

WINTER DISTRIBUTION OF SEABIRDS IN THE NORTH SEA: AN OCEANOLOGICAL INTERPRETATION

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INTRODUCTION

Seabirds were recorded during the 47th trip of the German *R/V Meteor*, from 31 January to 2 March 1978. Observations were made from the wheel-house of the ship, 11.5 m above sea level, during 145 standard one-hour periods (Fig. 1). Birds were recorded mainly in front and on both sides of the ship, within an angle of about 180°. No attempt was made to estimate the limit of the observation zone, so that the data are not expressed in densities. The ship was generally moving at a speed of almost 12 knots, and stationary on a few occasions: stations 21, 23 to 25 on 4 February, 34 on 7 February and 52 on 10 February. We stayed in Edinburgh from 18 to 21 February.

The salinity data provided by the Deutsches Hydrographisches Institut (Hamburg) (Fig. 2) permit recognition of different water bodies: Atlantic water, with salinity higher than 34.95‰ (as fixed earlier: Joiris, 1978), North Sea water, between 34.95 and 33.0‰, and coastal waters (mainly of the Baltic Sea and the Norwegian current) with salinity lower than 33.0‰. The same kind of conclusion can be deduced from the temperature data (Fig. 3), without taking into account the low values around the Dogger Bank, where an important winter decrease of temperature takes place in this shallow water. Both data sets were obtained on board; even if they do not describe an instantaneous distribution of water masses like a satellite picture for instance, they reflect the conditions really met during the counting periods.

SYSTEMATIC LIST OF MAIN MARINE SPECIES

Fulmar, *Fulmarus glacialis*. — The most abundant species encountered, with a total of about 4000 birds. Dark-phased birds represented more than 0.6 percent of the total, a minimal evaluation since dark birds certainly were not detected in large groups observed at distance. This relatively high amount seems to reflect the presence of northern populations in winter, the local populations presenting a much lower proportion of dark birds (less than 0.2%, Fisher, 1952; Joiris, 1976, 1978).

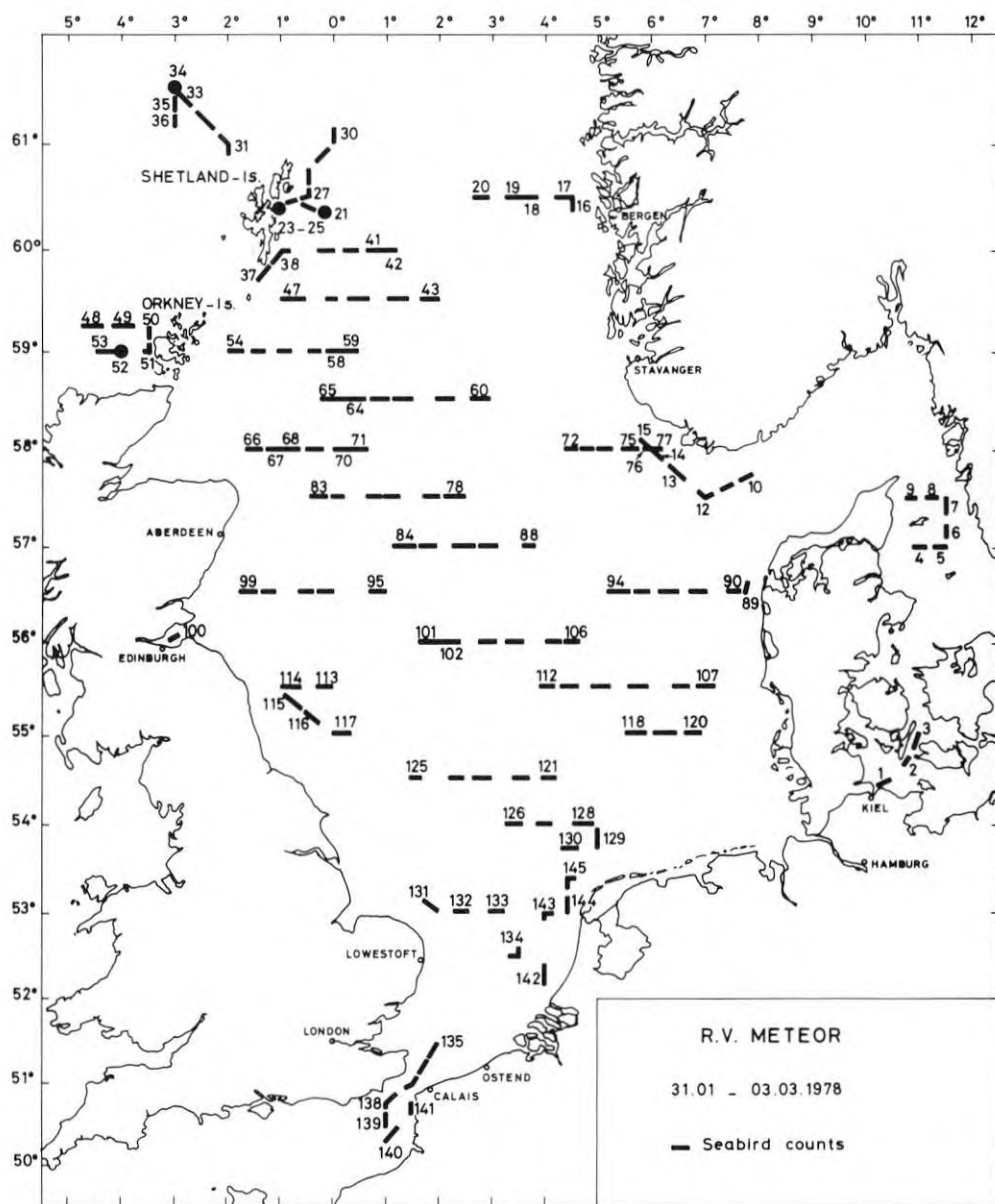


Fig. 1. Position of the one-hour stations where seabirds were recorded between 31 January and 2 March 1978. Lines, ship moving; dots, ship stationary.

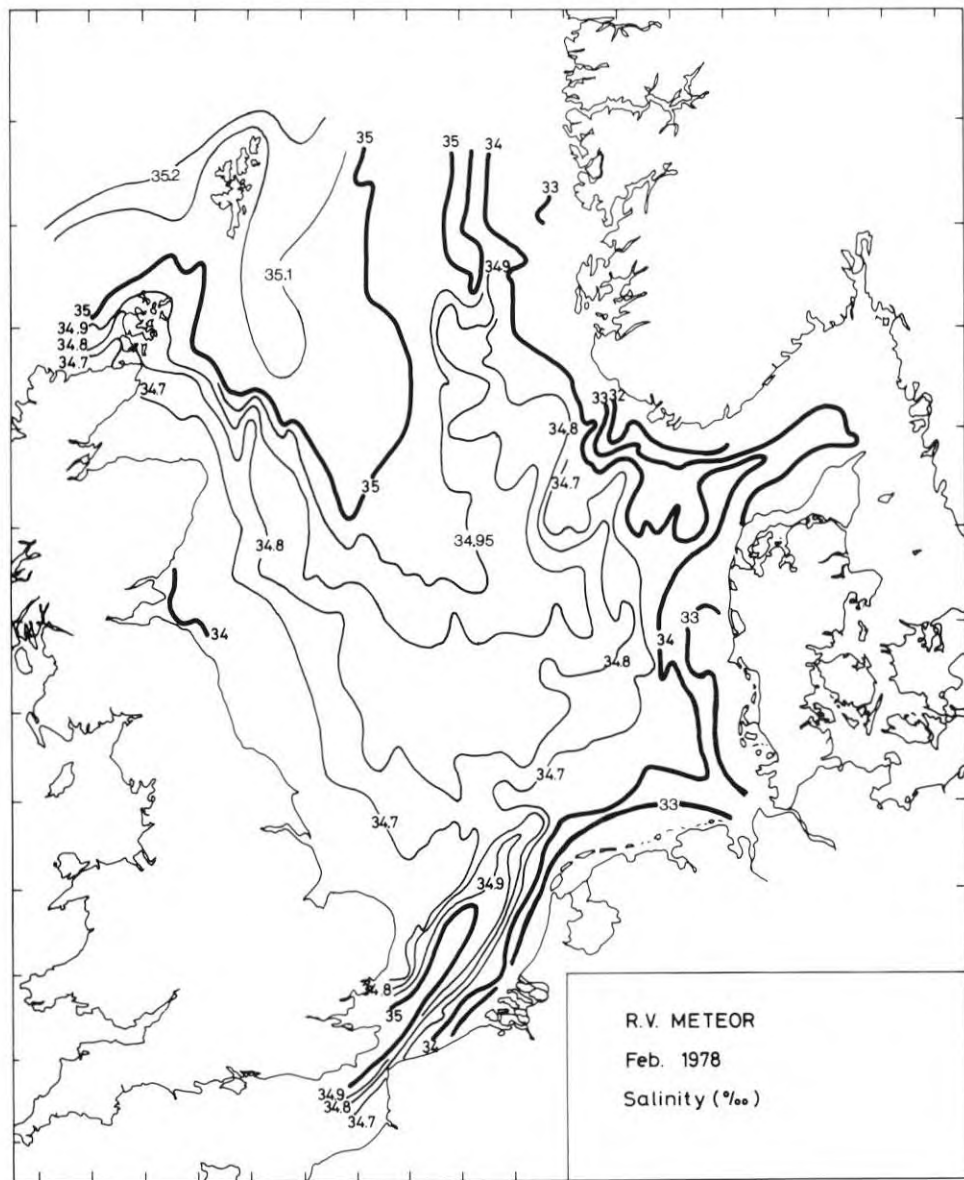


Fig. 2. Salinity data obtained on board *RV Meteor* between 31 January and 3 March 1978. Originator: G. Wegener, Deutsches Hydrographisches Institut, Hamburg.

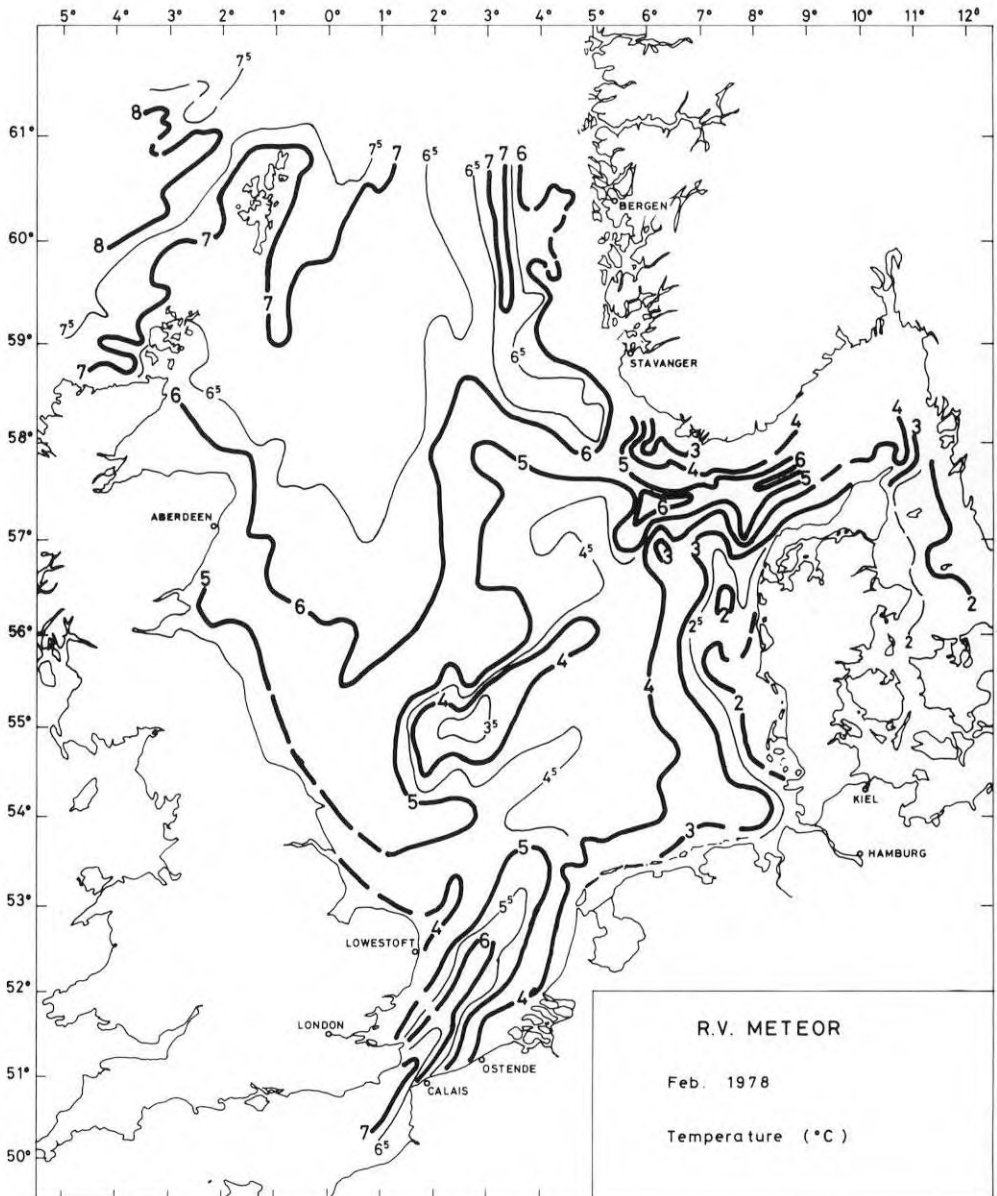


Fig. 3. Temperature data (see legend Fig. 2).

The Fulmar was nearly absent in the southern North Sea, a few only being recorded south of 55° 30' N (Fig. 4).

There exists a clear difference in the numbers of birds observed in North Sea and in Atlantic waters, with median values of 4 birds per station in the former, and 24 (30 if the southern stations of the English Channel are not taken into account) in the latter zone (Fig. 5). The mean values are influenced by high numbers recorded at a few stations, but show the same difference: 7.7 birds per station in North Sea water, 52.5 birds in Atlantic water.

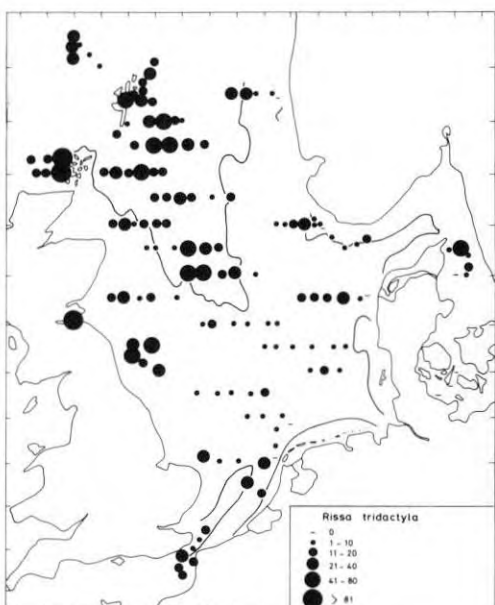
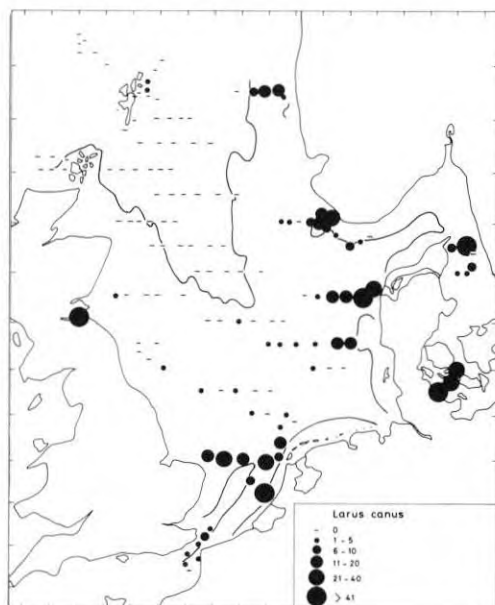
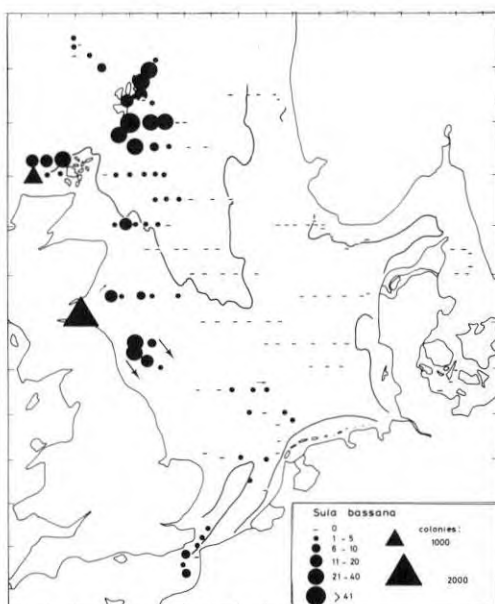
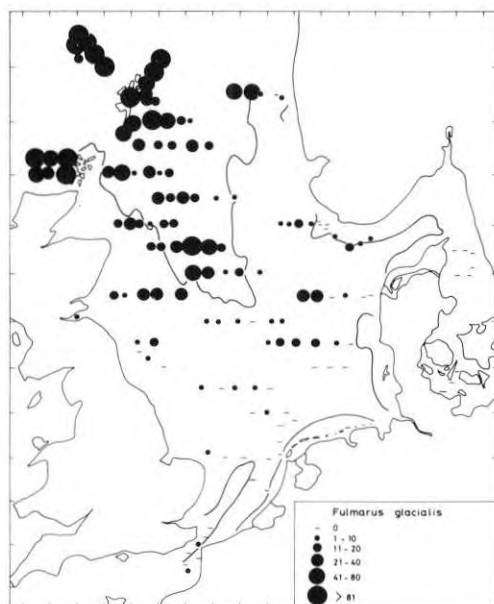
It is often difficult to detect the relative role of natural food, such as zooplankton, and of refuse of human origin in the diet of the Fulmar (Whitherby *et al.*, 1941; Dement'ev and Gladkov, 1951; Fisher, 1952; Nelson, 1980). The fact that the species was more abundant in Atlantic than in North Sea water, as pointed out previously (Joiris, 1978), constitutes an indication that the Fulmar largely depends on natural food in our region, since its distribution mainly parallels the ecological structure of the seawater (see discussion): a conclusion very similar to that of Brown (1970), concerning Fulmar distribution in the western North Atlantic.

Gannet, *Sula bassana*. — About 3500 birds were recorded, 3000 of them already occupying their breeding colonies: 1000 at Sule Skerry, station 53, on 10 February and 2000 (or even 3000) at the Bass Rock, station 100, on 21 February (Fig. 4). These are early dates, since it is generally considered that the breeding populations come back to their colonies in March (Bauer and Glutz, 1966; Cramp, 1977; Nelson, 1978). At the Bass Rock, the top of the island was inaccessible to the birds because of snow, but the cliffs, all around, gave the impression of a normal occupation.

All recorded Gannets were adult; only five immatures were counted, from 24 February on, when a first-year bird accompanied by an adult was present at station 114. Another, "second year" immature, also accompanied by an adult, was recorded on 1 March at station 137, two "second year" at station 138 and one "third year" flying east at station 143 on 2 March. They possibly represent that small fraction of immatures remaining in north European waters during winter, or perhaps a few birds wintering off Africa and coming back to the breeding area at very early dates (Nelson, 1978).

On some occasions, the Gannets were clearly moving: at station 99, they were flying high in a north-easterly direction; at stations 113 to 117, they were moving south and south-east. I guess that, in both cases, these birds were leaving the Bass Rock colony in order to forage in Atlantic water. A similar movement was detected already along the coast (Joiris, 1976). At stations 121 and 122, 1 and 5 birds were moving east and south-east.

A difference in density was noted between the main zones (Fig. 6): the number was lower in North Sea water (median 0.5, mean 0.5 birds per station, without taking into account the groups moving into another zone), than in Atlantic water (median 1.8, mean 6.0). In this case, it must be remarked that all stations with more than 20 Gannets were situated near the Shetlands and the Orkneys and were probably influenced by the proximity of the breeding colonies at Noss, Hermaness and Sule Skerry (Cramp *et al.*, 1974): if these



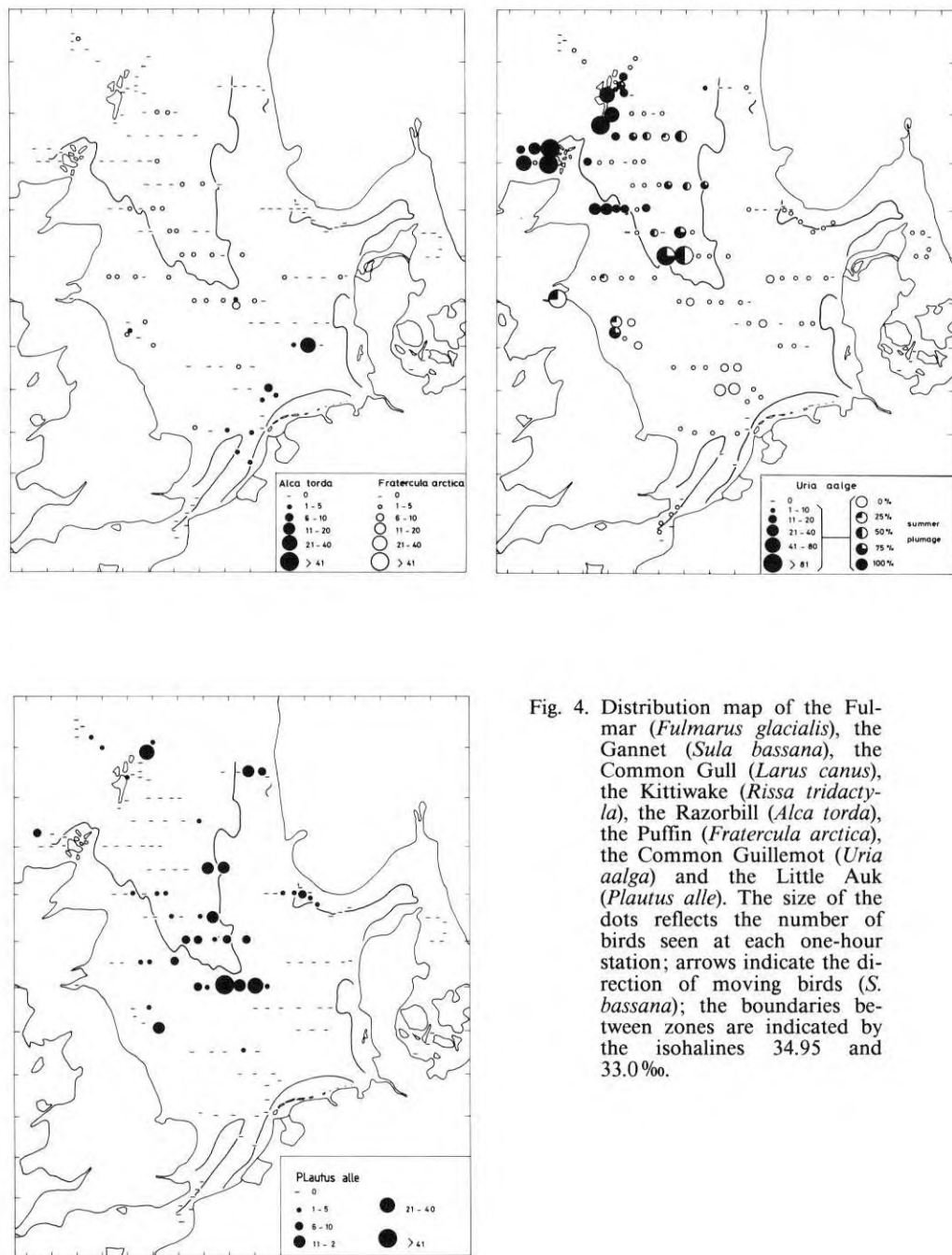


Fig. 4. Distribution map of the Fulmar (*Fulmarus glacialis*), the Gannet (*Sula bassana*), the Common Gull (*Larus canus*), the Kittiwake (*Rissa tridactyla*), the Razorbill (*Alca torda*), the Puffin (*Fratercula arctica*), the Common Guillemot (*Uria aalga*) and the Little Auk (*Plautus alle*). The size of the dots reflects the number of birds seen at each one-hour station; arrows indicate the direction of moving birds (*S. bassana*); the boundaries between zones are indicated by the isohalines 34.95 and 33.0‰.

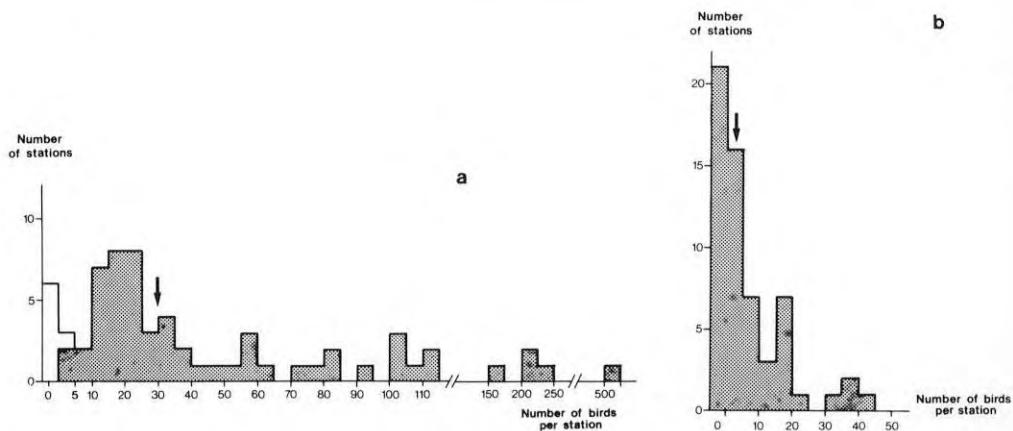


Fig. 5. Distribution diagrams for the observations of the Fulmar in the Atlantic zone (a) and the North Sea zone (b). The arrow indicates the median value, calculated without taking into account the data plotted in white (explanation: see text).

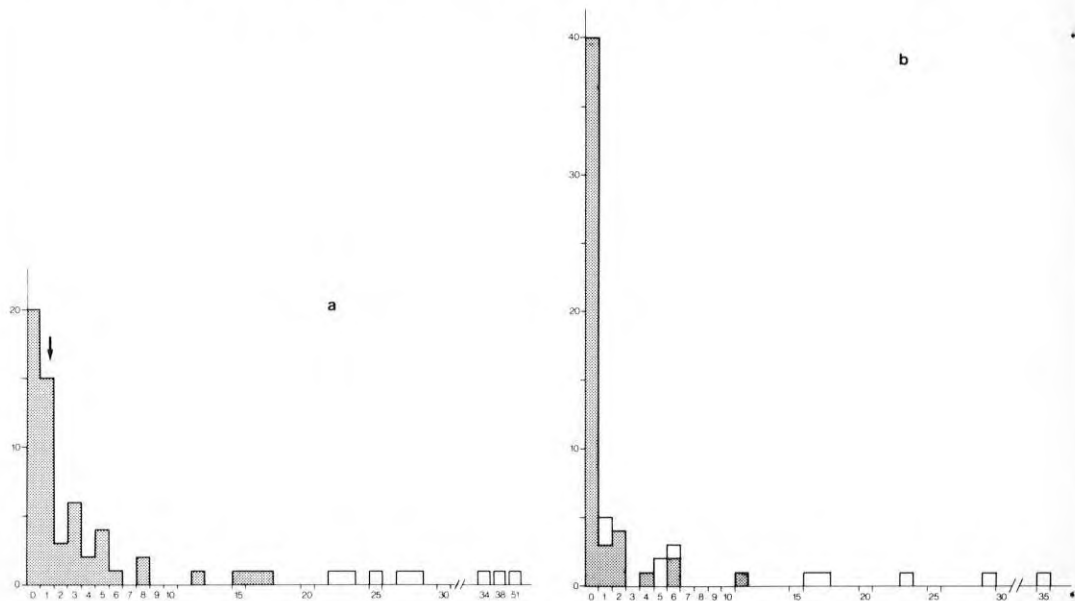


Fig. 6. Distribution diagrams of the Gannet (see legend Fig. 5).

stations are not taken into account, the values for Atlantic water become 1.6 for the median and 4.9 for the mean values.

Glaucous Gull, *Larus hyperboreus*. — Two records, probably concerning the same immature, at stations 27 and 28 (Shetlands).

Lesser Black-backed Gull, *Larus fuscus*. — The species was absent during almost all the trip. The first birds, probably coming back from their winter range, were recorded on 28 February: one flying east at station 132; 1 March: 8, 11, 5, 18, 5 and 65 at stations 135 to 140 respectively, and 2 March: 15 at station 142. Most of them were adults of the *graellsii* type, six immatures only being recorded.

Great Black-backed Gull, *Larus marinus*. — This species was recorded at almost every station, with mean values of 4.2, 3.9 and 4.6 birds per station for the Atlantic, North Sea and coastal zones. This represents an important increase of density at sea in comparison with the summer situation (Joiris, 1976, 1978), as detected in the southern North Sea (Joiris, 1972).

Herring Gull, *Larus argentatus*. — Present at almost all stations as well, with mean values of 18, 35 and 84 birds per station in the Atlantic, North Sea and coastal zones. The winter density of this species in open sea is also much higher than in summer (Joiris, 1972, 1976, 1978).

Common Gull, *Larus canus*. — As noticed earlier (Witherby *et al.*, 1941; Joiris, 1978), the Common Gull remained within a range of about 50 km from the coasts (Fig. 4) and most of the birds were recorded where salinities were lower than 34.0‰. The majority of the birds were adults both in summer and in winter plumage, less than 5% of a total of 1500 being immatures. The recorded numbers are clearly higher in winter than in summer (Joiris, 1972, 1978), and are related to the migratory movements of the species, the majority of Danish-ringed birds being recovered in Belgium, France and Great Britain in January and February (Halling Sørensen, 1977).

Kittiwake, *Rissa tridactyla*. — A common species present at almost every station (Fig. 4), but with higher density in Atlantic water (mean: 31.5, median: 19 birds per station) than in North Sea water (11.8, 7.5) (Fig. 7) or in the

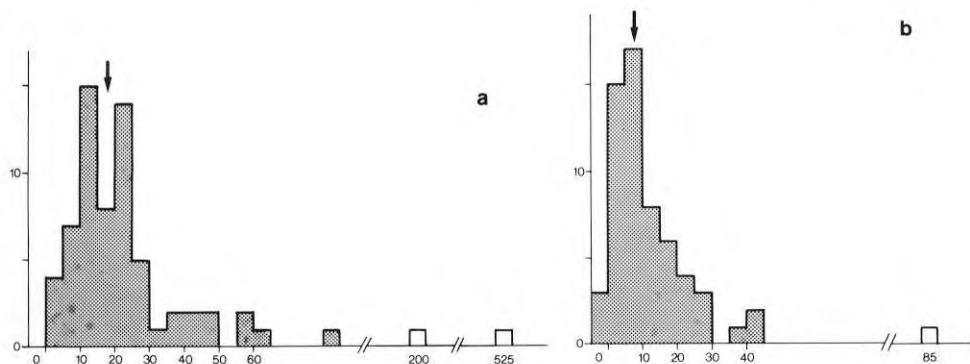


Fig. 7. Distribution diagrams of the Kittiwake (see legend Fig. 5).

coastal zone (mean: 7.5). With the exception of the coastal station 100 (Edinburgh), where 75 birds out of a total of 85 were immature, the vast majority of Kittiwakes were adult: of a total of 3000, only 120 were immature. As noted for the Gannet, the birds were moving south and south-east at stations 113, 114, 115 and 118.

Black-headed Gull, *Larus ridibundus*. — Almost absent from all stations, this strictly coastal species was recorded seven times only: two birds at station 6, three moving south at station 128, one moving south at 129, three moving south at 130, two moving south at 132, five at 143 and two at 144.

Little Gull, *Larus minutus*. — Two birds at station 2 (Kattegat), two at station 119; two adults and one immature together at station 140.

Sabine's Gull, *Xema sabini*. — One immature was recorded, moving south at station 95 on 12 February.

Razorbill, *Alca torda*. — A total of only 71 Razorbills were recorded, including 32 at station 119 on 25 February (Fig. 4). The most northern observation was made at 56° N (one individual at station 104, 22 February), probably reflecting the northern limit of the winter range of this species at sea (Mead, 1974; Nelson, 1980). The majority of Razorbills were in winter plumage, but a few birds (about 15) were already in summer plumage.

Common Guillemot, *Uria aalge*. — About 3400 Guillemots were recorded, including concentrations of 1000 and 450 close to the important Orkneys breeding grounds (Fig. 4). They were encountered in all zones, but with higher densities in Atlantic water (mean: 22.7 birds per station, median 8) than in North Sea water (mean: 9.9, 5.2 without taking into account the 250 birds from station 100, median 3) and the coastal zone (mean of 2.0).

There was also a striking difference in plumage between the zones: the majority of Guillemots in full summer dress were concentrated in the Atlantic zone, the other birds, in winter plumage or moulting, being recorded mainly in North Sea water (Fig. 4). The median values for Guillemots in summer plumage are 4 in Atlantic water and 0.8 in North Sea water; for the other birds, the values are 0.5 and 3 respectively (Fig. 8). According to observations made in captivity (Swennen, 1980), there exists a delay in the moulting period as a function of age, the older birds having completed their pre-nuptial moult earlier than immatures. The present observation probably means that in February the adults, fairly sedentary, were concentrated in Atlantic water, but not yet the immatures wintering further south (Mead, 1974; Nelson, 1980).

Little Auk, *Plautus alle*. — This species does not seem to be strictly bound to the water masses but was mainly present around the boundaries of North Sea water (Fig. 14), (Fig. 4), with a concentration just north of the Dogger Bank: of a total of 332, 92 birds were present at stations 101 to 106, with a

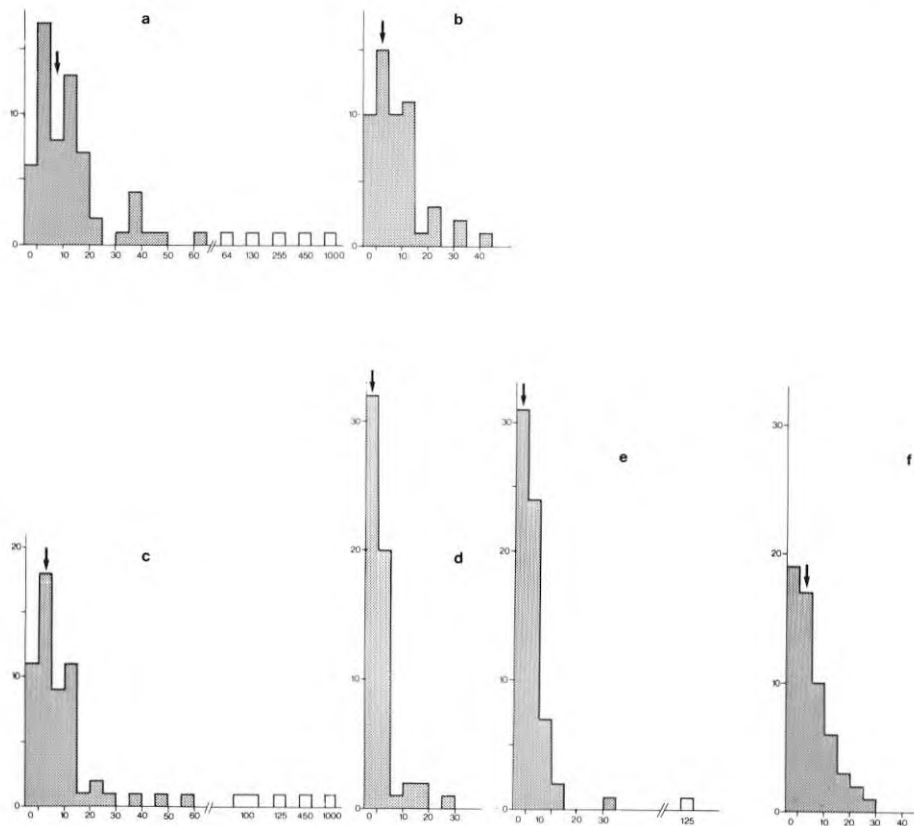


Fig. 8. Distribution diagrams of the Common Guillemot: total (a, b), in summer plumage (c, d) or in winter plumage and moulting (e, f) (see legend Fig. 5).

maximum of 42 birds at station 103. The majority were recorded north of 56° N, the most southern record being 54° 30' N (four birds at station 122). Even if the reasons for this distribution are not evident, one must notice that it seems rather stable, since Little Auks were encountered at stations 13 and 14 on 2 February (six birds in total), and again in the same place at stations 74, 75 and 76 on 14 February (16 birds).

All birds were in winter plumage, with the exception of two noted in summer plumage at station 32, on 7 February: a very early date, since the moult is normally completed in May (Dement'ev and Gladkov, 1966).

Black Guillemot, *Cephus grylle*. — An individual recorded in the Kattegat, at station 4.

Puffin, *Fratercula arctica*. — A few birds were present both in the Atlantic and the North Sea zones, with a total of only 63 (Fig. 4). Their density was much lower than in summer (Joiris, 1978), indicating that most Puffins were still in their winter range and had not yet returned to Atlantic water. This observation seems to be in contradiction with the significant numbers of ringed Puffins recovered on the east coast of Great Britain in February and March, giving the impression that the east coast adults are almost sedentary (Mead, 1974).

DISCUSSION AND CONCLUSION

The comparison of the results obtained in February 1978 on seabird distribution in the North Sea with counts made in summer by the same ornithologist in the same region (Joiris, 1972, 1976, 1978, 1983) allow a few general remarks.

- As expected, a few species completely left the region and were not observed at all: shearwaters (*Puffinus* sp.), petrels (*Oceanodroma*, *Hydrobates*) and skuas (*Stecorarius* sp.). The Lesser Black-backed Gull appeared on 28 February only.
- The Little Auk, on the other hand, is present in the winter period only.
- For some species present throughout the year (Great Black-backed, Herring and Common Gulls) the numbers recorded at sea are much higher in winter, while others (Razorbill, Puffin) are still occupying their winter range and are present in low numbers only.

Table 1. Pelagic seabirds counts in Atlantic water (continental shelf) and North Sea water at various periods
(birds per station, mean value)

Month Year	Atlantic water			North Sea water			
	Feb. 1978	May- June 1980	July 1975	Feb. 1978	April- June 1976	May- June 1980	July 1975
Number of stations	66	52	12	60	80	11	24
Ref.	(1)	(2)	(3)	(1)	(4)	(2)	(3)
<i>Fulmarus glacialis</i>	52.5	44.5	44.5	7.1	17.9	14.7	19.0
<i>Sula bassana</i>	4.9	1.1	1.4	0.5	0.8	0.3	0.7
<i>Stecorarius</i> spp.	—	2.5	3.7	—	0.4	—	0.8
<i>Rissa tridactyla</i>	31.5	12.3	29.3	11.0	8.4	3.7	6.0
<i>Uria aalge</i>	13.0	11.6	16.1	9.2	1.3	1.5	0.8
Alcidae (total)	18.7	36.0	21.5	14.0	2.5	1.9	1.8

(1) This paper; (2) Joiris, unpublished; (3) Joiris, 1978; (4) Joiris, 1983.

- It is, however, striking that the other pelagic species are encountered at the same density in February as in summer, and are bound to the same water bodies (Table 1): Fulmar, 40 to 50 birds per station in Atlantic water, 7 to 19 in North Sea water; Gannet, 1 to 5 and 0.3 to 0.8 respectively; Kittiwake, 12 to 32 and 4 to 11; Common Guillemot, 13 to 16 and 1 to 9 (for this species, the distribution of adults is comparable in summer and in winter, but immatures wintering in North Sea water are responsible for the high value of 9 birds per station: for the adults, this figure goes down to 2.5). The utilization of distribution histograms shows that these conclusions are also valid when median—instead of mean—values are used.

These results constitute a confirmation that the distribution of pelagic seabirds in the North Sea is bound to the different water masses, and more specifically to the Atlantic water intruding into the North Sea north of Scotland and through the English Channel (Joiris, 1978).

Even if various factors can influence this distribution, like transparency of the water or distance to the colonies for breeding birds, I consider that the main factor lies in the ecological structure of these water masses, the Atlantic water being characterized by a complete food web phytoplankton-zooplankton-pelagic fish-seabirds (Joiris, 1978), while in North Sea water the phytoplankton is mainly recycled by planktonic bacteria (40% of the net primary production) and by benthic bacteria (40%), the zooplankton consuming a small part of it only (20%) (Joiris *et al.*, 1982), which does not allow important populations of pelagic fish nor seabirds to develop. Other heterogeneities exist on a smaller scale within the Atlantic zone (*i.e.* Bourne, 1976, 1982), but such results can be integrated in our scheme as well.

ACKNOWLEDGEMENTS

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SUMMARY

Seabirds were recorded at 145 one-hour stations in the North Sea in February 1978. The main pelagic species were bound to Atlantic water, and were recorded at densities to be compared with the summer ones: Fulmar, Gannet, Kittiwake and Common Guillemot (especially the adults in summer plumage for the last species). This conclusion appears at the levels of both mean and median values. Razorbill and Puffin were present in lower numbers than in summer, while Little Auk was wintering in the area. The densities of Great Black-backed, Herring and Common Gulls were higher than in summer periods; Lesser Black-backed Gulls were recorded in the southern North Sea from 28 February on.

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SAMENVATTING

In februari 1978 werden gedurende telkens één uur ornithologische tellingen verricht in de Noordzee op 145 waarnemingspunten. De verspreiding van zeevogels is gebonden aan bepaalde watermassa's: Noordse Stormvogel, Jan van Gent en Drieteenmeeuw zijn duidelijk talrijker in Atlantisch water dan in water van het Noordzee type. Zo zijn ook de

adulte Zeekoeten in parkleed in Atlantische water geconcentreerd, maar de ruiende vogels en deze in winterkleed bevinden zich in Noordzee water. Deze conclusies zijn zowel duidelijk op het niveau van de gemiddelde waarden als op dat van de medianen; zij worden besproken in functie van de ecologische structuur van de betrokken watermassa's. De densiteiten van deze in februari waargenomen soorten zijn vergelijkbaar met de waarden bekomen in de zomerperiode. Alk en Papegaaiduiker daarentegen zijn in februari minder talrijk dan in de zomer; de Kleine Alk is alleen als overwintelaar aanwezig. De densiteit van Grote Mantelmeeuw, Zilvermeeuw en Stormmeeuw is groter dan in de zomer. De Kleine Mantelmeeuw verschijnt in het zuiden van de Noordzee vanaf 28 februari.

RÉSUMÉ

En février 1978, des comptages ornithologiques ont été réalisés en mer du Nord, à 145 stations d'une heure chacune. Les oiseaux pélagiques présentent une distribution liée aux masses d'eau: Fulmar, Fou de Bassan et Mouette tridactyle sont nettement plus abondants en eau atlantique qu'en eau de type mer du Nord. De même, les Guillemots de Troil adultes — déjà en plumage nuptial — sont concentrés en eau atlantique, mais les oiseaux en mue ou en plumage hivernal fréquentent plus la mer du Nord. Ces conclusions apparaissent tant au niveau des valeurs moyennes que des valeurs médianes de comptage; elles sont discutées en fonction de la structure écologique des masses d'eau concernées. Les densités de ces espèces détectées en février sont fort comparables aux valeurs obtenues en périodes estivales. Pingouin et Macareux, par contre, sont moins fréquents qu'en été; le Mergule nain n'est présent qu'en hivernage. La densité des Goélands marin, argenté et cendré est plus élevée qu'en été; le Goéland brun apparaît dans le sud de la mer du Nord à partir du 28 février.

APPENDIX 1

SYSTEMATIC LIST OF OTHER SPECIES

Diver, *Gavia sp.* — Unidentified divers were recorded, with a maximum of 8 birds at station 4 (Kattegat), 3 at station 107 and individuals at stations 1, 5, 6 and 100.

Cormorant, *Phalacrocorax carbo.* — Individuals at station 3 (Kattegat) and station 89; two coastal observations.

Shag, *Phalacrocorax aristotelis.* — One immature was accompanying the ship at station 10 and 55 birds were recorded at the coastal station 100, near to the Bass Rock.

Swan, *Cygnus sp.* — A group of five unidentified swans were flying from open sea to the coast at station 1.

Greylag Goose, *Anser anser.* — Twelve birds were flying last south-east at station 137, English Channel, on 1 March.

Long-tailed Duck, *Clangula hyemalis.* — This species was recorded in the Kattegat only: 3500 birds at station 1, one at station 4, in their normal wintering range (Atkinson-Willes, 1975).

Velvet Scoter, *Melanitta fusca.* — 3285 and 18 birds, both males and females, were recorded at stations 1, 4 and 5 respectively (Kattegat).

Common Scoter, *Melanitta nigra.* — Recorded in the Kattegat only: 850, 20 and 6, both males and females, at stations 1, 4 and 5.

Eider, *Somateria mollissima*. — In the Kattegat, 1600, 450, 467, 76 and 17, both males and females, were noted at stations 1 to 5. Two males were recorded at station 37 (Shetlands) and 350 birds at station 100 (Edinburgh).

Red-breasted Merganser, *Mergus serrator*. — Three birds at station 100 (1 pair, 1 male), and two unidentified *Mergus sp* in female plumage, at stations 112 and 122 respectively.

Lapwing, *Vanellus vanellus*. — Three flying south at station 114, 24 February, and one flying south at station 118 (25 February).

Ringed Plover, *Charadrius hiaticula*. — One individual at station 115 (24 February).

Bar-tailed Godwit, *Limosa lapponica*. — One flying south at station 144 (2 March).

Stint, *Calidris sp.* — Five unidentified small stints were recorded at station 115 (24 February).

Skylark, *Alauda arvensis*. — Individuals at stations 108 and 126, five flying south-east at station 130 (27 February) and four flying east at station 142 (2 March).

Pipit, *Anthus sp.* — Unidentified pipits were noted at stations 110 (23 February, six birds), 114 (24 February, one bird), and 115 (24 February, two birds).

Robin, *Erithacus rubecula*. — One came on board at station 142 (2 March).

Song Trush, *Turdus philomelos*. — Five birds at station 136 (1 March).

Mistle Trush, *Turdus viscivorus*. — One flying east at station 120 (25 February) and two birds at station 136 (1 March).

Starling, *Sturnus vulgaris*. — Individuals at stations 39 (8 February) and 119 (23 February), two at station 120 (25 February) three at station 127 (27 February), one flying south at station 128 (27 February), 140 flying east at station 136 (1 March), one on board and eight flying east at station 144 (2 March).

The presence at sea of migratory waders and passerines at the end of the period indicates the onset of spring migration.

APPENDIX 2

LIST OF STATIONS PER ZONE

1. Atlantic water (salinity $\geq 34.95\%$); stations 19-59, 61-65, 69-71, 78-82, 84-87, 95, 133-139 (n = 66).

2. North Sea water: (34.95 > salinity $\geq 33.0\%$); stations, 12, 16-18, 60, 66-68, 72-74, 83, 88-94, 96-132, 140, 141, 143, 145 (n = 60).

3. Coastal (salinity $< 33.0\%$); stations 1-11, 13-15, 75-77, 142, 144 (n = 19).

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