monthly age composition in Little Gulls (adult, immature and first year) in the southern North Sea, 1985-93.
Tabel 4.7 Maandelijkse leeftijdsverdeling van de Dwergmeeuw (volwassen, onvolwassen en eerste jaars) in de zuidelijke Noordzee, 1985-93.

Month	adult	imm	first year	% adult	sample
Jan	234	1	5	97.5	240
Feb	192	2	5	96.5	199
Mar	471	4	11	96.9	486
Apr	886	38	20	93.9	944
May	31		2	93.9	33
Jun	1				1
Jul	11				11
Aug	24	1	5	80.0	30
Sep	78		28	73.6	106
Oct	1002	24	73	91.2	1099
Nov	683	37	84	85.0	804
Dec	99	1	7	92.5	107
Totals	3712	108	240	91.4	4060

spring (7300 April/May) is rather conservative and that normally around 10,000 Little Gulls and sometimes as many as 30,000 individuals (*i.e.* 40% of the C/E European breeding population) pass through our coastal waters (Den Ouden & Stougie 1990). Many Little Gulls were feeding on tidal lines, near sewage outlets or in areas where lots of rubbish was floating around. There are nine records of scavenging Little Gulls at commercial trawlers (122 individuals). Peak numbers were 85 Little Gulls at a single boat, on 29 March 1990, 2 km from the coast of Zuid-Holland. Little Gulls were uncommon as beached birds: only 0.6% of all stranded *Larus*-gulls during 1969-85 (n= 18,616) and 56.9% were oiled (n= 65; #2). Aerial surveys were different with respect to the seasonal pattern (much less peaked) and distribution of birds at sea (a much wider band off the coast). Since mis-identifications were apparently a common source of error in Little Gulls reported from these surveys (#1, Baptist 1991), the differences are not further discussed here.

Sabine's Gull *Larus sabini*

Sabine's Gulls were rarely encountered at sea, and usually quite far offshore (4 sightings, figure 4.62). Three were seen in autumn, which is in

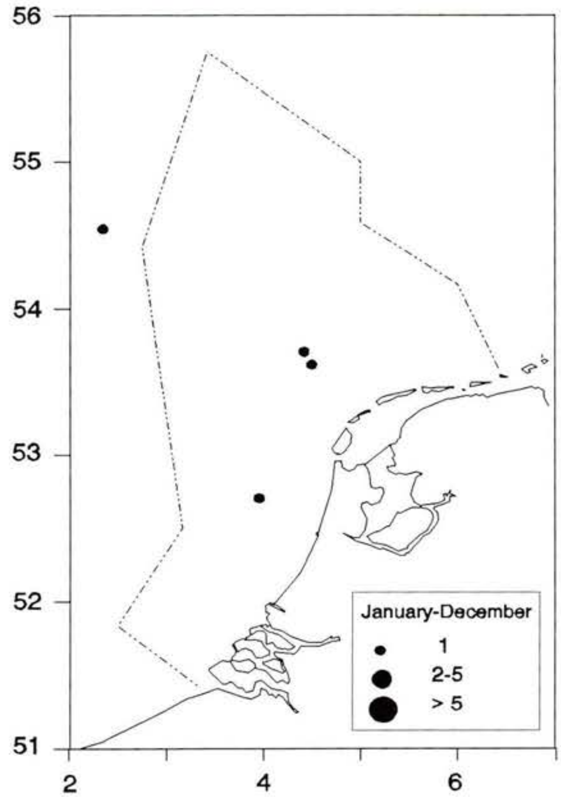


Figure 4.62 Sightings of Sabine's Gulls, January-December (•, n= 4)

agreement with seawatching results (#4), while a single gull in March (an adult in breeding plumage) must be considered highly unusual (#3, #4, Sharrock 1971). Sabine's Gulls spend the winter south of the equator (Lambert 1967, 1969, Griffiths & Sinclair 1982), and spring or late winter records were very rare in the Netherlands (#4). The other records were a juvenile bird in September and two solitary adult winter plumage Sabine's Gulls in October and November.

Black-headed Gull *Larus ridibundus*

Black-headed Gulls increased markedly in most of Northwest Europe in the 19th, but mainly in the 20th century (Cramp & Simmons 1983). The total Dutch population numbered 65,000-95,000 pairs in 1961 (Higler 1962), while it was estimated at >200,000 pairs in the mid-1970s (Teixeira 1979) and 225-275,000 pairs in the early 1980s (SOVON 1988). In the 1960s, 12,000-18,000 Black-headed Gulls were breeding in the Delta area,

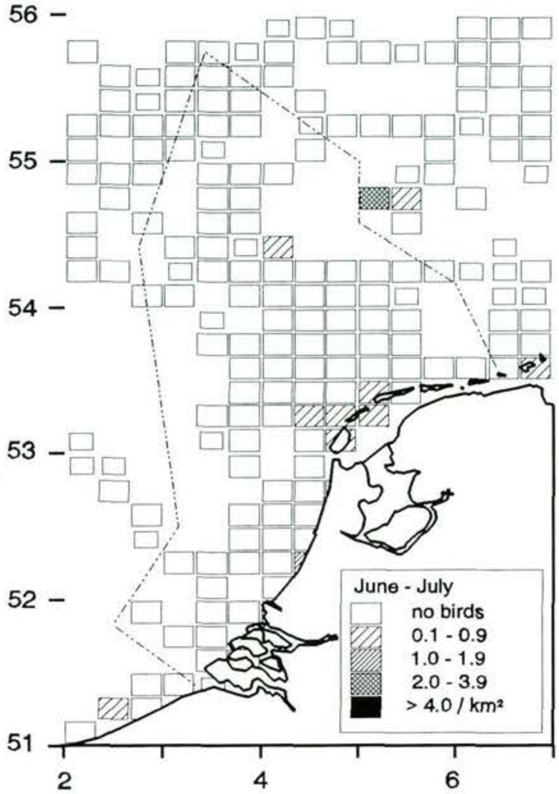


Figure 4.63 Distribution of Black-headed Gull, June-July (n= 104)

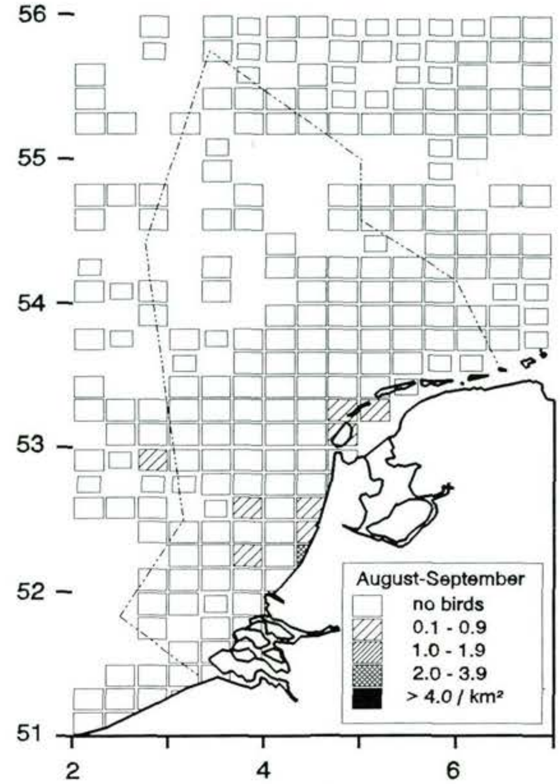


Figure 4.64 Distribution of Black-headed Gull, August-September (n= 182)

9,000-14,000 in Zuid-Holland, 8,000-12,000 in Noord-Holland, 5,000-7,000 in Friesland and on the Frisian islands, and 2,700-4,000 in Groningen (in all, 36,700-55,000 pairs in coastal provinces; substantial numbers of the Dutch population were not breeding near the coast). For 1990/91, the size of coastal colonies is better known. In the Wadden Sea region, 74,732 pairs were found breeding, only 547 pairs bred along the mainland coast of Noord- and Zuid-Holland, and another 40,752 pairs were found in the Delta area (A.J. van Dijk, SOVON unpublished data). This indicates that the coastal population has at least doubled since the early 1960s.

In summer, **June-July**, scattered low densities of Black-headed Gulls were found in coastal waters (figure 4.63). Off the mainland coast, particularly off harbours such as Scheveningen, densities of these gulls could be rather high, but most gulls were observed very closely inshore. Offshore, notably in the Oestergronden region, occasional groups of Black-headed Gulls, most probably migrant birds, were observed. Of all Black-headed Gulls observed at sea, 80-90% were adults (table 4.8). It was estimated that some 1000 Black-headed Gulls occurred in the coastal zone, plus some 1400 individuals offshore (table 4.2), but only 800 of these gulls occurred within the Dutch sector. Seabird migration studied from coastal sites revealed a seasonal pattern in Black-headed Gulls which was rather consistent through the years. Mass movements were recorded at intervals, including peaks in autumn migration (usually July and October), cold-rushes in response to winter conditions (irregularly) and peaks in spring migration (usually February/March and April; Platteeuw 1987, #3, #4). In June, numbers of Black-headed Gulls seen from coastal sites were usually rather small, but July often produced massive southward movements, mainly of adult gulls. Aerial surveys produced a pattern of low to moderate densities in the entire coastal strip and occasional offshore sightings (#1). It was estimated that around 2700 Black-headed Gulls occurred in Dutch waters.

Late summer, **August-September**, offshore sightings were rather scarce, and low to moderate densities were found in the coastal zone of the mainland coast and around Texel and Vlieland (figure 4.64). It was estimated that 800 Black-headed Gulls were present in the coastal zone and 900 further offshore (mainly Southern Bight; table 4.2), of which 1100 occurred within the Dutch sector. First year birds were comparatively numerous, with the proportion of adults in these months dropping to *ca.* 50% (table 4.8). From seawatching sites, a continuation of southward movements was reported, with gradually increasing numbers of juveniles (Platteeuw 1987). Half of the Black-headed Gulls recorded in September were juveniles, a figure which is in agreement with assessments during ship-based surveys. Southward passages of Black-headed Gulls were usually less impressive in September. On the Wadden Sea islands, substantial numbers of dead Black-headed Gulls washed ashore in these months, many of which were juveniles and a minority were oiled, suggesting natural, post-fledging mortality (#2). From aerial surveys it was deduced that Black-headed Gulls occurred more widespread in a rather broad zone, particularly along the mainland coast and in the Voordelta (#1). Moderate densities were found off Noord-Holland. It was estimated that around 1500 Black-headed Gulls occurred in the Dutch sector in these months.

In autumn, **October-November**, densities of Black-headed Gulls in the coastal zone increased sharply (figure 4.65). Scattered offshore records included sightings in the Doggersbank, Nordschillgrund and Terschellingerbank regions. High densities were found around Borkum, moderate densities off Texel and Den Helder and moderate to high densities occurred off the mainland coast of Zuid-Holland and in the Voordelta. For these months, the estimate of total numbers in the coastal zone came at 23,500 individuals, with another 1400 Black-headed Gulls offshore (table 4.2). Some 22,000 of these gulls were found in the Dutch sector. Adults predominated in these months, with 85.5% in October (n= 1231) and 90.9% in November (n= 507; table 4.8). From seawatching sites, a second wave of autumn migrants was recorded in these months (#3, #4, Platteeuw 1987). Most of these gulls were a-

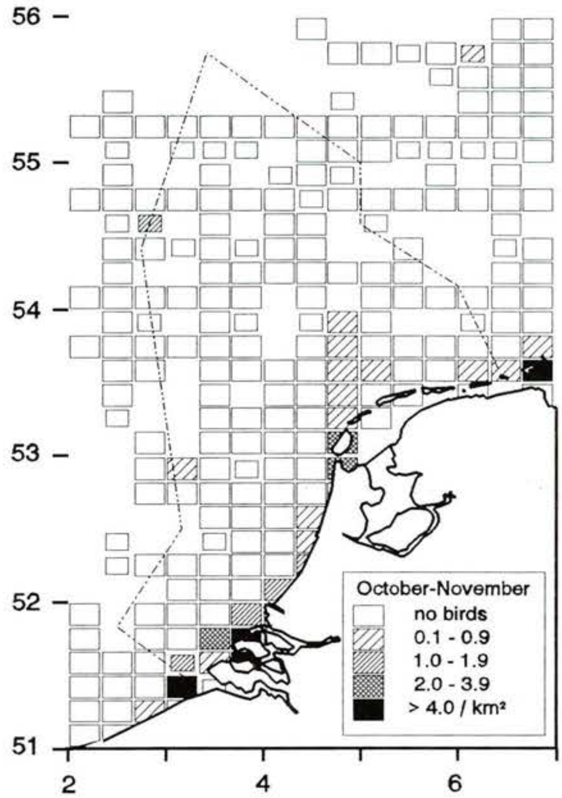


Figure 4.65 Distribution of Black-headed Gull, October-November (n= 1750)

dults, just as found during ship-based surveys. The distribution pattern derived from aerial surveys was quite similar in the coastal strip, with moderate to high densities scattered along most of the coast, but the distribution was considerably wider and offshore sightings appeared more frequent (#1). It was estimated that nearly 7000 Black-headed Gulls occurred in the Dutch sector of the North Sea.

Lower densities, but a similar distribution pattern, were found in **December-January** (figure 4.66). Highest numbers were reported in the Voordelta, low densities were found scattered in coastal waters of Belgium, mainland coast and off the Wadden Sea islands. Black-headed Gulls were still a strictly coastal species, although scattered sightings in the offshore zone occurred (as in other months and particularly in easterly winds), but mostly outside the transect. Nearly all Black-headed Gulls seen in these months were adult birds (table 4.8). It was estimated that 11,200

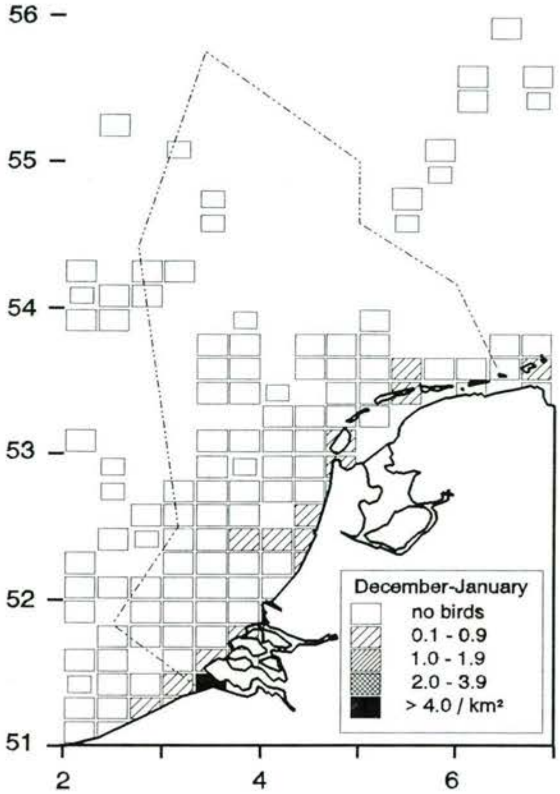


Figure 4.66 Distribution of Black-headed Gull, December-January (n = 1608)

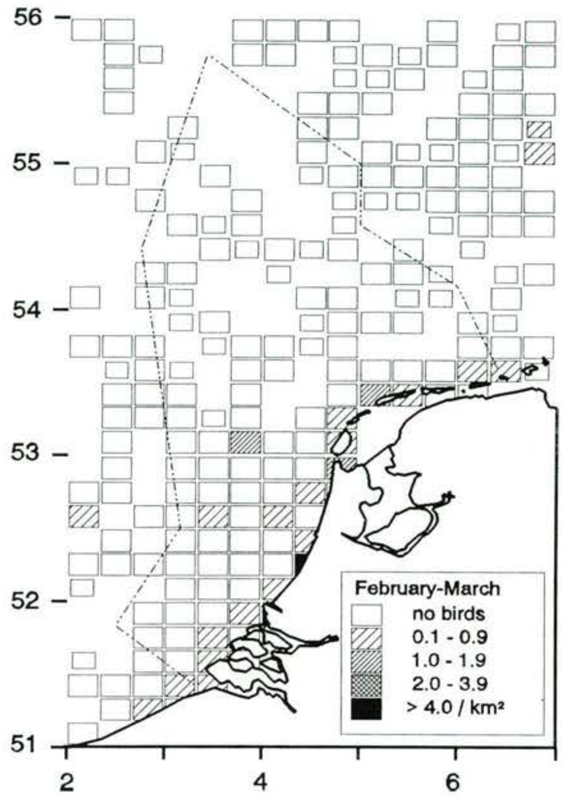


Figure 4.67 Distribution of Black-headed Gull, February-March (n = 1754)

individuals occurred in the coastal zone and 500 further offshore. Just over 10,000 of these Black-headed Gulls occurred within the Dutch sector. Severe weather conditions could lead to cold-rushes of Black-headed Gulls along the coast (#3, #4, Platteeuw 1987) and these movements could occur at any time. Easterly winds generally produced a larger number of sightings of this species at sea. Adult Black-headed Gulls predominated, both in seawatching results and ship-based surveys (#3). Numbers of dead Black-headed Gulls on the beach peaked between December and April (#2). Results from aerial surveys, just as in the months discussed so far, were similar to ship-based sightings in that moderate to high densities occurred scattered in the coastal strip. However, the distribution away from the coast seemed very different. Flights in December/January produced a wide area, a band of at least 90km wide, with low to moderate densities. It was estimated that over 8500 Black-headed Gulls occurred in the Dutch sector of the North Sea. The offshore zone in the northern half of our study area, poorly surveyed in ship-based surveys, did not yield many sightings.

Sightings in the coastal zone were more frequent again in **February-March**, with low to moderate densities everywhere in the coastal strip (figure 4.67). Scattered offshore sightings occurred, mainly in the Southern Bight. Over 90% of the Black-headed Gulls observed were adult birds (table 4.8). It was estimated that around 9800 Black-headed Gulls occurred in the coastal zone and another 1300 individuals offshore (table 4.2), of which 10,000 occurred in the Dutch sector. Spring migration was recorded late February and March at coastal sites scattered on the Dutch coast (#3, #4). Most gulls were adults and it was suggested that this peak comprised Dutch breeding birds, as well as birds heading for Danish and German colonies (Platteeuw 1987). In cold winters, large numbers of dead Black-headed Gulls were found in these months, scattered all over

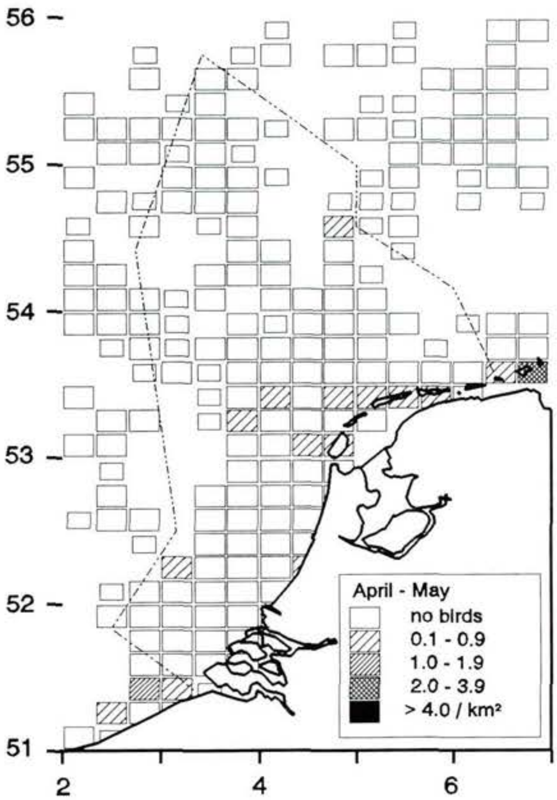


Figure 4.68 Distribution of Black-headed Gull, April-May (n= 118)

the entire coast (#2). Aerial surveys were different from ship-based surveys in the much wider distribution, a huge homogeneous area off the mainland coast, where the latter produced hardly any records of Black-headed Gulls (#1). Densities near the coast were much lower than in December and January and it was now estimated that around 2000 Black-headed Gulls occurred in the Dutch sector.

In **April-May**, very low densities were found along the mainland coast, whereas low to moderate densities occurred widespread off Belgium and off the Wadden Sea islands (figure 4.68). The proportion of adult birds fell sharply, indicating that most mature individuals had returned to the colonies (table 4.8). Scattered offshore birds were probably mainly late migrants heading for more easterly or northerly breeding stations. Estimates of total numbers in the southern North Sea came at 600 Black-headed Gulls in the coastal zone and 3200 individuals offshore (table 4.2). Some 3100 of these Black-headed Gulls occurred in the Dutch sector. A second peak in spring migration was witnessed from coastal sites in April, probably mainly including breeding birds heading for Baltic colonies (#3, #4, Platteeuw 1987). In this peak, immatures were much more numerous (often over half the birds seen passing by late April/early May were 2nd calendar year individuals) than earlier in spring (#3). Numbers of dead Black-headed Gulls declined considerably in late April and May (#2). Aerial surveys produced a pattern of scattered low densities over a wide area along the entire coast and an estimate of over 3000 gulls in the Dutch sector of the North Sea (#1).

Discussion and conclusions Black-headed Gulls were common as migrants in the southern North Sea, both during spring and autumn migration, but were otherwise restricted to the coastal strip (mainly within 5 km from the nearest shore. Compared to the huge NE Atlantic population of this widespread species, the numbers found at sea were rather insignificant. Within the Dutch sector of the North Sea, peak numbers of *ca.* 22,000 individuals were found in October-November, whereas the southern North Sea at large was found to hold peak numbers of *ca.* 25,000 Black-headed Gulls in autumn (October-November, 0.5% of the NE Atlantic population, table 4.3; Rose & Scott 1994). Some 11.3% of trawlers seen in the southern North Sea were attended by scavenging Black-headed Gulls, with a maximum of 755 individuals at a time (Camphuysen 1993a). As a scavenger, this species was only frequently observed between October and March. Large groups of scavengers (*i.e.* >50 Black-headed Gulls) occurred exclusively within 2 km from land. Much larger numbers were seen at trawlers, both in summer and winter, within the Wadden Sea (NIOZ unpubl. data). Black-headed Gulls were the second most numerous species in beached bird surveys, which formed 16.7% of all dead *Larus*-gulls found during 1969-85 (n= 18,616, #2). Some 44.2% were contaminated with oil (n= 2112) and large numbers were usually found in cold winters (70.8% between December and April). Oil pollution is not a significant threat to the population of this species.

The differences between aerial surveys and ship-based surveys were remarkable. Whereas ship-based surveys produced a pattern of a highly coastal species which occurs as a migrant only under certain conditions (aided by easterly winds) further offshore, aerial surveys suggested that

Table 4.8 Monthly age composition in Black-headed Gulls (adult, immature and first year) in the southern North Sea, 1985-93.

Tabel 4.8 Maandelijkse leeftijdsverdeling van de Kokmeeuw (volwassen, onvolwassen en eerste jaars) in de zuidelijke Noordzee, 1985-93.

Month	adult	imm	first year	% adult	sample
Jan	633	3	16	97.1	652
Feb	1298	12	57	95.0	1367
Mar	721	23	50	90.8	794
Apr	104	20	9	78.2	133
May	33	6	51	36.7	90
Jun	98	12		89.1	110
Jul	233	5	35	85.3	273
Aug	58	3	59	48.3	120
Sep	60	5	49	52.6	114
Oct	1052	4	175	85.5	1231
Nov	461	2	44	90.9	507
Dec	180		6	96.8	186
Totals	4931	95	551	88.4	5577

this species was widespread in all seasons through most of the Southern Bight and off the Wadden Sea islands. The patchy distribution, a result of this gull usually migrating in distinct flocks, was not found from the air. This cannot just be effort related, as suggested by Baptist (*in litt.*). Even if all data are combined, a year round picture would still show many holes in the distribution pattern. Estimates derived from ship-based surveys were higher than aerial assessments when high densities occurred at sea, but lower when Black-headed Gulls were scarce at sea.

Common Gull *Larus canus*

Common Gulls increased in numbers in most of its range during the 20th century, except in Denmark (Cramp & Simmons 1983). The Dutch population of the Common Gull, which was established in 1908 with 2 pairs, increased rapidly since the late 1940s. In the late 1940, some 100 pairs were found breeding, in 1960 the population was estimated at 377 pairs (Braaksma 1964). Some 7000 pairs were found in the mid-1970s (Teixeira 1979) and 11,000 Common Gulls were counted in 1985 (SOVON 1988) and again in the early 1990s (Arts 1993). In recent years, however, mainland colonies suffered from increased predation of eggs, chicks and adults by Red Fox *Vulpes vulpes* and some important colonies were totally abandoned (Woutersen 1992, Costers 1992). The largest colony in the Netherlands, established in the dunes of Schoorl (Noord-Holland) in 1931, increased to some 6000 pairs in the mid-1980s, but declined to less than 2000 pairs in the early 1990s (Woutersen 1992). New, smaller colonies were established on alternative sites in the region, often outside the dunes (Costers 1992, Groot & Cottaar 1992, Woutersen & Roobeek 1992, Woutersen 1994).

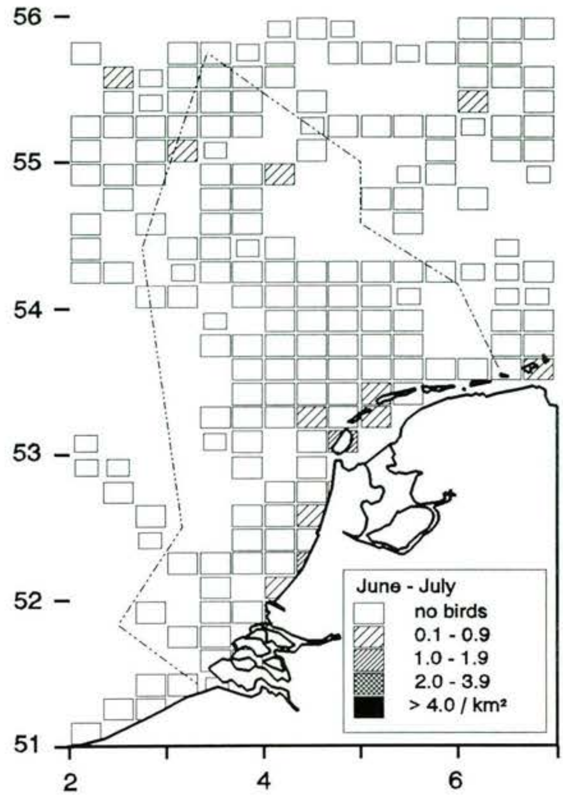


Figure 4.69 Distribution of Common Gull, June-July (n = 176)

Low to moderate densities of Common Gulls were found scattered in the coastal strip in **June-July**, particularly near breeding colonies (figure 4.69). Scattered offshore sightings included birds in the Doggersbank and Nordschillgrund region. Most of the birds seen offshore were immatures, while closely inshore adults predominated (table 4.9). Juveniles were not yet seen at sea. It was estimated that 1300 Common Gulls occurred in coas-

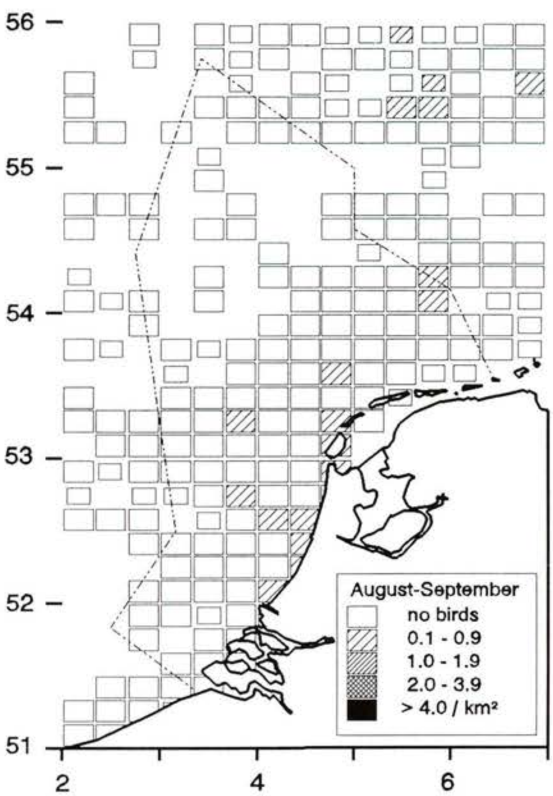


Figure 4.70 Distribution of Common Gull, August-September (n= 108)

tal waters, plus another 800 individuals offshore (table 4.2), of which 1700 occurred within the Dutch sector. From seawatching sites, vast numbers of Common Gulls were observed throughout the year, but particularly in these months (#3, #4). Unfortunately, systematic counts of this abundant species were only conducted in Noord-Holland, so the following text only refers to data obtained in this subregion. Very large numbers of Common Gulls were seen flying up and down the coast (or in fact in and out the nearby colony), and most these birds were adults (*cf.* Platteeuw 1986ab). Late July, when the numbers declined rapidly, substantial numbers of just fledged juveniles appeared on the scene (#3). Aerial surveys produced a similar pattern with respect to the distribution of patches of birds near important breeding stations, but densities recorded in the coastal strip were considerably higher and Common Gulls appeared more widespread at greater distances away from the coast (#1). From these surveys it was estimated that nearly 10,000 Common Gulls occurred in the Dutch sector during 1985-88 and 3-4000 between 1989 and 1992.

Common Gulls became slightly more widespread off the mainland coast and the westernmost Wadden Sea islands during **August-September**, but densities were very low (figure 4.70). Offshore sightings were particularly frequent in the Nordschillgrund region. Juveniles became progressively more abundant at sea and numerically dominated in September (table 4.9). Only 300 Common Gulls were estimated to occur in the coastal zone, whereas 1900 were estimated for offshore waters (table 4.2). Within the Dutch sector, only 400 of these gulls were found. This indicates that Common Gulls prefer inland feeding habitats during the post-nuptial primary moult. Numbers of Common Gulls seen from coastal sites in Noord-Holland declined dramatically from July to August and remained very low during the entire period discussed here (#3, #4). Juveniles were scarcely reported after the small peak in appearance late July, while the number of adults at sea had simply collapsed. Aerial surveys produced lower densities of Common Gulls in the coastal strip than in summer and the frequent offshore sightings north of 54°N were in agreement with ship-based sightings (#1). The estimate of *ca.* 2000 Common Gulls in the Dutch sector was well above that derived from ship-based sightings.

Common Gulls invaded the coastal zone in autumn, with moderate to high densities all over the coastal strip during **October-November** (figure 4.71). Very large numbers were seen around Borkum and Schiermonnikoog, off IJmuiden and in the Voordelta. Low densities occurred widespread in the offshore zone, directly bordering coastal waters. It was estimated that now 29,200 Common Gulls occurred in coastal waters and 5900 individuals offshore (table 4.2), nearly 30,000 of which were in the Dutch sector. All age classes were abundant in these months, but adults predominated (68.3%, n= 3813; table 4.9). From seawatching sites a gradual return of Common Gulls was recorded throughout October and November (#3, #4). Adults predominated, while only small numbers of juveniles and immatures were seen (#3). The tremendous increase in numbers in the coastal zone was much less obvious in aerial surveys (#1). Distribution patterns derived from the two schemes were roughly similar, but densi-

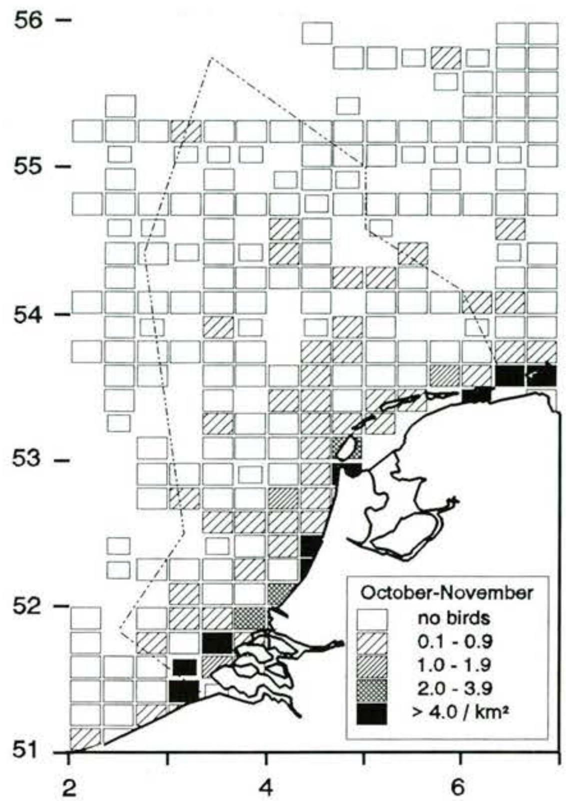


Figure 4.71 Distribution of Common Gull, October-November (n= 3529)

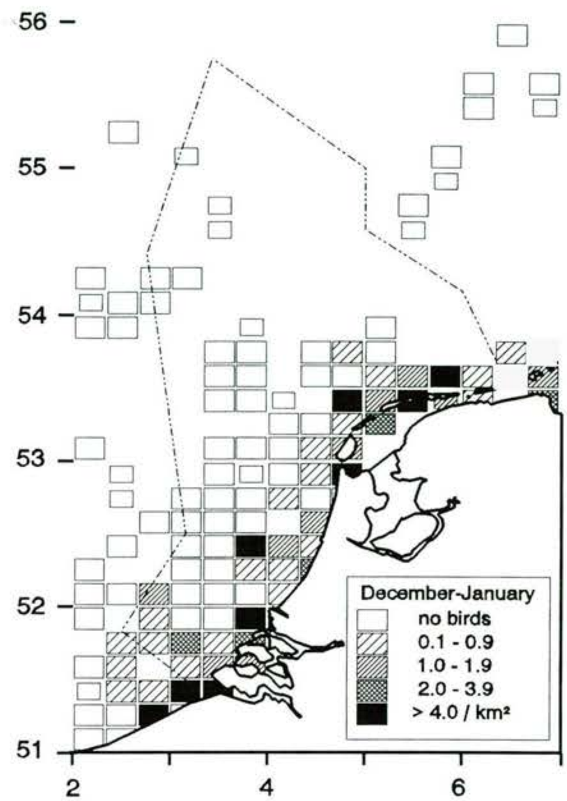


Figure 4.72 Distribution of Common Gull, December-January (n= 5974)

ties found from the air near the coast, particularly in the Voordelta, were distinctly lower. The overall estimate from aerial surveys, *ca.* 7250 individuals, was well below the estimate derived from ship-based surveys.

The coastal zone gained further importance for Common Gulls in winter, **December-January** (figure 4.72). Moderate to high densities occurred in a wider strip along the coast than in autumn and the overall estimate for the coastal zone therefore arrived at 55,300 individuals in these months (3.4% of the NE Atlantic population; Rose & Scott 1994). The offshore zone was not very well covered in these months, and numbers found in the area studied in winter were tentatively estimated at 25,100 individuals. Over 60,000 were found in the Dutch sector of the North Sea. Obviously, with a total number of 80,400 Common Gulls in the southern North Sea at large, this area is very important as a wintering area for this species. Adult birds predominated stronger than in autumn (87.6%, n= 4060; table 4.9) and juveniles were comparatively scarce, indicating that most young Common Gulls had left the southern North Sea in autumn. Numbers of Common Gulls observed at seawatching sites in Noord-Holland were large during most of late autumn and winter (#3, #4). Massive movements in any direction were not reported, indicating that birds formed a stable winter population in the coastal zone which were recorded again and again. Corpses of Common Gulls on the beach increased in December and in cold winters, stranded Common Gulls were rather numerous (#2). Aerial surveys produced similar densities in the coastal strip, but connected to this zone was a wide area of low densities filling the entire southern half of the Dutch sector (#1). Offshore sightings were common north of 54°N and it was concluded that peak numbers of over 20,000 Common Gulls occurred in the Dutch sector. Despite the widespread distribution, this estimate is considerably below the estimate from ship-based surveys.

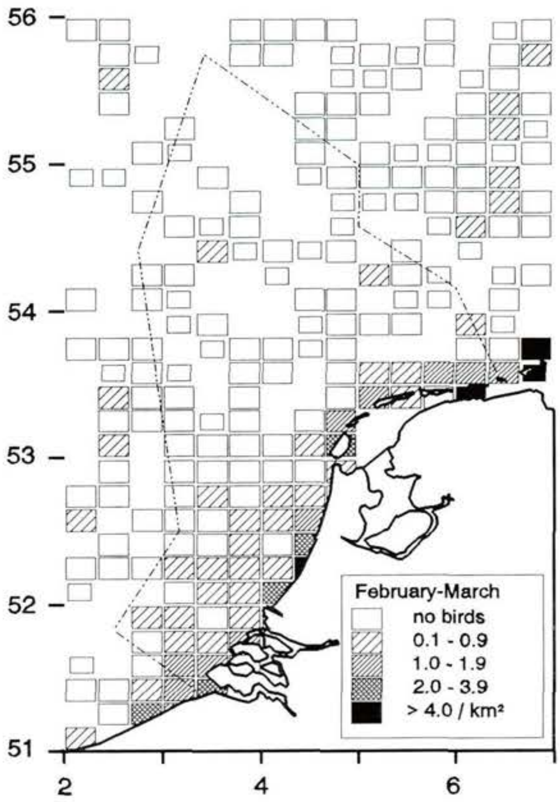


Figure 4.73 Distribution of Common Gull, February-March (n = 4925)

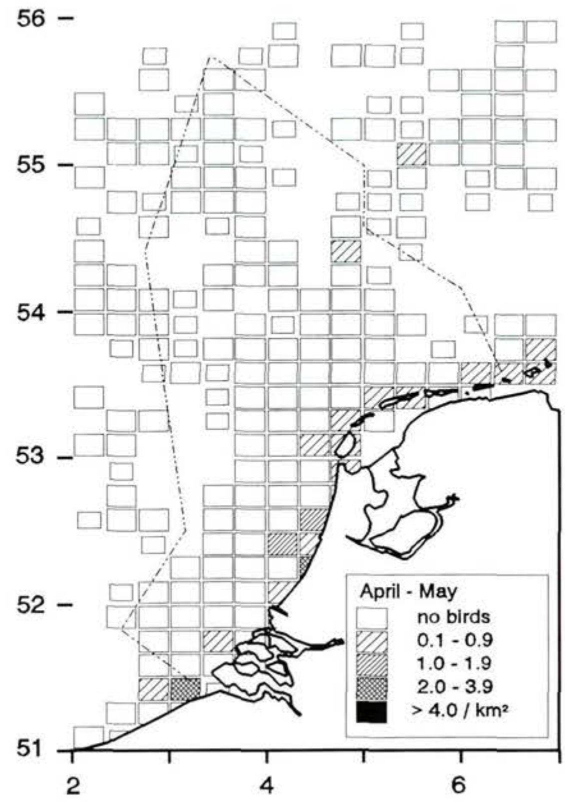


Figure 4.74 Distribution of Common Gull, April-May (n = 494)

In **February-March**, a contraction of Common Gull distribution towards the coastal strip was witnessed (figure 4.73). *Moderate to high densities* were frequently reported along the entire coastline, but only near the coast. Offshore densities were considerably lower than in winter. The overall estimates of numbers of Common Gulls in the southern North Sea had, as a result, declined to 34,300 in the coastal zone and 7100 offshore (table 4.2; 29,100 in the Dutch sector if the North Sea). Adults predominated again in these months, but immatures became progressively more numerous (table 4.9). Seawatching in Noord-Holland confirmed that Common Gulls were abundant in the coastal zone, but a signficant increase in numbers compared to December and January was not found (#3, #4). Especially in cold winters, substantial numbers of Common Gulls were found dead in these months (#2). Aerial surveys, in agreement with ship-based data, produced lower densities in the coastal strip than earlier in winter, and a lower overall estimate of numbers in the Dutch sector (*ca.* 8000). In conflict with the ship-based surveys was the *regular pattern of low densities everywhere south* of 54°N. Offshore sightings in the northern half of the study area, scattered low densities, were in agreements with ship-based surveys.

Most Common Gulls were associated with the colonies in **April-May**, and the decline in numbers witnessed in the coastal zone was mainly caused by a departure of mature birds (figure 4.74, table 4.9). Low to moderate densities occurred in most of the coastal zone, and were highest off the *mainland coast and in the Voordelta. Only a third* of the Common Gulls seen at sea in May were adults, indicating that most food during egg-laying was obtained on inland feeding sites (*cf.* Arbouw & Swennen 1980, 1985). Numbers of gulls in the coastal zone had fallen dramatically in these months and were estimated at 4800 individuals. Another 400 Common Gulls were estimated to occur offshore (table 4.2). Within the Dutch sec-

Table 4.9 Monthly age composition in Common Gulls (adult, immature and first year) in the southern North Sea, 1985-93.

Tabel 4.9 Maandelijkse leeftijdsverdeling van de Stormmeeuw (volwassen, onvolwassen en eerste jaars) in de zuidelijke Noordzee, 1985-93.

Month	adult	imm	first year	% adult	sample
Jan	3125	260	183	87.6	3568
Feb	2959	339	115	86.7	3413
Mar	1770	393	217	74.4	2380
Apr	316	258	48	50.8	622
May	41	21	48	37.3	110
Jun	67	15	1	80.7	83
Jul	183	11		94.3	194
Aug	56	4	16	73.7	76
Sep	46	37	81	28.0	164
Oct	1451	364	604	60.0	2419
Nov	1154	136	104	82.8	1394
Dec	431	38	23	87.6	492
Totals	11599	1876	1440	77.8	14915

tor some 3400 individuals were found. From coastal sites in Noord-Holland, predominantly northward movements were recorded, indicating spring migration of Common Gulls breeding elsewhere (#3, #4). Numbers declined gradually through May, but increased again in June when the chicks hatched, and the parents switched to marine prey. Aerial surveys produced a wider distribution pattern than ship-based surveys, with occasional high densities in the coastal strip (#1). It was estimated that *ca.* 5500 Common Gulls occurred in the Dutch sector of the North Sea.

Discussion and conclusions The southern North Sea appeared to be a very important wintering area for Common Gulls. Peak numbers observed in December-January, an estimated 80,400 individuals, formed around 5.0% of the NE Atlantic population (table 4.3; Rose & Scott 1994) and 60,800 of these gulls occurred within the Dutch sector of the North Sea. The coastal strip is of particular importance, because comparatively small numbers occurred offshore. Common Gulls were frequent scavengers at commercial trawlers (141 records, 10.6% of all identified gulls at trawlers, n= 63,523; Camphuysen 1993a), but mainly in winter and mainly in a narrow band along the coast. Larger groups of scavengers (>100 individuals), were only reported in winter and virtually all these groups were recorded within 10 km from the nearest shore. Only few summer and early autumn records are available (1 in May, 2 in June, 1 in July, none in August, 2 in September; usually less than 10 individuals). Obviously, discards formed a minor part of the diet for Common Gulls during chick rearing, or these scraps were obtained very closely to the coast. Common Gulls were only slightly less numerous than Black-headed Gulls among birds found dead on beaches between 1969 and 1985 (15.5% of all *Larus*-gulls found dead, n= 18,616; #2), but a considerably higher proportion of these birds were contaminated with oil (59.6%, n= 1800). This difference reflects the more pelagic lifestyle of Common Gulls in winter in comparison with Black-headed Gulls, which mainly stick to the coast. Most Common Gulls were found in winter, while post-fledging mortality was hardly recorded on the beaches. Apparently, juveniles leave Dutch coastal waters rather rapidly, a finding which was confirmed by seawatchers (a short peak of juveniles in late July/early August). The differences between aerial surveys and ship-based surveys were even more remarkable than in Black-headed Gulls. Ship-based surveys produced a pattern of a highly coastal species which occurs in very large numbers in autumn and winter, aerial surveys suggested that this species was widespread in all seasons through most of the Southern Bight and off the Wadden Sea islands. We suggest that misidentifications from the faster plane (200 km/hr), from which observers have less than five seconds to distinguish similar looking species like Common Gull, Herring Gull and Kittiwake (#1), are a likely source of error in this case. Estimates derived from ship-based surveys were considerably higher than estimates from aerial studies when high densities were present (winter), but lower when Common Gulls were scarce (summer).

Lesser Black-backed Gull *Larus fuscus*

Lesser Black-backed Gulls bred first in 1926 in the Netherlands, and numbers increased steadily since, particularly since the late 1960s (Noordhuis & Spaans 1992). In 1985, the Dutch population numbered an estimated 19,000 pairs (14,100 pairs Wadden Sea area, 2800 mainland coast, 2100 Delta area; Spaans 1987b). In 1990, the population was estimated at just over 24,000 pairs (12,332 pairs Wadden Sea area, 3547 mainland coast, 9279 Delta area; Arts 1993). Ter-

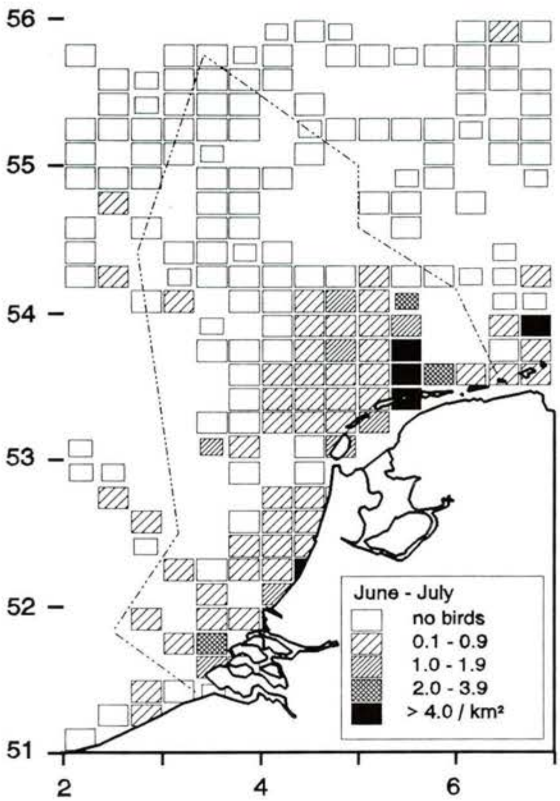


Figure 4.75 Distribution of Lesser Black-backed Gull, June-July (n= 2414)

schelling has always been the most important colony in the Netherlands. In the late 1960s, only several hundreds of pairs of Lesser Black-backed Gulls bred on the island. In 1985 this colony numbered 13,000 pairs (Spaans 1987b), but in 1990 the colony was found to have declined to 10,200 pairs (Arts 1993). The colony which became established at the Maasvlakte (Delta area) has increased spectacularly during the last few years. In 1985, this colony was estimated to number 400 pairs, whereas in 1990 some 6500 Lesser Black-backed Gulls nested here (Spaans 1987b, A.J. van Dijk, SOVON unpublished data).

Lesser Black-backed Gulls were the most numerous and widespread *Larus*-gull in the southern North Sea in summer, **June-July** (figure 4.75). Off the Wadden Sea islands, high densities were found near Terschelling, moderate to low densities elsewhere. Sightings were frequent at considerable distances from the coast and the Friese Front area and Terschellingerbank were regions where mature birds were common and often numerous. Large flocks of adult Lesser Black-backed Gulls were seen to join commercial trawlers in these months (Camphuysen 1993ac). Moderate to high densities were also found occasionally along the mainland coast and in the Voordelta, and low densities occurred in a wide band off the coast. It was estimated that 20,200 Lesser Black-backed Gulls occurred in the coastal zone, plus another 37,200 individuals offshore (13.0% of the NE Atlantic population; table 4.2, 4.3; Rose & Scott 1994). Some 36,300 Lesser Black-backed Gulls were estimated to occur within the Dutch sector of the North Sea. Just over 90% of all Lesser Black-backed Gulls were adults (table 4.10). From coastal sites, Lesser Black-backed Gulls were recorded as an abundant species, without any preferential direction of movement being observed (#3, #4). Apparently, most movements observed from the shore were feeding flights of mature birds towards and from the colonies. From aerial surveys, it was concluded that Lesser Black-backed Gulls occurred widespread in low densities south of 54°N, with moderate to high densities near the coast (#1). It was estimated that around 15,000 Lesser Black-backed Gulls were present in the Dutch sector during 1985-88, and over 25,000 individuals in 1989-92, a difference that remains unexplained.

After fledging of the offspring, **August-September**, the proportion of adult Lesser Black-backed Gulls at sea declined gradually (81.9% adult in August, 60.4% in September; table 4.10). The species was still numerous and widespread in a broad band off the coast, but fewer birds were found the reach the Friese Front area and larger numbers were found off the mainland coast (figure 4.76). It was estimated that around 16,200 Lesser Black-backed Gulls occurred int he coastal zone in these months and another 18,600 offshore (24,600 in the Dutch sector). Hence, with nearly 8% of the NE Atlantic population of this species in the southern North Sea, these waters were still of international importance for Lesser Black-backed Gulls. Numbers of Lesser Black-backed Gulls seen from coastal sites increased sharply in these months and the dominant direction of flight (westward along the Wadden Sea islands and southwestward along the mainland coast) marked the departure of this species from Dutch waters. Many hundreds, up to a few thousands of Lesser Black-backed Gulls could be seen

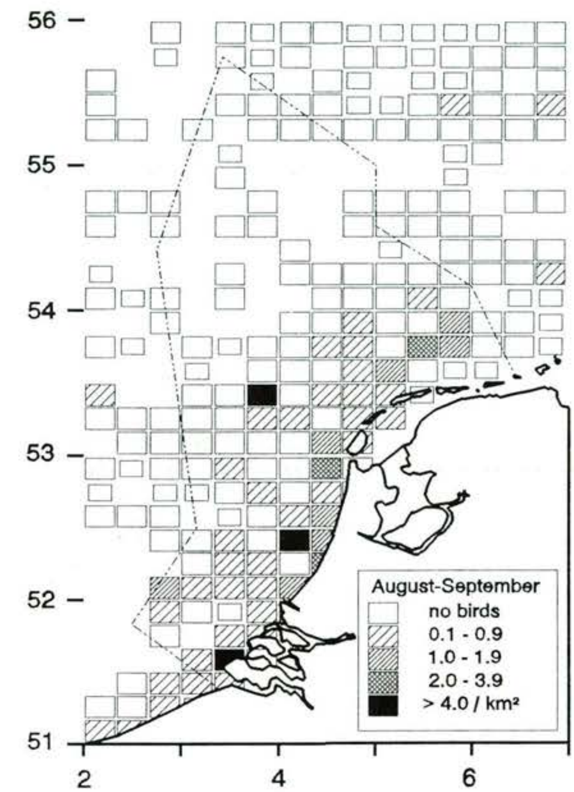


Figure 4.76 Distribution of Lesser Black-backed Gull, August-September (n = 2769)

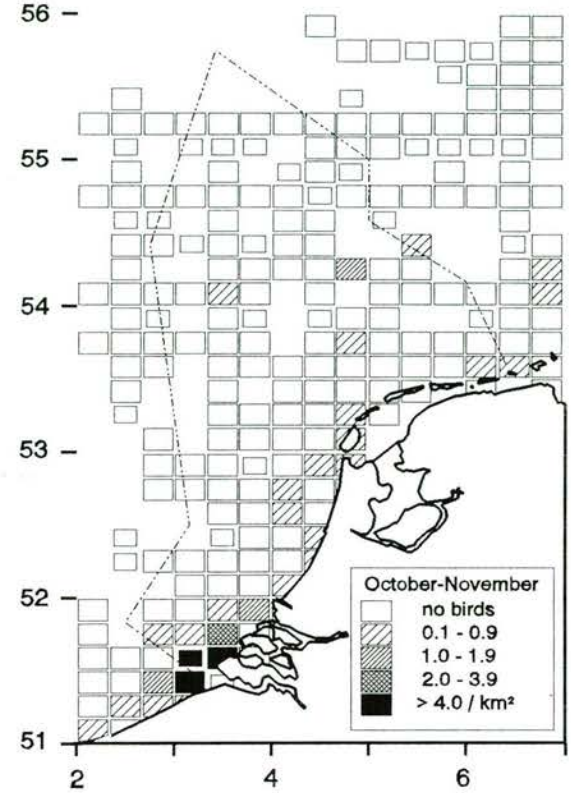


Figure 4.77 Distribution of Lesser Black-backed Gull, October-November (n = 1587)

heading south on a single day in September (#3, #4). The distribution pattern derived from aerial surveys was similar to that described for ship-based surveys, with scattered moderate to high densities inshore and an broad band of low densities offshore (#1). Also, numbers estimated to occur in the Dutch sector (13,500) had declined compared to June-July.

Numbers declined rapidly in **October-November**, and the southward departure was clearly reflected in the distribution pattern found (figure 4.77). Moderate to high densities were mainly recorded in the Voordelta area, whereas off the Wadden Sea islands Lesser Black-backed Gulls were comparatively scarce. Immatures and juveniles were the first to leave the area, considering the proportion of adults which increased in November when total numbers became quite small (table 4.10). It was estimated that 19,600 Lesser Black-backed Gulls occurred in coastal waters (while numbers in November were distinctly smaller than in October), plus some 4900 individuals offshore (table 4.2). Of these, some 15,300 individuals were in the Dutch sector of the North Sea. Massive southward movements, as recorded from coastal sites, of Lesser Black-backed Gulls continued in early October, but numbers declined rapidly in November (#3, #4). Juveniles were comparatively scarce during these passages, perhaps because these birds are difficult to separate from juvenile Herring Gulls and therefore overlooked. The departure of Lesser Black-backed Gulls and the displacement of the zone with highest densities to the south was much less obviously recorded in aerial surveys (#1). From these counts, it was concluded that Lesser Black-backed occurred still in a very wide band along the entire coast, in fact a similar distribution pattern as described for aerial surveys in June-September, but with lower densities near the coast. It was estimated that between 7000 and 10,000 Lesser Black-backed Gulls occurred in the Dutch sector.

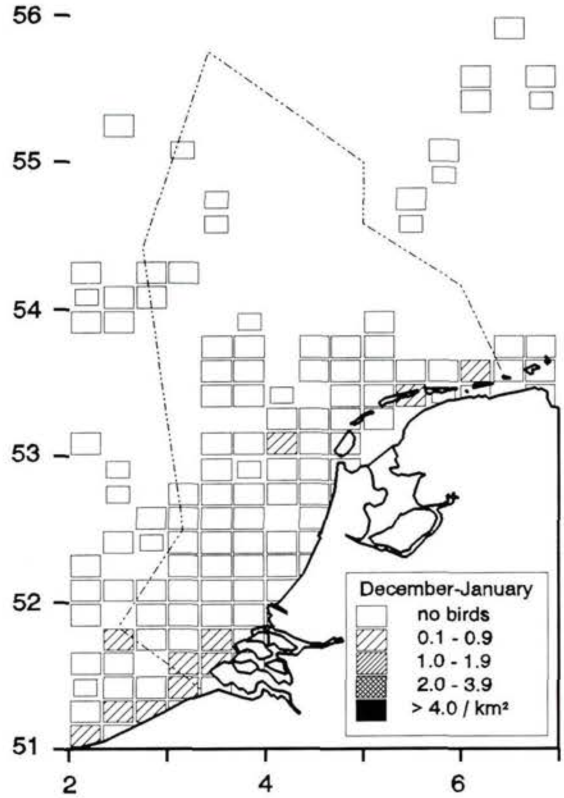


Figure 4.78 Distribution of Lesser Black-backed Gull, December-January (n= 70)

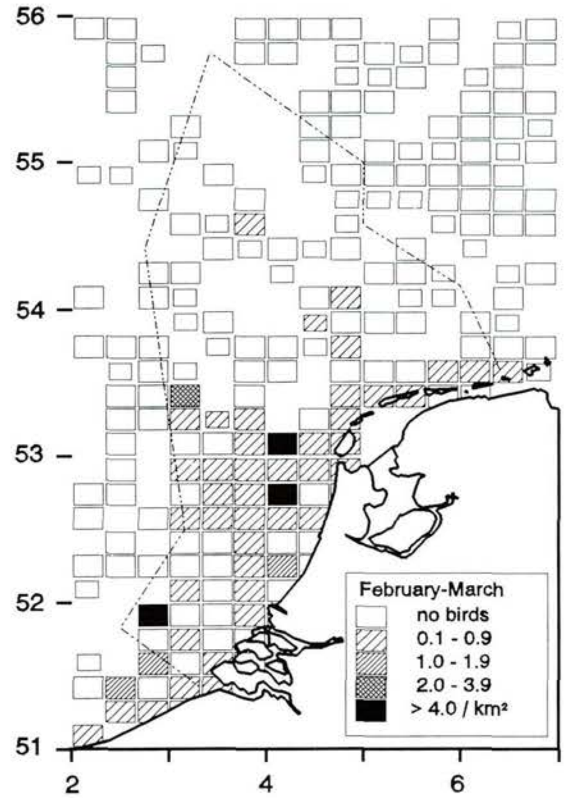


Figure 4.79 Distribution of Lesser Black-backed Gull, February-March (n= 670)

Low densities were recorded in winter, **December-January**, with Lesser Black-backed Gulls being most frequently reported off Belgium (figure 4.78). Just over 80% of the gulls were adults (table 4.10) and it was estimated that 700 Lesser Black-backed Gulls occurred in the coastal zone, plus another 500 offshore. The fact that the northern half of the offshore zone was poorly surveyed is not important for this species. Only 800 Lesser Black-backed Gulls were found in the Dutch sector. Numbers of Lesser Black-backed Gulls reported during seawatching were very low, and most birds were seen along the coast of Zuid-Holland (#3, #4). Aerial surveys produced a pattern of scattered low densities, everywhere south of 54°N (#1) and an estimate of total numbers in the Dutch sector in the range of 2000 birds. The even distribution and the fact that estimates are now suddenly considerably higher than estimates from ship-based surveys make it tempting to speculate that Great Black-backed Gulls were frequently mistaken for its smaller lookalike, the Lesser Black-backed Gull (as already suggested in #1).

Lesser Black-backed Gulls returned in **February-March**, particularly in the Southern Bight (figure 4.79). Low densities were found off the Wadden Sea island and the Friese Front area was not of significance for the species in early spring. Some 90.0% of the gulls were adults (n= 1435; table 4.10) and it was estimated that 2800 individuals occurred in the coastal zone, plus 9800 offshore (9300 in the Dutch sector). In fact, along the mainland coast Lesser Black-backed Gulls were most numerous at some distance away from the coast, as if it were a truely offshore species. Very small numbers of Lesser Black-backed Gulls were recorded from coastal sites, but a gradual return was witnessed during late March, particularly along the coast of Zuid-Holland (#3, #4). Aerial surveys produced a similar distribution pattern, except that patches with higher densities did not occur (#1). Instead of a return of Lesser Black-

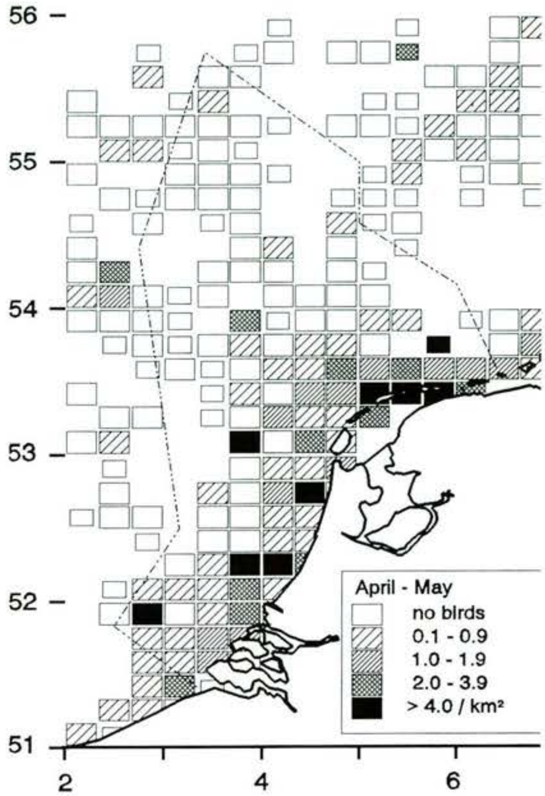


Figure 4.80 Distribution of Lesser Black-backed Gull, April-May (n= 4662)

backed Gulls, documented both in seawatching data and ship-based surveys, the estimate of 1500 individuals from aerial surveys, lower than in December/January, would indicate that numbers in Dutch waters had stabilized since early winter.

Very high numbers were recorded in **April-May**, in the beginning of the breeding season. Highest densities were found around Terschelling, but moderate to high densities occurred everywhere along the coast. Offshore sightings were frequent, this obviously partly being caused by migrant birds (Doggersbank, Nordschillgrund, Outer Silver Pit), but also by birds frequenting the Friese Front and Terschellingerbank areas (figure 4.80). It was estimated that 29,800 Lesser Black-backed Gulls occurred in the coastal zone, plus as many as 53,100 offshore (18.2% of the NE Atlantic population; table 4.2, 4.3; Rose & Scott 1994). Of these gulls, 57,900 individuals were found in the Dutch sector of the North Sea. Adult gulls predominated (86.9%, n= 6513; table 4.10). Numbers of Lesser Black-backed Gulls seen during seawatching increased rapidly during these monhts, and northward passages predominated (#3, #4). Aerial surveys produced a similar distribution pattern, except that moderate densities occurred seldom in the coastal strip and high densities were not found (#1). It was estimated from these counts that around 19,000 Lesser Black-backed Gulls occurred in the Dutch sector, indicating a very sudden return of the species compared to the previous period.

Discussion and conclusions Lesser Black-backed Gulls are the only truely marine species of gull breeding in the Netherlands. High densities occurred around colonies in the breeding season, but adults were found venturing out to sea over considerable distances. Peak numbers were found in April-July (over 80,000 individuals in the southern North Sea, some 58,000 of which within the Dutch sector), when the majority of these gulls were adults. Considering the Dutch breeding population (24,000 pairs in 1990), it is obvious that a substantial proportion of the food of this gull is obtained at sea. In April-May, over 18% of the NE Atlantic population was estimated to occur in the southern North Sea, indicating the international importance of this area for this species. Lesser Black-backed Gulls were frequent scavengers in the southern North Sea in summer (Camphuysen 1993a). Large flocks (≥ 500) Lesser Black-backed Gulls were observed attending trawlers during May-July. This species was found dispersed at considerably larger distances from the shore than the Herring Gull, but it should still be considered a coastal species. As a dominating species (>50% of the birds behind a trawler), Lesser Black-backed Gulls were frequently encountered in a zone within 50 km from the coast. Off the mainland coast, Herring Gulls were always dominating over Lesser Black-backed Gulls within 20 km from the shore. Commercial fisheries were found to form an important source of food for Lesser Black-backed Gulls nesting on the Wadden Sea islands (Noordhuis & Spaans 1992, Camphuysen 1993c, Camphuysen 1994a). Drastic changes in fishing effort should therefore carefully be evaluated in the light of possible effects on breeding success or population dymamics of this species. The relative importance of pelagic shoaling fish like herring for breeding Lesser Black-backed Gulls needs further investigations. It has been shown that food-limitations have caused a decline

Table 4.10 Monthly age composition in Lesser Black-backed Gulls (adult, immature and first year) in the southern North Sea, 1985-93.

Tabel 4.10 Maandelijkse leeftijdsverdeling van de Kleine Mantelmeeuw (volwassen, onvolwassen en eerste jaars) in de zuidelijke Noordzee, 1985-93.

Month	adult	imm	first year	% adult	sample
Jan	103	5	16	83.1	124
Feb	78	9	22	71.6	109
Mar	1214	78	34	91.6	1326
Apr	2371	183	22	92.0	2576
May	3291	430	216	83.6	3937
Jun	2001	183	28	90.5	2212
Jul	3327	293	63	90.3	3683
Aug	2602	78	497	81.9	3177
Sep	1565	119	907	60.4	2591
Oct	910	72	369	67.4	1351
Nov	333	19	39	85.2	391
Dec	38	1	6	84.4	45
Totals	17833	1470	2219	82.9	21522

in breeding success in recent years and also that the few seasons which have been successful could be characterised by adults feeding chicks with herring (Spaans 1994). Lesser Black-backed Gulls were found in small numbers on the beach (2.6% of all *Larus*-gulls found dead, n= 18,616; #2), 40.3% of which were oiled. The main reason for these small numbers were the fact that Lesser Black-backed Gulls were primarily summer birds, while beached bird surveys and most seabird mortality is concentrated in winter. Post-fledging mortality was found on a small scale, compared to the massive mortality of juvenile Herring Gulls in most (late) summers.

From aerial surveys, the changes in the abundance and spatial distribution of this species were not as obvious as ship-based data suggest. Considering the aggregations of Lesser Black-backed Gulls near fishing vessels, it is difficult to explain the lack of 'high density' squares in the maps from aerial surveys (#1). A comparatively high effort, which would have smoothed these clusters to a long-term lower average was suggested by H. Baptist (*in litt.*) to be the reason for this. However, given that clusters of hundreds of birds regularly occur, encountering one such cluster is a square would give that square the highest density class for the next ten years (calculated from effort data in #1). The departure of this species from the southern North Sea was obvious considering the total numbers estimated to occur, but not very well demonstrated in the distribution patterns. Estimates of total numbers ranged from figures well below those found in ship-based surveys in summer, to roughly equal numbers during spring and autumn migration and higher figures in winter. A wide band of low densities, nearly homogeneous over the entire southern half of the Dutch sector, only interrupted by patches of moderate to high densities in the coastal strip between April and September was found.

Herring Gull *Larus argentatus*

Herring Gulls were abundant, particularly in coastal waters, whereas Yellow-legged Gulls were only rarely observed. In the Netherlands, numbers of Herring Gulls have increased quite spectacularly during this century (Spaans 1987a). Until the mid-1960s, Herring Gulls were severely persecuted and numbers were kept around 20,000 pairs between the 1930s and 60s (Noordhuis & Spaans 1992). The effect of persecution was clearly shown some three years after it stopped: an annual increase of 15% until 1976 (Spaans 1987a). During 1976-1984, numbers increased some 8% per annum. Breeding numbers peaked during 1984-85 (*ca.* 88,500 pairs; Spaans 1987ab) but have declined since. In 1990, the total population was estimated at 69,936 pairs (Arts 1993). In the late 1960s, some 6000-8000 pairs of Herring Gulls bred on Terschelling, which has always been an important colony in the Netherlands. In 1982-83, the number had increased to just over 21,000 pairs (Noordhuis & Spaans 1992). In 1985, however, this colony numbered 16,800 pairs (Spaans 1987b), and in 1990 it was found to have declined to 8099 pairs (Arts 1993). The colony which became established at the Maasvlakte (Delta area) has increased spectacularly during the last few years. In 1985, this colony was estimated to number 800 pairs, whereas in 1990 some 2500 pairs of Herring Gulls nested here (Spaans 1987b, Arts 1993). Other important colonies in 1990 were Rottumeroog/-plaat (8658 pairs), Vlieland (10,000 pairs), Texel (8804 pairs), Schouwen, Delta area (7006 pairs), and Saeftinge (7000 pairs; SOVON unpubl. data).

In summer, **June-July**, Herring Gulls were abundant at sea, but only just near the coast (figure 4.81). Moderate to high densities were found off

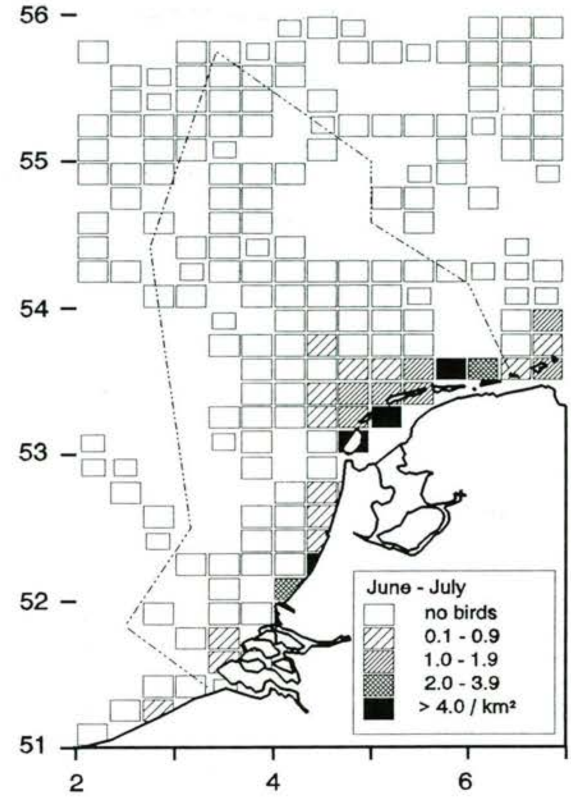


Figure 4.81 Distribution of Herring Gull, June-July (n = 1250)

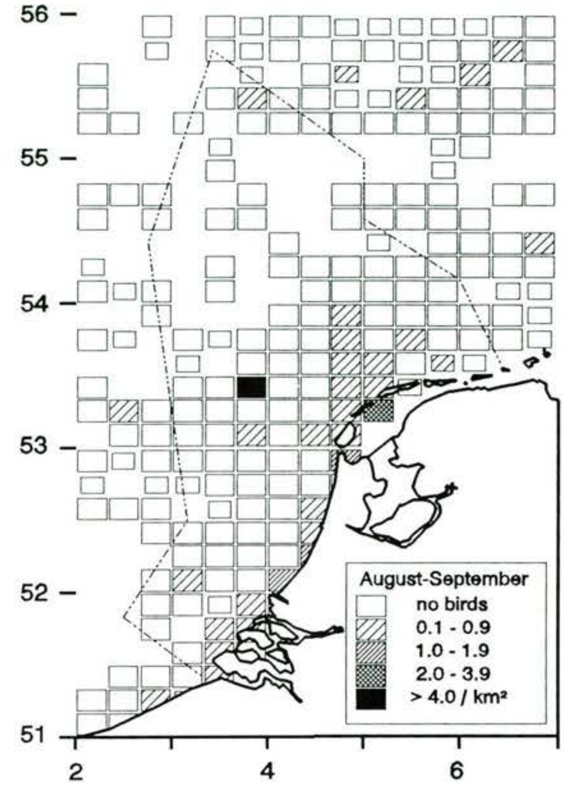


Figure 4.82 Distribution of Herring Gull, August-September (n = 599)

the Wadden Sea islands and off the mainland coast of Zuid-Holland. Large numbers of Herring Gulls, feeding at sea or associated with commercial trawlers, were almost exclusively found within 10km from the coast (Camphuysen 1993a). Over 90% of all Herring Gulls at sea were adults (table 4.11) and it was estimated that some 14-,500 individuals occurred in the coastal zone and only 1600 offshore (table 4.2). Of these, 14,700 Herring Gulls were found in the Dutch sector of the North Sea. Herring Gulls were not systematically recorded from seawatching sites, except in Camperduin (Noord-Holland) since 1989. Hence, data of only one year and one site were available for comparisons (#4). June and July were characterized by massive movements of Herring Gulls in both directions along the mainland coast of Noord-Holland. Obviously, these were mainly feeding flights of mature birds in the coastal zone. In late summer, large numbers of dying and dead juvenile Herring Gulls were found on most beaches: post-fledging mortality. The scale of this mortality fluctuated between years (#2, NZG/NSO unpubl. data). In June-July 1984, large numbers of dying and dead Herring Gulls were found on the mainland coast of Noord-Holland (3 corpses per km beach; #2). Very few of these juveniles were oil contaminated, but most were severely emaciated. Aerial surveys produced a distribution pattern which was quite different from that described here (#1). Moderate to high densities were found in the coastal strip, but otherwise the species was found to be widespread over most of the Dutch sector, at least south of 54°N. The Herring Gull thus seemed an equally offshore species as the Lesser Black-backed Gull, while the ship-based surveys showed it to be a much more inshore bird. From aerial surveys, an estimate of *ca.* 24,000 Herring Gulls for the Dutch sector was made.

In **August-September**, numbers of Herring Gulls in the coastal zone declined considerably, whereas slightly more offshore sightings were reported

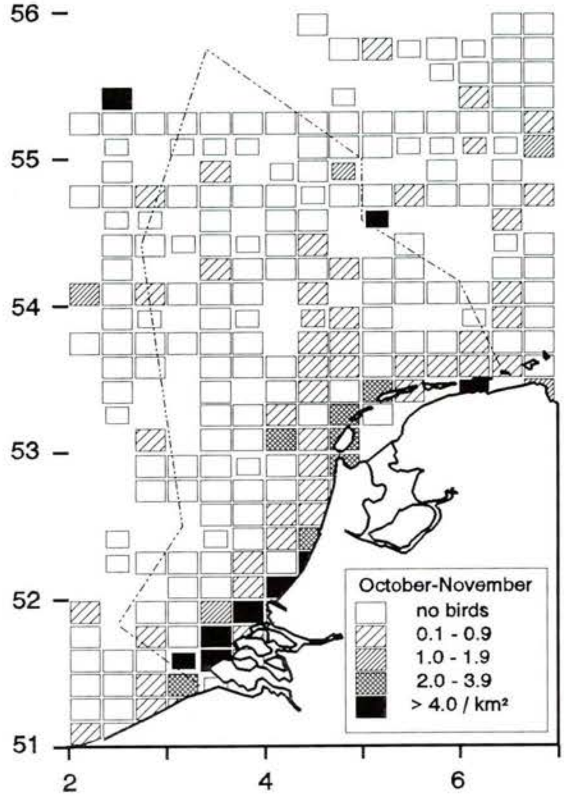


Figure 4.83 Distribution of Herring Gull, October-November (n= 5021)

(figure 4.82). The drop in numbers along the coast was also very obvious among scavengers associated with commercial trawlers (Camphuysen 1993a). The proportion of adult birds at sea fell sharply, to 67.0% (n= 552) in August and 16.6% in September (n= 657; table 4.11), indicating that most breeding birds had left the sea during the post-nuptial (primary) moult. Estimates of total numbers arrived at 3800 for the coastal zone and 3000 offshore (table 4.2; only around 5000 in the Dutch sector). Numbers observed from the coast of Noord-Holland declined sharply in August, to a level of less than ten birds per hour in either direction during August and September (#4). Post-fledging mortality was frequently reported in these months and could occur on a large scale in all coastal provinces. Very large numbers were found August 1979, September-October 1979, September 1981, 1982, 1983, 1984 and 1989 (#2, NZG/NSO unpubl. data). Just as in June and July, aerial surveys produced a pattern of occurrence over a much wider area in the North Sea (#1). The estimated number on the basis of these surveys was *ca.* 9750 individuals.

Herring Gulls suddenly became abundant at sea in autumn, **October-November**, particularly in the coastal zone and most notably in the Voordelta (figure 4.83). Offshore sightings became more frequent and Herring Gulls could be seen everywhere in the study area during these monhts. Adults were still comparatively scarce, but the overall proportion increased from 34.0% in October (n= 2576) to 66.9% in November (n= 2322; table 4.11). It was estimated that some 46,300 Herring Gulls occurred in the coastal zone and 28,000 offshore in these months (table 4.2; 51,900 within the Dutch sector of the North Sea). Numbers of Herring Gulls observed during seawatching in Noord-Holland remained rather low, but a remarkable increase in numbers was witnessed during late November/early December (#4). These data are not in agreement with the seasonal pattern described from ship-based surveys. Fewer juveniles were found dead on the coast, but densities increased gradually in November. Oil contamination of the feathers was a factor which was more important in Herring Gulls in winter than in late summer and early autumn (#2). The increase in numbers was less dramatic in data from aerial surveys (#1). It was estimated that around 22,000 Herring Gulls occurred in the Dutch sector. Moderate to high densities were found near the coast, whereas low densities extended over a much wider area.

Numbers of Herring Gulls further increased in winter, **December-January**, and the lack of widespread surveys in the northern half of the study area is to be pitied here (figure 4.84). An estimated 108,800 Herring Gulls were thought to occur in the coastal zone, apparently filling a niche which was just abandoned by Lesser Black-backed Gulls. A tentative estimate of 62,500 Herring Gulls offshore (over only 70% of the offshore area; table 4.2) indicates that at least 12% of the NE Atlantic population of Herring Gulls might occur in the southern North Sea in winter (*cf.* Rose & Scott 1994). The estimate for the Dutch sector of the North Sea is *ca.* 117,500 individuals. Over two-thirds of the Herring Gulls wintering in the southern North Sea were adults (71.3%, n= 9877; table 4.11). Very large numbers of Herring Gulls were observed from the coast of Noord-Holland in December, whereas numbers

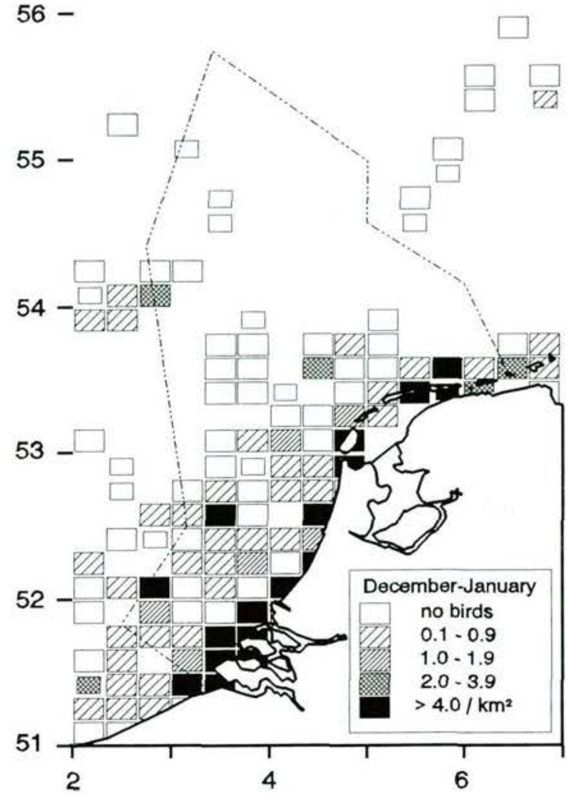


Figure 4.84 Distribution of Herring Gull, December-January (n= 10,679)

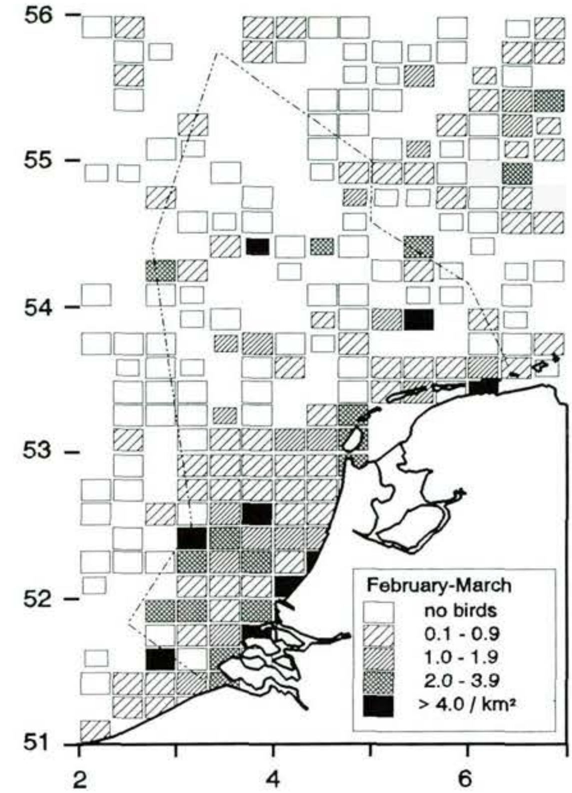


Figure 4.85 Distribution of Herring Gull, February-March (n= 9253)

were quite small in January (#4). The fact that these data are only collected in one year make further comparisons superfluous. Severe winters could produce large numbers of starved Herring Gulls on the beach. Numbers of Herring Gulls washing ashore were particularly large in 1979, 1982, 1985, 1987 (#2). From aerial surveys it was estimated that around 56,000 Herring Gulls occurred within the Dutch sector. Hence, the increase found in ship-based survey results was confirmed but seemed much less dramatic.

Herring Gulls were widespread, both inshore and offshore, in **February-March** (figure 4.85). Moderate to high densities were found in most of the Southern Bight, along the coast and in places in the Nordschillgrund area. A North Sea wide survey in February 1993 showed that Herring Gulls were among the most abundant and numerous offshore species all over the North Sea (Camphuysen *et al.* 1993). Nearly half a million birds were thought to occur in the North Sea at large in February (ESAS unpubl. data) and estimates derived from ship-based surveys in the southern North Sea indicated that around 25% of these birds were found here (55,100 individuals in the coastal zone, 75,900 offshore; table 4.2; just over 100,000 individuals in the Dutch sector). The proportion of adults in these months ranged from 69.5% in March (n= 4524) to 72.8% in February (n= 5631), a similar figure as found earlier in winter. Low to moderate numbers of Herring Gulls were recorded in Noord-Holland during seawatching, without any preferential direction (#4). Strandings of fresh, dead Herring Gulls declined in these months, but old corpses continued to wash ashore in substantial quantities (#2). The distribution pattern deduced from aerial surveys (#1) was similar to that from ship-based work. The estimate of total numbers in the Dutch sector was again comparatively low (50,000 birds).

The early breeding season, **April-May** led to a major contraction of birds away from the offshore

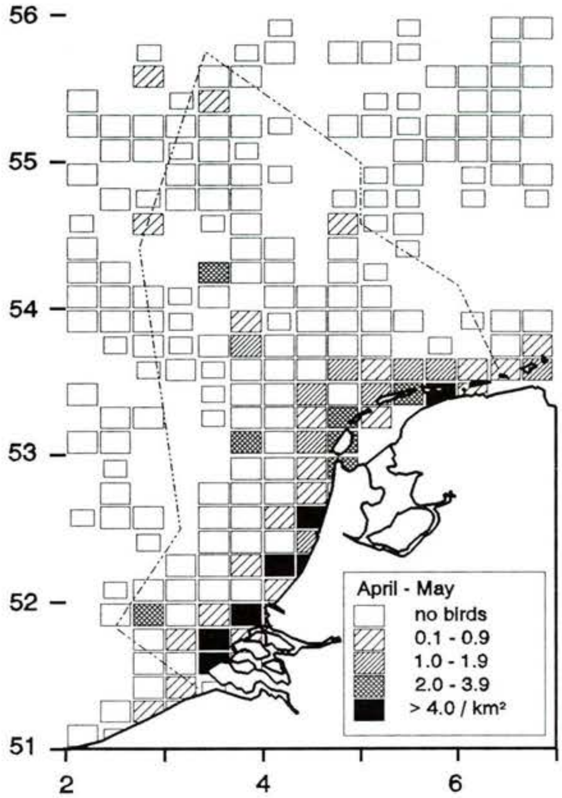


Figure 4.86 Distribution of Herring Gull, April-May (n= 3816)

zone, into coastal waters (figure 4.86). High densities were found inshore in the Voordelta and along the mainland coast of Zuid-Holland, moderate to high densities occurred elsewhere closely to the coast. Scattered sightings offshore occurred, mainly of immature gulls. It was estimated that 35,800 Herring Gulls occurred in the coastal zone in these months, plus another 9500 individuals offshore. Nearly 40,000 Herring Gulls occurred in the Dutch sector of the North Sea. Adult birds formed just over half of the Herring Gulls found at sea (63.1% in April, n= 2603, 56.4% in May, n= 2481), indicating that for breeding Herring Gulls, feeding areas other than the coastal zone were of great significance for this species (*cf.* Spaans 1971, Noordhuis 1987, Noordhuis & Spaans 1992). Low to moderate numbers of Herring Gulls were recorded in Noord-Holland during seawatching, flying in equal numbers in both directions (#4). The contraction towards the coast was also noticed during aerial surveys, but Herring Gulls were still also a widespread species in the offshore zone (#1). It was estimated that some 21,000 Herring Gulls occurred in the Dutch sector.

Discussion and conclusions Herring Gulls were strictly confined to coastal waters during the breeding season and obviously obtained most of their food in these months on land, in the littoral zone or in the Wadden Sea (*cf.* Spaans 1971). Most gulls were found within 5 km of the nearest coast. Immediately after fledging of the young, the numbers of gulls at sea (and associated with commercial trawlers near the coast; Camphuysen 1993a), fell dramatically, indicating that the post-nuptial wing moult was spent on or at least very much near land. In autumn, a rapid increase in numbers was witnessed leading to very high numbers at sea in winter. Peak numbers were observed in winter (estimated over 170,000 individuals, or 12.2% of the NE Atlantic population, table 4.3; Rose & Scott 1994). In winter, Herring Gulls were more widespread and occurred scattered over the offshore zone. Substantial concentrations could be observed at trawlers or associated with offshore installations. Herring Gulls were the most numerous and most frequent scavengers behind commercial trawlers in the southern North Sea (287 records, 48.6% of all identified gulls, n= 63,523; Camphuysen 1993a). Herring Gulls have been observed as scavengers throughout the year, but least frequently in late summer (July-September). In summer, it was essentially a coastal species as a scavenger, while in winter this species appeared as a widespread and common scavenger offshore (Camphuysen *et al.* 1993). As a dominating species at trawlers, Herring Gulls were mainly found within 10 km from the coast off the Delta area and off the Wadden Sea islands and within 20 km from the shore off the mainland coast. Larger groups (>50 individuals) were most frequent from October through July (24-50% of all trawlers with scavenging seabirds), but remarkably absent in August and September (in total 9 flocks of scavenging Herring Gulls, 8 of which less then 10 individuals). Some very large flocks of scavenging Herring Gulls were observed in July, while other large groups of scavenging Herring Gulls (>500 individuals), sometimes joined by Common Gulls and/or Great Black-backed Gulls, were reported during January-March, usually within 10 km from the shore. One record included three scavenging adult **Yellow-legged Gulls** *Larus cachinnans* in a mixed group of 6 species of gulls, some 50 km off the coast of the Delta area

Table 4.11 Monthly age composition in Herring Gulls (adult, immature and first year) in the southern North Sea, 1985-93.
Tabel 4.11 Maandelijkse leeftijdsverdeling van de Zilvermeeuw (volwassen, onvolwassen en eerste jaars) in de zuidelijke Noordzee, 1985-93.

Month	adult	imm	first year	% adult	sample
Jan	6345	959	1469	72.3	8773
Feb	4102	727	802	72.8	5631
Mar	3143	876	505	69.5	4524
Apr	1642	822	139	63.1	2603
May	1399	529	553	56.4	2481
Jun	1482	146	14	90.3	1642
Jul	1174	44	12	95.4	1230
Aug	370	31	151	67.0	552
Sep	109	117	431	16.6	657
Oct	877	345	1354	34.0	2576
Nov	1554	202	566	66.9	2322
Dec	699	198	207	63.3	1104
Totals	22896	4996	6203	67.2	34095

(51°43'N, 02°45' E; Camphuysen 1993a). Of 18,616 *Larus*-gulls dead stranded during 1969-85, 48.2% were Herring Gulls, making it by far the most numerous species of this genus (#2). Of all Herring Gulls found dead, 32.9% were oil fouled (n= 6065). Post-fledging mortality contributed significantly to these figures, even despite the fact that beached bird surveys were conducted infrequently in late summer. The oil rate in winter was distinctly higher than the overall rate mentioned above, and considering the numbers of oiled Herring Gulls sometimes visible in flocks resting on the beach, the impact of oil pollution on this species is perhaps underestimated. In Herring Gulls, frequent entanglements in fishing gear (nylon thread) were recorded (Camphuysen 1990a, Camphuysen 1994b). In severe winters, large numbers of Herring Gulls died through starvation and the proportion of gulls found contaminated with oil was than significantly below that in 'normal' winters (#2).

An apparent difference between results of aerial and ship-based surveys was the much wider area in which Herring Gulls were reported from the air, but this may be partly effort related. However, considering that vessels may attract these birds and, hence, overestimates are likely to occur, a wider distribution (a large 'grey' area on distribution maps) was more likely to be found from ship-

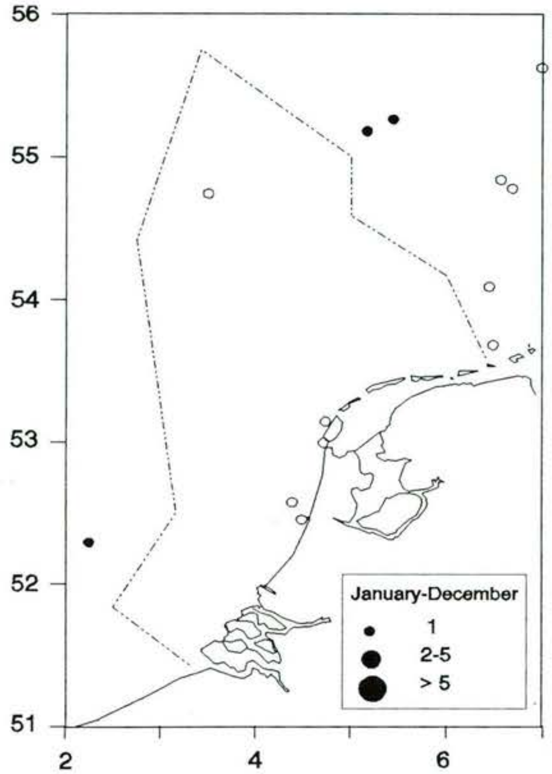


Figure 4.87 Sightings of Iceland Gulls (•, n= 3) and Glaucous Gulls (○, n= 11), January-December

based surveys. Abundance estimates were usually a lot lower than from ship-based surveys, except in summer and late summer when numbers at sea were relatively small.

Iceland Gull *Larus glaucoides*
Glaucous Gull *Larus hyperboreus*

Iceland Gulls (3 sightings) were exclusively seen in winter, but Glaucous Gulls (11) were occasionally seen during most of the year. Iceland Gulls are rare in the southern North Sea (#3, #4, Tasker *et al.* 1987) and are very difficult to identify with certainty (Hedgren & Larsson 1973, Hume 1980, Thomas & Andresen 1986). Because the authenticity of records of Iceland Gulls has not been checked, it is possible that these records were actually referring to the larger species. Four records of Glaucous Gulls were near the coast, all others were scattered offshore and mainly north of 53°30'N (figure 4.87). Plumages recorded

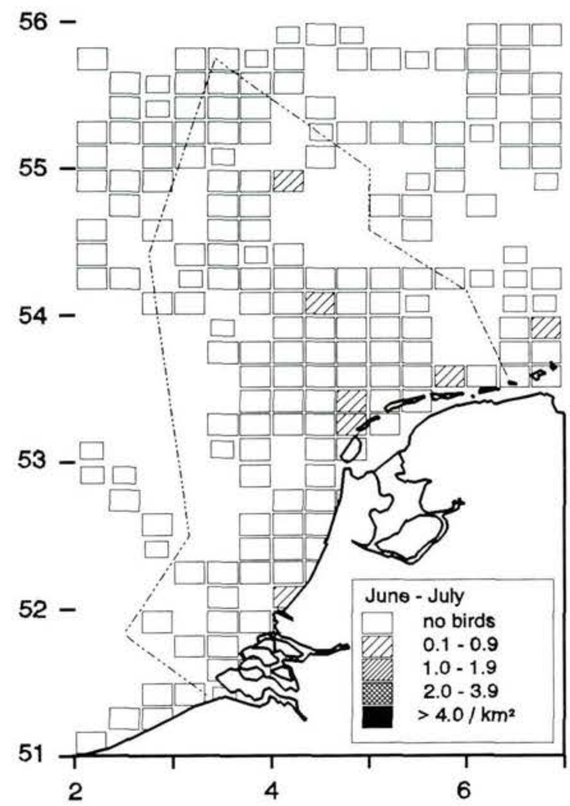


Figure 4.88 Distribution of Great Black-backed Gull, June-July (n= 24)

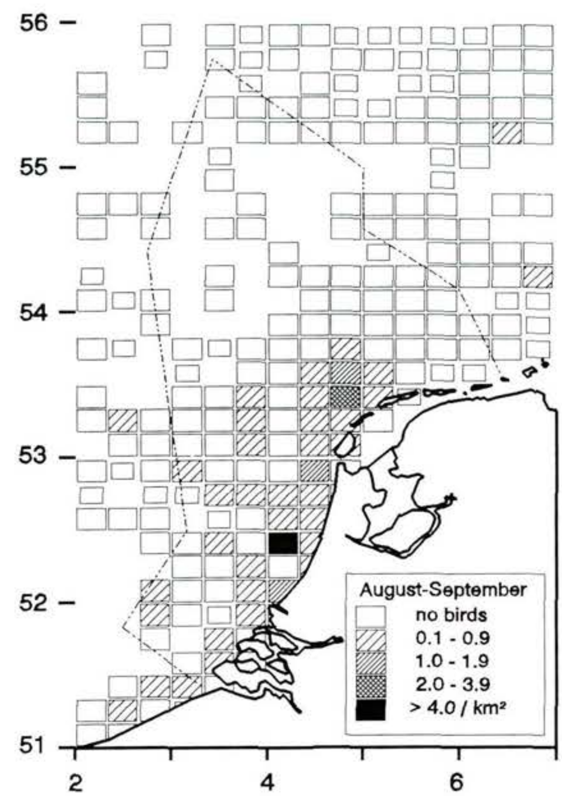


Figure 4.89 Distribution of Great Black-backed Gull, August-September (n= 1132)

were 2 adult, 3 immature and 6 juvenile Glaucous Gulls and 2 adult and 1 juvenile Iceland Gull. At coastal sites, Glaucous Gulls and Iceland Gulls were seen in a ratio of 14 : 1 (#3, #4). Strandings of seabirds during 1969-85 included 6 Glaucous Gulls and one Iceland Gull (0.04% of all *Larus*-gulls found dead, n= 18,616; #2). During aerial surveys, 24 Glaucous (or Iceland) Gulls were spotted, which is a considerably larger number than expected from ship-based surveys (#1). Considering that 71% of these gulls during ship-based surveys were seen outside the transect (*cf.* discussion in skuas), whereas the records from the aircraft applied only to gulls within transect (150m on each side of the aircraft; #1), a much smaller figure from the latter source would have been expected.

Great Black-backed Gull *Larus marinus*

Great Black-backed Gulls did not breed in the Netherlands during our work, except a single pair in the Delta area in 1993 (Vercruijsse & Spaans 1994). This species is a common winter visitor in the Netherlands, being most numerous between September and March (#3, #4).

Scattered low densities were found in summer, **June-July**, particularly off the Wadden Sea islands (figure 4.88). Many gulls were immatures (50.0%, n= 86) and, obviously, all birds classified as adults were non-breeders (table 4.12). It was estimated that 200 Great Black-backed Gulls occurred in the coastal zone, with another 900 individuals offshore (table 4.2). Around 700 individuals were calculated to occur within the Dutch sector of the North Sea. From seawatching sites, only very small numbers of Great Black-backed Gulls were seen in June, while numbers gradually increased in July (#3, #4). Adults were slightly more numerous than immatures in both months (#3). Strandings or Great Black-backed Gulls were very scarce in these months (#2). Sightings during aerial surveys were more wide-spread, although

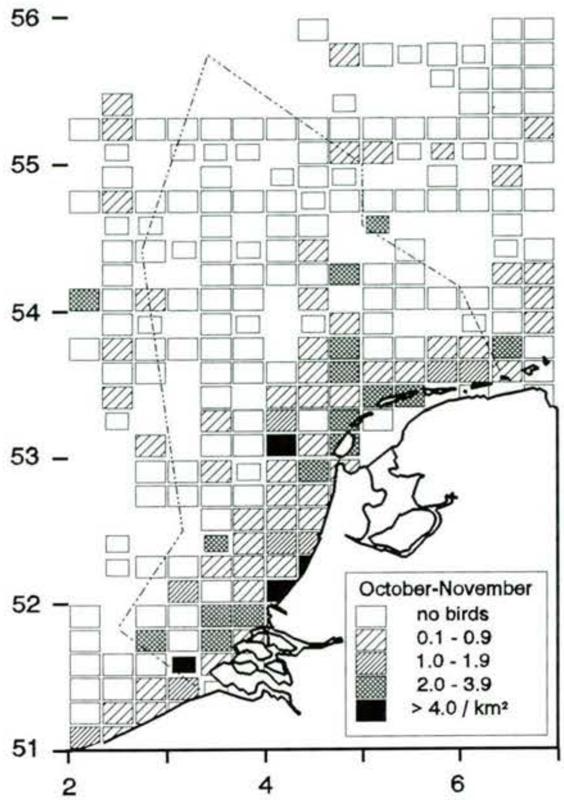


Figure 4.90 Distribution of Great Black-backed Gull, October-November (n= 3614)

only low densities were found, scattered over a wide area (#1). The estimate of total numbers in the Dutch sector was very similar though (*ca.* 600 individuals).

Numbers increased sharply in **August-September**, particularly in the second half of September, becoming numerous and widespread in the Southern Bight (figure 4.89). Great Black-backed Gulls were remarkably scarce off the eastern Wadden Sea islands (several sightings, but none in transect). Moderate to high densities occurred mainly in the coastal zone: off Vlieland and scattered off the mainland coast. Around two-thirds of the birds seen at sea were adults (65.0%, n= 2217; table 4.12). The estimated totals for coastal and offshore zone in these months were 5000 and 4100 individuals respectively (including *ca.* 6900 birds in the Dutch sector). From coastal sites, gradually increasing numbers were reported in these late summer/early autumn months (#3, #4). South(west)ward movements predominated, particularly along the Wadden Sea islands and Zuid-Holland. Adults were still slightly more numerous than immatures. Small numbers of Great Black-backed Gulls, many of which were immatures, were found scattered over the beaches (#2). Sightings north of 53°30'N were more numerous during aerial surveys, but otherwise the distribution pattern was quite similar (#1). The estimate of total numbers in the Dutch sector was *ca.* 4750 birds.

Great Black-backed Gulls became truely numerous in autumn, **October-November** (figure 4.90). In the coastal zone this species occurred widespread in moderate to high densities and offshore sightings were frequent. Highest numbers were found along the mainland coast of Zuid-Holland, in the Voordelta and off the Wadden Sea islands. An estimated 22,300 individuals occurred in coastal waters in autumn and another 41,200 birds were found offshore, making it the second most numerous *Larus*-gull in the southern North Sea in autumn (table 4.2). Just over 35,000 Great Black-backed Gulls were calculated to occur wihtin the Dutch sector of the North Sea. Around three quarters of the Great Black-backed Gulls observed were adults (74.4%, 6225). Autumn passage is most pronounced in October during seawatching, with peaks of around 1000 Great Black-backed Gulls on a single day along the Wadden Sea islands and the mainland coast of Noord-Holland (#3, #4). Large numbers were also recorded in November, but north(east)ward movements gained importance, indicating the presence of a wintering population rather than movements along the coast. On the Wadden Sea islands, strandings of Great Black-backed Gulls became gradually more frequent in these months (#2). Along the mainland coast strandings were just as frequent as earlier in autumn. The distribution pattern found from aerial surveys was rather similar, except that patches with moderate and high densities were scarce or even absent in most regions (#1). As a result, the estimated total numbers (9500) were lower than estimates from ship-based surveys.

Numbers of Great Black-backed Gulls further increased in winter, **December-January**, making the lack of data in the northern half of the study area a great pity. Moderate to high densities occurred in a wide zone off the coast in offshore waters, generally slightly further away from the coast than in autumn (figure 4.91). An estimated

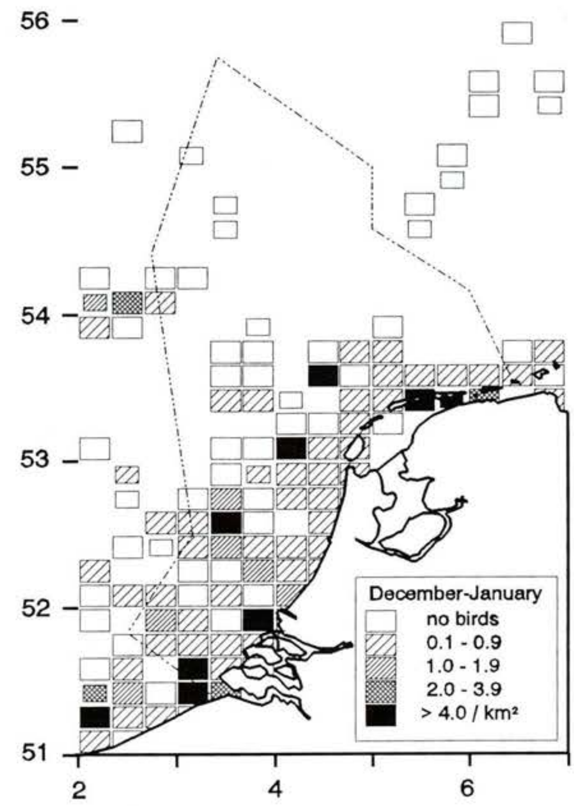


Figure 4.91 Distribution of Great Black-backed Gull, December-January (n= 3111)

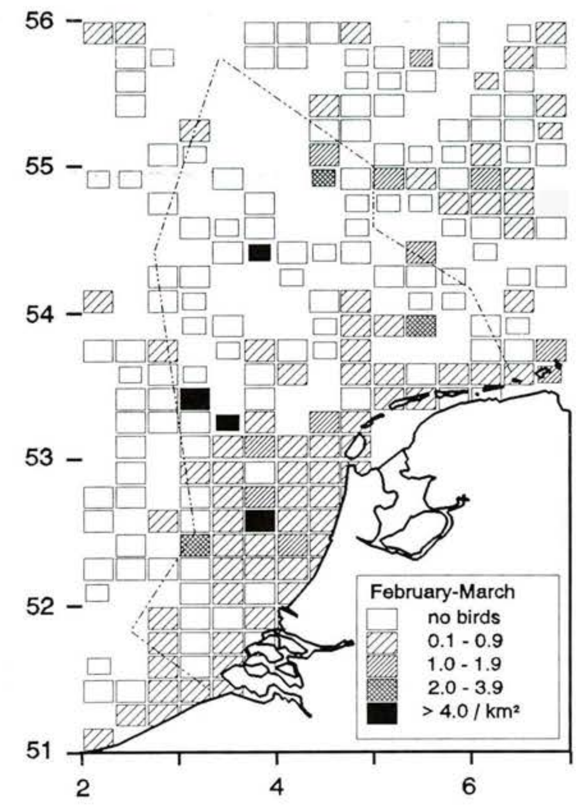


Figure 4.92 Distribution of Great Black-backed Gull, February-March (n= 1830)

23,100 Great Black-backed Gulls were found in the coastal zone in these months, whereas incomplete surveys offshore (70% of the area was used to estimate total numbers) held *ca.* 70,400 Great Black-backed Gulls (71,500 within the Dutch sector). These estimates were greatly influenced by some very large flocks in transect in a rather small area and further studies will be needed to assess total numbers more accurately. Hence, for the time being, the estimates derived from ship-based surveys in autumn were used to compare numbers at sea (64,600) with the NE Atlantic population (table 4.3). The proportion of adult Great Black-backed Gulls was similar to values found in autumn (76.9%, n= 3763; table 4.12). Numbers seen from coastal sites remained high during winter, with adult predominating with a ratio of *ca.* 10 adults : 1 immature (#3, #4). Severe winters would produce higher numbers of corpses of Great Black-backed Gulls on the beach. Adults usually formed only a minority (#2). Large numbers were found in the cold winters of 1979 and 1982, but rather low numbers were recorded in another severe winter, in 1985. The distribution pattern found from aerial, as far as comparable (south of 54°N), surveys was rather similar, except that patches with moderate and high densities were scarce or even absent in most regions (#1).

Great Black-backed Gulls were widespread in **February-March**, but densities in coastal waters had declined considerably (figure 4.92). Moderate to high densities were not found near the coast, but occurred scattered in the Southern Bight and far offshore, further to the north. The proportion of adult birds declined to 63.6% in February (n= 1175) and 51.1% in March (n= 734; table 4.12), marking the departure of mature birds, returning to the more northerly breeding areas. An estimated 6200 Great Black-backed Gulls were thought to occur near the coast, and another 36,000 individuals were found offshore (table 4.2; 32,800 birds in the Dutch sector). Numbers ob-

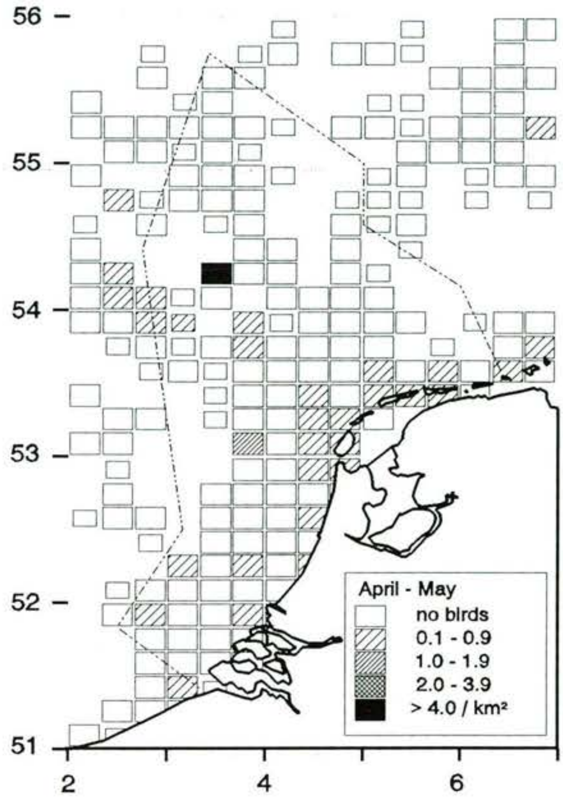


Figure 4.93 Distribution of Great Black-backed Gull, April-May (n= 227)

served from coastal sites declined, particularly as a result of the departure of adult birds. In March, the numbers of adults and immatures were equal (#3). Northward movements predominated, particularly in March (#4). Aerial surveys produced a vast area of homogeneous low densities in the southern half of the study area, again with very few patches with moderate densities (#1). Offshore in the Doggersbank/Oestergronden region the distribution patterns of both schemes were rather similar: patches with low densities, scattered over the area. The estimated number in the Dutch sector from the aerial surveys was 12,500 individuals.

A further departure of Great Black-backed Gulls away from the southern North Sea was witnessed in **April-May**, when low densities were found along the coast (mainly off the Wadden Sea islands) and scattered offshore (figure 4.93). The proportion of adults continued its sharp monthly decline to 45.9% in April (n= 451) and 14.4% in May (n= 139; table 4.12). Estimates of total numbers in the southern North Sea came at 1000 Great Black-backed Gulls near the coast, plus another 7400 individuals offshore (table 4.2). The population within the Dutch sector of the North Sea was estimated at *ca.* 5600 gulls. Small numbers of Great Black-backed Gulls were observed from coastal sites, with equal numbers of immatures and adults (#3, #4). Aerial surveys produced only slightly lower numbers for the Dutch sector (*ca.* 3750 individuals).

Discussion and conclusions The southern North Sea is a very important wintering area for Great Black-backed Gulls, considering the peak estimate of 63,500 individuals in late autumn (13.2% of the NE Atlantic population, table 4.3; Rose & Scott 1994). Most Great Black-backed Gulls occurred in the coastal zone, but less concentrated than most other gulls. Offshore sightings were common and total numbers away from the coast were usually considerably larger than inshore (table 4.2). Great Black-backed Gulls were frequently encountered as scavengers at commercial trawlers (188 records, 9.5% of all identified gulls, n= 63,523; Camphuysen 1993a). This species was mainly found during August-April, and was virtually absent in summer. Its seasonal pattern as a scavenger is well in accordance with that found in Dutch coastal waters, where it was found most frequently during September-February and least frequently during May and June (ship-based surveys, #3, #4). Scavenging Great Black-backed Gulls were seen in a wide area, scattered over the southern North Sea both inshore and offshore (Camphuysen *et al.* 1993). Great Black-backed Gulls, despite being predominantly winter visitors in the southern North Sea, were frequently found dead on the beach throughout the year. On the Wadden Sea islands, winter strandings were more pronounced than elsewhere and severe winters increased the numbers all over the country. Of 18,616 dead *Larus*-gulls found during 1969-85, 8.6% were Great Black-backed Gulls. Entanglements in nylon thread were frequently reported in this species (Camphuysen 1990a, Camphuysen 1994b).

The main difference between results of aerial and ship-based surveys were the considerably higher estimates from ship-based surveys, particularly in winter, when Great Black-backed Gulls were abundant. Moderate to high densities were seldom reported from aerial surveys, whereas observers onboard of research vessels frequently

Table 4.12 Monthly age composition in Great Black-backed Gulls (adult, immature and first year) in the southern North Sea, 1985-93.
Tabel 4.12 Maandelijkse leeftijdsverdeling van de Grote Mantelmeeuw (volwassen, onvolwassen en eerste jaars) in de zuidelijke Noordzee, 1985-93.

Month	adult	imm	first year	% adult	sample
Jan	2070	200	380	78.1	2650
Feb	747	175	253	63.6	1175
Mar	375	153	206	51.1	734
Apr	207	154	90	45.9	451
May	20	35	84	14.4	139
Jun	13	19	3	37.1	35
Jul	30	15	6	58.8	51
Aug	288	70	146	57.1	504
Sep	1153	210	350	67.3	1713
Oct	2565	166	845	71.7	3576
Nov	2067	164	418	78.0	2649
Dec	822	71	220	73.9	1113
Totals	10357	1432	3001	70.0	14790

reported larger flocks of birds, usually the result of nearby fishing activities. These birds were sometimes partly or completely 'in transect' and inevitably produced patches of moderate to high densities, scattered over the study area.

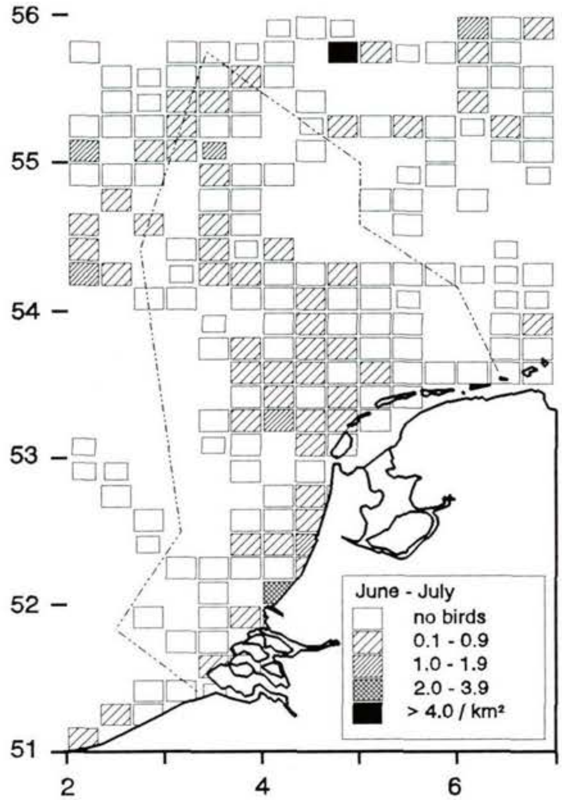


Figure 4.94 Distribution of Kittiwake, June-July (n = 526)

Kittiwake *Rissa tridactyla*

The nearest breeding colonies of this cliff-nesting species are found in East England in Kent, Cleveland, North Yorkshire and Humberside (1985-87 *ca.* 100,000 'Apparently Occupied Nests' (AON); Lloyd *et al.* 1991) and on Helgoland (Germany; 1100 pairs in 1975, 2342 pairs in 1980, 2964 in 1988 to the current population of 3326 pairs (Vauk 1982, Meyer 1989, Hansohn 1992).

Kittiwakes were widespread in summer **June-July**, both inshore and offshore, but occurred mainly in very low densities (figure 4.94). Low to moderate densities were found at the Doggersbank and in the Nordschillgrund region, low densities occurred in the Friese Front region (distribution pattern partly probably effort affected). Remarkable were moderate densities off the mainland coast of Zuid-Holland, an area where also seawatchers have recorded the occasional presence of concentrations of Kittiwakes close to the beach (*e.g.* 1500 Kittiwakes off Noordwijk, 16 July 1978; #3). Some 59.2% of the Kittiwakes observed at sea were classified as adults (n = 858, table 4.13), but it is unlikely that many of these birds were associated with any breeding colony. Apparently, adult Kittiwakes predominated among the birds seen in July in the late 1970s from coastal sites (#3). It was estimated from ship-based surveys that 1200 Kittiwakes occurred in coastal waters (considering seawatching results this could sometimes be higher), plus another 12,500 individuals offshore (table 4.2). Within the Dutch sector of the North Sea, some 7100 Kittiwakes were estimated to occur. A wreck of recently fledged Kittiwakes was witnessed in July/August 1987 (Costers 1987, Camphuysen 1987b, 1989c), and this wreck was a North Sea wide phenomenon that autumn, where large numbers of juveniles died either on the nests or directly after fledging. In Shetland, the local ferry was able to find its way in dense fog simply by sailing

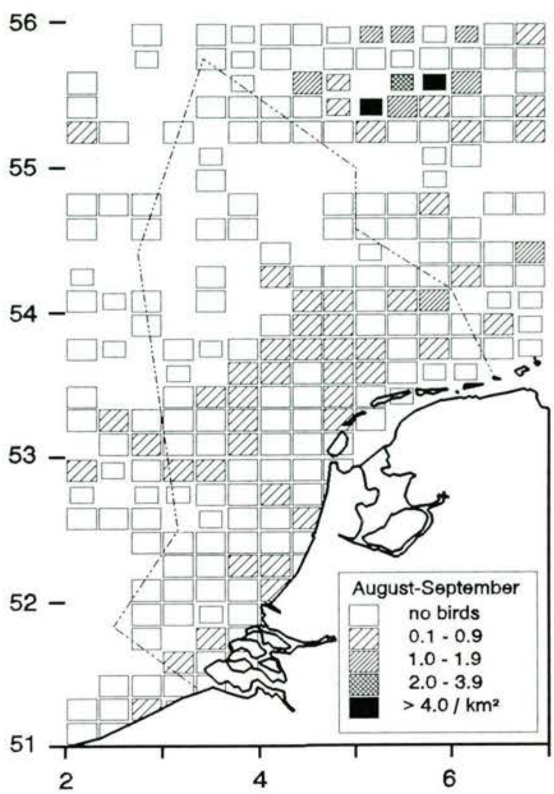


Figure 4.95 Distribution of Kittiwake, August-September (n= 910)

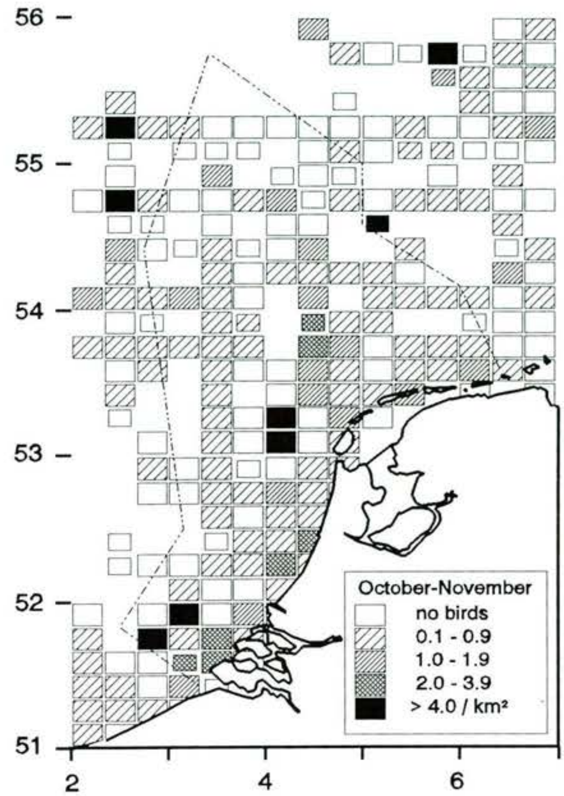


Figure 4.96 Distribution of Kittiwake, October-November (n= 4050)

in against the stream of corpses of Kittiwakes drifting away from Fair Isle (Ellis 1988). Aerial surveys produced a similar distribution pattern, with patches of birds scattered over the offshore zone. The estimated total numbers in the Dutch sector (*ca.* 9250) were also similar to those from ship-based surveys.

Kittiwakes were still widespread, but only slightly more numerous in late summer/early autumn (**August-September**). Moderate to high densities occurred in the Nordschillgrund region, but scattered low densities were found elsewhere (figure 4.95). It was estimated that 1100 Kittiwakes occurred in the coastal zone and another 22,000 individuals offshore (table 4.2; 6400 within the Dutch sector of the North Sea). The proportion of adults increased from 50.4% in August (n= 1090) to 60.5% in September, and this increase would continue in autumn (table 4.13). Very small numbers of Kittiwakes were observed from coastal sites in these months, although an occasional westerly storm could produce substantial numbers of storm-driven birds (#3, #4). Kittiwakes were more abundant in the Doggersbank and Outer Silver Pit regions during aerial surveys (#1). Otherwise, distribution patterns and estimated total numbers in the Dutch sector derived from this scheme (*ca.* 9750 individuals) were rather similar.

Much higher numbers were encountered in autumn, **October-November**, when moderate to high densities were found more frequently and scattered over the entire area. High numbers were found in the Voordelta, northwest of Texel and in the Doggersbank and Nordschillgrund regions (figure 4.96). Around 80% of these birds were adults (table 4.13), and it was estimated that 21,800 Kittiwakes occurred in the coastal zone, plus some 127,700 individuals offshore (table 4.2). Around 53,000 Kittiwakes were estimated for the Dutch sector. Kittiwakes were seen frequently, but in highly variable numbers along the

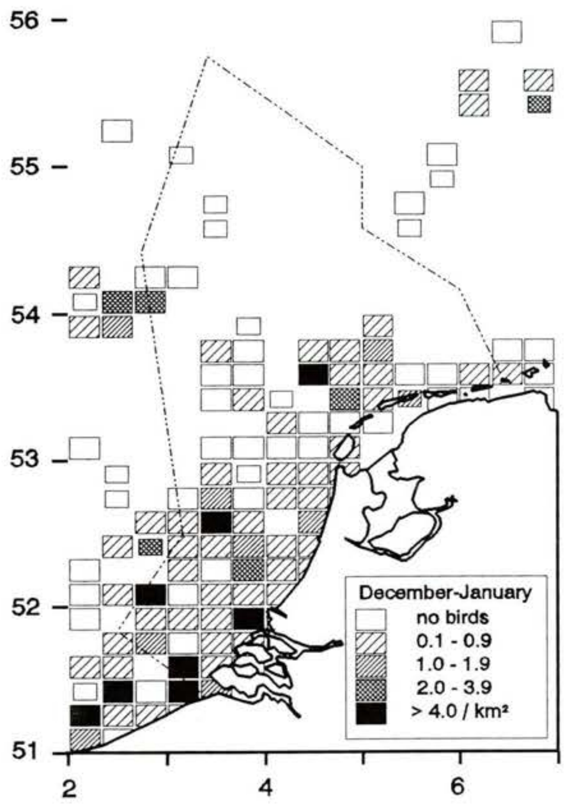


Figure 4.97 Distribution of Kittiwake, December-January (n = 2643)

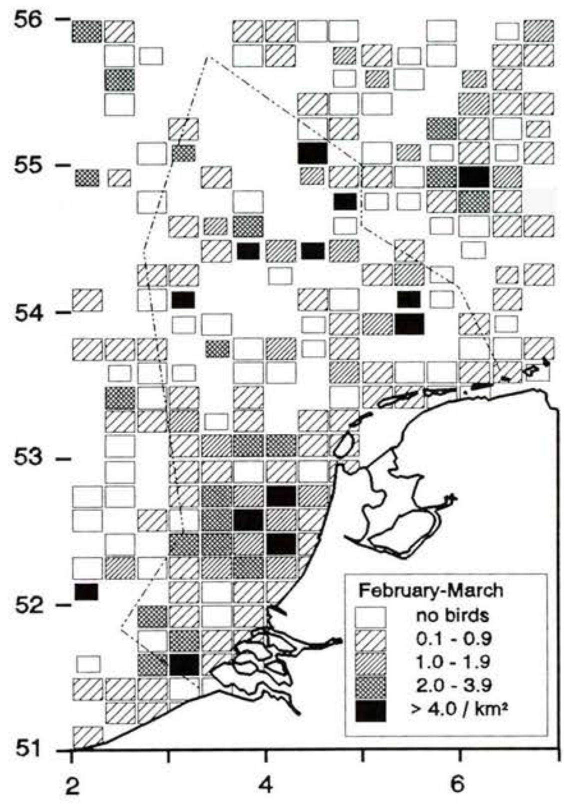


Figure 4.98 Distribution of Kittiwake, February-March (n = 3866)

coast (#3, #4). Some westerly storms drove large numbers of these offshore gulls into the coastal zone, whereas other storms did not produce higher numbers than normal. Normally, adult Kittiwakes predominated, but a huge movement recorded in 1974 consisted primarily of juveniles (#3). On exceptional days, between 4000 and 10,000 Kittiwakes may be counted from a single site on the mainland coast of Noord-Holland. The increase in the southern North Sea was also witnessed during aerial surveys, but densities were generally low (#1). As a result, the estimated numbers for the Dutch sector (*ca.* 26,750 Kittiwakes) was only half that estimated from ship-based surveys.

The Southern Bight maintained its significance for Kittiwakes in winter, **December-January** (figure 4.97). Unfortunately, the estimate for the offshore zone is quite meaningless for most waters north of 54°N, so the tentative estimate of 54,200 Kittiwakes offshore should not be regarded seriously. In the coastal zone, some 19,500 Kittiwakes were found in winter (table 4.2). Both in these months and in autumn, numbers of Kittiwakes peaked in the southern North Sea, reaching an estimated 1.8% of the NE Atlantic population (table 4.3; Rose & Scott 1994). Within the Dutch sector, being incompletely covered, at least some 33,000 Kittiwakes occurred. Around 80% of the wintering Kittiwakes in the southern North Sea were adults (table 4.13). In recent years, Kittiwakes were numerous along the coast in these months and in harbours such as IJmuiden the presence of small wintering flocks of Kittiwakes was normal (#4, Geelhoed *et al.* 1989). Westerly storms could still produce large numbers (*e.g.* 5100 individuals, 2 January 1986 Zuid-Holland). This was markedly different from observations in the 1970s, when wintering Kittiwakes were rather scarce (#3). The dramatic increase in numbers wintering in Dutch coastal waters was a feature which was witnessed in a variety of pelagic, piscivorous seabirds (Camphuysen 1990b, 1992b) and was also very clearly reflected in the number of birds stranding on Dutch beaches in the 1980s (#2, Camphuysen 1992a). Very large numbers of starved birds washed ashore in winter 1980/81 and 1983/84. Most wrecks of Kittiwakes in the southern North Sea were confined to the early 1980s, while numbers washing ashore have declined since 1986 (#2). During aerial surveys, the offshore zone north of 54°N was better surveyed and because this is an important area for Kittiwakes, the estimated number for the Dutch sector was twice as high as that from ship-based surveys (64,750 individuals; #1). In the Southern Bight, however, patches with high densities were scarcely found from the air, while these were quite frequent during ship-based surveys.

Scattered moderate to high densities occurred in spring, **February-March**, particularly in offshore waters. Densities nearest to the coast were always low (figure 4.98). The coastal population was estimated to number 9200 individuals in these months, whereas some 112,200 Kittiwakes were found offshore (table 4.2; nearly 75,000 within the Dutch sector). The proportion of adult birds was on a similar level as in winter, approximately 80% (table 4.13). Important areas for Kittiwakes were part of the Voordelta, Bruine Bank/Breeveertien and parts of the Oestergronden. In the 1970s, only insignificant numbers of Kittiwakes were recorded during seawatching in these months (#3), but in the 1980s, substantial numbers were reported in February, declining rapidly in March (#4). Numbers of dead Kittiwakes on the beach normally peaked in February and gradually declined in March through May (#2). Nearly 85% of these birds were contaminated with oil, also in years when food-shortages were the proximate cause of starvation and death. Aerial surveys produced a pattern of widespread low densities over the entire Dutch sector and moderate densities in the Bruine Bank region (#1). Patches with high densities, frequently reported from ships, were seldom found from the air, which is hard to explain (see discussion Lesser Black-backed Gull). As a result, the estimated number for the Dutch sector was considerably lower (35,500 individuals).

Numbers of Kittiwakes in the southern North Sea had declined sharply during **April-May**, and an overall westward displacement of birds was recorded. Moderate to high densities were scattered around Outer Silver Pit, south of Bruine Bank and in the Doggersbank region. The coastal strip

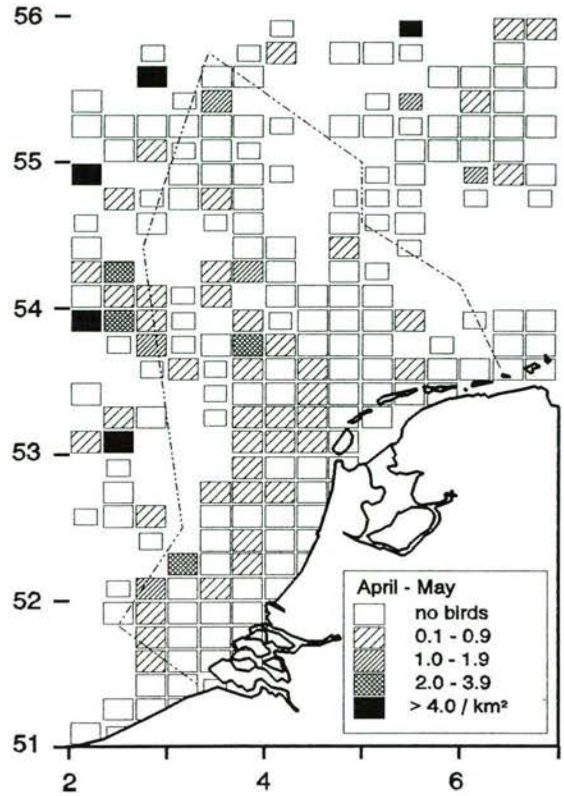


Figure 4.99 Distribution of Kittiwake, April-May (n= 1105)

was virtually abandoned (figure 4.99). The proportion of adult Kittiwakes dropped to 59.1% in April (n= 1141) and 49.6% in May (n= 528), marking the return of mature birds to breeding areas. An estimated 200 Kittiwakes were left in the coastal zone, whereas offshore waters held some 103,600 birds (table 4.2). Only 16,900 Kittiwakes were estimated to occur within the Dutch sector of the North Sea, as most had retreated further west (figure 4.99). Very small numbers of Kittiwakes were observed during seawatching in early summer (#3, #4), confirming that the coastal strip was abandoned. Strandings of fresh corpses were scarce, but substantial numbers were killed in an oil spill in April 1985 (#2). The movement away from the coast was also found in aerial surveys, but the departure of birds away from the Dutch sector was less prominent (#1). The estimated numbers had hardly dropped since the previous two-month period and were now higher than numbers derived from ship-based surveys (*ca.* 26,750 Kittiwakes).

Table 4.13 Monthly age composition in Kittiwakes (adult, immature and first year) in the southern North Sea, 1985-93.
Tabel 4.13 Maandelijkse leeftijdsverdeling van de Drieteenmeeuw (volwassen, onvolwassen en eerste jaars), zuidelijke Noordzee, 1985-93.

Month	adult	imm	first year	% adult	sample
Jan	1897	65	421	79.6	2383
Feb	2063	130	286	83.2	2479
Mar	1426	183	196	79.0	1805
Apr	674	369	98	59.1	1141
May	262	101	165	49.6	528
Jun	264	104		71.7	368
Jul	244	146	100	49.8	490
Aug	549	89	452	50.4	1090
Sep	489	102	217	60.5	808
Oct	2959	50	714	79.5	3723
Nov	4468	32	901	82.7	5401
Dec	1869	15	445	80.2	2329
Totals	17164	1386	3995	76.1	22545

Discussion and conclusions Kittiwakes were mainly winter visitors in the southern North Sea of which substantial numbers were found between October and April. Peak numbers occurred in autumn (nearly 150,000 individuals, 53,000 of which within the Dutch sector of the North Sea), but considering the huge NE Atlantic population, these waters should not be labelled as internationally of great importance. Kittiwakes were common as scavengers at commercial trawlers in Dutch waters in late summer, autumn and winter, while the species was virtually absent in April, May and June (Camphuysen 1993a). This seasonal pattern is well in accordance with its status in coastal waters as recorded during ship-based surveys and seawatching. The species occurred both offshore and inshore, but larger numbers were usually seen at considerable distances from the coast. An exception were 350 Kittiwakes scavenging behind a trawler together with 750 large gulls on 20 February 1989 at only 1.7 km from the beach. The massive wrecks which occurred in the early 1980s may have coincided with larger numbers wintering in the southern North Sea, but adequate information (except indications obtained during seawatching that Kittiwakes were more abundant) is not available. Coastal information of this pelagic species may be misleading, as was demonstrated in the 1987 wreck. Near the coast, emaciated juvenile Kittiwakes were abundant, whereas at some distances away from the shore a normal age composition, normal densities and apparently fit Kittiwakes were observed (Camphuysen 1987b, 1989c). Numbers of stranding Kittiwakes were low between 1965 and 1979. Between 1980 and 1985, very large numbers died every winter, with exceptionally high numbers in 1981 and 1984. These wrecks coincided with increased numbers of dead Razorbills and Guillemots washing ashore and were probably related to changes in the availablity of fish in the normal wintering areas (the northwestern North Sea; Camphuysen 1990b, 1992b). In these wrecks, most Kittiwakes were starved to death, but the proportion of Kittiwakes with oil in the feathers was higher than any other gull (1969-85, 84.1%, n= 7000). Kittiwakes were frequently hit in local oil incidents and chronic oil pollution is a factor affecting the survival of these birds in the southern North Sea (#2, Camphuysen 1992a, Camphuysen & Van Franeker 1992). Since 1985, numbers of Kittiwakes washing ashore went down again, but until now did not return to the low levels of the 1970s (NZG/NSO unpubl. data). Further efforts to reduce chronic oil pollution in the southern North Sea are needed to significantly lower oil rates in Kittiwakes washing ashore in this area. Both Kittiwakes and oil sicks occur widespread and specific actions in case of certain oil spills are therefore unlikely to have an effect on the risk for these birds to become oil contaminated.

Comparison with data from aerial surveys led to a conclusion mentioned in several other gulls. Aerial surveys, aided by a better coverage in the Dutch sector, produced more areas in which low densities were found, but did not show patches with moderate to high densities. The overall seasonal pattern showed higher numbers in the Dutch sector than from ship-based surveys when the gulls were comparatively scarce, but lower estimates when the species was abundant.

4.11 TERNS

Terns are summer visitors in the southern North Sea (table 4.1). All five species observed during ship-based surveys breed in the Netherlands and threeof these are almost exclusively found in the coastal zone (Sandwich Tern, Common Tern, Arctic Tern). Common Terns are widespread in the northwestern half of our country and find much of

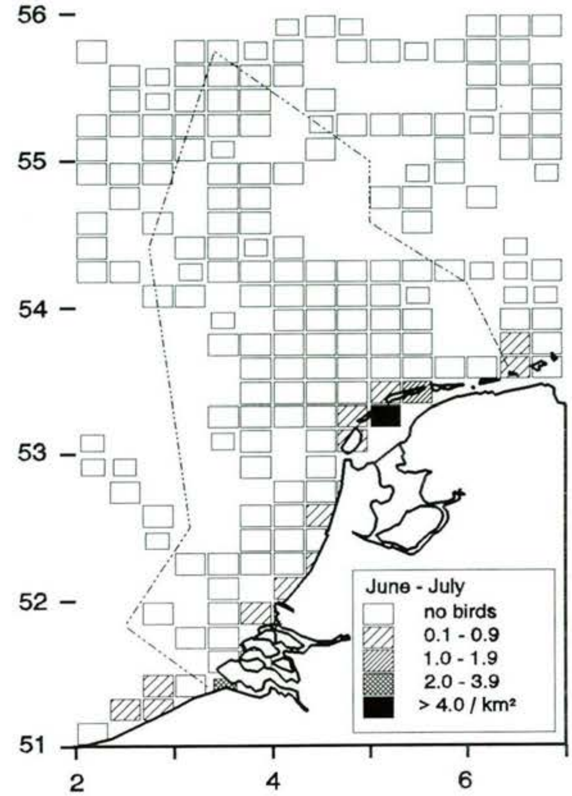


Figure 4.100 Distribution of Sandwich Tern, June-July (n= 456)

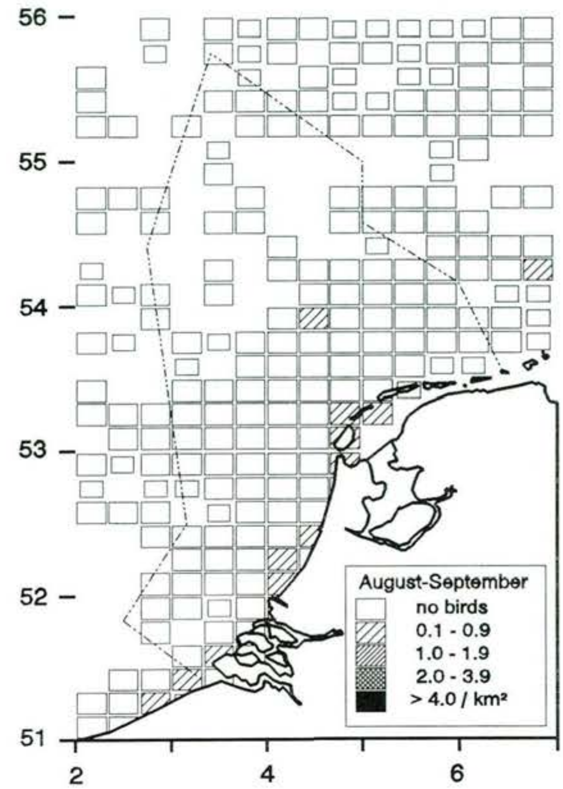


Figure 4.101 Distribution of Sandwich Tern, August-September (n= 140)

their food in fresh water, whereas Black Terns breed in marshes. Besides the terns breeding in the Netherlands, the southern North Sea is of importance for migrants breeding further to the north and to the east.

Sandwich Tern *Sterna sandvicensis*

In recent years, around 10,000 pairs of Sandwich Terns were breeding in coastal colonies in the Netherlands (Arts 1993, Derks & De Kraker 1993). Important colonies were found on Hompelvoet/Markenje (Delta area), Griend (Wadden Sea), and Texel (Rooth 1989, Brenninkmeijer & Stienen 1992). In Zeebrugge (Belgium) a Sandwich Tern colony was recently established and this colony attracted breeding pairs from the Delta area (Derks & De Kraker 1993). Sandwich Terns are a coastal species in the Netherlands of which inland colonies as well as inland records are quite rare (Rooth 1989, Platteeuw & Stegeman 1989, Camphuysen 1992c).

Sandwich Terns occurred widespread but in low densities in the coastal zone in **June-July**. Highest numbers were seen near Griend, the largest colony in the area (figure 4.100). Offshore records were very rare and most terns were found within 5 km from the coast. It was estimated that some 4700 Sandwich Terns occurred in the coastal strip, with another 100 individuals offshore (table 4.2). Of these terns, 3500 individuals occurred within the Dutch sector of the North Sea. Seawatchers recorded peak numbers of Sandwich Terns in these months, and in July southward migration began to dominate in all coastal regions (#3, #4). The distribution pattern derived from aerial surveys was quite similar, except that Sandwich Terns appeared more widespread and in higher densities in the Delta area (#1). It was estimated that over 5000 Sandwich Terns occurred in the Dutch sector from this source.

Densities were slightly lower in **August-September**, when migrating terns were particularly fre-

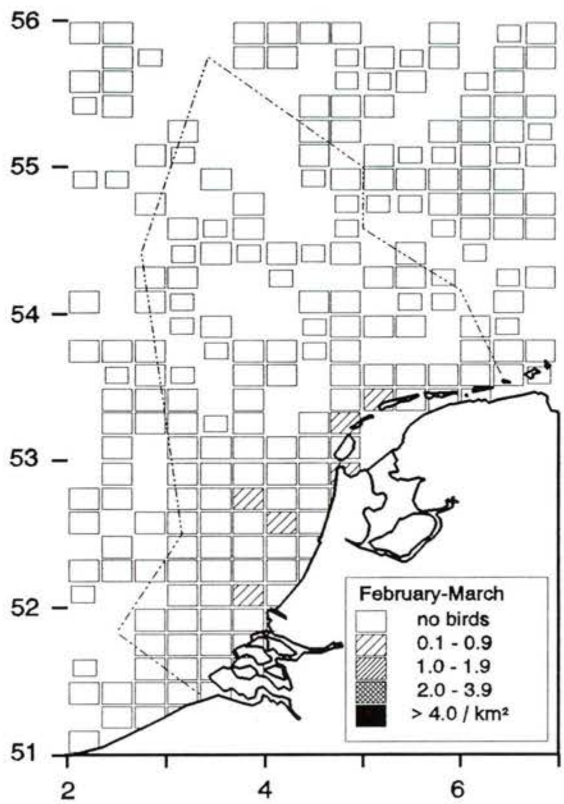


Figure 4.102 Distribution of Sandwich Tern, February-March (n = 40)

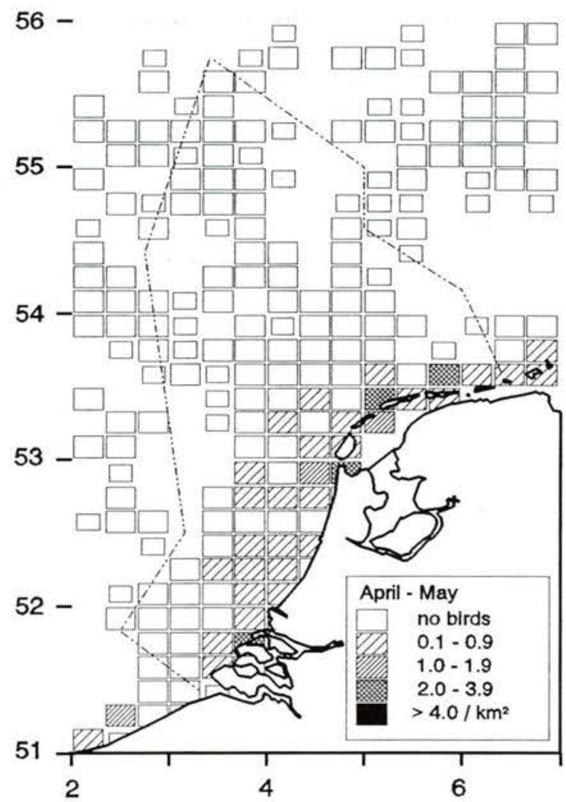


Figure 4.103 Distribution of Sandwich Tern, April-May (n = 667)

quent off the mainland coast and in the Voordelta (figure 4.101). Several offshore records obviously referred to migrants. From densities found in ship-based surveys it was estimated that around 1000 Sandwich Terns occurred in the coastal zone, plus a 100 odd individuals offshore (table 4.2; 900 terns within the Dutch sector). Large numbers of Sandwich Terns were seen migrating to the south in August from seawatching sites, while numbers of terns rapidly declined in late September (#3, #4). Aerial surveys produced a more regular distribution pattern and a much wider distribution in the Voordelta (#1). From these surveys it was estimated that over 2600 Sandwich Terns occurred in Dutch waters in these months.

Between October and January, densities of Sandwich Terns were very low (not mapped). Resident Sandwich Terns were frequently recorded from the coast in the Delta area (Ouweneel 1975, 1979, 1981, 1989b), but during ship-based surveys only 6 Sandwich Terns were observed in October/November and a single individual in December/January (Voordelta). Small numbers of Sandwich Terns were seen from coastal sites in these months (#3, #4). Aerial surveys produced more sightings in the Voordelta (#1) and, in autumn, scattered along the mainland coast and the Wadden Sea islands.

Sandwich Terns returned early March; there is only a single record of this species in February in the entire ESAS database. Low densities were found in the coastal strip in **February-March** (figure 1.102) and it was estimated that 200 Sandwich Terns occurred in the coastal strip, plus some 80 terns further offshore. Although the first Sandwich Terns arrived early March in coastal waters (#4), frequent passages were not recorded until early April (#3, #4). The arrival of terns was largely missed during aerial surveys (#1): very low densities were recorded and only in the Voordelta in these months.

Numbers increased rapidly in **April-May**, when moderate densities were found off Belgium, in the Voordelta and along the Wadden Sea islands (figure 4.103). For the coastal zone it was estimated that some 5700 Sandwich Terns occurred in these months, with another 1300 individuals offshore. These offshore terns were probably mainly migrating birds heading for colonies further to the east or northeast. Within the Dutch sector, *ca.* 5900 Sandwich Terns were estimated to occur. Along seawatching sites, large scale northward movements of Sandwich Terns were recorded (spring migration; #3, #4). The intriguing fact that the colony on Griend is usually fully occupied, well before substantial numbers of Sandwich Terns are recorded from seawatching sites along the mainland coast, could perhaps be explained by the distribution of terns at sea. In these months, offshore records were relatively common and part of the spring migration may have been hidden from seawatchers as a result of the birds' distance to the coast. In aerial surveys, Sandwich Terns were found in low densities over an even wider area off the coast than ship-based surveys (#1). The estimate of total numbers in the Dutch sector (*ca.* 5300) was similar to that derived from ship-based surveys.

Discussion and conclusions Only the coastal strip is of great importance to Sandwich Terns breeding in the Netherlands or further northeast. Offshore records were scarce and probably mainly referred to migrants. Concentrations of sightings near the major colonies indicate that feeding ranges are relatively small, and that most terns breeding on the largest colony, Griend, obtain much of their prey in the Wadden Sea or the coastal waters near Texel and Vlieland (*cf.* Veen 1977, Raaijmakers *et al.* 1993). Seawatching data are very useful to reveal migration patterns along our coast, but feeding flights around colonies cannot easily be distinguished from these passages. Beached bird surveys in the Netherlands, performed on a rather low level in the summer months, did not produce many Sandwich Terns. During 1969-85, most corpses were found between May and November (2 individuals in February), and 36.4% of these birds were contaminated with oil (n= 22). Although Sandwich Terns have repeatedly been seen to feed in areas with small oil slicks in the southern North Sea, chronic oil pollution does not seem te be a serious threat to these birds, certainly not compared with the effect of disturbance or ground predators in colonies. Ship-based surveys and aerial surveys produced roughly similar distribution patterns and similar estimates of total numbers in the coastal zone.

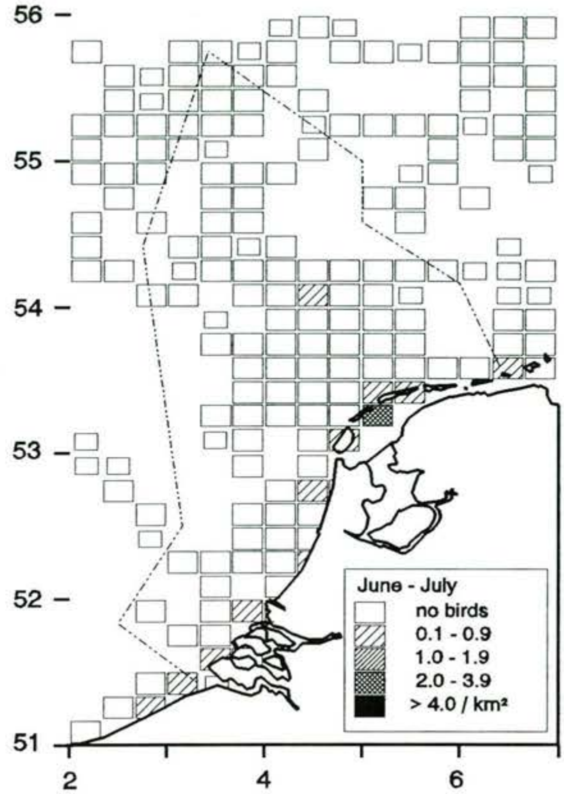


Figure 4.104 Distribution of "commic" terns, June-July (n= 173)

Common Tern *Sterna hirundo*
Arctic Tern *Sterna paradisaea*

Common and Arctic Terns breed in relatively small colonies scattered along the Dutch coast. Highest numbers are found in the Delta area (*e.g.* Europoort, Hooge Plaaten, Land van Saeftinghe en Slijkplaat) and the Wadden Sea (Stienen & Brenninkmeijer 1992, Arts 1993). For recent years (1985-90), estimated numbers of breeding pairs for Common Terns were 9-10,000 pairs, 4-5000 in the Delta area, 3-4,000 in the Wadden Sea and 1500-2000 in the IJsselmeer. Approximately 1000 pairs of Arctic Terns were found in the Wadden Sea area, and very small numbers elsewhere (Arts 1993). These two terns are rather difficult to identify under normal field conditions. Of 3909 terns of these species, 66.1% were

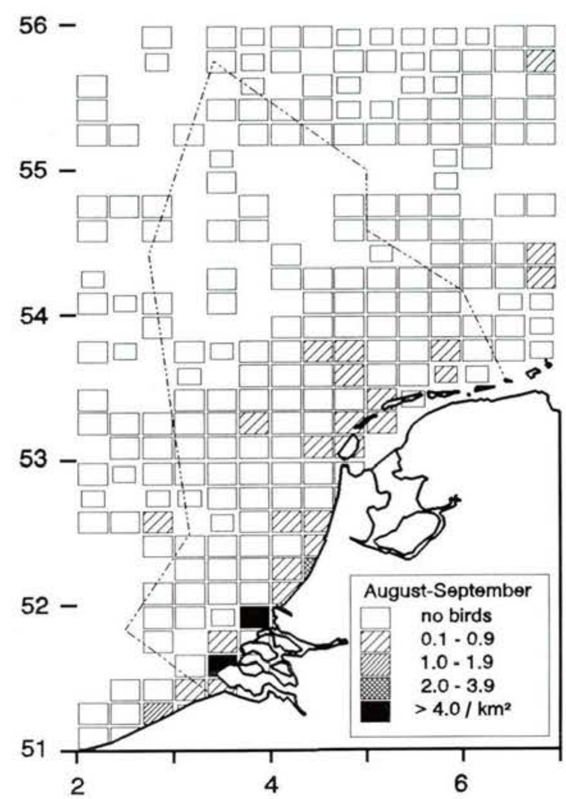


Figure 4.105 Distribution of "commic" terns, August-September (n = 947)

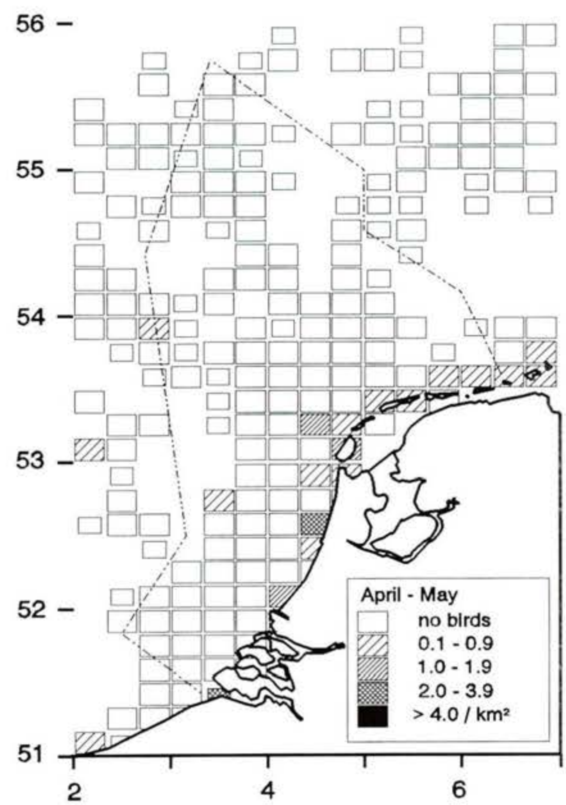


Figure 4.106 Distribution of "commic" terns, April-May (n = 509)

specifically identified. For practical reasons, distribution maps of Arctic Tern and Common Tern were combined and named **'commic terns'**. Unidentified terns, which could also have been Sandwich Terns (4538 individuals seen in very large, distant groups in August/September), were not used for the analysis. Probably, most these terns were Common and/or Arctic Terns.

In summer, **June-July**, scattered low densities of 'commic' terns were found along the coast, with moderate densities around Vlieland (figure 4.104). Offshore records occurred rather frequently, though only just outside the coastal zone. It was estimated that around 1700 'commic' terns were present in the coastal zone and another 2200 offshore (only 1200 occurred in the Dutch sector). Some 28.9% of the identified terns were Arctic Terns. From the coast, rather low numbers of 'commic' terns were recorded in these months (#3, #4), but southward movements usually commenced during late July. The distribution derived from aerial surveys was a much wider band of low densities along the entire coast (#1). The estimate of total numbers, *ca.* 4400 individuals, was also considerably higher.

During the peak of autumn migration, **August-September**, lage numbers of 'commic' terns were observed along the mainland coast. Densities were particularly high in the Voordelta region (figure 4.105). Offshore, 'commic' terns were observed frequently, indicating a relatively wide 'front' of terns heading south into the Southern Bight and away through the Channel. Some very large feeding flocks of terns, sometimes numbering thousands of individuals, were observed on warm sunny days off the mainland coast in August. Many of these terns were probably either Common or Arctic Terns. For the estimates of total numbers, these groups were not used (outside the strip-transect), but the size of individual groups indicated that the total estimate for these months (10,500 in the coastal zone, 1100 offshore) is probably conservative. Within the Dutch sector, 10,100 'commic' terns were thought to occur. Common Terns were, according to 1620 identifications, 10 times more numerous than Arctic Terns. The estimated 10,600 Common Terns in the southern North Sea in these months formed approximately 5.9% of the NE Atlantic population of this species (table 4.3). Massive numbers of 'commic' terns were seen heading south, particularly along the mainland coast of Zuid-Holland (#3, #4). Large numbers were observed along the mainland coast of Noord-Holland, while the stream of terns along the Wadden Sea islands was slightly less impressive. The increase in numbers from north to south indicates that substantial numbers of (Common) terns migrate overland and reach the North Sea mostly in Zuid-Holland or the Delta area. Aerial surveys produced rather similar distribution pattern, but again a considerably wider band of birds along the coast (#1). The freqeunt offshore records in the Friese Front region were confirmed by sightings from the air. From these surveys it was also estimated that peak numbers (over 8000 individuals) occurred in Dutch coastal waters in these months.

Very small numbers were seen in late autumn (10 sightings), winter (none) and early spring (8) (October-March, not mapped). 'Commic' Terns returned in substantial numbers in **April-May**, particularly in the coastal zone (figure 4.106). However, offshore records occurred frequently. Small groups of Arctic Terns were observed far offshore, sometimes demonstrating aerial display flights, and these were probably birds on their way to arctic breeding grounds (arrivals in June; Camphuysen 1991). Arctic Terns formed a fifth of the 'commic' terns which could be identified in these months (21.7%, n= 760). It was estimated that 4300 terns occurred in coastal waters in these months, with an additional 2100 individuals offshore (table 4.2; 4000 in the Dutch sector). Very few 'commic' terns were seen during seawatching between October and March, while these terns returned in substantial numbers mid-April (#3, #4). Spring migration peaked in May. While ship-based surveyes produced hardly any terns in October-November, aerial surveys indicate the presence of low densities in a narrow band along the entire coastline. It was estimated that around 1800 'commic' terns occurred in Dutch coastal waters in these months (#1). Winter sightings were, as in ship-based surveys, very scarce. In April and May, when 'commic' terns were found to return in the coastal strip, a much wider distribution and considerably more offshore records were found (#1). The estimate of total numbers of 'commic' terns was higher than that derived from ship-based surveys: *ca.* 5000 individuals.

Discussion and conclusions Common Terns are abundant in Dutch coastal waters between April and September. Peak numbers occur in late summer, when approximately 6% of the NE Atlantic population can be found in the southern North Sea (table 4.3). The coastal zone is of prime importance for this species, while offshore records probably mainly refer to migrant birds. Numbers of Arctic Terns were always low in the study area when compared to the NW European population at large. 'Commic' terns were scarce or absent in the Doggersbank and Nordschillgrund region, at any time of the year. Seawatching data indicated that 'commic terns' arrive late March and that numbers increased rapidly in April and May (#3, #4). Comparatively small numbers were observed during the breeding season, whereas southward movements start to dominate in the second half of July. Large numbers were seen in August and early September, after which numbers gradually decline. Few terns were seen in November and December. Beached bird surveys in the Netherlands, performed at a rather low level in the summer months, did not produce many Common (63) and Arctic Terns (10; plus 15 'commic' terns #2). During 1969-85, these terns were found througout the year in very small numbers, except in December and January. Some 26.2% of the Common Terns were oiled (n= 42). Chronic oil pollution does not seem te be a serious threat to these birds, certainly not compared with the effect of disturbance or ground predators in colonies. Aerial and ship-based surveys produced a rather similar picture with respect to seasonal and spatial patterns, except that the aerial surveys found these terns to be more widespread.

Little Tern *Sterna albifrons*

Little Terns were seldom seen during ship-based surveys (5 individuals, figure 4.107). Three of these terns were seen in coastal waters but several kilometres away from the coast, the other two closely inshore. From seawatching results a regular pattern of spring migration (late April/-May), low numbers mid summer and autumn passage (August/September) was derived compri-

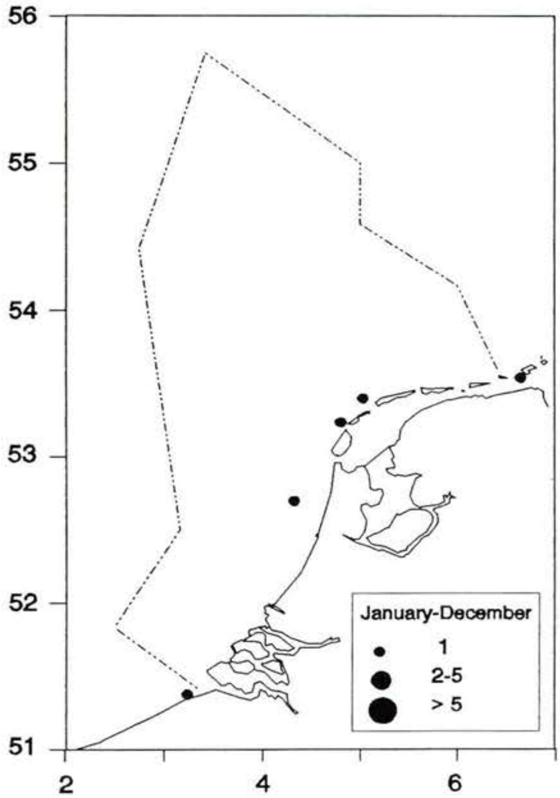


Figure 4.107 Sightings of Little Terns, January-December (•, n= 5)

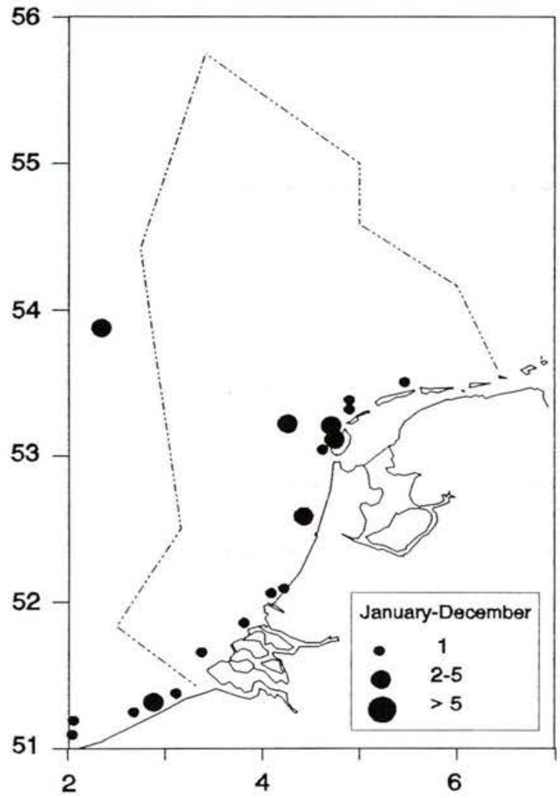


Figure 4.108 Sightings of Black Terns, January-December (•, n= 27)

sing several thousands of birds each year (#3, #4). Numbers fluctuated considerably between years: high numbers were observed in spring 1980, '84, '88 and '89, and in autumn 1980, '86, and '87. Obviously, Little Tern passage takes place closely inshore and ship-based surveys failed to produce results which can be used to describe the occurrence of this species in any detail. Remarkably, sightings from the air of this species were comparatively frequent. Most Little Terns were seen early autumn (whereas coastal sightings produced three times more Little Terns during spring migration; #4) and a concentration of sightings in the Voordelta region occurred. The difference between ship-based surveys, aerial surveys and seawatching data cannot be explained with the data available here.

Black Tern *Chlidonias niger*

Black Terns were seen occasionally and in very small numbers (27 individuals). Most Black Terns were seen during spring migration (19, mainly in May), and several sightings were well offshore (figure 4.108). These sightings indicate that small numbers of Black Terns cross the North Sea at this latitude. The seasonal pattern of Black Terns observed from coastal sites is very similar to that of Little Terns, but slightly smaller numbers were recorded (#3, #4). Black Terns were not mentioned from aerial surveys (#1).

4.12 AUKS

Five species of auks were observed in the southern North Sea, one of which, the Brünnich's Guillemot, was a rarity. Most of the common auks breed in the northwestern half of the North Sea, whereas the Little Auk is an arctic species (*e.g.* Greenland, Svalbard). The four common species are basically winter visitors in the southern North Sea, but the larger species occur through the year (table 4.1).

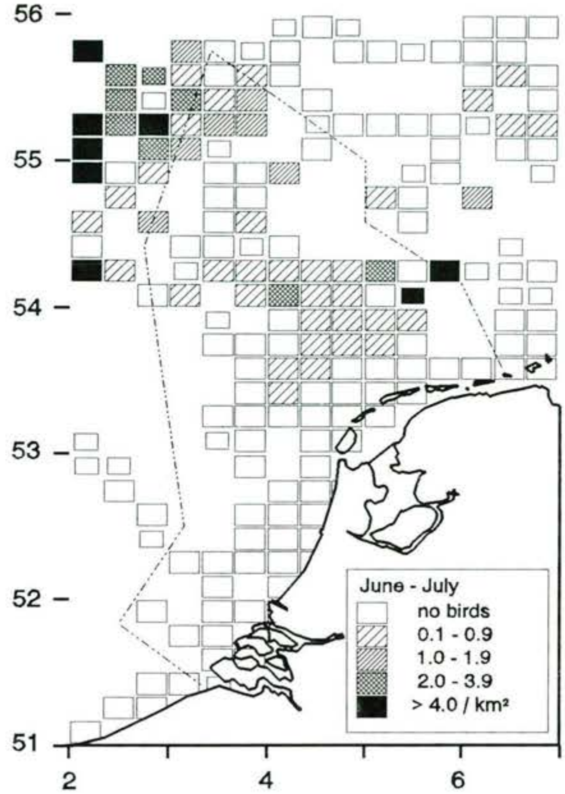


Figure 4.109 Distribution of Guillemot, June-July (n= 925)

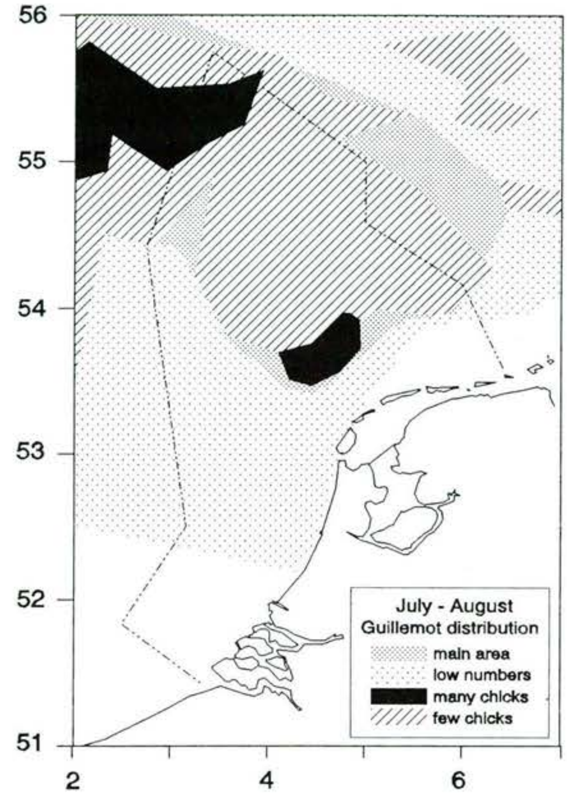


Figure 4.110 Generalised distribution of Guillemots and presence of chicks (impression from plotted sightings), July-August

Guillemot *Uria aalge*

The nearest breeding colonies of Guillemots are found along the coast of NE England (Northumberland- Humberside; 1985-87 *ca.* 50,000 individuals, Lloyd *et al.* 1991) and on Helgoland (nearly 2200 pairs in 1993; Hansohn 1994). Very large numbers breed in Scotland.

In summer, **June-July**, Guillemots occurred widespread in the northwestern half of the study area, from the Doggersbank to the Friese Front area (figure 4.109). Moderate to high densities were found at the Doggersbank and in several patches further to the south. In fact, Guillemots arrived in substantial numbers in this region from late June and many of these birds appeared to be mature birds accompanying downy young (father-chick combinations; Harris & Birkhead 1985). Screaming chicks begging for food (or for company when the adult was below the surface) could be encountered anywhere in the region described above, but particularly around the Doggersbank and on the Friese Front (figure 4.110). The first father-chick combination was seen on 27 June, the second on 30 June, 221 of such couples were found in July. Considering the direction from which these Guillemots entered the study area, the residual currents and prevailing winds in these waters, the region from Flamborough Head to the Firth of Forth is the most likely breeding area where these Guillemots originated. Birds from the other nearby colony, Helgoland, live 'downstream' from the Friese Front area. Ringing results of chicks on this colony indicated that these birds move first to the north, towards the Skagerrak (O. Hüppop *in litt.*). Much effort was directed to the Frisian Front area in these months and in August. Part of the reason for this work was the predictable presence of juvenile Guillemots in the enriched zone (Leopold 1988, 1991). It was estimated that around 45,500 Guillemots occurred in the offshore zone in these months plus another 100 birds in coastal waters (table 4.2). In July, at least 71.5 % were adults (n= 1106; 791 individuals accompanying a chick and/or in full breeding plumage). Another 46 individuals showing head moult, but not accompanying chicks, could have been adults (maximum proportion adults 75.7%). Some 248 individuals were recognized as pulli (22.5%, n= 1106), another 20 winter plumage individuals could have been pulli (maximum proportion of pulli 24.3%). Hence, it can be estimated that in July the following numbers of adults, immatures and pulli were found in the southern North Sea: 32,500-34,500 adults, 1900-2700 immatures, and 10,200-11,100 pulli.

Along the coast, seawatchers recorded very low numbers of large auks (#3, #4). Considering the fact that Razorbills *Alca torda* were not seen during ship-based surveys in the coastal zone, all the auks observed during seawatching may be considered to be Guillemots. Numbers of Guillemots found dead on Dutch beaches were normally rather small in these months (#2), reflecting their offshore distribution. Recently fledged Guillemots were rarely found on our coast (Roselaar *pers. comm.*, Zoological Museum Amsterdam). Obviously, corpses of Guillemots dying offshore and north of 53°30'N have only a remote change to reach the Dutch coast. Currents and prevailing winds will bring such corpses further to the east and northeast. Aerial surveys produced a similar distribution pattern for 'auks', although densities found in the northwestern half of the study area were rather low (#1). The estimate of total numbers of auks derived from this source, a few thousands at most, was low compared to results of ship-based surveys for the Dutch sector (15,500 Razorbills/Guillemots).

In **August/September**, adult-chick combinations were still frequently observed in the area shown in figure 4.110, but chicks became less and less obvious (losing downy feathers, growing to adult size, full winter plumage, breaking up of father-chick bonds). In August, 182 chicks were recognized, in September only 14 individuals were labelled as juveniles. Guillemots became more widespread in waters north of 53°N and small numbers penetrated into the Southern Bight (figure 4.111). It was estimated that just over 92,000 Guillemots occurred in the offshore zone in these months, plus another 1400 in coastal waters (table 4.2). Following the same calculations as given for July, it can be estimated that in August the age distribution of Guillemots in the southern North Sea, translated to total numbers of birds, came at 38,300-48,100 adults, 10,000-38,600 immatures (winter plumage individuals were probably juveniles) and 15,200-44,000 chicks/juveniles. At seawatching sites, large auks were still rarely recorded, although records became slightly more frequent in September (#3, #4). Ship-based surveys failed to find any Razorbills in the coastal zone, so the large auks recorded during seawatching were still most likely to be Guillemots. Numbers of beached Guillemots were still very small in these months (#2). Aerial surveys confirmed that most 'auks' occurred in the northwestern half of the study area and that the Southern Bight was penetrated only by very small numbers only (#1). The estimate of total numbers derived from this source, just under 20,000 auks, is low considering results of ship-based surveys (nearly 40,000 Razorbills/Guillemots in the Dutch sector).

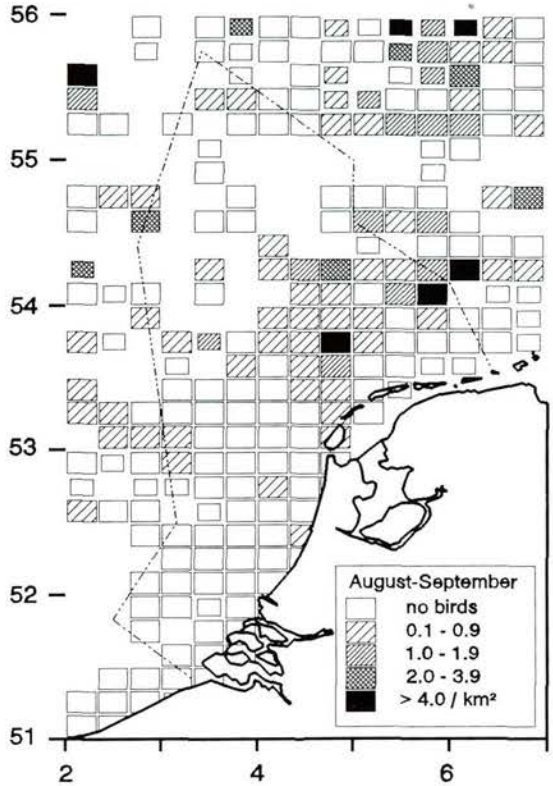


Figure 4.111 Distribution of Guillemot, August-September (n= 2185)

Massive numbers arrived in the southern North Sea during **October** and **November**, and substanti-

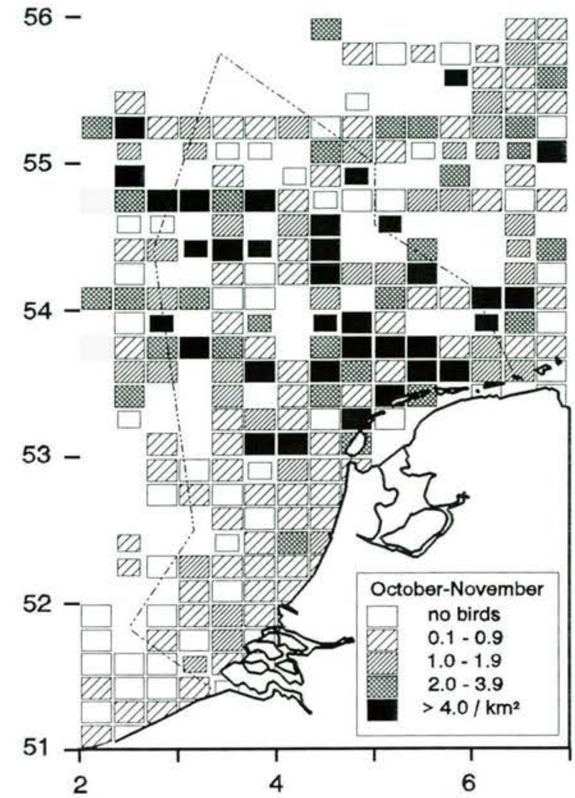


Figure 4.112 Distribution of Guillemot, October-November (n = 6990)

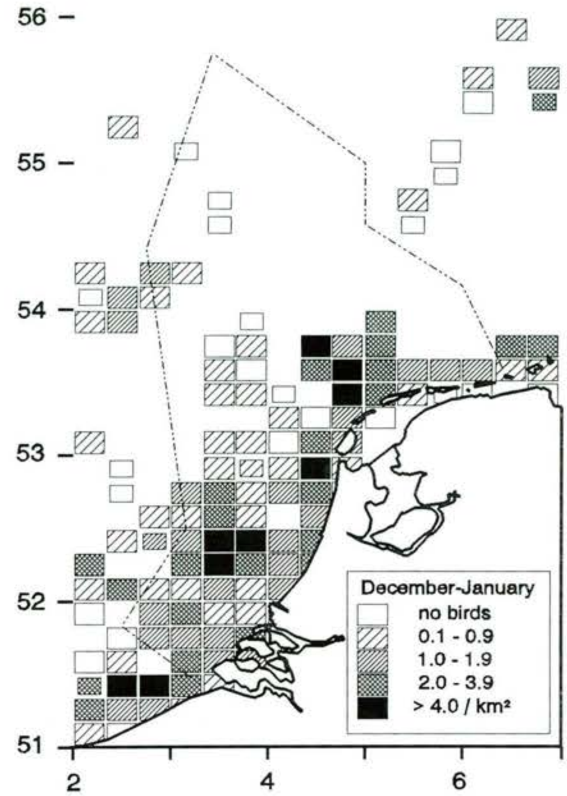


Figure 4.113 Distribution of Guillemot, December-January (n = 3788)

al numbers entered the Southern Bight (figure 4.112). Moderate to high densities were mainly found north of 53°N. It was estimated that 23,700 Guillemots were in the coastal zone and 211,300 individuals offshore: a total number of over 240,000 Guillemots in the Southern North Sea (table 4.2, 4.3). Most Guillemots were in winter plumage in these months, but summer plumage individuals were found more frequently in November (mature birds; table 4.14). At coastal sites, numbers of auks flying by increased sharply in these months (#3, #4). In the coastal zone, ship-based surveys produced a ratio of 5.6 Guillemots : 1 Razorbill in these months, whereas in the offshore zone Guillemots were 9.3x more nume-rous (Appendix 1). Numbers of auks seen during seawatching were usually rather small, although several days with hundreds of auks at a single site have been reported. Some mass movements have been recorded, (*e.g.* 6 October 1984 2150 individuals moving N, 2-3 November 1985 6400 N, 7 November 1989 2000 moving S (all mainland coast Noord-Holland), but numbers along the mainland coast of Zuid-Holland and further south were always comparatively small (#4). The 'strandings season' of corpses of Guillemots normally starts in November. Several mass strandings were reported in this month (Camphuysen 1980, Camphuysen & Keijl 1991), but the normal pattern was a gradual increase in numbers per km from early November onwards (#2). A high proportion of stranded Guillemots in early winter were adults, many were slightly oiled and emaciated. Aerial surveys produced a similer distribution pattern, but generally lower densities (despite the fact that the two species of auks were combined; #1). From these surveys, it was estimated that *ca.* 27,000 large auks occurred in the Dutch sector, whereas ship-based surveys resulted in an estimate of 147,300 Razorbills/Guillemots.

In winter, **December-January**, the offshore zone north of 53° was poorly covered (figure 4.113). Densities in the Southern Bight were higher than in autumn and the coastal strip had gained importance in these months. It was estimated that 30,400 Guillemots were present in the coastal zone, whereas a decent estimate for the offshore zone (93,000 in the area covered; table 4.2) cannot be made. Summer plumage individuals became more abundant in these months, but it seemed as if fully mature birds left the area quickly to return to the breeding colonies, as after January, the proportion of summer plumage individuals got stuck at just over 20% (table 4.14). One individual was identified as a **Brünnich's Guillemot** *Uria lomvia* (the authenticity of this record has not been checked). Coastal sightings of large auks were still frequent, but in considerably smaller numbers (#3, #4). Numbers seen flying past declined significantly in January, but Guillemots (often in poor physical condition) were frequently seen swimming and feeding near the beach throughout the winter. The ratio Guillemot-/Razorbill found during ship-based surveys in the coastal strip had changed in favour of the first species (11.3:1), but this was not caused by a decline of the number of Razorbills, but rather an increase of the number of Guillemots in the coastal zone. Aerial surveys, in which regular visits of the northern half of the study area were continued, showed that moderate to high densities occurred frequently in this part of the study area (#1). From aerial surveys it was concluded that numbers of auks peaked in these months (a mean of nearly 120,000 over 1985-92, but nearly 160,000 individuals over 1989-1992). Strandings of dead Guillemots peaked during December-April, when many thousands washed ashore on the Dutch coast each year. In some years with exceptionally high numbers of casualties, it was estimated that between 10,000 and 25,000 Guillemots washed ashore (#2, Camphuysen 1990b).

In **February-March** a remarkable 'retreat' away from the coast was witnessed (figure 4.114). Moderate to high densities were still widespread in the Southern Bight, but low densities were found near the coast. Further north, patches of moderate and high densities of Guillemots were found, but Guillemot were rather scarce in the eastern half of the study area. It was estimated that 9900 Guillemots occurred in the coastal zone, while just over 150,000 Guillemots were present offshore (table 4.2). This estimate is 4x higher than the estimate derived from aerial surveys for Guillemot and Razorbill combined (#1). Nearly a quarter of the Guillemots were summer

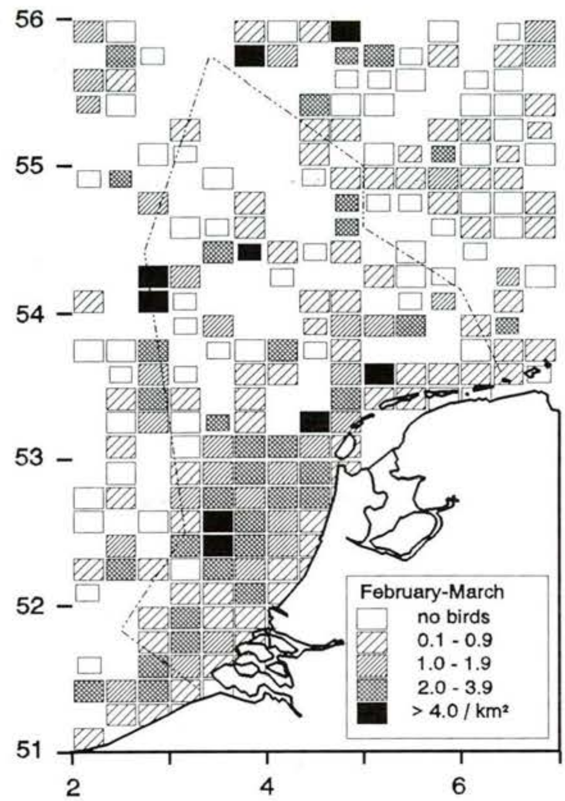


Figure 4.114 Distribution of Guillemot, February-March (n= 4406)

plumage individuals (table 4.14). The movements away from the coast found during ship-based surveys was clearly reflected in seawatching results (#3, #4). Numbers of auks seen from coastal sites became rather small, and remained small until autumn. In ship-based surveys, Razorbills became proportionally numerous in these months, basically because the number of Guillemots in the coastal zone dropped (table 4.2). One Razorbill was seen on each 2.8 Guillemots in coastal waters, whereas in the offshore zone the ratio was 1:3.7. Guillemots stranded in large numbers in these months (#2). The retreat of auks away from the coast was less obvious in distribution patterns derived from aerial surveys, that show a rather uniform distribution (with the exception of the Bruine Bank area) for the whole study area (#1). From these counts it was estimated that some 35,750 large auks occurred within the Dutch sector, whereas from ship-based surveys and estimate of 109,000 Razorbills/Guillemots was calculated.

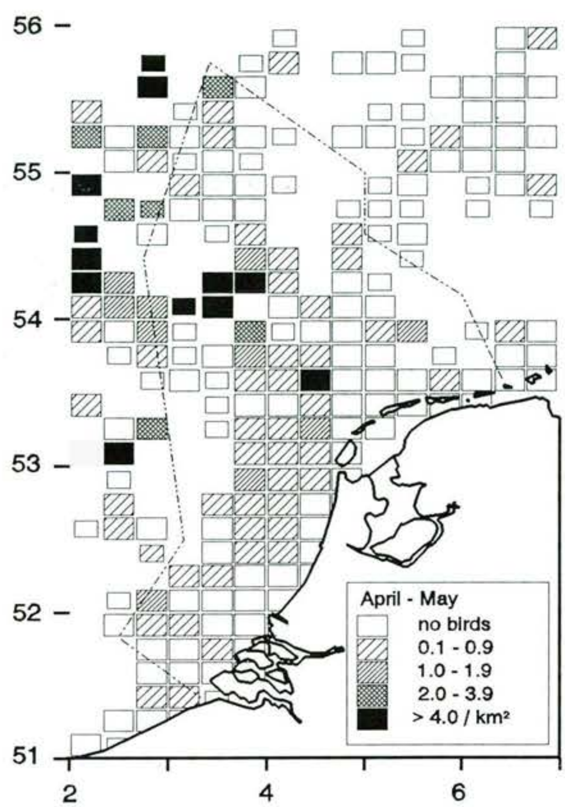


Figure 4.115 Distribution of Guillemot, April-May (n= 1565)

Low densities of Guillemots were found in the Southern Bight in **April-May**, and moderate to high densities in the northwestern half of the study area (figure 4.115). Numbers rapidly declined in April and Guillemots were rather scarce in May. In April, still only around a quarter of the Guillemots seen at sea were summer plumage individuals (26.7%, n= 1000), whereas this proportion was substantially higher in May (69.4%, n= 929; table 4.14). It was estimated that around 900 Guillemots occurred in the coastal zone, with another 116,700 individuals offshore (table 4.2). Along the coast, very small numbers of auks were seen (#3, #4). Aerial surveys suggested that auks were still evenly distributed over the entire area in these months (#1), but the estimate of total numbers was distinctly lower (*ca.* 12,000 in 1985-88, 36,000 in 1989-92 from aerial surveys, 50,900 Razorbills/Guillemots from ship-based surveys in the Dutch sector). Mass strandings of dead Guillemots were less frequent in these

Table 4.14 Monthly frequencies of plumage types in Guillemots (breeding, transient and winter plumage) in the southern North Sea, 1985-93.
Tabel 4.14 Maandelijks voorkomen van verschil lende kleden bij de Zeekoet (broed-, overgangs- en winterkleed) in de zuidelijke Noordzee, 1985-93.

Month	breed	trans	wint	% breed	sample
Jan	532	104	1916	20.9	2553
Feb	582	89	1939	22.3	2610
Mar	664	260	1644	25.9	2569
Apr	266	206	528	26.7	1000
May	645	72	212	69.4	929
Jun	23	1	1	90.4	25
Jul	796	70	240	72.0	1106
Aug	376	257	823	25.8	1456
Sep	12	56	650	1.6	718
Oct	7	35	4027	0.2	4069
Nov	77	69	4554	1.6	4700
Dec	273	116	1757	12.7	2146
Totals	4253	1335	18290	17.8	23879

months. A stranding of heavily oiled Guillemots late April/early May 1985 was studied in detail. Dissections showed that a large proportion of these birds were immatures, actively moulting body feathers, which is in agreement with the results of ship-based surveys in which very low proportions of full summer plumage individuals were reported (table 4.14). Most birds found dead in the above incident were in perfect physical condition when killed by the oil and the diet comprised a variety of fish including Sprat, Herring, Whiting *Merlangius merlangus* and sandeel *Ammodytes* spp. (Camphuysen 1990c).

Discussion and conclusions The southern North Sea, particularly the offshore zone, is an important area for wintering Guillemots. Peak numbers of over 240,000 Guillemots were estimated to occur in late autumn (October-November), representing around 3.0% of the NE Atlantic population (table 4.3). Total numbers in December/January could be higher still (*cf.* #1), but poor coverage in these months does not allow for a proper estimate. Seawatching data and information on strandings suggest that this area gained importance in the early 1980s, after a period of *ca.* 10 years with comparatively low numbers of birds. It must be stressed that both seawatching and beached bird surveys cannot be used to monitor numbers of auks north of 54°N, but that penetrations into the Southern Bight are probably recorded quite well. The area is of particular importance for Guillemots breeding on cliffs in East England and SE Scotland, to raise the just fledged chicks (Leopold 1988d, 1989, Webb *et al.* 1988, Harris *et al.* 1991, Leopold 1991). Late summer/early autumn is probably the most crucial period for auks, being flightless and therefore less mobile. Predictable resources of food, such as the Friese Front has turned out to be, are very important for the survival of chicks in the first half year (Scott 1990). The diet of Guillemots in the Friese Front area consists mainly of juvenile Scad *Trachurus trachurus* and Sprat (Geertsma 1992). In these months, the auks are extremely vulnerable to oil pollution, whereas late summer storms seem to lower the survival of chicks considerably (Harris *et al.* 1992). The maximum number of Guillemots estimated to occur within the study area, around a quarter of a million birds, included a large number of juveniles.

Chronic oil pollution is a significant threat for auks wintering in the Southern North Sea. Some 89.0% of all Guillemots found stranded during 1969-85 were oiled (n= 14,554; #2). Large numbers of auks were starved to death, however. For many dead Guillemots it was not clear whether lightly oiled, emaciated casualties were killed by the oil or were dying anyway. Studies of stranded Guillemots since the late 1960s showed that the numbers washing ashore increased enormously since the early 1980s (#2, Camphuysen 1990b, 1992ab). Mass strandings of Guillemots occurred frequently, if not annually (*e.g.* Camphuysen 1981, 1989a, 1990cd, 1992b Camphuysen & Keijl 1991). Although most Guillemots were oiled, it was concluded that structural food shortages in the winter months (further north in the North Sea?) had caused the repeated influxes into the Southern Bight and the series of wrecks witnessed since winter 1980/81. The presence of larger than usual numbers of auks in the Southern Bight was also reflected in oil incidents in this region (#2, Leopold & Camphuysen 1992). However, the diet of Guillemots in the southern North Sea has not been sufficiently studied to come up with further conclusions or suggestions on (probable) causes of the observed wrecks. From ringing recoveries, it can be concluded that most Guillemots stranded in the Netherlands originated from colonies on the east coast of Scotland and in the Western Isles (Outer and Inner Hebrides). Probably, Guillemots from the Faeroes do not visit these waters frequently, but ringing effort is comparatively low on these islands (De Wijs 1985). Occasionally high arctic Guillemots were found in the southern North Sea (Camphuysen 1989b). The combined effect of the series of wrecks and oil incidents became well visible in the development of colonies from which the casualties originated: populations stabilized or declined on study plots in colonies in the Western Isles and east coast Scotland (summarized in Camphuysen 1990b, 1992b). A significant reduction of chronic oil pollution is an important aspect in Guillemot conservation in the southern North Sea and this would undoubtedly increase the survival in winter of this species. Of particular importance is the concentration of moulting birds accompanying chicks in the northern half of the Dutch sector (figure 4.110), a group of birds which is flightless and therefore particularly vulnerable to oil pollution. Future ship-based surveys should aim at this region in order to accurately assess and monitor the distribution and numbers of these auks and intensified aerial patrol flights for oil slicks, coupled with clean-up operations should be recommended.

From aerial surveys, in which sightings of Guillemots and Razorbills must be combined, estimates of total numbers in the Dutch sector of the North Sea were generally considerably lower. Only in December/January, when the offshore zone was poorly covered and when a smaller area had to be used to extrapolate for total numbers, the estimated numbers were somewhat higher. In other periods, estimates from ship-based surveys were a factor 1.7-5.5 higher. The combination of these underestimates and the fact that these two very different species (seasonal pattern, spatial distribution, diet, relative importance of Dutch numbers to the NE Atlantic population) cannot be separated, make the aerial surveys a less efficient tool than ship-based surveys to monitor the numbers of auks in the southern North Sea.

Razorbill *Alca torda*

During seawatching and in aerial surveys, Guillemots and Razorbills cannot normally be separated and the species are therefore usually treated together (#1, #3, #4). Patterns of occurrence of 'large auks' from these sources are described under Guillemot and will not be repeated here. The nearest colonies of Razorbills are found along the coast of East England, on Bempton-Flambo-

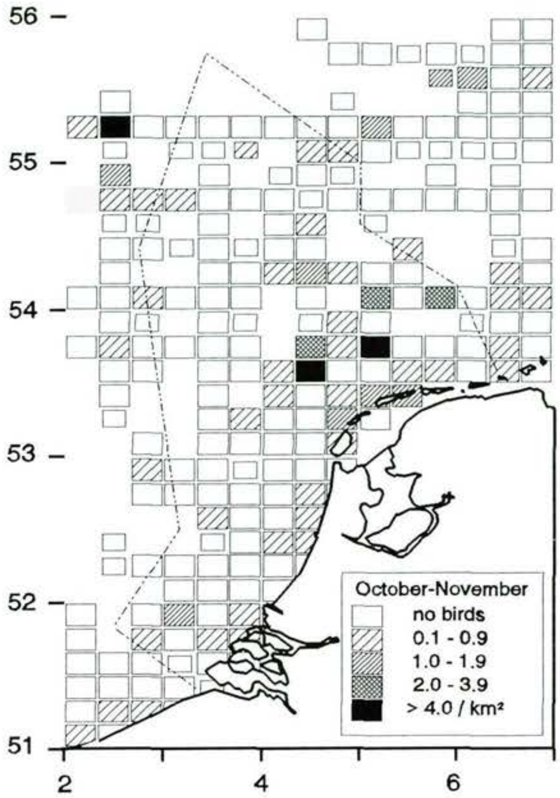


Figure 4.116 Distribution of Razorbill, October-November (n= 982)

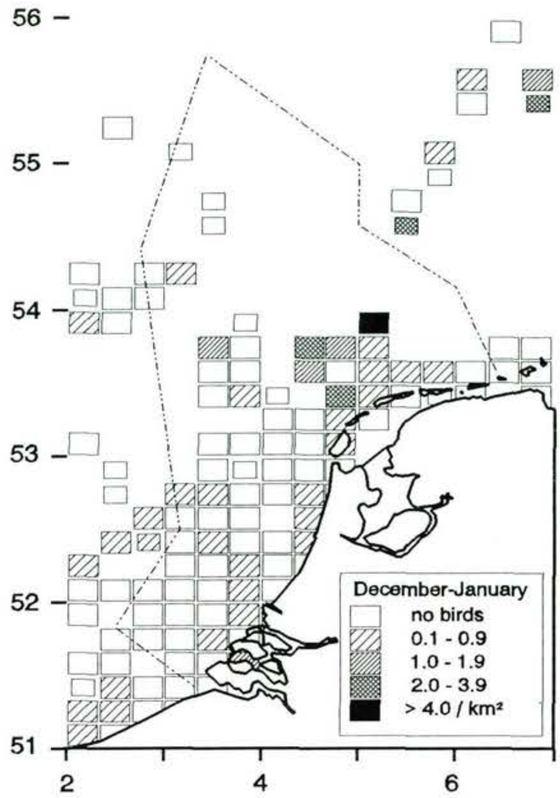


Figure 4.117 Distribution of Razorbill, December-January (n= 417)

rough cliffs (*ca.* 7700 individuals in 1985-87) and on the Farne Islands (65 sites; Lloyd *et al.* 1991) and on Helgoland (4 pairs; Hansohn 1994).

In late summer and early autumn, June-September, Razorbills were very scarce in the southern North Sea (not mapped). From scattered areas with very low densities in June/July and August/September it was estimated that respectively 70 and 300 Razorbills occurred in the offshore zone (table 4.2). In late autumn, **October-November**, this pattern changed radically. Moderate to high densities of Razorbills were found in the Friese Front region and on the Doggersbank, low to moderate densities were found in most of the coastal zone and scattered offshore (figure 4.116). It was estimated that around 4200 Razorbills occurred in coastal waters, plus another 22,600 individuals offshore. Virtually all Razorbills seen in these months were winter plumage individuals, indicating that this species enters the southern North Sea after completion of the post-nuptial moult (table 4.15). Only few Razorbills were found dead on the Dutch coast in autumn (#2).

Despite poor coverage of the offshore zone in **December-January**, an estimated 23,200 Razorbills occurred offshore in the area surveyed. Apparently, numbers had increased, but further studies will have to demonstrate what actually happens north of 54°N (figure 4.117). An estimated 2700 Razorbills were found in the coastal zone in this month, an area where 11.3x more Guillemots were recorded. Moderate to high densities were exclusively found north of the Wadden Sea islands, scattered low densities occurred in the Southern Bight. Feeding Razorbills were often joined by Little Gulls (see text Little Gull). In winter, numbers of dead Razorbills on the beach gradually increase (#2). Most birds were found on the mainland coast of Noord-Holland and an analysis of biometrics of stranded Razorbills indicated that most individuals belonged to the subspecies *A.t.islandica* (#2). Ringing recoveries have shown

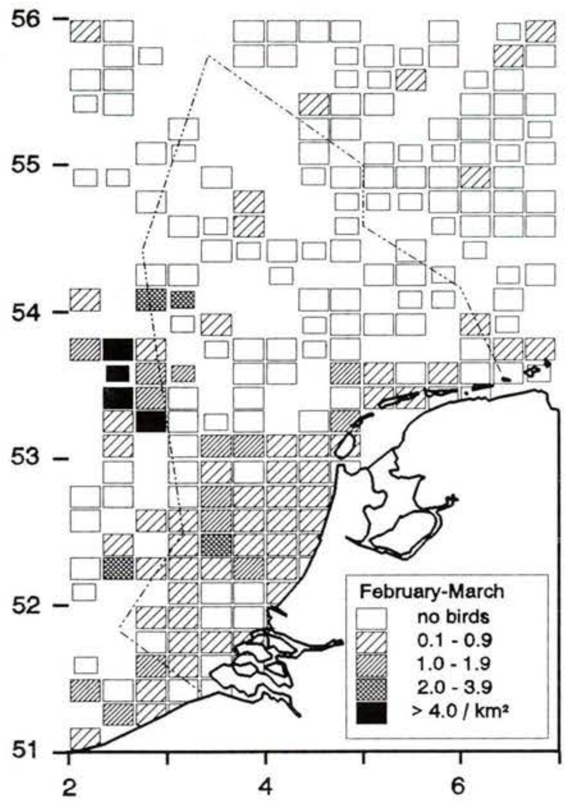


Figure 4.118 Distribution of Razorbill, February-March (n= 1296)

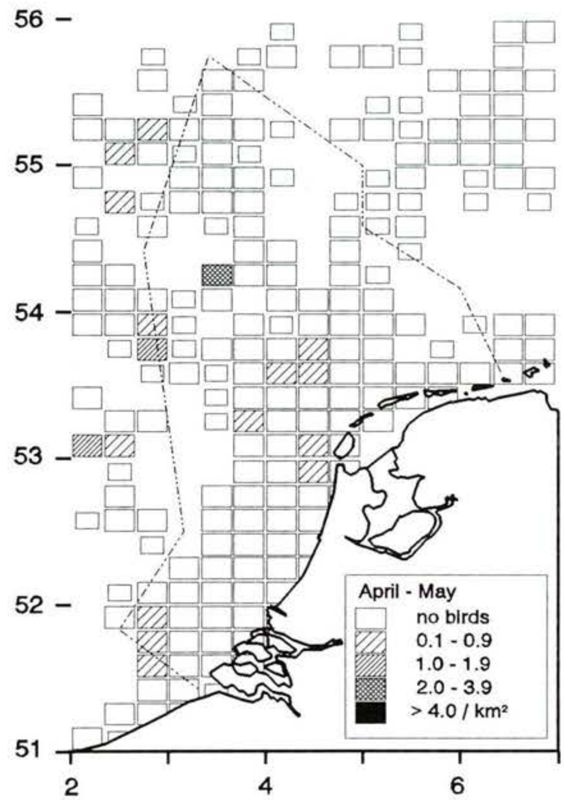


Figure 4.119 Distribution of Razorbill, April-May (n= 214)

that most Razorbills found dead in the Netherlands originated from colonies around the Irish Sea, with smaller numbers from Scottish colonies (NZG/NSO unpubl. data). A minor wreck of Razorbills was witnessed in December 1988 (#2).

Most Razorbills observed in **February-March** were found in the southern Bight (figure 4.118). Moderate to high densities were found just to the south of Outer Silver Pit over the sand ridges east of Norfolk (England). Low to moderate densities occurred everywhere south of 53°N. It was estimated that around 40,800 Razorbills occurred offshore and another 3500 individuals in coastal waters. It was calculated that the coastal zone held now only 2.8x more Guillemots than Razorbills (many birds had left these waters), whereas in offshore waters 3.7x more Guillemots than Razorbills occurred. The proportion of birds in breeding plumage had increased to over 20% in these months (table 4.15). Numbers of dead, stranded Razorbills peaked in February and March (#2). Several wrecks of slightly oiled, emaciated Razorbills were witnessed, including mass strandings in 1981, 1983, 1984, 1990 (#2, Camphuysen 1990de).

Numbers of Razorbills declined rapidly in **April-May** (figure 4.119). Low densities were found in patches in the Southern Bight, low to moderate densities over the sand ridges south of Outer Silver Pit. Only 200 Razorbills were estimated to occur in the coastal zone, another 11,300 individuals offshore. Guillemots remained in larger numbers within the study area in these months, so that the coastal and offshore ratios between Guillemots and Razorbill had changed to 4.5:1 and 10.3:1 respectively. Individuals in summer plumage were suddenly quite scarce in April, compared to February and March, indicating that adults and older immatures had left the area. In May, when younger immatures have developed a breeding plumage, the proportion of summer plumage individuals had grown to 51.5% (n= 56). Numbers of

Table 4.15 Monthly frequencies of plumage types in Razorbills (breeding, transient and winter plumage) in the southern North Sea, 1985-93.
Tabel 4.15 Maandelijks voorkomen van verschillende kleden bij de Alk (broed-, overgangs- en winterkleed), zuidelijke Noordzee, 1985-93.

Month	breed	trans	wint	% breed	sample
Jan	15	8	242	5.7	266
Feb	192	75	616	21.7	882
Mar	189	65	419	28.1	673
Apr	22	28	80	16.7	130
May	29	2	26	51.5	56
Jun	1	0	0		1
Jul	2	0	0		2
Aug	0	1	1		2
Sep	1	0	5		6
Oct	0	3	645	0.0	648
Nov	3	1	525	0.6	529
Dec	2	0	263	0.8	265
Totals	455	183	2820	13.2	3458

dead Razorbills washing ashore in these months gradually declined and most fresh birds found dead were immatures (#2).

Discussion and conclusions Substantial numbers of Razorbills winter in the southern North Sea, with peak numbers in February/March (*ca.* 44,000 individuals, 1.8% of the NE Atlantic population; table 4.3). Razorbills arrive after having finished the post-nuptial moult and an invasion of chicks, similar to that described for Guillemots, has not been observed. The proportion of summer plumage individuals suddenly dropped in April, indicating that mature Razorbills either leave these areas immediately after completing pre-nuptial moult, or even prior to this moult. This seasonal pattern is different from that described for Guillemots (table 4.1) and this highlights ecological differences between the two species. Such differences are also indicated by the fact that wrecks of Guillemots and Razorbills did not necessarily take place at the same time. Razorbills arrive rather late in the southern North Sea and, each year, their arrival is clearly witnessed in beached bird surveys. Chronic oil pollution is a significant threat to Razorbills wintering in the southern North Sea. Some 89.3% of all Razorbills found dead during 1969-85 were contaminated with oil (#2). Recent years have produced several wrecks of emaciated Razorbills, similar to those described for Guillemots (#2, Camphuysen 1990bde, 1992b). In contrast to most wrecks of Guillemots, most stranded Razorbills were adults or older immatures. Only in 1990 a comparatively large fraction (32.6%) were juveniles (n= 221; Camphuysen 1990e). As in Guillemots, for many dead Razorbills it was not clear whether lightly oiled, emaciated casualties were killed by the oil or were dying anyway (#2, Camphuysen 1990b, 1992ab). Most Razorbills were oiled, but it was concluded that structural food shortages in the winter months (further north in the North Sea?) had caused the repeated influxes into the Southern Bight and the series of wrecks witnessed since winter 1980/81. The diet of Razorbills in the southern North Sea is not sufficiently studied to come up with further conclusions or suggestions on (probable) causes of the observed wrecks. From ringing recoveries, it can be concluded that many Razorbills stranded in the Netherlands originated from colonies on the west coast of Scotland, on the coast of Ireland and from islands in the Irish Sea. One ringed Razorbill found dead was ringed on Iceland. There are no obvious concentrations of Razorbills in Dutch waters, so the best conservation measures taken are an overall reduction of chronic oil pollution in the southern North Sea.

Little Auk *Alle alle*

Small groups of Little Auks were frequently observed around the Doggersbank and in the Nordschillgrund area between November and March (figure 4.119). Scattered offshore sightings occurred elsewhere, with a cluster of records at the Outer Silver Pit. Few Little Auks were observed south of 54°N, and only small numbers occurred in coastal waters. Estimates of total numbers of Little Auks in the study area were in the range of 18,000 individuals between December and March (table 4.2). Peak numbers must have occurred in December-January, when the offshore zone was poorly surveyed. Future surveys may provide more accurate estimates for this area. Coastal observations produced comparatively large numbers of Little Auks since 1985 (#4). Most Little Auks were seen between November and March, totalling at most several hundreds per season. Relatively large numbers occurred in winter 1990/91 (Van der Ham *et al.* 1991). The distribution pattern derived from aerial surveys is not in

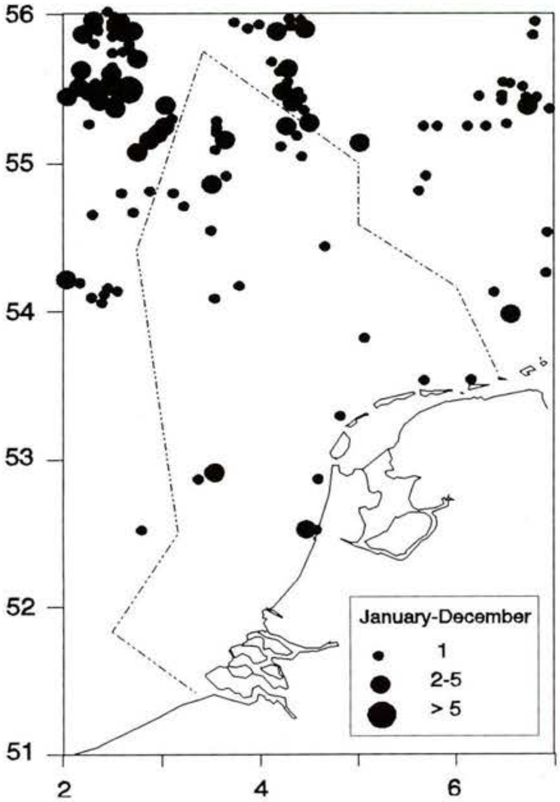


Figure 4.120 Sightings of Little Auks, January-December (•, n= 225)

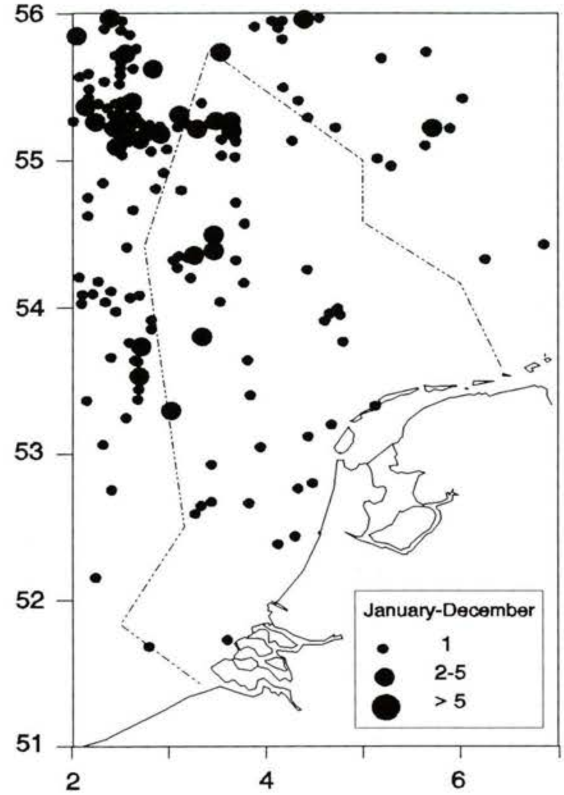


Figure 4.121 Sightings of Puffins, January-December (•, n= 201)

agreement with that established from ship-based surveys, probably because most Little Auks are overlooked (#1). The concentration of sightings from ship-based data in the NW of the study area fits well into the overall pattern of Little Auks in the North Sea, with very large numbers in the NE North Sea, low to moderate densities in the NW and very small numbers in the SE North Sea (German Bight and Southern Bight; Camphuysen *et al.* 1993, Stone *et al. in press*). Little Auks have increased slightly in numbers washing ashore in the Netherlands in recent years (Camphuysen 1986, #2). They are well known for their massive influxes in areas south of the normal wintering range (Haverschmidt 1930, Murphy & Vogt 1933). The last large scale wreck was witnessed in 1950 (O'Donovan & Regan 1950, Sergeant 1952, Bateson 1961), but smaller influxes and wrecks have occurred rather frequently (Poulsen 1957, Elkins & Williams 1972, Furtado & LeGrand 1979, Lichtenbeld 1981, Underwood & Stowe 1984, Van der Ham *et al.* 1991, Heubeck & Suddaby 1991, Jardine *et al.* 1993). Severe gales in autumn sometimes produced elevated numbers washing ashore (*e.g.* November/December 1985, autumn 1988; #2). The oil rate of Little Auks stranded in the Netherlands amounted to 84.6% during 1969-85 (n= 91; #2), showing the birds' high vulnerability to surface pollutants.

Puffin *Fratercula arctica*

Puffins occurred in very low densities and mainly in the northwestern half of the study area, particularly on the Doggersbank (figure 4.120). Of 201 Puffins observed, 193 were seen between October and May. Maximum numbers were estimated to occur during February/March (7000 Puffins in the offshore zone; table 4.2). Records of this species in the Southern Bight occurred more frequently than those of Little Auks, but the coastal strip was usually avoided. Seawatchers recorded most Puffins between October and March, generally in slightly smaller numbers than Little Auks and with little fluctuations between years (#3, #4). Slightly higher numbers were seen in 1983, which coincided with a stranding of Puffins (Camphuysen 1986, #2). The oil rate of Puffins stranded in the Netherlands, most of which were found between January and March, amounted to 85.0% during 1969-85 (n= 80; #2). Rather few Puffins were observed during aerial surveys, but the overall distribution pattern was in agreement with ship-based sightings (most birds in the NW and generally far offshore; #1). It is remarkable that Puffin sightings during aerial surveys were restricted to October-February, whereas ship-based surveys produced fair numbers until May.

5. DISCUSSION

Seabirds in the southern North Sea: a review

Rose & Scott (1994) summarized current knowledge of waterfowl populations in the world. From these estimates, it was concluded that the present study area is of international importance for wintering Red-throated Divers (13.1% of the NE Atlantic population, December-January), Great Crested Grebes (21.1%, February-March), Eider (exceptionally 3.5%, January-February 1993), Common Scoters (10.4%, January-February 1993), Common Gull (5.0%, December-January), Herring Gulls (12.2%, December-January), Great Black-backed Gulls (13.2%, October-January) and Guillemots (3.0%, October-November). In summer, the area was of international importance for Lesser Black-backed Gull (18.4%, April-May) and Sandwich Tern (4.7%, April-May). For migrants in autumn the area is important for Gannets (3.0%, October-November), Great Skua (10.7%, August-September), Little Gull (18.9%, October-November), and Common Tern (5.9%, August-September). Besides, substantial numbers of Fulmars (2.3% in autumn), Velvet Scoter (exceptionally 1.3% in winter), Arctic Skua (2.2% in autumn), Kittiwakes (1.8% in late autumn) and Razorbills (1.9% in winter) were found. The coastal waters were of prime importance in winter, because divers, grebes, seaduck, and *Larus*-gulls were found concentrated in this zone. Guillemots were most numerous in winter. However, these birds were especially vulnerable in late summer and autumn, when tens of thousands of moulting (flightless) adults accompanying downy young entered the area.

Beached bird surveys in Europe have demonstrated that the southern North Sea must be regarded as the area most heavily affected by chronic oil pollution (Camphuysen & Van Franeker 1992). The combination of high numbers of corpses and high oil rates found on the Dutch coast (#2) has not been reported anywhere else. The 10 most numerous oiled seabirds stranded on the Dutch coast in recent years (1969-85, n= 65,654; #2) were Guillemot (22.6%), Common Scoter (16.5%), Kittiwake (11.3%), Eider (8.6%), Razorbill (6.2%), Herring Gull (4.5%), Common Gull (2.6%), Great Crested Grebe (2.6%), Fulmar (2.2%) and Black-headed Gull (2.1%), eight of which were found to occur in internationally important numbers in the southern North Sea. Recent oil incidents in the coastal zone and illegal discharges of oil and other lipophilic substances have demonstrated the excessive vulnerability of these birds (Camphuysen *et al.* 1988, Camphuysen 1990c, Bommelé 1991, Camphuysen & Keijl 1991, Zoun 1991, Zoun *et al.* 1991, Leopold & Camphuysen 1992, Zoun & Boshuizen 1992, Camphuysen & Van Franeker 1992, #2). Yet, chronic oil pollution of inshore and offshore waters rather than specific oil incidents, should still be considered one of the most significant threats for seabirds wintering in the southern North Sea (#2, Camphuysen & Van Franeker 1992).

Other potential hazards to seabirds in the southern North Sea have not been studied in much detail in recent years. Persecution or harvesting in colonies has declined since the late 1960s, and Cormorants and several species of gulls were allowed to expand considerably as breeding birds (De Wit & Spaans 1984, Spaans *et al.* 1987, Zijlstra & Van Eerden 1991). Ground predators, destruction of habitat, and recreational pressure were important factors behind breeding failures and population declines of gulls and terns in recent years (Derks & de Kraker 1993, Furness 1993, Woutersen 1994). Potential hazards at sea are obviously not easily studied. Recreational pressure of the coastal zone is evidently increasing in many parts of the Dutch coast, but internationally important concentrations of divers, grebes and seaduck are typically a winter phenomenon, when water sports are much less popular a passtime. Net and line mortality are factors of limited significance (Camphuysen 1990c, Camphuysen 1994b). A very low proportion of birds found on beaches was killed as a result of entanglements. The only exception was the Gannet, of which around 5% were killed in fishing nets, probably mainly in pieces of net floating around. Overall numbers killed were quite small, though.

Drowning in gill nets, or fish traps, occurs on a large scale in inland waters like the IJsselmeer (Van Eerden & Bij de Vaate 1984), but considering the small number of fish traps in coastal waters and the scarcity of set-net fishermen in the southern North Sea, mortality in gill nets is probably negligable. Ingestion of plastics is a problem frequently encountered in stranded seabirds, particularly in Procellariiforms (Coleman & Wehle 1984, Van Franeker 1985, Furness 1985, Furness 1993), but cannot be labeled as a significant threat on the population level (Connors & Smith 1982, Day *et al.* 1985, Ryan 1987, 1988, Ryan *et al.* 1988).

Offal and discards are important as an additional source of food for scavengers in the southern North Sea. High consumption rates, severe inter- and intraspecific competition and large numbers of birds associated with commercial trawlers were observed in the southern North Sea (Camphuysen 1993abc, Camphuysen *et al.* 1993). Drastic changes in fisheries policy, such as a significant reduction of fishing days, smaller mesh sizes, or the establishment of areas which are closed for fisheries, may lead to a re-arrangement in the hierarchy of scavengers at trawlers and extra mortality as a result of the (partial) loss of an important source of food (*cf.* Furness 1986, 1992). Reductions in the availability of fish or shellfish are probably a very significant threat for seabirds and seaduck. The availability of pelagic fish such as Herring and Sprat or of bottom dwelling species like sandeels for seabirds are notoriously hard to study (Bailey 1980, Blake 1983, Bailey 1986, 1989, 1991, Bailey *et al.* 1991). Massive wrecks witnessed in the 1980s and early 1990s were probably (partly) caused by serious reductions in the available resources of fish for seabirds wintering in the North Sea (Blake 1984, Camphuysen 1990b, 1992b, Harris & Bailey 1992). Whether overfishing or natural fluctuations in stock size or in spatial distribution have caused these problems will probably never be clarified. Current developments of North Sea fisheries, particularly in industrial fisheries for sandeel and Sprat/Herring, in combination with the observed extra mortality of wintering seabirds in the North Sea are reasons for great concern, however (Gauld *et al.* 1986, Camphuysen 1990b, Furness 1993). Much more obvious relationships between overfishing of shellfish in the Wadden Sea, and more recently in the coastal zone of the North Sea as well, demonstrated how easy conflicts between seabirds (seaduck in this case) and fisheries may develop (Van de Kuip 1991, Leopold 1993, Leopold & Plat *in prep.*). Mass mortality and emigration were direct results observed in Dutch coastal waters and the Wadden Sea, and the value of our coastal waters to wintering seaduck may have decreased significantly as a result.

The Dutch sector of the North Sea

The Dutch sector of the North Sea is of international importance as a wintering area for Red-throated Diver (9.5% of the NE Atlantic population, December-January), Great Crested Grebe (13.7%, February-March), Eider (exceptionally 3.3%, February 1993), Common Scoter (exceptionally 10.4%, February 1993), Common Gull (3.8%, December-January), Herring Gull (8.4%, December-January), and Great Black-backed Gull (7.4%, October-January). In summer, the area was of international importance for Lesser Black-backed Gull (12.9%, April-May) and Sandwich Tern (3.9%, April-May). For migrants in autumn the area is important for Gannets (2.2%, October-November), Great Skua (7.4%, August-September), Little Gull (14.3%, October-November), and Common Tern (5.1%, August-September). Besides, substantial numbers of Fulmars (1.1% in autumn), Velvet Scoter (exceptionally 1.3% in winter), Arctic Skua (1.1% in autumn) and Guillemots (1.7%, winter) were found. The coastal waters were of prime importance in winter, because divers, grebes, seaduck, and *Larus*-gulls were found concentrated in this zone. The largest numbers of seabirds in the Dutch sector were found in winter (February-March), when over half a million of birds occurred.

Of great significance is the coastal zone, particularly in winter. The shallow areas of the Belgian coast, the Voordelta and a narrow strip off the Wadden Sea islands were found to hold substantial numbers of piscivorous divers, grebes, Cormorant, and terns, omnivorous gulls, and benthivorous seaduck. Many of these birds are concentrated in waters of less than 15-20 metres deep (*cf.* Skov *et al.* 1994, Leopold *et al.* 1993). This zone is certainly not homogeneous. Seaduck occurred in huge concentrations, which coincided with rich resources of shellfish (particularly *Spisula subtruncata*; Leopold *et al. in press*). Divers occurred everywhere in the coastal strip, but feeding flocks were observed frequently off the Wadden Sea islands and in the Voordelta. Divers were often concentrated in turbulent water between Wadden Sea islands, where also more pelagic species like Guillemot and Razorbill were frequently found in winter. In summer, most *Larus*-gulls in the coastal zone were concentrated near colonies, whereas in winter, when overall numbers of gulls increased sharply, most species became widespread. Tidal fronts, which occurred freqently off the piers of Hoek van Holland, Scheveningen and IJmuiden, and small areas with strong currents, most prominent between Wadden Sea islands, attracted surface feeding seabirds. Little Gulls, Black-headed Gulls, and Common Gulls in winter were often seen feeding at tidal fronts, but occasionally, such fronts attracted rare pelagic seabirds such as Storm Petrels (Koerts 1992).

Further offshore, the area can be divided into two important parts. A 'deep water' area (over 35m depth) north of Terschellingerbank and a comparatively shallow area (less than 35m depth) in the south. Pelagic seabirds like Fulmars and Kittiwakes were usually more numerous in the northern part of the Dutch sector (in deeper, relatively clear Central North Sea water), Guillemots were mainly restricted to the northern half in late summer. Most of these species entered the southern Bight only in winter in large numbers. Puffins and Little Auks were common in winter in the northern part of the Dutch sector, but hardly penetrated into the Southern Bight. Gannets and Great Skuas were more widespread over the area, partly as a result of the fact that these species migrated further to the south (with Bay of Biscay, Atlantic waters off West Africa and the Iberian peninsula and the western Mediterranean as important wintering areas). It appeared that for many pelagic species wintering in the North Sea, the NW corner of the Netherlands normally forms the southern border of distribution. Locally, important concentrations of seabirds occurred in the offshore zone. Of particular importance (see species accounts) were the Doggersbank (*e.g.* Guillemot, Little Auk), the Friese Front region (*e.g.* Guillemot, Lesser Black-backed Gull), the Outer Silver Pit (*e.g.* Kittiwake), and the Bruine Bank region (*e.g.* Fulmar, Gannet and *Larus*-gulls associated with extensive beamtrawl fisheries).

Seabirds in surrounding areas

In the following section, the numbers and significance of concentrations of seabirds in the study area are compared to other sea and coastal areas within the biogeographic region for the species under consideration, *viz.* the Wadden Sea (Meltofte *et al.* 1994 *in press*) and the IJsselmeer (Voslamber 1991), the Delta region (including the now reclaimed, freshwater parts; Meininger *et al.* 1994), the coastal area of the whole southeastern North Sea from Belgium up to Blåvandshuk (Denmark; Skov *et al.* 1994), the North Sea at large (ESAS-database; Stone *et al.* 1994 *in press*), and adjoining waters west of Britain and Ireland (Webb *et al.* 1990). Unless otherwise stated, figures for these areas that are mentioned in this section are taken from the sources listed above, this to avoid burdening the text with the same references time and again.

The **Red-throated Divers** that winter in internationally important numbers in our coastal waters are part of a larger wintering population, extending from at least Belgium to 56°N. Dedicated surveys, carried out in winter from 1986 to 1993 have resulted in a total population estimate of 42,740 wintering Divers (±95% Red-throated Divers). The divers are found concentrated in a rather narrow strip between the coast and *ca.* the 20 meter isobath, (or the shipping lane, with its high incidence of disturbance) from Belgium up to the Elbe esturary in Germany (6625 divers); in a low density further offshore in the southern North Sea (11,800) while north of the Elbe the zone with high numbers of divers widens, from the coast to at least the 30 meter isobath, while lower densities are found down to the 40 meter isobath. This area contains the largest wintering concentration of divers in the world: 36,000. In spring (April-May) the divers retreat to this northern area and numbers of divers falls to 26,500-28,500 divers, now including a much higher number of Black-throated Divers (46%) that arrive in the area to moult. The coastal waters of the southeastern North Sea are the prime diver area in the North Sea at large. In other coastal parts, off Norway and around Great Britain and Ireland, only several thousands divers winter. Numbers of wintering divers in the southeastern North Sea are in western Europe only challenged in the western and southern Baltic, where 56,665 divers (95% Red-throated) were recently estimated wintering. Divers do not readily enter the enclosed waters of the Wadden Sea, IJsselmeer or reclaimed parts of the Delta area, where numbers are negligable.

The numbers of **Great Crested Grebes** in the study area are intimately linked to the principal freshwater winter areas in the Netherlands. In the Delta area, some 3000 Great Crested Grebes have been present on average in recent years in autumn, and in mid-winter average numbers go up to 4-5000. In the IJsselmeer up to 40,000 spend late summer moulting (Piersma *et al* 1986), and an estimated 10-20,000 winter here. In the main rivers of the Netherlands, nearly 2000 birds may also winter (van den Bergh *et al.* 1979). In the Wadden Sea numbers are not very important. Unlike the divers, Great Crested Grebe distribution in winter does not extend into German and Danish waters in the North Sea. Similar to the divers however, are the low numbers around the British isles and in the fjords of Norway, and the large numbers in several coastal parts of the Baltic, where some 11,300 are estimated to winter in areas near large freshwater bodies.

Part of the internationally very important wintering concentration of **Scaup** in the IJsselmeer and adjoining part of the Wadden Sea (up to nearly 200,000 have recently been counted here: Platteeuw *et al.* 1994) may temporarily take refuge in the coastal waters of the North Sea during severe ice-winters. Even if very large groups were not found in the surveys presented here (and probably never will, from ships under extreme conditions) the area can at times be of great importance for the species. **Eiders**, normally living in the Wadden Sea, have recently also taken to the North Sea in large numbers, in responce to food shortage in their preferred habitat. Numbers in the study area, although impressive in recent winters, are small in comparison to the 'true' Eider areas in western Europe: the international Wadden Sea (246-331,000 wintering; 250,000 moulting in July-August; 200-250,000 in autumn; lower numbers in spring and summer: 6-7,000 pairs, with summering subadults totalling maybe 100,000); the Baltic (1 milion wintering, of which 341,000 in the Kattegat); Iceland (900,000 wintering). Numbers in the western North Sea are considerably lower: 53,500 estimated wintering, of which the largest recent concentration of 10,000 occurs in the Moray Firth, while another 23,000 winter around Ireland and at the British westcoasts (Baillie 1986). Numbers in the IJsselmeer and Delta area (less than 300) are insignificant. The **Common Scoters** that wintered in large numbers off our coasts in recent years are part of the southeastern North Sea wintering population of some 200,000 birds. Large flocks may winter anywhere between Belgium and Blåvandshuk, Denmark in the shallow coastal zone. The Netherlands will probably loose their large concentrations of seaduck to Germany or Denmark in the near future, where the non-treatment of the fishery problem with regard to the clam *Spisula subtruncata* has not (yet) resulted in the almost total removal of this seaduck food source from the habitat. The wintering 'population' in the North Sea is probably linked to the much larger numbers (800-940,000) wintering in the Baltic and Kattegat area and another 150-200,000 birds wintering further south. Numbers of wintering birds around the British isles are in the order of 30,000 birds (Webb *pers. comm.*) and numbers off the Norwegian coast are around 4000 birds (Nygard 1992). Considerable numbers must winter somewhere south of the study area, as 150-200,000 pass the Netherlands each year (Platteeuw 1990). As numbers in Belgium (max 12,000: Maertens *et al.* 1988, 1990, Seys 1993), France (27-40,000: Girard 1992), Spain (unknown but unlikely to be significant), Portugal (5800: Rufino 1992) and the Mediteranian coastal waters (insignificant, Cortes *et al.* 1980), together do not nearly make up for the suggested total, the North West African coast may be of greater importance than as yet supposed. The numbers wintering today in the Wadden Sea are rather insignificant. At least 40,000 were estimated to winter in the Western part of the Dutch Wadden Sea in the 1960's, but today less than 1000 remain here (Leopold *et al.* 1994a), and there is little evidence for the presence of large flocks elsewhere in the Wadden Sea. Common Scoters do not normally enter freshwater lakes and are thus as good as absent from IJsselmeer and Delta. The Baltic is also the main wintering area for **Velvet Scoters** (932,690 is the current estimate). Off Norway another 30,000 are estimated to winter (Nygård *et al.* 1988). Other areas, including the present study area are only marginally important: around the British isles only 3000 winter and off France 8000.

The apparent importance of the study area for the **Great Skua** (some 10% of the world population is to be found here in late summer/early autumn) is somewhat surprising, as by far the most important area in summer is the sea around its breeding strongholds: Shetland and Orkney. In July and August quite a large number cross over to the Skagerrak, probably to benefit from the riches that also the Guillemots and several *Larus* gulls seek out. When the Great Skuas leave the North Sea in September, the stream from the breeding area in the northwestern North Sea meets the stream of birds from the Skagerrak, towards the southern exit of the North Sea, and hence numbers in the study area increase. The birds do not seem to be in a hurry on their way south, and linger for a considerable amount of time in the southern North Sea, bringing numbers up to an internationally important figure.

Likewise, important numbers (tens of thousands) of **Little Gulls** migrate through the area. Although in autumn many birds linger at current lines and plume fronts, which seems to indicate that the area suits the species as a feeding area in this time of year, only some 4000 remain in winter. As at least some 10-15,000 birds are considered to winter in the nearby IJsselmeer, the numbers wintering at sea in the study area are somewhat low.

Common Gulls winter in the North Sea in most coastal areas that are bordering major estuaries, where they are particularly abundant around plume fronts. Most are found in the southern North Sea, off the Wash, Tyne and Thames in the west, in the Delta area and the Wadden Sea, but also in vast numbers inland. The number estimated at sea in the Dutch sector are comparable with those in the Wadden Sea (up to 100,000), but rather small when related to the estimated total for the Netherlands as a whole: 350-400,000 (SOVON 1987). The distribution at sea off the Wadden Sea does not end at the German Border however, and for the whole coastal strip from Belgium to Blåvandshuk some 72,380 are estimated to winter. This is hardly more than the current estimate for the southern North Sea which stresses the importance of the latter area, in combination with the Wadden Sea, Dutch mainland and Delta as a wintering area for the species. In the Baltic, another 71,880 are estimated to winter at sea. Numbers at sea west of Britain are small, as this gull is mainly an inland bird that does not venture too far out into the open sea. During spring migration (March-April) Common Gulls are found almost exclusively in the North Sea along the eastern seaboard, with high densities all the way from Cap Griz Nez in France to the top of Jutland, Denmark, and down again into the western Baltic. This is a good illustration of the highly important migratory pathway used by a large proportion of the Scandinavian birds, that make up for most of the total European population.

In terms of percentage of the NE Atlantic Population, the area is of even greater importance to the **Herring Gull**, in the Netherlands usually seen as a bird that is too common to be of interest. The core of the distribution extends over the whole North Sea, both offshore and inshore and into estuaries, bays and freshwater bodies, from northern Scotland down to the Channel and along the east coasts up to southern Norway (with an estimated population of some 300-500,000 birds: Camphuysen *et al.* 1993). The area with high numbers of Herring Gulls probably continue further to the north and south, but no estimates of numbers are available. In the Baltic some 300,000 winter at sea, but throughout the region also considerable numbers winter inland. The overall picture for the winter distribution of the species is one of a large range, of which the present study area is only a part. In the breeding season, the situation is distinctly different: now the birds are very much concentrated in the coastal zone and this area is of prime importance to the species all along the eastern North Sea seaboard.

The number of wintering **Great Black-backed Gulls** in the study area is an important part of the total wintering population that apparently has its core wintering area in the North Sea at large, with important extensions around the top of Scotland into the Irish Sea in the west, and around the top of Jutland, into the western Baltic, in the east. Winter 'population' estimates exist for the North Sea at large (*e.g.* 180,000 individuals, February 1993; Camphuysen *et al.* 1993 and 190,000, February; ESAS Database unpubl. data), for the Baltic (21,000), and the Wadden Sea (some 8000). Numbers in freshwater areas are relatively insignificant: *e.g.* on the IJsselmeer no more than several hundreds have been found.

The **Lesser Black-backed Gull** is a species that breeds in internationally important numbers in the Netherlands. As our breeding birds forage mainly in the North Sea, the study area is vital for our colonies. Avoiding competition with Herring Gulls, that occupy the nearshore waters in large numbers, the Lesser-black Backed Gulls use feeding areas further offshore (Camphuysen 1993c). This distribution pattern of two abundant coastal breeders extends along the German Frisian islands. In the German Bight, surprisingly high numbers of Lesser Black-backed Gulls have recently been found in a similar strip, beyond the 'reach' of its more coastal counterpart in the breeding season, the Herring Gull. In the south of the study area, where some 15,000 pairs breed, the Dutch Lesser Black-backed Gulls meet their English conspecifics halfway in the Southern Bight. As the North Sea is narrow there, the species can exploit the entire span of the sea in the south. In the North Sea, Lesser Black-backed Gulls exploit most of the coastal areas in the breeding season, but the Southern and German Bights and the Skagerrak appear to be of greatest significance. As the majority of the British and Irish Lesser Black-backed Gulls (totalling some 90,000 pairs: Gibbons *et al.* 1993) breed along the western coasts, densities at sea to the west of the British isles, with concentrations often well offshore are also considerable.

Another species that breeds in internationally important numbers in the Netherlands, the **Sandwich Tern**, has strongholds in much the same regions: the Delta and Wadden Sea. In the North Sea, the vast majority is found in the souteastern North Sea, from Belgium to Blåvandshuk, Denmark, *i.e.* of the Delta and international Wadden Sea, where *ca.* half of the total Northwest European breeding population is found. The study area is obviously a part of this greater habitat. Being an inshore species rather than a pelagic seabird in summer, large numbers of the 40,000 pairs that breed in the Wadden Sea, also use the Wadden Sea itself, and particularly the major tidal inlets between the islands for foraging. This tern does not venture into fresh water bodies in any numbers, and therefore the IJsselmeer and reclaimed parts of the Delta are unimportant to the species. In the western North Sea and to the west of Great Britain numbers are distinctly lower than in and around the study area in the eastern half, with only 14,000 pairs in Great Britain and an Irish population of just 4400 pairs (Gibbons *et al.* 1993).

The most abundant auk of the North Sea, the **Guillemot**, enters Dutch waters in late summer, when tens of thousands find the Friese Front suitable for raising chicks and to moult. This patch is unique in the North Sea, in that other offshore areas with similar concentrations of Guillemots in this time of year, are unknown. Most North Sea Guillemots either raise their chicks and moult off the British eastcoast, or cross over to do so in the Skagerrak area. In winter, when numbers in the study area are highest, the Guillemots in our waters comprise the southeastern end of a broad band of Guillemots, that spans the North Sea in an NW-SE direction, from NE Scotland down to the Netherlands. A second band of Guillemots circumvents SW Norway, off the Norwegian Deep, into the Skagerrak and Kattegat. This leaves the central northern, central and southwestern North Sea, including the Channel as areas of minor importance to wintering Guillemots. Changes in food availability, even though these may happen far outside the study area, particularly further to the northwest, may greatly inlfuence numbers in Dutch waters, by either pushing the major band of Guillemots further to the southeast, *i.e.* into our waters, or to the northwest, out of the study area. In the 1970's when numbers at sea in the Dutch sector were apparently small (Engelsman & Hulsmann 1974, #2) the former was probably the case. Winter food shortages in the 1980's in the northwestern North Sea have apparently increased numbers in our waters significantly (Camphuysen 1990b).

Razorbills only reach our waters in any numbers in October. Hence, these birds do not use the virtues of the Friese Front like the Guillemots do in August and September. In early winter (October-January) their distribution in the North Sea resembles that of the Guillemot, but later in winter (February-March) relative numbers in the southern North Sea (51°-54° N) are considerably larger. Razorbills tend to concentrate in the northwestern North Sea and in the Kattegat and Skagerrak in autumn and winter. Unlike the distribution pattern in the Guillemot, the Razorbills wintering in the southern North Sea birds seem only loosely connected to these concentration areas further north. Razorbills move mainly on the wing (Guillemots swim most of the way in summer, being accompanied by growing chicks and simultaneously moulting their flight feathers). They suddenly appear in the southern North Sea in autumn without an obvious build-up from anywhere. Apparently, also many birds from the Irish Sea region winter in the North Sea. As Guillemots and Razorbill are very hard to separate during seawatching, diffences in their migratory habits are very hard to detect this way. Intriguing in this respect is the often impressive passage of 'Razormots' along the Dutch coast in October-November (#4), which may signify the arrival of the Razorbills, as well as the arrival of (more) Guillemots that moulted elsewhere.

Migration through the study area

Systematic watches from land at several locations along the eastern North Sea seabord (most notably Blåvandshuk (DK), Hondsbossche Zeewering (NL) and Cap Gris Nez (F), have shown that the coastal zone of the eastern North Sea is a major flyway for migrating (sea)birds. One could argue that migrating birds do not really use the area for anything else than a passing-through corridor, and that the ecological significance of such an area is limited. In the case of seabirds migration over sea, however, the birds have the opportunity to forage on the way, and indeed are frequently seen doing so. Because of this, the flyway may also be a much needed foraging area. However, stops are usually brief and the birds make relatively little contact with the water during the migration period, as shown by the relatively low number of oil-victims in these periods, despite the fact that vast numbers of seabirds pass through the area. Migrating Sandwich, Arctic and Common Terns obviously forage on the way, as do the Arctic Skuas that chase them. Little Gulls often stop at plume fronts in autumn (but pass rapidly in spring) and Gannets specifically seek out our coastal waters in autumn for foraging. All these species however forage by surface dipping or plunge diving, avoiding long periods of contact with the water, which explains the comparatively small number of oil victims. Guillemots and Razorbills are often seen 'truely migrating' as are seaduck, but these birds also winter in the area and as a result suffer much more from local oil pollution, making the picture less clear in this respect. Species that normally prefer offshore waters, such as the Fulmar and the Kittiwake are usually only seen along the coast during or after storms, on compensatory movements that resemble, but are not true migratory flights (Blomqvist & Peterz 1984). To such species the coastal zone is a boundary rather than a bonus.

In conclusion, the study area treated in this report has great significance for a number of different seabird species. The coastal strip is very important for wintering Red-throated Divers, Great Crested Grebes, Common Scoter, Eider and Common Gull. In summer it is an undispensable foraging area for the breeding gulls and terns. This coastal area forms part of a much larger network of related inshore habitats, stretching from the Baltic, via the Wadden Sea, IJsselmeer, Delta and parts of the English eastcoast, further south to at least France, and for some species to western Africa. In the offshore part densities of seabirds are generally lower, but important numbers of birds winter (Herring Gull, Guillemot and Razorbill) and migrate through the area (Great Skua). Core areas are the Frisian Front, the Brown Bank and probably the slopes of the Dogger Bank.

Ship-based surveys and aerial counts compared

The principal objective for the production of this atlas was to present an overview of the results of ship-based counts of seabirds in the Dutch sector of the North Sea. In order to facilitate a first comparison between ship-based and aerial survey data, the distribution maps are given in the same formats as presented in the recently published atlas on aerial surveys in the area by Baptist & Wolf (#1). A comparison of results was considered appropriate, particularly because future planning would benefit from an analysis of advantages and disadvantages of the two methods. A thorough comparison of data is beyond the scope of this report. This would involve an extensive statistical analysis of both databases, using the raw data. Simultaneous surveys should be planned to better judge the outcome of both methods. In this report, we can only compare distribution patterns, and estimates of total numbers of birds occurring within the Dutch sector of the North Sea. It should be noted that both estimates of numbers of birds in the area have their own, presumably large but unknown standard error (#1). A striking difference, however, between the maps of ship-based counts presented in this atlas and those from the aerial surveys is found in several coastal species. Distribution patterns of divers, *Larus*-gulls and terns differ from those produced from aerial surveys, all these species appear to have a much broader and more uniform distribution. This feature seems to be only partly effort related. Without insight in the data processing techniques employed by Baptist and Wolf (#1), we cannot elaborate on how their smooth distribution patterns, extending relatively far offshore, emerged from the aerial data. In Fulmar, Gannet and gulls, a patchy distribution occurs as a result of aggregations near fishing vessels and flocks of surface feeding birds. The patchiness of seabirds at sea, a well known aspect of seabird biology, is obvious in patterns of spatial distribution of these seabirds in the southern North Sea, as derived from ship-based surveys. These patches contributed significantly to the estimates of total numbers of so-called ship-followers, and this patchiness showed up clearly in the results of ship-based surveys. It is surprising to find the maps resulting from the aerial surveys (#1) to be more uniform in most cases. This suggests that numbers of birds involved in mass-feeding have been underestimated during the time available to the aerial observers, who might get 'swamped' in situations where they meet such concentrations (*cf.* Dayton 1993). The similarity between spatial distribution patterns of ecologically quite different species like Herring Gull and Lesser Black-backed Gull is remarkable and not corroborated by data from ship-based surveys. The similar patterns found for different species during aerial surveys may be partly the result of identification problems, particularly in large flocks associated with fishing vessels. These flocks contributed significantly to the overall density in an area and, hence, errors in the assessment of group-size and species composition of such cases can lead to major errors. The conclusion of Baptist & Wolf (#1), that ships are of little use for mapping gulls and other ship-followers, is unwarranted. Birds that were obviously attracted to reseach vessels were in the field routinely omitted and hence, excluded from density estimations. Obviously, some attraction may be too subtle for the observers to be noticed, which will than result in overestimates of densities. However, observed mass-feedings contributed significantly to the overall estimate of numbers and probably overrides the effects of ship-attraction.

A true comparison between results of aerial and ship-based surveys cannot be made as yet, because the variabilities in both data sets have not been sufficiently evaluated. Therefore, distribution patterns were compared only qualitatively. Gross and systematic differences between the two sets of estimates can also provide information on the strengths and weaknesses of either method. To this end, we compared our own bimonthly estimates for the Dutch sector of the North Sea (table 4.4) to the estimates given by Baptist & Wolf (#1). Estimates based on aerial surveys were obtained by taking the mean of the estimates for 1985-88 and 1989-92, from the bar-diagrams in #1. The estimated numbers were log-transformed and plotted in figure 5.1. Comparisons were made for divers and large auks (comparatively inconspicuous species), Gannets (conspicuous) and gulls and Fulmar (often difficult to separate from the air), for all periods but December-January, when most of the northern half of the area was not surveyed by ship. Only datapoints for which both estimates were larger than 100 birds were used. Both sets of estimates are positively correlated. However, several deviations are obvious. In divers and auks, the estimates from ship-based surveys were considerably higher in all periods (by a factor 1.7-5.5 for the auks and 1.4-4.0 for divers). This difference cannot be explained from the corrections for birds not seen from the ship only (table 3.1), and from this we conclude that detection of this group of mostly swimming, dark-backed birds was considerably better from ships. Similarly, other dark-backed species that spend most of their time swimming rather than flying, like Great Crested Grebe, Puffin and Little Auk were not seen frequently enough from the air for a meaningful estimate of numbers (#1).

In the Gannet estimates derived from ship-based surveys were also higher (by a factor 1.2-4.7). In this case, attraction to research vessels appears to have been an important factor. Gannets have a habit of checking out nearby vessels, perhaps even stronger than Fulmars and gulls, which may lead to higher numbers in transect than in species with less interest in vessels. Without large concentrations contributing significantly to the total estimate, like in the next group, ship-based surveys probably lead to an overestimate in this species.

In gulls and Fulmar, aerial surveys produced remarkably small fluctuations in estimated numbers between different periods. When a species was comparatively abundant (in both schemes), ship-based surveys produced higher estimates. When a species was scarce (again, in both schemes), aerial surveys produced the higher estimates (regression line in figure 5.1). This does not support the suggestion by Baptist & Wolf (1993) that ships attract these birds to a large extent. Attraction should have the greatest influence in a low-density situation, when it is not masked by the occurrence of large flocks attracted to the far more attractive fishing vessels. It rather seems that ship-based observers have been 'too strict' in discarding possibly attracted birds from the counts. Fulmars and gulls often form large aggregations, either around fishing vessels or during 'natural' feeding, and these patches are responsible for high densities in certain areas. These patches masked the effect of attraction that vessels may have on these birds. Estimates of total numbers of terns (not plotted in figure 5.1) varied, were sometimes lower, sometimes higher on the basis of aerial surveys.

To summarize and conclude, (1) estimates of numbers in inconspicuous diving species as divers, grebes and auks were systematically lower in aerial surveys, (2) numbers of Gannets were probably over-estimated from ship-based data, and (3) numbers of gulls and Fulmar were apparently underestimated during ship-based surveys in areas or periods with low densities, and underestimated by aerial surveys in areas or periods with high densities.

In general, the data gathered from ship and plane differ considerably. Detection and specific determination is likely to be comparatively better from the slower platform, which makes estimates of seabird density more accurate. The argument used by Baptist and Wolf (1993) that only common species are important to management-orientated monitoring is valid in itself, but loses cogen-

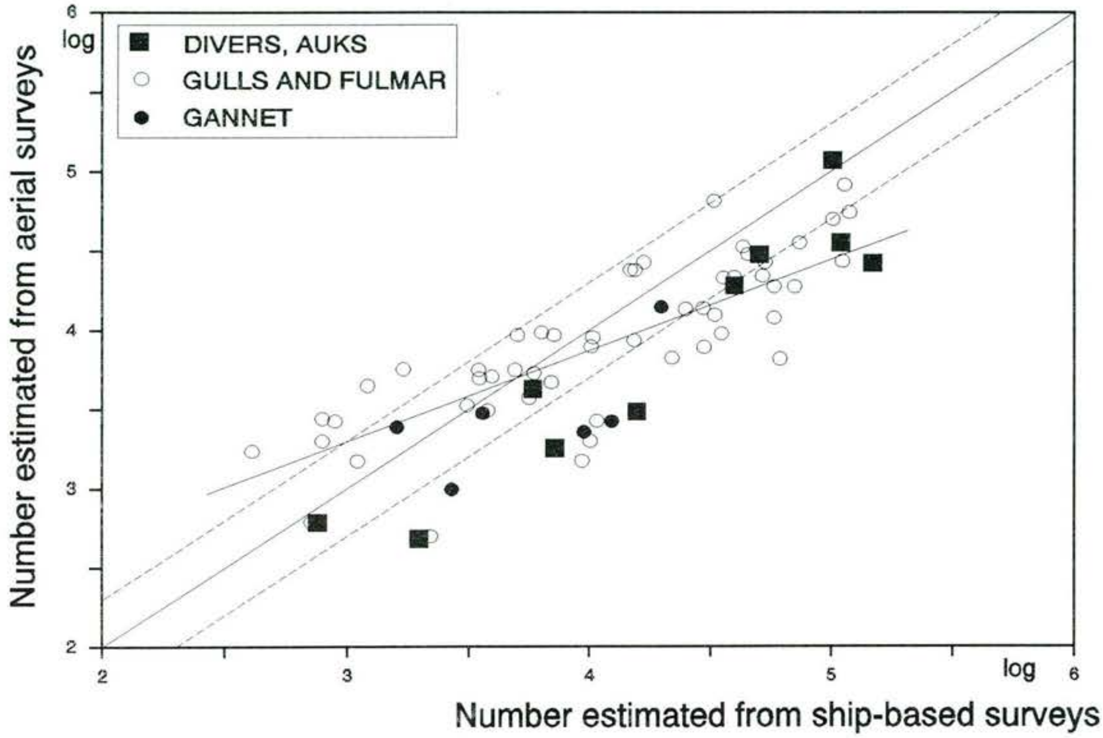


Figure 5.1 Estimates of total numbers of birds in the Dutch sector of the North Sea derived from ship-based surveys and aerial surveys compared (log transformed, only if > 100 birds were found, see text). Diagonal line: log(y) = log(x) (equal esimates), top dashed line: log(y)= log(2.0x) (estimates from aerial surveys two times higher than ship-based surveys), bottom dashed line: log(y) = log(0.5x) (estimates from ship-based surveys two times higher than aerial surveys), regression line: relationship between estimates of Fulmar and gulls derived from aerial surveys and ship-based surveys.

cy if several of the target species (divers, black-backed gulls, swimming Fulmar/grey-backed gulls, terns/Little Gull/*Sepia* skeletons, and auks) cannot properly be identified from the platform selected for the work. For management purposes, information on the species level is very important. Moreover, different age-classes in birds usually have different seasonal patterns and spatial distribution, and therefore a different vulnerability to surface pollutants or other threats. For instance, the concentration of adult Guillemots and chicks at the Friese Front is very vulnerable, due to the presence of the (flightless) succesful breeders. Concentrations of Guillemots later in the season, such as at the Brown Bank in late winter, are more likely to comprise mainly immatures, which are less 'valuable' in terms of breeding potential. There is no doubt that ships are the best platform for determining such age-related distribution patterns.

Finally, from ships other data can be gathered simultaneously, that may be related to, or even explain distribution patterns of seabirds (Briggs *et al.* 1985). Examples are simultaneous measurements on salinity and water temperature, to determine the location of fronts (Van Haren & Joordens 1990, Baars 1991), fine-scale determination of water depth (Durinck *et al.* 1994), measurements on water clarity (Leopold *et al.* 1994b), data from echo-sounding equipment, showing (prey)fish distribution (Leopold 1988d, 1991), or bottom sampling to determine food abundance for seaduck (Leopold & Plat *in prep.*).

Future research

Monitoring would not be necessary in a stable environment. The results obtained by Baptist and Wolf (1993), Camphuysen (1990b), Camphuysen & Van Franeker (1992) and Platteeuw *et al.* (1994) strongly suggest however, that at least numbers and possibly also the distribution of seabirds in our part of the North Sea show considerable year to year fluctuations and/or long term trends. For an adequate management of shifting seabird populations, up to date knowledge of distribution patterns is a prerequesite. For a proper monitoring scheme, the virtues of aircraft (quick, but dirty; #1) and ships (slow, but thorough) are best combined. Ships have been considered to be an expensive tool to measure seabird densities at sea (#1). This is not necessarily the case. With the wealth of marine research going on in the North Sea, involving a large number of research vessels, there is no problem in finding platforms that are free of charge for seabird observers. In fact, the bulk of our counts has been obtained this way. By intregrating seabird counts into regular cruises of ships monitoring other marine variables, true monitoring of seabird distribution is well possible. The Holland-cruises are a good example. A limited amount of work from dedicated ships has been necessary to cover areas of particular interest that were not covered by ships of opportunity. The database that resulted from the combination of regular monitoring cruises (Holland), more or less randomly distributed 'piggy back rides' on a variety of ships, including ships manned by teams from other countries, and the dedicated surveys, probably does not compare unfavourably (in size or costs) with the data gathered by plane. Still, the present database is by no means perfect, and by definition out of date. The composite maps presented may suggest that coverage of the Dutch sector of the North Sea has been good, but maps showing the data on a month by month basis for each of the years 1985-93 would show a much less impressive and far more erratic picture. Only the work aboard the *Holland* was ever meant for monitoring the environment, while some of the *Navicula* 'seaduck cruises' may also be seen as such. For monitoring the environment from ships, research vessels engaged in long-term fixed sampling programmes are best used. It is of particular importance to realise that seabird observations cannot be made at night and the ship should not cover large distances in the darkness. Seabird work should be considered when designing future monitoring programmes, or current schemes should be adapted to accomodate ornithologists. Obviously, the scheme should cover the Dutch sector in an appropriate way. However, this area has seaward borders that are biologically meaningless. Surveys in the surrounding waters of the North Sea are useful for a proper interpretation of data obtained in the Southern Bight. Observations from the air should be integrated, visiting the same areas at the same time, but the plane can also be used to make quick surveys of the whole sector at other times, to monitor sudden changes (particularly in seaduck). Intercalibration of data obtained from both platforms at the same time and place could lead to a better appreciation of both datasets.

6. REFERENCES

Key references

Frequently cited and therefore numbered references were:

#1 BAPTIST H.J.M. & WOLF P.A. 1993. Atlas van de vogels van het Nederlands Continentaal Plat. Rapport DGW-93.013, Rijkswaterstaat, Dienst Getijdewateren, Middelburg, pp 1-168.

#2 CAMPHUYSEN C.J. 1989. Beached Bird Surveys in The Netherlands 1915-1988; Seabird Mortality in the southern North Sea since the early days of Oil Pollution. Techn. Rep. Vogelbescherming 1, Werkgroep Noordzee, Amsterdam 322pp.

#3 CAMPHUYSEN C.J. & DIJK J. VAN 1983. Zee- en kustvogels langs de Nederlandse kust, 1974-79. Limosa 56: 81-230.

#4 PLATTEEUW M., HAM N.F. VAN DER & OUDEN J.E. DEN 1994. Zeetrektellingen in Neder-land in de jaren tachtig. Sula 8: 1-203.

Further references

ADRIAENSEN F., ULENAERS P. & DHONDT A.A. 1993. Ringing recoveries and the increase in numbers of European Great Crested Grebes *Podiceps cristatus*. Ardea 81: 59-70.

ALLEIN S., BEYEN B., BOUDOLF L., GOETHALS T., JONCKHEERE G., OPSTAELE B., OPSTAELE P. & VANHOECKE D. 1992. Vogels aan de Vlaamse Middenkust: zeetrekwaarnemingen juli'89 - juni'90. Vogelwerkgroep Oostende, Oostende, 116pp.

ALLSOPP K. & DAWSON I. 1986. Recent Reports. Brit. Birds 79: 97-100, 152-154.

ARTS F. 1993. Kustbroedvogeldatabase DGW/SOVON. Voorlopig SOVON rapport 93/08, ongepubl., Beek-Ubbergen.

BAARS M.A., DUINEVELD G.C.A., VAN DUYL F.C., DE GEE A., KRAAY G.W., LEOPOLD M.F., OOSTERHUIS S., VAN RAAPHORST W. & WESTRA C. 1991. The ecology of the Frisian Front. ICES C.M. 1991/L: 25Q.

BAILEY R.S. 1980. Problems in the management of short-lived pelagic fish as exemplified by North Sea Sprat. Rapp. P.-v. Réun. Cons. int. Explor. Mer 177: 477-488.

BAILEY R.S. 1986. Food consumption by seabirds in the North Sea in relation to the natural mortality of exploited fish stocks. ICES C.M. 1986/G: 5.

BAILEY R.S. 1989. Interactions Between Fisheries, Fish Stocks and Seabirds. Mar. Poll. Bull. 20: 427-430.

BAILEY R.S. 1991. The interaction between sandeels and seabirds - a case history at Shetland. ICES C.M. 1991 L: 41, 12pp.

BAILEY R.S., FURNESS R.W., GAULD J.A. & KUNZLIK P.A. 1991. Recent changes in the population of the sandeel (*Ammodytes marinus* Raitt) at Shetland in relation to estimates of seabird predation. ICES mar. Sci. Symp. 193: 209-216.

BAILLIE S.R. 1982. Eider *Somateria mollissima*: 114-115. In: LACK P. (ed.). The atlas of wintering birds in Britain and Ireland. T. & A.D. Poyser, Calton.

BAKKER L. & LOK C.M. 1988. Aalscholvers *Phalacrocorax carbo*, een nieuwe broedvogel op Voorne. Limosa 58: 145-148.

BAPTIST H.J.M. 1988. Vogelconcentraties in de Voordelta tijdens en voorafgaande aan het 'Borcea-incident', december 1987-januari 1988. Sula 2: 21-23.

BAPTIST H.J.M. 1990. Errors of sampling, analysis of distribution and sampling methods. In: LAURSEN K. & CRACKNELL G. (eds). IWRB Western Palearctic seaduck database newsletter, December 1990: 27-28.

BAPTIST H.J.M. 1991. Dwergmeeuwen in augustus 1991 een rectificatie. Sula 5: 158.

BAPTIST H.J.M. & CAMPHUYSEN C.J. 1987. Concentraties Zwarte Zeeëenden *Melanitta nigra* voor de Hollandse en Zeeuwse kust, 9-11 maart 1987. Sula 1: 17-18.

BAPTIST H.J.M. & MEININGER P.L. 1984. Ornithologische verkenning van de Voordelta van Zuidwest-Nederland, 1975-1983. Nota DDMI-8319, Deltadienst, Rijkswaterstaat, Middelburg.

BAPTIST H.J.M. & WOLF P.A. 1991. Vogels monitoren per vliegtuig. Sula 5: 16-23.

BAPTIST H.J.M. & WOLF P.A. 1992. Het zuidelijke Nederlands Continentale Plat (NCP) als overwinteringsgebied voor vogels. Sterna 37: 42-47.

BARTON T.R., BARTON C., CARTER I.C. & WEBB A. 1993. Seabird distribution in inshore waters between Flamborough Head and Dungeness from aerial surveys in 1989. Joint Nature Cons. Comm. Rep. No. 182, Aberdeen.

BARTON T.R., BARTON C., WEBB A. & BARTON C.J. 1994. Seabird distribution in inshore waters between Dungeness and St. David's Head from aerial surveys in 1991. Joint Nature Cons. Comm. Rep. No. 184, Aberdeen.

BATESON P.P.G. 1961. Studies of less familiar birds 112. Little Auk. Brit. Birds 54: 272-277.

BEEKMAN F., BEIJERSBERGEN J., LEEFTINK K., MEININGER P.L., SLUIJTER T.C.J. & VERGEER J.-W. (EDS) 1986. De vogels van Schouwen-Duiveland. Werkgroep Avifauna Natuur- en Vogelwacht Schouwen-Duiveland, Zierikzee.

BEINTEMA A., BUESINK H. & BERGH L. VAN DEN 1993. Overwinterende watervogels in Nederland, 1967-89. Limosa 66: 17-24.

BERGENDAHL R. 1986. Tretåig Mås *Rissa tridactyla*, Tårnmås *Larus sabini* och Dvårgmås *Larus minutus* i Kattegat 1985. Pelagicus 1: 24-29.

BERGH L.M.J. VAN DEN 1988. Watervogeltelling in januari 1986. Limosa 61: 27-32.

BERGH L.M.J. VAN DEN, GERRITSE W.G., HEKKING W.H.A., KEIJ P.G.M.J. & KUYK F. (eds) 1979. Vogels van de grote rivieren. Spectrum, Utrecht.

BERGMAN M.J.N., LINDEBOOM H.J., PEET G., NELISSEN P.H.M., NIJKAMP H. & LEOPOLD M.F. 1991. Beschermde gebieden Noordzee - noodzaak en mogelijkheden. NIOZ Report 1991-3, Netherl. Inst. Sea Res, Texel.

BERGMAN M.J.N. & LEOPOLD M.F. 1992. De ecologie van de kustzone van Vlieland en Terschelling. NIOZ Report 1992-2, Netherl. Inst. Sea Res, Texel.

BLAKE B.F. 1983. Threats to birds of the sea. New Scientist 20 October 1983: 210-211.

BLAKE B.F. 1984. Diet and fish stock availability as possible factors in the mass death of auks in the North Sea. J. Exp. Mar. Biol. Ecol. 76: 89-103.

BLAKE B.F., TASKER M.L., JONES P.H., DIXON T.J., MITCHELL R. & LANGSLOW D.R. 1984. Seabird Distribution in the North Sea. Nature Conservancy Council, Huntingdon.

BLERKOM, J. VAN, HONCOOP R. & VRIES G. DE 1936. Grote Pijlstormvogel. Amoeba 15: 161.

BLOMQVIST S. & PETERZ M. 1984. Cyclones and pelagic seabird movements. Mar. Ecol. Progr. Ser. 20: 85-92.

BOER P. 1971. Vogeltellingen op de Noordzee in augustus 1970. Limosa 44: 23-28.

BOMMELÉ M. 1991. Harmful effects on birds of floating lipophilic substances discharged from ships. In: CAMPHUYSEN C.J. & J.A. VAN FRANEKER (eds). Oil pollution, Beached Bird Surveys and Policy: towards a more effective approach to an old problem. Proc. Int. NZG/NSO workshop, 19 April 1991, Rijswijk, Sula 5 (special issue): 44-45.

BOURNE W.R.P. 1976. Birds of the North Atlantic Ocean: 705-715. Proc. 16th Int. Orn. Congr., Austr. Acad. Sc., Canberra.

BRAAKSMA S. 1964. Het voorkomen van de Stormmeeuw (*Larus canus* L.). Limosa 37: 58-95.

BRENNINKMEIJER A. & STIENEN E.W.M. 1992. Ecologisch profiel van de Grote Stern (*Sterna sandvicensis*). Rin-rapport 92/17, Rijksinst. Natuurbeheer, Arnhem.

BRIGGS K.T., TYLER W.B. & LEWIS D.B. 1985. Comparison of ship and aerial surveys of birds at sea. J. Wildl. Manage. 49: 405-411.

BROUWER G.A. & VERWEY J. 1919. Waarnemingen van het trekstation Noordwijk aan Zee. Ardea 8: 1-92.

BROUWER G.A. & VERWEY J. 1922. Waarnemingen van 1 Januari 1920 tot en met 30 Juni 1922. Ardea 11: 129-150.

BRUUN B. 1968. Migration of Little Gull (*Larus minutus*) in the north Atlantic region. Dansk Orn. Foren. Tidsskr. 62: 126-136.

BUCKLAND S.T., ANDERSON D.R., BURNHAM K.P. & LAAKE J.L. 1993. Distance sampling: estimating abundance of biological populations. Chapman and Hall, London.

BULTEEL G. & VLOET H. VAN DER 1969. Zeevogelwaarnemingen aan de Belgische kust. Giervalk 59: 192-218.

BUURMA L.S. & MIRANDA J.F. DE 1968. Enige opmerkingen bij de voorjaarszeetrek 1968 langs de NZ-Holl. kust. Tjiftjaf 13(4): 13-15.

BURNHAM K., ANDERSON D. & LAAKE J. 1980. Estimation of density from line sampling of biological parameters. Wildl. Monogr. 72: 1-202.

CAMPHUYSEN C.J. 1979a. Meetpost Noordwijk Najaar 1978. Meded. CvZ 2(2): 19-31.

CAMPHUYSEN C.J. 1979b. "Offshore" transecttellingen en platformobservaties. Het Noordzee-project. Meded. CvZ 2(2): 3-18.

CAMPHUYSEN C.J. 1981. Omvangrijke slachting onder de Zeekoeten (*Uria aalge*) eind 1980. NSO Jaarverslag 1980: 14-20.

CAMPHUYSEN C.J. 1984. Vogels van de Noordzee (Nederlands Deel van het continentaal plat). Rapport Ecoland, bureau voor ecologisch onderzoek, Leeuwarden.

CAMPHUYSEN C.J. 1986. Vondsten van Kleine Alken *Alle alle* en Papegaaiduiker *Fratercula arctica* langs de Nederlandse kust. Limosa 59: 138-141.

CAMPHUYSEN C.J. 1987a. Invasie en 'wreck' van de Middelste Jager *Stercorarius pomarinus* in de Noordzee, november 1985. In: ANONYMOUS (ed.). Samenv. voordr. Symp. Zeevogels van de Poolgebieden, Nederl.

Orn. Unie, Haren, 16 oktober 1987: 15-16.
CAMPHUYSEN C.J. 1987b. Stranding van Noordse Stormvogels *Fulmarus glacialis* en (juveniele) Drieteenmeeuwen *Rissa tridactyla* op de Hollandse kust juli-augustus 1987. Sula 1: 77-78.
CAMPHUYSEN C.J. 1989a. Massale sterfte van Zeekoeten *Uria aalge* voor de Nederlandse kust, winter 1988/89. Sula 3: 22-25.
CAMPHUYSEN C.J. 1989b. Vondst van een noordelijke Zeekoet *Uria aalge hyperborea* in Nederland. Limosa 62: 47-48.
CAMPHUYSEN C.J. 1989c. Crash van pas uitgevlogen Drieteenmeeuwen (*Rissa tridactyla*) op de Nederlandse kust augustus 1987. Graspieper 9: 11-17.
CAMPHUYSEN C.J. 1990a. Verstrikking van zeevogels in plastics: een probleem van toenemende omvang? Sula 4: 12-18.
CAMPHUYSEN C.J. 1990b. Fish stocks, fisheries and seabirds in the North Sea. Techn. Rapport Vogelbescherming nr. 5, Vogelbescherming, Zeist.
CAMPHUYSEN C.J. 1990c. Dieet, Leeftijd en Geslacht van de Zeekoet *Uria aalge* in de Nederlandse Noordzee in het voorjaar. Sula 4: 41-53.
CAMPHUYSEN C.J. 1990d. Massastranding van Alk *Alca torda* en Zeekoet *Uria aalge* op de Nederlandse kust, jan-feb 1990. Sula 4: 23-25.
CAMPHUYSEN C.J. 1990e. Massastranding van Alken *Alca torda* op de Nederlandse kust, Jan-Mrt 1990: Aantal, Leeftijd en Oliebesmeuring. Sula 4: 135-138.
CAMPHUYSEN C.J. 1991. Baltsvluchten van Noordse Sterns *Sterna paradisaea* op open zee. Sula 5: 59-61.
CAMPHUYSEN C.J. 1992a. Zeevogelstrandingen op de Nederlandse kust: 26 jaar een vinger aan de pols (1965-1991). Limosa 66: 1-16.
CAMPHUYSEN C.J. 1992b. Auk wrecks in the southern North Sea, 1981-1991: oil pollution or food shortage? In: Tasker M.L. (ed.). Proc. Seabird Group Conference 'European Seabirds', Glasgow 27-29 March 1992: 23.
CAMPHUYSEN C.J. 1992c. Nachttrek van Grote Sterns *Sterna sandvicensis* door het binnenland. Sula 6: 56-57.
CAMPHUYSEN C.J. 1993a. Scavenging seabirds behind fishing vessels in the Northeast Atlantic, with emphasis on the southern North Sea. NIOZ Report 1993-1, Netherl. Inst. Sea Res., Texel.
CAMPHUYSEN C.J. 1993b. De exploitatie van op zee overboord geworpen vis en snijafval door zeevogels. Het Vogeljaar 41: 106-114.
CAMPHUYSEN C.J. 1993c. Foerageermogelijkheden voor zeevogels in de boomkorvisserij: een verkennend onderzoek. Sula 7: 81-104.
CAMPHUYSEN C.J. 1994a. Scavenging seabirds at beamtrawlers in the southern North Sea: distribution, relative abundance, behaviour, prey selection, feeding efficiency, kleptoparasitism, and the possible effects of the establishment of 'protected areas'. BEONADD IV/V Unpubl. intern. report, Netherlands Institute for Sea Research, Texel.
CAMPHUYSEN C.J. 1994b. Verstrikkingen van vogels in plastics en vistuig aan de Nederlandse kust, 1990-93. Sula 8: 226-229.
CAMPHUYSEN C.J. & DERKS P.J.T. 1989. Voorkomen en sterfte van de Fuut *Podiceps cristatus* voor de Nederlandse kust, 1974-86. Limosa 62: 57-62.
CAMPHUYSEN C.J., ENSOR K., FURNESS R.W., GARTHE S., HÜPPOP O., LEAPER G., OFFRINGA H. & TASKER M.L. 1993. Seabirds feeding on discards in winter in the North Sea. Final report to the European Comm., study contr. 92/3505, NIOZ Report 1993-8, Netherl. Inst. Sea Res., Texel.
CAMPHUYSEN C.J. & FRANEKER J.A. VAN 1992. The value of beached bird surveys in monitoring marine oil pollution. Techn. Rep. Vogelbescherming 10, Werkgroep Noordzee, Amsterdam.
CAMPHUYSEN C.J., HART S. & ZANDSTRA H.S. 1988. Zeevogelsterfte na olielekkage door de ertscarrier MS Borcea voor de Zeeuwse kust, januari 1988. Sula 2: 1-12.
CAMPHUYSEN C.J. & IJZENDOORN E.J. VAN 1988a. Invasie van Middelste Jagers in Nederland in november 1985. Dutch Birding 10: 54-65.
CAMPHUYSEN C.J. & IJZENDOORN E.J. VAN 1988b. Influx of Pomarine Skua in northwestern Europe in autumn 1985. Dutch Birding 10: 66-70.
CAMPHUYSEN C.J. & KEIJL G.O. 1991. Dissectie van Zeekoeten *Uria aalge*, betrokken bij de massastranding op de Hollandse kust, november 1990. NZG/NSO Internal Report, Zaandam, 5pp.
CAMPHUYSEN C.J., KEIJL G.O. & OUDEN J.E. DEN 1982. Meetpost Noordwijk 1978-1981, Report no. 1 Gaviidae-Ardeidae. CvZ MpN-verslag nr. 1, Amsterdam.
CAMPHUYSEN C.J., LEOPOLD M.F. & TASKER M.L. 1992. Conservation of seabirds in coastal and offshore waters. In: Proc. & abstr. int. seminar 'The Conservation of Dispersed Species in Europe' at the XVIII ICBP Europ. Cont. Sect. Conference, Aachen, May 1992, pp 28-30.
CAMPHUYSEN C.J. & OUDEN J.E. DEN 1988. Opmerkelijke concentratie jagers Stercorariidae in zeevogelrijk zeegebied ten oosten van Aberdeen (Schotland), september 1988. Sula 2: 91-92.
CAMPHUYSEN C.J. & PLATTEEUW M. 1988. Voortgangsrapport Offshore Waarnemingen Nr. 1, 1987. Sula 2: 119-132.
CARTER I.C., WILLIAMS J.C., WEBB A. & TASKER M.L. 1993. Seabirds concentrations in the North Sea: an atlas of vulnerability to surface pollutants. Joint Nature Conservation Committee, Aberdeen.
CHANDLER R.J. 1981. Influxes into Britain and Ireland of Red-necked Grebe and other waterbirds during winter 1978/79. Br. Birds 74: 55-81.
COMMISSIE NEDERLANDSE AVIFAUNA 1970. Avifauna van Nederland, 2e herziene druk. Brill, Leiden.
COLEMAN F.C. & WEHLE D.H.S. 1984. Plastic Pollution: A worldwide oceanic problem. Parks 9(1): 9-12.
CONNORS P.G. & SMITH K.G. 1982. Oceanic Plastic Particle Pollution: Suspected Effect on Fat Deposition in Red Phalaropes. Mar. Poll. Bull. 13: 18-20.
CORTES J.E., J.C. FINLAYSON, M.A.J. MOSQUERA & E.F.J. GARCIA. 1980. The birds of Gibraltar. Gibraltar.
COSTERS R. 1987. Opvallende aantallen juveniele Drieteenmeeuwen *Rissa tridactyla* op de Hondsbossche Zeewering in de zomer van 1987. Sula 1: 75-77.
COSTERS R. 1992. Hoe vergaat het de Stormmeeuw *Larus canus* bij Petten?. Sula 6: 93-99.
COSTERS R. 1993. De spectaculaire toename van de Aalscholver rond Petten. De Windbreker no. 58: 13-17.
CRAMP S. & SIMMONS K.E.L. 1977. The Birds of the Western Palearctic, 1. Oxford Univ. Press, Oxford.
CRAMP S. & SIMMONS K.E.L. 1983. The Birds of the Western Palearctic, 3. Oxford Univ. Press, Oxford.
DANIELSEN F., DURINCK J. & SKOV H. 1986. Havfugle og olieforurening i Dansk farvande 1984-85. Oliefuglegruppen, Dansk Orn. Forening, Copenhagen.
DAVENPORT D. 1987. Large passage of Skuas, North Uist in May 1986. Scott. Birds 14: 180-181.
DAVENPORT D. 1991. The spring passage of Long-tailed Skuas off North Uist in 1991. Scott. Birds 16: 85-89.
DAY R.H., WEHLE D.H.S. & COLEMAN F.C. 1985. Inges-

tion of plastic pollutants by marine birds: 344-386. In: R.S. SHOMURA & H.O. YOSHIDA (eds) 1985. Proceedings of the workshop on the fate and impact of Marine debris, 26-29 November 1984, Honolulu, Hawaii. U.S. Dep. Commer., NOAA Tech. Memo. NMFS, NOAA-TM-NMFS-SWFC-54.

DAYTON L. 1993. Why you can't count on aerial surveys. New Scientist 1860: 15.

DERKS P. & KRAKER K. DE 1993. Broedende Grote Sterns *Sterna sandvicensis* op Hompelvoet en Markenje, 1989-1992. Sula 7: 53-63.

DIESCH K. 1932. Papegaaiduikers op Walcheren. Amoeba 11(5): 65-66.

DIJK J. VAN 1987. Veel Zwarte Zeeëenden *Melanitta nigra* voor de kust van Zuid-Holland in januari-februari 1987. Sula 1: 15-17.

DIJK J. VAN & BUURMA L.S. 1973. Overzicht van de passage van zee- en kustvogels gedurende de herfst 1972. Pieper 12: 13-25.

DOBBEN W.H. VAN & MAKKINK G.F. 1931. De vogeltrek op Vlieland van 14 sept. tot 19 okt. 1930. Ardea 20.

DUIVEN P. 1974. Vondst van een levende Grauwe Pijlstormvogel *Puffinus griseus* bij Den Helder. Limosa 47: 144-145.

DUNN P.J. & HIRSCHFELD E. 1991. Long-tailed Skuas in Britain and Ireland in autumn 1988. Brit. Birds 84: 121-136.

DURINCK J., DANIELSEN F. & SKOV H. 1987. Havfugle og sæler i danske farvande optalt fra skibe i oktober og november 1987. Ornis Consult, Copenhagen 17pp.

DURINCK J., SKOV H., JENSEN F.P. & PIHL S. 1994. Important marine areas for wintering birds in the Baltic Sea. EU DG XI research contract no. 224/90-09-01, Ornis Consult Report 1994: 1-110, Copenhagen.

DYMOND J.N., FRASER P.A. & GANTLETT S.J.M. 1989. Rare Birds in Britain and Ireland. T. & A.D. Poyser, Calton.

EADES R.A. 1982. Notes on the distribution and feeding of Little Gulls at sea in Liverpool Bay. Seabird 6: 115-121.

EERDEN M.R. VAN & VAATE A. BIJ DE 1984. Natuurwaarden van het IJsselmeergebied. Flevobericht no. 242, Min. Verkeer en Waterst., Rijksd. IJsselmeerp., Lelystad.

EISMA D. 1980. De Noordzee. Het Spectrum, Utrecht.

EISMA D., JANSEN J.H.F. & WEERING T.J.C.E. VAN 1979. Sea-floor morphology and recent sediment movement in the North Sea. In: OELE E., SCHUTTENHELM R.T.E. & WIFFERS A.J. (eds). The Quaternary history of the North Sea: 217-231. Acta Univ. Ups. Annum Quingentesimum Celebrantis: 2, Uppsala.

ELLIS P.M. (ed.) 1988. Shetland bird report 1987. Shetland Bird Club, Lerwick.

ENGELSMAN S. & HULSMANN A. 1974. Zeevogelproject Texel. Int. Rep. Netherl. Inst. Sea Res, Texel.

ENKELAAR H. 1934. Gemengd nieuws voor buitenlieden, Papegaaiduikers. Amoeba 13: 46.

EVANS C. 1989. Little Gull associating with auks in winter. Brit. Birds 82: 373.

EVANS P.G.H. 1984. Status and conservation of seabirds in northwest Europe (excluding Norway and the USSR): 293-321. In: CROXALL J.P., EVANS P.G.H. & SCHREIBER R.W. (eds). Status and Conservation of the World's Seabirds. Techn Publ. No. 2, ICBP, Cambridge.

FERDINAND L., JENSEN B. & LARSEN A. 1956. Trækobservationer i Blåvandshuk-området, Vestjulland, i begundelsen af august 1955. Dansk Orn. Foren. Tidsskr. 50: 299-323.

FOX A.D. 1986. The Little Gull *Larus minutus* in Ceredigion, West Wales. Seabird 9: 26-31.

FRANEKER J.A. VAN 1985. Plastic Ingestion in the North Atlantic Fulmar. Mar. Poll. Bull. 16: 367-369.

FRANEKER J.A. VAN & WATTEL J. 1982. Geographical variation of the Fulmar *Fulmarus glacialis* in the North Atlantic. Ardea 70: 31-44.

FURNESS R.W. 1985. Plastic particle pollution: accumulation by Procellariiform seabirds at Scottish colonies. Mar. Poll. Bull. 16: 103-106.

FURNESS R.W. 1986. The impact of fisheries on seabird populations in the North Sea: 179-192. In: WERKGROEP NOORDZEE. Reasons for concern. Proc. 2nd North Sea Seminar. Werkgroep Noordzee, Amsterdam.

FURNESS R.W. 1992. Implications of changes in net mesh size, fishing effort and minimum landing size regulations in the North Sea for seabird populations. Contr. Rep. to JNCC and Scottish Office, Appl. Orn. Unit. Dept. Zool., Univ. Glasgow, Glasgow.

FURNESS R.W. 1993. An assessment of human hazards to seabirds in the North Sea. WWF International Report & Executive summary, February 1993, London.

FURNESS R.W., HUDSON A.V. & ENSOR K. 1988. Interactions between scavenging seabirds and commercial fisheries around the British Isles: 240-268. In: BURGER J. (ed.). Seabirds & Other Marine Vertebrates: Competition, Predation and Other Interactions. Columbia Univ. Press, New York.

FURTADO D. & LEGRAND G. 1979. Présence hivernale du Mergule nain *Plautus alle* aux Açores. Alauda 47: 113-114.

GARTHE S. 1993. Durchzug und Wintervorkommen der Zwergmöwe (*Larus minutus*) bei Helgoland in den Jahren 1977 bis 1991. Die Vogelwarte 37: 118-129.

GAULD J.A., MCKAY D.W. & BAILEY R.S. 1986. The current state of the Industrial Fisheries. Fishing News 27 June 1987: 30-31.

GEE A. DE, BAARS M.A. & VEER H.W. VAN DER (eds) 1991. De Ecologie van het Friese Front. NIOZ Report 1991-2, Netherl. Inst. Sea Res, Texel.

GEELHOED S., HIESELAAR F., HUIJSSTEEDEN E.VAN & STUART J. 1989. Vogels van de strandvlakte en de zuidpier van IJmuiden. Vogelwerkgroep Zuid-Kennemerland, Haarlem.

GEERTSMA M. 1990. Celtic Sea: verspreiding van zeevogels en zeezoogdieren en het verband tussen dichtheden en voedselaanbod in de Keltische Zee in november/december 1989. Unpubl. intern. report Netherlands Institute for Sea research, Texel.

GEERTSMA M. 1992. Dieet van de Zeekoet *Uria aalge* op het Friese Front in het najaar van 1989; een vergelijkend voedselonderzoek. Doctor. onderz., NIOZ-Texel/ Dieroecol. R.U. Groningen, 44pp.

GIBBONS D.W., REID J.B. & CHAPMAN R.A. (eds) 1993. The new atlas of breeding birds in Britain and Ireland: 1988-1991. British Trust for Ornithology, T. & A.D. Poyser, London.

GIRARD O. 1992. Report on seaduck counts in France. IWRB Seaduck Bulletin 1: 34-35.

GRAAF C. DE 1930. Nawinter en voorjaar in 1928. De Levende Natuur 34: 175-178.

GRIFFITHS A.M. & SINCLAIR J.C. 1982. The occurrence of holarctic seabirds in the African sector of the southern Ocean. Cormorant 10: 35-44.

GROOT H. & COTTAAR F. 1992. Meer broedgevallen van de Stormmeeuw *Larus canus* in Noord-Holland buiten het duingebied. Sula 6: 112-113.

HAM N.F. VAN DER 1987. Zomerkleed Parelduikers *Gavia arctica* voor de Noordhollandse kust. Sula 1: 47-48.

HAM N.F. VAN DER 1988. Meetpost Noordwijk 1978-1982, verslag nr. 4, Columbidae - Emberizidae. Sula

2: 83-90.
HAM N.F. VAN DER 1989. Influx of Long-tailed Skuas in The Netherlands in autumn 1988. Sula 3: 128-133.
HAM N.F. VAN DER, STEGEMAN L. & PLATTEEUW M. 1991. Influx van Kleine Alken *Alle alle* in Nederland in winter 1990/91. Sula 5: 92-100.
HANSOHN E. 1992. Brutpaaraufstellung aus unseren Schutzgebieten. Seevögel 13: 11-14.
HANSOHN E. 1994. Brutpaaraufstellung aus unseren Schutzgebieten 1993. Seevögel 15: 11-14.
HAREN J.J.M. VAN & JOORDENS J.C.A. 1990. Observations of physical and biological parameters at the transition between the southern and central North Sea. Neth. J. Sea Res. 25: 351-364.
HARRIS M.P. & BAILEY R.S. 1992. Mortality rates of puffin and guillemot and fish abundance in the North Sea. Biol. Conserv. 60: 39-46.
HARRIS M.P. & BIRKHEAD T.R. 1985. Breeding ecology of the Atlantic Alcidae. In: Nettleship D.N. & T.R. Birkhead (eds). The Atlantic Alcidae: 156-204. Academic Press, London/New York.
HARRIS M.P., HALLEY D. & WANLESS S. 1992. The post-fledging of young Guillemots *Uria aalge* in relation to hatching date and growth. Ibis 134: 335-339.
HARROP H. 1993. Massive skua passage off Shetland. Seabird Group Newsletter No. 64: 8-9.
HAVERSCHMIDT F. 1930. Invasie van Kleine Alken (*Alle alle* (L.)) en Papegaaiduikers (*Fratercula arctica* (L.)) na de stormen in de tweede helft van december 1929. Ardea 19: 63-65.
HEDGREN S. & LARSSON L. 1973. Vittrut *Larus hyperboreus*, vitvingad trut *L. glaucoides* eller missfärfad annan trut - svårugheten vid fältbestämning av ljusvingade trutar. Vår Fågelvärld 32: 173-198.
HEIDE G. VAN DER 1938. Waarnemingen over het voorkomen van enkele zeevogels bij de Doggersbank in October 1936. Ardea 27: 256-258.
HEUBECK M. & SUDDABY D. 1991. Post-mortem examination of Little Auks *Alle alle*, Shetland, December 1990. Seabird 13: 51-53.
HIGLER L.W.G. 1962. De Census van de Kokmeeuw (*Larus ridibundus* L.) in Nederland, België en Luxemburg in 1961. Limosa 35: 260-265.
HOLLANDER N. DEN 1993. Zwarte Zeeëenden (*Melanitta nigra*) en schelpdiervisserij. Studentenverslag, Nederlands Instituut voor Onderzoek der Zee en DLO-Instituut voor Bos- en Natuuronderzoek, Texel.
HUME R.A. 1980. Identification and ageing of Glaucous and Iceland Gulls: 170-182. In: SHARROCK J.T.R. (ed.). Frontiers of Bird Identification. Macmillan Journals Ltd, London.
HÜPPOP O. 1992. Ornithological research at Helgoland: seabirds as indicators of change in the marine food web. Oral pres. Int. Symp. 'The Challenge to Marine Biology in a changing world, Helgoland, September 1992.
HUTCHINSON C.D. & NEATH B. 1978. Little Gulls in Britain and Ireland. Brit. Birds 71: 563-582.
JARDINE D., JOHNSTON A., KERR I., MCKEOWN D. & ROSSITER N. 1993. Birds in Northumbria, 1992. The 1992 Bird Report for Northumberland, Newcastle and North Tyneside. Northumberland & Tyneside Bird Club, Newcastle.
JESPERSEN P. 1949. Notes on Fulmars and other birds in the southern North Sea in the month of May. Brit. Birds 42: 257-259.
JOIRIS C. 1972. Observations ornithologiques realisees dans le sud-est de la Mer du Nord, entre juin 1971 et janvier 1972. Aves 9: 85-103.
JOIRIS C. 1976. Seabirds seen during a return voyage from Belgium to Greenland in July. Le Gerfaut 66: 63-87.
JOIRIS C. 1978. Seabirds recorded in the Northern North Sea in July: the ecological implications of their distribution. Le Gerfaut 68: 419-440.
JOIRIS C. 1983a. Winter distribution of seabirds in the North Sea: an oceanological interpretation. Le Gerfaut 73: 107-123.
JOIRIS C. 1983b. Seabirds recorded in the Fladenground Area, Northern North Sea, in April, May and June 1976. In: SÜNDERMANN J. & LENZ W. (eds). North Sea Dynamics: 676-686. Springer-Verlag, Berlin, Heidelberg.
JOIRIS C. 1989. Seabirds in the North Sea: distribution and ecological role. ICES C.M. 1989/N:8.
KATWIJK Q. VAN & CAMPHUYSEN C.J. 1993. Post-breeding dispersal of Guillemots *Uria aalge* in the North Sea, late summer 1993. Sula 7: 133-140.
KEIJL G.O. & KOOPMAN E.V. 1991. Veel Aalscholvers *Phalacrocorax carbo* en Dwergsterns *Sterna albifrons* op Rottumeroog in juli en augustus 1990. Sula 5: 146-149.
KOERTS J. 1992. Fouragerende Stormvogeltjes *Hydrobates pelagicus* bij de pieren van IJmuiden, 22 september 1990. Sula 6: 19-20.
KUIP C. VAN DE 1991. Wanbeleid in de Waddenzee kost duizenden vogels het leven. Vogels 66: 230-235.
LAEVASTU T. 1963. Surface water types of the North Sea and their characteristics. Serial Atlas of the Marine Environment, folio 4: 1-3. Am. Geogr. Soc., New York.
LAMBERT K. 1967. Beobachtungen zum Zug und Winterquartier der Schwalbenmöwe (*Xema sabini*) im östlichen Atlantik. Vogelwarte 24: 99-106.
LAMBERT K. 1969. Schwalbenmöwen (*Xema sabini*) im April und Mai 1968 vor Südwest- und Südafrika. Vogelwarte 25: 49-52.
LEEUWEN A. VAN, POSTMA T.A.C., LEOPOLD M.F. & BERGMAN M.J.N. 1994. De ecologie van de kustzone van Ameland tot Borkum. NIOZ Report 1994-4, Netherl. Inst. Sea Res, Texel.
LICHTENBELD H.J. 1981. Veldwaarnemingen CXIX. Het Vogeljaar 29: 108-110.
LEOPOLD M.F. 1987. Zeevogels op zee: een onderzoek naar verspreiding en kwaliteitsverschillen van zeevogels binnen een deel van het Nederlandse Continentale Plat. NIOZ Internal Report 1987-2, Netherl. Inst. Sea Res, Texel.
LEOPOLD M.F. 1988a. Dode zeehonden op de Noordzee. Sula 2: 94.
LEOPOLD M.F. 1988b. Zeevogels met belangstelling voor windhozen. Sula 2: 59-61.
LEOPOLD M.F. 1988c. De zeeëenden-survey van januari 1988. Sula 2: 23-24.
LEOPOLD M.F. 1988d. A concentration of Guillemots *Uria aalge* at a tidal front near Texel after the breeding season. In: TASKER M.L. (ed.). Seabird Food and Feeding Ecology. Proc. 3rd Int. Conf. Seabird Group, Cambridge, 12-14 Febr. 1988, pp 32-33.
LEOPOLD M.F. 1989. Dolfijnen op de Doggersbank. Sula 3: 134-135.
LEOPOLD M.F. 1991. Toppredatoren op het Friese Front: zeevogels en zeezoogdieren. In: GEE A. DE, BAARS M.A. & VEER H.W. VAN DER (eds). De Ecologie van het Friese Front. NIOZ Report 1991-2: 79-89, Netherl. Inst. Sea Res, Texel.
LEOPOLD M.F. 1993. Spisula's, zeeëenden en kokkelvissers: een nieuw milieuprobleem op de Noordzee. Sula 7: 24-28.
LEOPOLD M.F. & BERG J. VAN DEN 1992. Een zoutwater-

kolonie Aalscholvers *Phalacrocorax carbo* in Groningen. Sula 6: 100-102.

LEOPOLD M.F. & CAMPHUYSEN C.J. 1992. Olievogels op het Texelse strand, februari 1992. Oiled seabirds on Texel, February 1992. NIOZ Report 1992-5, Netherl. Inst. Sea Res., Texel.

LEOPOLD M.F., BAPTIST H.J.M. , WOLF P.A. & OFFRINGA H. 1994a *in press* De Zwarte Zeeëend *Melanitta nigra* in Nederland. Limosa.

LEOPOLD M.F., GRUNSKY B., HÜPPOP O. & VAN DER MEER J. 1994b *in press* How large an area of sea do Helgoland seabirds use for foraging, during the breeding season? Helgoländer Meeresunters. 49.

LEOPOLD M.F., MAAS F.J. & HIN H. 1986. Elfstedenwinter 1986: slachting onder wadvogels met name de Toppereend. Skor 5: 70-78, 90-96.

LEOPOLD M.F. & PLAT S. *in prep* Seaduck and man competing for shellfish riches in the North Sea: can we harvest shellfish banks without compromising environmental values?

LEOPOLD M.F. & PLATTEEUW M. 1987. Talrijk voorkomen van Jan van Genten *Sula bassana* in de herfst: reactie of lokale voedselsituatie. Limosa 60: 105-110.

LEOPOLD M.F., RENNER M. & DREES C. *in prep*. The Black-browed Albatross *Diomedea melanophris* in the North Sea. Sula.

LEOPOLD M.F., SKOV H. & HÜPPOP O. 1993. Where does the Wadden Sea end? Links with the adjacent North Sea. Wadden Sea Newsl. 1993: 5-9.

LEOPOLD M.F., WOLF P.A. & LAKS M.H. 1990. Zeekoeten *Uria aalge* op een drijvende klif. Sula 4:100-103.

LIPPENS L. & WILLE H. 1986. Uitzonderlijke vogels in Belgie en West-Europa. I. Watervogels, dagroofvogels en steltlopers.

LORENTSEN S.-H., ANKER-NILSSEN T., KROGLUND R.T. & ØSTNES J.E. 1993. Konsekvensanalyse oljesjøfugl for petroleumsvirksomhet i norsk del av Skagerrak. NINA forskningsrapp. 39: 1-84.

MADGE S.G. 1965. Little Gull associating with feeding Razorbills. Brit. Birds 58:.

MAERTENS L., MEIRE P. & KUIJKEN E. 1988. Vliegtuigtellingen van watervogels voor de Belgische kust; winter 1986/1987. Oriolus 54: 55-60.

MAERTENS L. MEIRE P. DEVOS K. & KUIJKEN E. 1990. Vliegtuigtellingen van watervogels voor de Belgische kust, winters 1987/1988 en 1988/1989. Oriolus 56: 11-19.

MELTOFTE H. & FALDBORG J. 1987. Forekomsten af måger og terner på Blåvandshuk 1963-1977. Dansk orn. Foren. Tidsskr. 81: 137-166.

MEININGER P.L. 1978. Het voorkomen van Duikers (Gaviidae) langs de Nederlandse kust in de periode juli 1972-juni 1976. Watervogels 3: 199-209.

MEININGER P.L. & BEKHUIS J.F. 1990. De Zwartkopmeeuw *Larus melanocephalus* als broedvogel in Nederland en Europa. Limosa 63: 121-134.

MEININGER P.L., BERREVOETS C.M., SCHEKKERMAN H., STRUCKER R.C.W. & WOLF P.A. 1991. Voedsel en fourageergebieden van broedende Zwartkopmeeuwen *Larus melanocephalus* in Zuidwest-Nederland. Sula 5: 138-145.

MEININGER P.L., BERREVOETS C.M. & STRUCKER R.C.W. 1994. Watervogeltellingen in het zuidelijk Deltagebied 1987-91. Rapport RIKZ-94.005.

MEININGER P.L. & VAN HAPEREN A.M.M. 1988. Vogeltellingen in het zuidelijk Deltagebied in 1984/85-1986/87. Report DGW, GWAO-88.1010, Middelburg, 1-134.

MEYER A. 1989. Brutpaaraufstellung aus unseren Schutzgebieten 1988. Seevögel 10: 14-18.

MIRANDA J.F. DE 1968. Telling van dode vogels op Terschelling, 3-4 januari 1968. Tjiftjaf 1968(2): 13.

MITCHELL R., LANGSLOW D.R., BLAKE B.F., JONES P.H., DIXON T. & TASKER M.L. 1980. Investigation of the distribution of seabirds at sea: first annual report, November 1979 to November 1980. Nature Conserv. Council, Aberdeen 88pp.

MITCHELL R., LANGSLOW D.R., BLAKE B., JONES P.H., DIXON T. & TASKER M.L. 1981. Investigation of the distribution of seabirds at sea: second annual report, November 1980 to October 1981. Nature Conserv. Council, Aberdeen 26pp.

MULDER T. & SWENNEN C. 1992. Ruiende Bergeenden *Tadorna tadorna* in de Nederlandse Waddenzee. Sula 6: 57-58.

MURPHY R.C. & VOGT W. 1933. The Dovekie influx of 1932. Auk 50: 325-349.

NEHLS G., KEMPF N. & THIEL M. 1992. Bestand und Verteilung mausernder Brandenten (*Tadorna tadorna*) im deutschen Wattenmeer. Die Vogelwarte 36: 221-232.

NISBET I.C.T. 1956. Hav- og vadefugletræk ved Blåvandshuk, Vestjulland, i september og oktober 1955. Dansk Orn. Foren. Tidsskr. 50: 324-335.

NOORDHUIS R. & SPAANS A.L. 1992. Interspecific competition for food between Herring *Larus argentatus* and Lesser Black-backed Gulls *L. fuscus* in the Dutch Wadden Sea area. In: SPAANS A.L. (ed.). Population dynamics of Lari in relation to food resources. Ardea 80: 115-132.

NYGÅRD T. 1992. The midwinter counts in Norway 1980-91: Numbers and trends. IWRB Seaduck Bulletin 1: 45-47.

NYGÅRD T., EINVIK K., PEDERSEN P.H. & RØV N. 1987. Havsvaler påvist på Sklinna, Nord-Trøndelag i hekketida. Vår Fuglefauna 10: 43-45.

NYGÅRD T., LARSEN B.H., FOLLESTAD A & STRANN K.-B 1988. Numbers and distributionn of wintering waterfowl in Norway. Wildfowl 39: 164-176.

NYGÅRD T. & RØV N. 1985. Bestandsovervaking av overvintrende sjøfugl. Sjøfuglprosjektet 1979-1984, Viltrapport 35, Trondheim.

O'DONOVAN J.E. & REGAN B.O. 1950. Little Auks in West Cork. Irish Nat. J. 10: 43.

OFFRINGA H. 1991a. Verspreiding en Voedseloecologie van de Zwarte Zeeëend (*Melanitta nigra*) in Nederland. Verslag Doctoraal onderwerp LU Wageningen/NIOZ Texel, NIOZ Report 1991-13, Netherl. Inst. Sea Res., Texel.

OFFRINGA H. 1991b. Baltsende Zwarte Zeeëenden *Melanitta nigra* voor de Nederlandse kust. Sula 5: 57-58.

OFFRINGA H. 1993. Zwarte Zeeëenden *Melanitta nigra* offshore. Sula 7: 142-144.

OFFRINGA H. & LEOPOLD M.F. 1991. Het tellen van Zwarte Zeeëenden *Melanitta nigra* voor de Nederlandse kust. Sula 5: 154-157.

OFFRINGA H. & WITBAARD R. 1990. Black-browed Albatross in FRG in October 1988. Dutch Birding 12: 69.

OLIVER P.J. 1976. Observations from cross-channel ferries. Seabird rep. 5: 49-51.

OLIVER P.J. 1977. Le passage d'autmne de la Mouette pygmee, *Larus minutus*, an Cap Gris-Nez. Alauda 45: 191-196.

OORD A.M. VAN DEN & SWAAB J. 1964. Waarnemingen van Grauwe Pijlstormvogels. Limosa 37: 191.

OUDEN J.E. DEN & CAMPHUYSEN C.J. 1983. Meetpost Noordwijk 1978-1981, Report no. 2 Anatidae- Scolopacidae. CvZ MpN-verslag nr. 2, Amsterdam.

OUDEN J.E. DEN & HAM N.F. VAN DER 1988. Meetpost Noordwijk 1978-1982, Report no. 3 Stercoraridae-Alcidae. CvZ MpN-verslag nr. 3, Alkmaar/ Amsterdam.

OUDEN J.E. DEN & STOUGIE L. 1990. Voorjaarstrek van Dwergmeeuwen *Larus minutus* langs de Noordzeekust. Sula 4: 90-98.

OUWENEEL G.L. 1975. Overwinterende Grote Sterns *Sterna sandvicensis* in Nederland. Limosa 48: 197--201.

OUWENEEL G.L. 1979. De winterwaarnemingen van Grote Sterns in Nederland. Het Vogeljaar 27: 38-39.

OUWENEEL G.L. 1981. Winterwaarnemingen van Grote Sterns *Sterna sandvicensis* in Nederland. Limosa 54: 96-97.

OUWENEEL G.L. 1985. Overzomerende Roodhalsfuten *Podiceps grisegena* op de Grevelingen. Limosa 58: 74-75.

OUWENEEL G.L. 1988. Ruiende Bergeenden *Tadorna tadorna* in het Haringvliet. Vogeljaar 36: 65-67.

OUWENEEL G.L. 1989a. Een ruiconcentratie Geoorde Futen (*Podiceps nigricollis*) op de Grevelingen. Het Vogeljaar 37: 100-102.

OUWENEEL G.L. 1989b. Wintering of Sandwich Tern in the Netherlands. Dutch Birding 11: 172-174.

OUWENEEL G.L. 1990. In 1989 meer overzomerende Roodhalsfuten op de Grevelingen. Het Vogeljaar 38: 170-171.

OUWENEEL G.L. 1993a. Roodkeelduikers *Gavia stellata* in het Brouwershavense Gat. Limosa 66: 164-166.

OUWENEEL G.L. 1993b. Een voorjaarsconcentratie Kuifduikers *Podiceps auritus* op de Grevelingen. Limosa 66: 29.

PASHBY B.S. & CUDWORTH J. 1969. The Fulmar "wreck" of 1962. Brit. Birds 62: 97-107.

PIERSMA T., VLUG J.J. & WESTHOF J.H.P. 1986. Twintig jaar ruiende futen *Podiceps cristatus* bij de Mokkebank, 1966-1985. Vanellus 39: 27-37.

PLATTEEUW M. 1980. De ruitrek van de Bergeend *Tadorna tadorna* langs de Nederlandse Noordzeekust. Limosa 53: 121-128.

PLATTEEUW M. 1986a. De timing van voedselvluchten bij de Schoorlse Stormmeeuwen. Kleine Alk 4: 15-27.

PLATTEEUW M. 1986b. Stormmeeuwen *Larus canus* op zee in het broedseizoen. Med. CvZ 9(2): 42-50.

PLATTEEUW M. 1987. Trekbewegingen van Kokmeeuwen *Larus ridibundus* langs de Noordzeekust: oorzaken en achtergronden. Sula 1: 29-37.

PLATTEEUW M. 1988. Voorlopige impressie van simultane zeevogeltellingen langs en voor de Nederlandse kust, oktober 1988. Sula 2: 133-137.

PLATTEEUW M. 1990. Het voorkomen van de Zwarte zee-eend *Melanitta nigra* langs de Nederlandse kust: een evaluatie. Sula 4: 55-65.

PLATTEEUW M., HAM N.F. VAN DER & CAMPHUYSEN C.J. 1985. K7-FA-1, K8-FA-1, Zeevogelobservaties winter 1984/85. CvZ spec. publ., Amsterdam.

PLATTEEUW M. & STEGEMAN L. 1989. Voorjaarstrek van Grote Sterns *Sterna sandvicensis* langs de Nederlandse kust: interpretatie van seizoenspatroon. Sula 3: 51-59.

POULSEN C.M. 1957. [Irruption of Little Auk (*Plotus alle* (L.)) in Danish waters in the winter 1955-56]. Dansk orn. Foren. Tidsskr. 51: 30-32.

RAAIJMAKERS M.H.J.E., BEERS P.W.M. VAN & HABRAKEN J.M.P.M. 1993. Telemetrische bepaling van de fourageerplaatsen en fourageerroutes van de op Griend broedende grote sterns *Sterna sandvicensis*. BEON Report 93-4, Inst. voor Bos- en Natuuronderzoek, Arnhem.

RETTIG L. 1977. Zum Durchzug der Zwergmöwe (*Larus minutus*) im nordwestlichen Ost-Friesland. Orn. Mitt. 29: 81-86.

ROOTH J. 1985. Recente ontwikkelingen van de broedpopulatie van de Aalscholver *Phalacrocorax carbo*. Limosa 58: 162-163.

ROOTH J. 1989. De Nederlandse broedpopulatie van de Grote Stern *Sterna sandvicensis* in 1961-88. Limosa 62: 121-124.

ROSE P.M. & SCOTT D.A. 1994. Waterfowl population estimates. IWRB Publ. 29, International Waterfowl and Wetlands Research Bureau, Slimbridge.

RUFINO R. 1992. Aerial seabird counts along the Portuguese coast in January 1992. IWRB Seaduck Bull. 2: 5-9.

RYAN P.G. 1987. The effects of ingested plastic on seabirds: correlations between plastic load and body condition. Env. Poll. 46: 119-125.

RYAN P.G. 1988. Intraspecific variation in plastic ingestion by seabirds and the flux of plastic through seabird populations. Condor 90: 446-452.

RYAN P.G., CONNELL A.D. & GARDNER B.D. 1988. Plastic ingestion and PCB's in seabirds: is there a relationship? Mar. Poll. Bull. 19: 174-176.

SALOMONSEN F. 1968. The moult migration. Wildfowl 19: 5-24.

SCOTT J.M. 1990. Offshore distributional patterns, feeding habits, and adult-chick interactions of the Common Murre in Oregon. In: Sealy S.G. (ed.). Auks At Sea. Studies in Avian Biology No. 14: 103-108.

SCOTT R.E. 1972. Little Gulls associating with feeding Razorbills. Brit. Birds 65: 259.

SERGEANT D.E. 1952. Little Auks in Britain, 1948-1951. Brit. Birds 45: 122-131.

SEYS J. 1993. De Belgische kustwateren in vogelperspectief. WWF België & Instituut voor Natuurbehoud, Hasselt.

SKOV H., DURINCK J., LEOPOLD M.F. & OFFRINGA H. 1994. Habitats at sea: "Action preparatory to the establishment of a protected areas network in the southeastern North Sea and the southern Baltic". EU DG XI ACE contract no. 445-45 Final Report, NIOZ Report 1994-6, Netherl. Inst. Sea Res., Texel.

SLINGS Q.L. 1981. Waarneming van Wenkbrauwalbatros in Nederland in Oktober 1971. Dutch Birding 2: 122--125.

SHARROCK J.T.R. 1971. Scarce migrants: Sabine's Gull *Larus sabini*. Brit. Birds 64: 93-113.

SMIT C.J. 1994. Alternatieve voedselbronnen voor schelpdier-etende vogels in Nederlandse getijdewateren. Report IBN-DLO, Texel and Wageningen.

SMITH P.H. 1987. The changing status of Little Gulls *Larus minutus* in North Merseyside, England. Seabird 10: 12-21.

SOVON 1987. Atlas van de Nederlandse vogels. SOVON, Arnhem.

SOVON 1988. Nieuwe aantalsschattingen van de Nederlandse broedvogels. Limosa 61: 151-162.

SPAANS A.L. 1971. On the feeding ecology of the Herring Gull *Larus argentatus* Pont. in the northern part of the Netherlands. Ardea 59: 73-188.

SPAANS A.L. 1987a. Stabilisatie van broedvogelaantallen bij de Zilvermeeuw. Limosa 60: 99-100.

SPAANS A.L. 1987b. Overzicht broedvogelstand Zilvermeeuw, Kleine Mantelmeeuw en Stormmeeuw in 1985. Internal report, Rijksinst. Natuurbeheer, Arnhem.

SPAANS A.L. 1994. The relationship between food supply, reproductive parameters and population dynamics in Dutch Lesser Black-backed Gulls *Larus fuscus*: a pilot study. IBN-rapport 000, Instituut voor Bos- en Natuuronderzoek, Arnhem.

SPAANS A.L., WIT A.A.N. DE, VLAARDINGEN M.A. VAN & NOORDHUIS R. 1987. Hoe kunnen we de Zilvermeeuw in ons land het beste beheren? De Levende Natuur 88: 103-109.

SPRONG I., KUIPERS B.R. & WITTE H. 1990. Acoustic phenomena related to an enriched benthic zone in the North Sea. J. Plankton Res. 12: 1251-1261.

STEGEMAN L. 1991. Seawatching, November 1990-January 1991. Sula 5: 37-38.

STEGEMAN L. 1992. Seawatching, November 1991-January 1992. Sula 6: 38.

STEGEMAN L. 1993. Zeetrektellingen, november 1992-januari 1993. Sula 7: 36-37.

STIENEN E.W.M. & BRENNINKMEIJER A. 1992. Ecologisch profiel van de Visdief (*Sterna hirundo*). Rin-rapport 92/18, Rijksinst. Natuurbeheer, Arnhem.

STONE C.J., WEBB A., BARTON C., CAMPHUYSEN C.J., RATCLIFFE N., REED T.C., TASKER M.L. & PIENKOWSKI M.W. *in press* An atlas of seabird distribution in North-west European waters. JNCC, Aberdeen.

STRIJBOS J.P. 1960. De Vogels van Zee en Strand. L.J.Veen, Amsterdam.

SUTHERLAND W.J. & BROOKS D.J. 1979. Nest of Black-browed Albatross in Shetland. Brit. Birds 72: 386--388.

SWENNEN C. 1970. Vogelwaarnemingen op het IJsselmeer. Limosa 43: 1-10.

SWENNEN C. 1978. Zeevogels en de ramp met de tanker "Pacific Colocotronis" in de Noordzee. Veldorn. Tijdschr. 1: 34-41.

SWENNEN C. 1991a. Resultaten waterwildtelling Nederlandse Waddenzee op 21 en 26 Januari 1991. Unpubl. report, Netherl. Inst. Sea Res., Texel.

SWENNEN C. 1991b. Ecology and population dynamics of the Common Eider in the Dutch Wadden Sea. PhD Thesis, State University of Groningen.

SWENNEN C., NEHLS G. & LAURSEN K. 1989. Numbers and distribution of Eiders *Somateria mollissima* in the Wadden Sea. Neth. J. Sea Res. 24: 83-92.

SWENNEN C. & SPAANS A.L. 1970. De sterfte van zeevogels door olie in februari 1969 in het Waddengebied. Het Vogeljaar 18: 233-245.

TASKER M.L. 1991a. Seabirds At Sea Projects in Europe. Seabird Group Newsletter 59: 6-8.

TASKER M.L. 1991b. Conservation uses of information on the distribution of seabirds at sea. In: CAMPHUYSEN C.J. & VAN FRANEKER J.A. (eds). Oil pollution, Beached Bird Surveys and Policy: towards a more effective approach to an old problem. Proc. int. NZG/NSO workshop, Rijswijk, 19 April 1991, Sula 5 (special issue): 28-29.

TASKER M.L., JONES P.H., BLAKE B.F. & DIXON T.J. 1985a. The marine distribution of the Gannet in the North Sea. Bird Study 32: 82-90.

TASKER M.L., WEBB A., GREENSTREET S.P.R., UTTLEY J. & GRIFFITHS A. 1985b. Concentrations of auks off the north-east coast of Britain August 1984. NCC comm. res. report no. 589, Nature Conservancy Council, Aberdeen.

TASKER M.L., WEBB A., HALL A.J., PIENKOWSKI M.W. & LANGSLOW D.R. 1987. Seabirds in the North Sea. Nature Conserv. Council, Peterborough.

TEIXEIRA R.M. (ed.) 1979. Atlas van de Nederlandse broedvogels. Vereniging tot Behoud van Natuurmonumenten, 's Graveland.

TEKKE M.J. 1971. Een groot aantal waarnemingen in 1970 van de Noordse Pijlstormvogel, *Puffinus puffinus*. Limosa 44: 184-185.

TEMME M. 1989. Über das Vorkommen von See- und Hochseevogelarten vor der Insel Norderney nach Planbeobachtungen. Vogelk. Ber. Nieders. 21: 54-63.

TEMME M. 1991. Der Wegzug der Zwergmöwe *Larus minutus* vor Norderney in Beziehung zum Wettergeschehen. Vogelk. Ber. Nieders. 23: 77-89.

THOMAS L. & ANDRESEN K. 1986. Wingbeat rates of Glaucous and Iceland Gulls. Br. Birds 79: 42.

THOMSON A.L. 1974. The migration of the Gannet: a reassessment of British and Irish ringing data. Brit. Birds 67: 89-103.

TRAANBERG G. 1923. Trekwaarnemingen op het licht schip ,Schouwenbank' van 16 tot 28 mei 1923. Ardea 12: 37-40.

UNDERWOOD L.A. & STOWE T.J. 1984. Massive wreck of seabirds in eastern Britain, 1983. Bird Study 31: 79--88.

VAUK G. 1982. Bestandsentwicklung der Silbermöwe (*Larus argentatus*) und die Regulierung ihres Bestandes durch jagdliche Maßnahmen auf der Insel Helgoland. Seevögel 3: 71-84.

VEEN J. 1977. Functional and causal aspects of nest distribution in colonies of the Sandwich Tern (*Sterna sandvicensis* Lath.). Behaviour Suppl. 20: 1-193.

VEENSTRA H. 1970. Sediments of the southern North Sea, 3. ICSU-SCOR working party 31 Symposium, Cambridge.

VERCRUIJSSE H.J.P. & SPAANS A.L. 1994. Eerste broedgeval van de Grote Mantelmeeuw *Larus marinus* in Nederland. Limosa 67: 111-113.

VOSLAMBER B. 1991. Meeuwen in het IJsselmeergebied: voedseloecologie van zeven op het meer voorkomende soorten. Intern rapport 1991 - 9 liw, Directie Flevoland, Rijkswaterstaat, Lelystad.

WALMSLEY J.G. 1987. Observations of colour-ringed Shelduck (*Tadorna tadorna*) of Camarque origin in the 'Großer Knechtsand' moulting area. Beitr. Nat. Nieders. 40: 294-296.

WATERSTON G. 1968. Black-browed Albatross on the Bass Rock. Brit. Birds 61: 22-27.

WEBB A. 1988. The international juvenile auk survey in the North Sea. In: TASKER M.L. (ed.). Seabird food and feeding ecology: 48-49. In: Tasker M.L. (ed.). Seabird Food and Feeding Ecology. Proc. 3rd int. Conf. Seabird Group, Cambridge.

WEBB A. & TASKER M.L. 1988. Distribution of seabirds in inshore waters between Rattray Head and Flamborough Head. Nature Conservancy Council, Chief Scientist Directorate Report No. 760, Nature Conservancy Council, Aberdeen.

WEBB A., TASKER M.L. & GREENSTREET S.P.R. 1985. The distribution of guillemots (*Uria aalge*), razorbills (*Alca torda*) and puffins (*Fratercula arctica*) at sea around Flamborough Head, June 1984. Nature Conservancy Council, Chief Scientist Directorate Report No. 590, Nature Conservancy Council, Aberdeen.

WIJS W.J.R. DE 1985. Herkomst en leeftijd van Zeekoeten *Uria aalge* in Nederland. Limosa 58: 61-64.

WINTER C. 1993. Zeetrekoverzicht april - juni 1993. Kleine Alk 11: 56-61.

WIT A.A.N. DE & SPAANS A.L. 1984. Veranderingen in de broedbiologie van de Zilvermeeuw *Larus argentatus* door toegenomen aantallen. Limosa 57: 87-90.

WITTE L. & CAMPS L. 1989. Zeevogels op het Friese Front. Unpubl. intern report Netherlands Institute for Sea Research, Texel.

WOLF P. DE (ed.) 1990. De Noordzee. Terra, Zutphen.

WOUTERSEN K. 1980. Migrating Little Gulls in The Netherlands. Brit. Birds 72: 192-193.

WOUTERSEN K. 1992. De Stormmeeuw *Larus canus* als broedvogel in de Schoorlse Duinen. Sula 6: 81-92.

WOUTERSEN K. (ed.) 1994. Heden, verleden en toekomst van de meeuwen in de kop van Noord-Holland. Kleine Alk 12(1, special issue): 1-42.

WOUTERSEN K. & ROOBEEK K. 1992. Broedgevallen van de Stormmeeuw *Larus canus* in het binnenland in Noord-Holland. Sula 6: 51-55.

ZIJLSTRA M. & EERDEN M.R. VAN 1991. Development of the breeding population of the Cormorant *Phalacrocorax carbo* in The Netherlands till 1989: 53-60. In: EERDEN M.R. VAN & ZIJLSTRA M. (eds). Proc. workshop on Cormorants *Phalacrocorax carbo*. Rijkswaterstaat, Dir. Flevoland, Lelystad.

ZOUN P.E.F. 1991. Onderzoek naar de Oorzaak van de Vogelsterfte langs de Nederlandse kust gedurende december 1988 en januari 1989. CDI-rapport nr. H121519, Lelystad, 55pp.

ZOUN P.E.F., BAARS A.J. & BOSHUIZEN R.S. 1991. A case of seabird mortality in the Netherlands caused by spillage of nonylphenol and vegetable oils, winter 1988/89. Sula 5: 101-103.

ZOUN P.E.F. & BOSHUIZEN R.S. 1992. Gannets victim to spillage of lubricating oil and dodecylphenol in the North Sea, winter 1990. Sula 6: 29-30.

ZWEERES K. 1935. Een Papegaaiduiker-invasie. Amoeba 14(3): 80.

Appendix I. All birds observed at sea, ship-based surveys 1985-93 (strip-transect & 180° scan data).

Euring	Scientific name	Jun-Jul	Aug-Sep	Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Total
20	Gavia stellata	1	1	280	910	994	52	2238
30	Gavia arctica		1	8	35	30	8	82
40	Gavia immer			1	4	7	1	13
50	Gavia adamsii						1	1
59	Gavia spec.		2	145	595	723	43	1508
90	Podiceps cristatus		2	237	1561	3201	5	5006
100	Podiceps griseigena			7	16	9	1	33
110	Podiceps auritus				1	5	1	7
120	Podiceps nigricollis				1			1
128	P. auritus/nigricollis					4		4
129	Podiceps spec.				1			1
140	Diomedea melanophris			1				1
220	Fulmarus glacialis	11482	12150	8129	2886	9741	6427	50815
430	Puffinus griseus	2	13	12	1		1	29
460	Puffinus puffinus	6	3	1		2		12
462	Puffinus puffinus mauretanicus		1					1
469	Puffinus spec.				1			1
520	Hydrobates pelagicus			8	2			10
550	Oceanodroma leucorhoa		11	13	1			25
558	O. leucorhoa/H. pelagicus			1				1
710	Sula bassana	403	2895	4707	428	1515	523	10471
720	Phalacrocorax carbo	317	175	40	128	92	193	945
800	Phalacrocorax aristotelis		2		1	1	4	8
1220	Ardea cinerea	2	9	12			1	24
1440	Platalea leucorodia					5		5
1520	Cygnus olor					6		6
1530	Cygnus columbianus			2	20	2		24
1540	Cygnus cygnus					16		16
1549	Cygnus spec.					25		25
1570	Anser fabalis			4	11	1		16
1580	Anser brachyrhynchus			3	11	95		109
1590	Anser albifrons			6	5	4		15
1610	Anser anser		38	777	43	824	27	1709
1639	Anser spec.					8		8
1670	Branta leucopsis			26		1		27
1680	Branta bernicla		25	708	74	1261	72	2140
1681	Branta bernicla bernicla				3			3
1699	Anser/Branta spec.		6	109		21		136
1730	Tadorna tadorna	14	39	133	19	76		281
1790	Anas penelope		9	465	467	1649		2590
1820	Anas strepera		1		30	30		61
1840	Anas crecca	2	5	36	33	135		211
1845	A. crecca / A. querquedula					70		70
1860	Anas platyrhynchos	12	15	121	684	391	9	1232
1890	Anas acuta		16	54	30	58		158
1940	Anas clypeata			16		13	2	31
1959	Anas spec.					1		1
1980	Aythya ferina		2	36	29	11		78
2030	Aythya fuligula			12	11	4	4	31
2040	Aythya marila	6		21	245	5633	8	5913
2060	Somateria mollissima	1267	250	2306	77300	144573	2397	228093
2120	Clangula hyemalis			1	18	7	2	28
2130	Melanitta nigra	47820	918	19024	252116	494400	221467	1035745
2140	Melanitta perspicillata					1		1
2150	Melanitta fusca	132		131	607	15916	5357	22143
2180	Bucephala clangula			11	237	88		336

Euring	Scientific name	Jun-Jul	Aug-Sep	Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Total
2189	Aythya spec.			4		2		6
2200	Mergus albellus				2			2
2210	Mergus serrator		2	43	320	233	14	612
2230	Mergus merganser				11			11
2269	unidentified duck		54	10	85	28		177
2310	Pernis apivorus						2	2
2600	Circus aeruginosus		1					1
2610	Circus cyaneus			3				3
2670	Accipiter gentilis		1					1
2690	Accipiter nisus			3				3
2870	Buteo buteo						1	1
3040	Falco tinnunculus			2			2	4
3090	Falco columbarius			2			3	5
3100	Falco subbuteo						1	1
3219	unidentified raptor		2					2
4070	Rallus aquaticus					1		1
4240	Gallinula chloropus			2				2
4290	Fulica atra		1	4	4	4	2	15
4500	Haematopus ostralegus	22	15		5	61	23	126
4560	Recurvirostra avosetta	2				17		19
4700	Charadrius hiaticula		1			6	6	13
4850	Pluvialis apricaria	4	14	14	13	1	1	47
4860	Pluvialis squatarola	1	4	25	1	7	28	66
4930	Vanellus vanellus	2	1	126	2	949		1080
4960	Calidris canutus	11	9	7		43		70
4970	Calidris alba			2	1	12	71	86
5090	Calidris ferruginea		2					2
5100	Calidris maritima		9	1		1		11
5120	Calidris alpina	3	13	27	3	111	18	175
5149	Calidris spec.					16		16
5170	Philomachus pugnax		1					1
5180	Lymnocryptes minimus			1				1
5190	Gallinago gallinago	1	8	5				14
5290	Scolopax rusticola			4		4		8
5320	Limosa limosa						1	1
5340	Limosa lapponica	4	36	1		1	256	298
5380	Numenius phaeopus	29	22				22	73
5410	Numenius arquata	31	112	3	23	149	42	360
5460	Tringa totanus	7	21		2	7	6	43
5480	Tringa nebularia		1					1
5560	Actitis hypoleucos		3				1	4
5610	Arenaria interpres	12	4	1		2	5	24
5640	Phalaropus lobatus	2						2
5659	unidentified wader	1	8	8	60	1	9	87
5660	Stercorarius pomarinus		17	17	7	2	7	50
5670	Stercorarius parasiticus	5	174	53	1	1	11	245
5680	Stercorarius longicaudus		3	1				4
5690	Stercorarius skua	40	566	149	21	14	18	808
5699	Stercorarius spec.		6	7	1			14
5750	Larus melanocephalus	1		6				7
5780	Larus minutus	12	143	2109	387	864	1295	4810
5790	Larus sabini		1	2		1		4
5820	Larus ridibundus	458	402	3941	4785	6401	343	16330
5900	Larus canus	313	296	7384	11509	10957	903	31362
5909	Larus / Rissa spec.			1	2			3
5910	Larus fuscus	7675	10295	4168	175	2312	13397	38022
5919	L. fuscus / L. argentatus	81	929	63	4	140	88	1305
5920	Larus argentatus	4127	2126	11574	22210	23629	10840	74506
5920	Larus cachinnans			3				3
5929	L. canus / L. argentatus						60	60
5980	Larus glaucoides			2	1			3
5990	Larus hyperboreus			3	2	4	2	11
6000	Larus marinus	98	2929	9422	6394	4057	754	23654
6005	Larus spec.	1362	2179	2029	2545	1033	1482	10630
6009	L. fuscus / L. marinus	5	198	7	57	49	3	319
6020	Rissa tridactyla	1127	3542	14997	8446	9185	2525	39822
6049	Larus spec.	596	4821	20577	7947	6289	2526	42756
6110	Sterna sandvicensis	981	495	6	1	110	1628	3221
6150	Sterna hirundo	138	1480	1			595	2214
6160	Sterna paradisaea	56	140	3		4	165	368
6169	S. hirundo / S. paradisaea	290	527	6		4	500	1327
6240	Sterna albifrons	3	2					5
6270	Chlidonias niger	4	6	2			15	27
6289	Sterna spec.		4533				5	4538
6340	Uria aalge	1085	2288	7751	4152	4705	1928	21909
6345	Alca torda / Uria aalge	1	6	988	487	483	41	2006
6350	Uria lomvia				1			1
6360	Alca torda	2	9	1006	476	1293	181	2967

Euring	Scientific name	Jun-Jul	Aug-Sep	Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Total
6470	Alle alle			52	65	107	1	225
6540	Fratercula arctica	4	4	49	19	75	50	201
6545	unidentified small auk				1			1
6549	unidentified auk	2		5	8	26	1	42
6655	Columba 'domestica'	4	6	5	19	40	11	85
6680	Columba oenas						1	1
6700	Columba palumbus	1		2		12	7	22
6840	Streptopelia decaocto	2				1	4	7
6870	Streptopelia turtur	1						1
7670	Asio otus			5				5
7680	Asio flammeus			2				2
7950	Apus apus	46					12	58
9720	Galerida cristata						1	1
9740	Lullula arborea			3				3
9760	Alauda arvensis		3	427		149	1	580
9780	Eremophila alpestris					31		31
9789	unidentified lark			5		24	5	34
9810	Riparia riparia	1						1
9920	Hirundo rustica	11	5				93	109
10010	Delichon urbica	4	1	1			17	23
10090	Anthus trivialis		3					3
10110	Anthus pratensis		24	156		32	35	247
10119	unidentified pipit	1	9	9		2	5	26
10140	Anthus spinoletta		3	1		1		5
10170	Motacilla flava		7	1			15	23
10190	Motacilla cinerea					1		1
10200	Motacilla alba		4	2		6	4	16
10202	Motacilla alba yarrellii					1		1
10209	Motacilla spec.		2					2
10660	Troglodytes troglodytes			4				4
10840	Prunella modularis						1	1
10990	Erithacus rubecula		2	37		8	3	50
11210	Phoenicurus ochruros		1	1		1	2	5
11220	Phoenicurus phoenicurus	1	3	2			1	7
11370	Saxicola rubetra		5					5
11460	Oenanthe oenanthe		8	1		1	4	14
11860	Turdus torquatus			2				2
11870	Turdus merula			68	6	71		145
11980	Turdus pilaris			391	94	69	2	556
12000	Turdus philomelos		1	53		22		76
12005	T. philomelos / iliacus			364				364
12009	Turdus spec.			86		43	2	131
12010	Turdus iliacus			791	27	246		1064
12020	Turdus viscivorus			15	1	9	1	26
12430	Acrocephalus schoenobaenus		1					1
12560	Hippolais caligata			1				1
12760	Sylvia borin		2	2				4
12770	Sylvia atricapilla		1	15			1	17
13110	Phylloscopus collybita		3	1			2	6
13115	P. collybita / P. trochilus		1	1			3	5
13120	Phylloscopus trochilus		5	1			4	10
13140	Regulus regulus		6	21		1	3	31
13350	Muscicapa striata						1	1
13490	Ficedula hypoleuca						1	1
14640	Parus major					1		1
15600	Corvus monedula			5		6	1	12
15630	Corvus frugilegus					1	2	3
15670	Corvus corone			10			2	12
15820	Sturnus vulgaris	7	1	4838	3	2539	50	7438
15980	Passer montanus					2	1	3
16360	Fringilla coelebs			204		198	7	409
16365	unidentified finch			1350		2		1352
16380	Fringilla montifringilla		1	28				29
16490	Carduelis chloris		3	10				13
16540	Carduelis spinus						1	1
16600	Carduelis cannabina		1	1			1	3
16660	Loxia curvirostra		2					2
18470	Calcarius lapponicus			1				1
18770	Emberiza schoeniclus			18				18
18820	Miliaria calandra		2					2
18829	Emberiza spec.		2					2
19999	unidentified passerine	2	19	153	1	41	13	229

Appendix II. Scientific, Dutch and English names of birds discussed in detail in this report.

Scientific name	Nederlandse naam	English name
Gavia stellata	Roodkeelduiker	Red-throated Diver
Gavia arctica	Parelduiker	Black-throated Diver
Gavia immer	IJsduiker	Great Northern Diver
Gavia adamsii	Geelsnavelduiker	White-billed Diver
Podiceps cristatus	Fuut	Great Crested Grebe
Podiceps griseigena	Roodhalsfuut	Red-necked Grebe
Podiceps auritus	Kuifduiker	Slavonian Grebe
Podiceps nigricollis	Geoorde Fuut	Black-necked Grebe
Diomedea melanophris	Wenkbrauwalbatros	Black-browed Albatross
Fulmarus glacialis	Noordse Stormvogel	Fulmar
Puffinus griseus	Grauwe Pijlstormvogel	Sooty Shearwater
Puffinus puffinus	Noordse Pijlstormvogel	Manx Shearwater
Puffinus puffinus mauretanicus	Vale Pijlstormvogel	Balearic Shearwater
Hydrobates pelagicus	Stormvogeltje	Storm Petrel
Oceanodroma leucorhoa	Vaal Stormvogeltje	Leach's Petrel
Sula bassana	Jan van Gent	Gannet
Phalacrocorax carbo	Aalscholver	Cormorant
Phalacrocorax aristotelis	Kuifaalscholver	Shag
Somateria mollissima	Eidereend	Eider
Clangula hyemalis	IJseend	Long-tailed Duck
Melanitta nigra	Zwarte Zeeëend	Common Scoter
Melanitta fusca	Grote Zeeëend	Velvet Scoter
Bucephala clangula	Brilduiker	Goldeneye
Stercorarius pomarinus	Middelste Jager	Pomarine Skua
Stercorarius parasiticus	Kleine Jager	Arctic Skua
Stercorarius longicaudus	Kleinste Jager	Long-tailed Skua
Stercorarius skua	Grote Jager	Great Skua
Larus melanocephalus	Zwartkopmeeuw	Mediterranean Gull
Larus minutus	Dwergmeeuw	Little Gull
Larus sabini	Vorkstaartmeeuw	Sabine's Gull
Larus ridibundus	Kokmeeuw	Black-headed Gull
Larus canus	Stormmeeuw	Common Gull
Larus fuscus	Kleine Mantelmeeuw	Lesser Black-backed Gull
Larus argentatus	Zilvermeeuw	Herring Gull
Larus cachinnans	Geelpootmeeuw	Yellow-legged Gull
Larus glaucoides	Kleine Burgemeester	Iceland Gull
Larus hyperboreus	Grote Burgemeester	Glaucous Gull
Larus marinus	Grote Mantelmeeuw	Great Black-backed Gull
Rissa tridactyla	Drieteenmeeuw	Kittiwake
Sterna sandvicensis	Grote Stern	Sandwich Tern
Sterna hirundo	Visdief	Common Tern
Sterna paradisaea	Noordse Stern	Arctic Tern
Sterna albifrons	Dwergstern	Little Tern
Chlidonias niger	Zwarte Stern	Black Tern
Uria aalge	Zeekoet	Guillemot
Alca torda	Alk	Razorbill
Alle alle	Kleine Alk	Little Auk
Fratercula arctica	Papegaaiduiker	Puffin

Appendix III. Abbreviations and terms used in this report

Breeveertien	area off the mainland coast (figure 2.1a)
Bruine Bank	clay ridge in the centre of the Southern Bight (figure 2.1a)
Coastal zone	Estimates of total numbers of birds at sea were made on the basis of 30'N x 1°E squares and summarized for a coastal zone of 11 (parts of) such rectangles (figure 3.1, see also 'Offshore zone')
CvZ	'Club van Zeetrekwaarnemers', group of seawatchers, currently a working group of the *Dutch Seabird Group*, NZG/CvZ)
DGW	'Dienst Getijdewateren', division of Rijkswaterstaat, Ministry of Transport, Public Works and Water Management (currently named RIKZ)
Doggersbank	major shallow area (20-30m depth) in the northwestern part of the study area and beyond (see figure 2.1a)
Dutch sector	Dutch sector of the North Sea (figure 2.1a), also used to estimate total number of birds (defined in figure 3.2)
IBN-DLO	'Instituut voor Bos- en Natuuronderzoek - Dienst Landbouwkundig Onderzoek'
Friese Front	Transition zone between Breeveertien and Oestergronden (figure 2.1a); see also De Gee *et al.* 1991)
Grevelingen	enclosed brackish water area in the Delta (figure 2.1b)
Griend	Small island in the Wadden Sea (figure 2.1b)
ICES squares	30'N x 1°E rectangles, used to estimate total numbers of birds in areas from densities in transect
IJsselmeer	large lake in the Netherlands, former part of the Wadden Sea (figure 2.1b)
INB	'Instituut voor Natuurbehoud', Hasselt, Belgium
K7-FA-1 K8-FA-1	offshore gas production platforms, used for observations by the Club van Zeetrekwaarnemers in 1984/85 (Platteeuw *et al.* 1985)
mainland coast	coast of *Noord-* and *Zuid-Holland* (figure 2.1b)
Meetpost Noordwijk	research platform in the coastal zone off mainland Zuid-Holland
Mijnbouwvakken	rectangles of 10 x 20 geographical minutes, used to plot densities of birds on distribution maps
NIOZ	'Nederlands Instituut voor Onderzoek der Zee'
Nordschillgrund	offshore waters in the northeastern part of the study area, *ca.* 55°N, 5°E (figure 2.1a)
NZG	'Nederlandse Zeevogelgroep', Dutch Seabird Group
Oestergronden	offshore waters in the northern part of the study area, *ca.* 54°N, 4°E (figure 2.1a)
Offshore zone	Estimates of total numbers of birds at sea were made on the basis of 30'N x 1°E squares and summarized for an offshore zone of 30 (parts of) such rectangles (figure 3.1, see also 'Coastal zone')
Ornis Consult	consultancy, Copenhagen, Denmark
Outer Silver Pit	deep water area just to the southwest of Doggersbank (figure 2.1a)
RIKZ	'Rijksinstituut voor Kust en Zee', National Institute for Coastal and Marine Management, division of the Ministry of Transport, Public Works and Water Management.
RV	research vessel
SAST	'Seabirds at Sea Team', division of Joint Nature Conservation Committee, Aberdeen, U.K.
Southern Bight	Southern half of the southern North Sea, from the Vlaamse Banken to approximately 53°N (figure 2.1a)
southern North Sea	study area, defined as between 51°-56°N, 02°-07°E (figure 2.1a). This area includes some of the British, Belgian, German and Danish parts of the North Sea, plus the entire Dutch sector.
Terschellingerbank	waters north off the Wadden Sea islands (figure 2.1a)
Vlaamse Banken	shallows off the Belgian coast (figure 2.1a)
Voordelta	shallows off the (Dutch) Delta area (figure 2.1ab)
VWH	'Inselstation Vogelwarte Helgoland', Helgoland, Germany
Wadden Sea	estuarine sea area between the mainland coast and the North Sea (figure 2.1ab)
Wadden Sea islands	Texel, Vlieland, Griend, Terschelling, Ameland, Schiermonnikoog, Rottum, Borkum (figure 2.1b)
Westerschelde	mouth of river Scheldt (Delta area, figure 2.1b)

CONTENTS

Ministerie van Verkeer en Waterstaat

Directoraat-Generaal Rijkswaterstaat

Directie Noord-Nederland

Bibliotheek

Nr. B-134 hh

Uitgeleend aan	Uit	Terug
Nicolai	24-10-98	9-12-'98