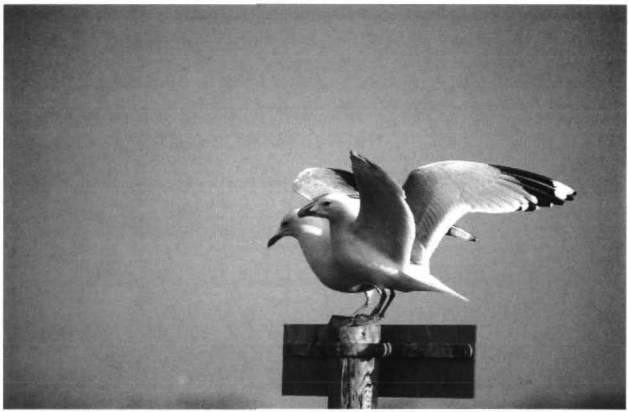
Atlantic Seabirds



Vol. 1, no. 2 (1999)

Quarterly journal of The Seabird Group
and the Dutch Seabird Group

Atlantic Seabirds *Edited by C.J. Camphuysen & J.B. Reid*

ATLANTIC SEABIRDS is the quarterly journal of the SEABIRD GROUP and the DUTCH SEABIRD GROUP (Nederlandse Zeevogelgroep, NZG), and is the continuance of their respective journals, *SEABIRD* (following no. 20, 1998) and *SULA* (following vol. 12 no. 4, 1998). *ATLANTIC SEABIRDS* will publish papers and short communications on any aspect of seabird biology and these will be peer-reviewed. The geographical focus of the journal is the Atlantic Ocean and adjacent seas at all latitudes, but contributions are also welcome from other parts of the world provided they are of general interest. *ATLANTIC SEABIRDS* is indexed in the Aquatic Sciences and Fisheries abstracts, Ecology Abstracts and Animal Behaviour Abstracts of Cambridge Scientific databases and journals.

Editors:

C.J. Camphuysen (NZG), Ankerstraat 20, 1794 BJ Oosterend, Texel, The Netherlands, tel/fax + 31 222 318744, e-mail kees.camphuysen@wxs.nl

Dr J.B. Reid (Seabird Group), c/o Joint Nature Conservation Committee (JNCC), Dunnet House, 7 Thistle Place, Aberdeen AB10 1UZ, Scotland, U.K., e-mail reid_j@jncc.gov.uk.

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Published by **THE SEABIRD GROUP**, c/o The Lodge, Sandy, Bedfordshire SG19 2DL, U.K., charity number: 260907

and the **DUTCH SEABIRD GROUP** (Nederlandse Zeevogelgroep), section of the Netherlands Ornithologists' Union (NOU), c/o De Houtmanstraat 46, 1792 BC Oudeschild, Texel, The Netherlands

STOMACH TEMPERATURE VARIATIONS IN A CAPE GANNET *MORUS CAPENSIS* AS AN INDEX OF FORAGING ACTIVITY AND FEEDING RATES

VERANDERINGEN VAN DE TEMPERATUUR IN DE MAAG BIJ KAAPSE JAN VAN GENTEN ALS INDEX VAN VOEDSELOPNAME EN FOERAGEERSUCCES

DAVID GRÉMILLET[1] & JOHN COOPER[2,3]

[1]*Institut für Meereskunde Kiel, Düsternbrooker Weg 20 D-24105 Kiel, Germany;* [2]*Percy FitzPatrick Institute of African Ornithology, University of Cape Town, Rondebosch 7700, South Africa;* [3]*Present adddress: Avian Demography Unit, Dept. of Statistical Sciences, University of Cape Town, Rondebosch 7700, South Africa*

Animal-mounted electronic devices are powerful tools for studying seabirds at sea. The potential handicap of additional load should be minimised, while nevertheless measuring relevant field data. In this paper, we show how records from a 16g stomach temperature logger may be used to calculate the key values of foraging effort and feeding rate in an avian marine predator.

Grémillet D. & Cooper J. 1999. Stomach temperature variations in a Cape Gannet *Morus capensis* as an index of foraging activity and feeding rates. Atlantic Seabirds 1(2): 49-56.

INTRODUCTION

For flying seabirds such as gannets, basic information on at-sea distribution and feeding behaviour, in terms of the number, frequency and duration of dives as well as on foraging rhythms, can be collected by direct observation conducted from research vessels (Goethe 1970, Tasker *et al.* 1984). Further, detailed information on the at-sea behaviour of the birds may be also gathered using animal-mounted electronic devices such as VHF transmitters (Trivelpiece *et al.* 1986), satellite transmitters (Jouventin & Weimerskirch 1990), activity loggers (Cairns *et al.* 1987), or dead-reckoners (Wilson & Wilson 1988). However, the total additional load caused to the birds obviously has to be minimised (Wilson *et al.* 1986), while collection of relevant data should be maximised. In this paper we present an example of this optimisation process, where a single 16g stomach temperature logger is used to determine the key value of catch per unit effort in a foraging seabird.

METHODS

Between 24 and 28 October 1992 two Cape Gannets *Morus capensis* breeding at Bird Island, Lambert's Bay (32°05'S, 18°07'E; South Africa) were equipped with stomach temperature loggers (SICUP, Single Channel Unit Processor, Driesen & Kern GmbH, Am Hasselt 25, D-24576 Bad Bramstedt Germany). The main elements of the device were a quartz clock, a PT100 temperature sensor and a volatile RAM of 128 Kbytes powered by a 6v-lithium battery. The logger registered temperature between 0° and 50°C with a relative accuracy of 0.2°C (absolute accuracy 1°C, no drift). The electronics were encapsulated in a titanium housing, 69 mm long and 12 mm in diameter. The temperature sensor was set flush with one end of the housing, which was directed to the top of the stomach. The complete unit weighed 16g and was of the 'sinker' type (*c.* 1.5% of the stomach volume; see Wilson *et al.* (1995) for further technical details).

Both incubating Cape Gannets were caught under licence at the nest site just after their partner had returned from a feeding trip. The device was introduced into the bird's stomach by concealing it in a fish, which was swallowed by the bird. The first individual was then observed for 35 min until it was seen to fly out to sea. Its nest site was checked every two hours between dawn (07:30 h) and dusk (20:30 h, local time) until the bird had returned, when it was caught and induced to regurgitate its stomach contents (including logger) by turning it upside down. The second equipped bird remained at the nest site where the logging unit was found regurgitated after 16 hrs.

The recorded stomach temperature data (Fig. 1), were analysed as follows. Short-term drops in stomach temperature, which only occurred when the first equipped bird was at sea (Fig. 2), were identified as PDER-events (Precipitous Drop and Exponential Rise, *sensu* Wilson *et al.* 1992). These reflect the intake of cold food (seabirds are considered to drink only small quantities of water at any one time, which do not influence these measurements; see Wilson *et al.* (1995)). These events were analysed following Wilson *et al.* (1992, 1995) and the TRIM method described in Grémillet & Plös (1994) so as to determine the time of feeding as well as the individual estimated mass of prey-items, M. Thus:

$$M = \frac{I}{mSH(T \quad - T_{\min})}$$

where I is the surface of the PDER-event calculated using the TRIM method, m is a constant taken to be 0.496 (which corresponds to the m-value given by Grémillet & Plös (1994) for TRIM calculations, corrected for highly active birds (Wilson *et al.* 1995)), SH is the specific heat capacity of water taken to be 4.17

$J°C^{-1}$ g^{-1}, T_{asym} is the temperature (°C) recorded after prey warming has been is the minimum temperature (°C) of the PDER-event (see
for more details). Individual prey masses calculated in this way are accurate to ± 15% (Grémillet & Plös 1994).

Long-term variations in stomach temperature (Fig. 1 and 2) were also recorded. These variations, which are not related to feeding, have been shown to reflect activity, higher temperatures generally being associated with greater energy expenditure (Wilson *et al.* 1992, 1995; Wilson & Grémillet 1996). In power fliers such as Gannets, there is thus a particularly clear-cut difference between high, variable temperature patterns related to time periods spent flying and plunge-diving, and lower, stable temperature patterns related to time periods spent resting at the water surface or on the nest. Knowing that the second equipped bird remained at the nest site throughout the measurement, we used its mean (± SD) abdominal temperature (39.7 ± 0.65 °C, 16 hours measurement) to define the body temperature of a resting bird. The sum of this mean and of its standard deviation (40.4°C) was then used to discriminate between periods of time spent foraging (flying and plunge-diving, $T > 40.4°C$) and periods of time spent resting ($T \leq 40.4°C$) in the first equipped bird foraging at sea. The validity of this technique has been recently confirmed by Garthe *et al.* (in press) who equipped Northern Gannets with both stomach temperature loggers and activity sensors.

RESULTS

A total of 104 hours of stomach temperature data was successfully recorded when the first equipped bird was at sea. This period of time spent at sea corresponds to the mean length of foraging trips conducted by undisturbed conspecifics observed during our study (90 hrs, $n = 4$). Eleven feeding events were recorded, all occurring during daylight (0730 h to 1900 h), with 73% of them being recorded before 1200 h. The first feeding event occurred only 25 min after the bird left the colony, indicating that travelling time to the first prey patch was extremely short. The mean (± SD) interval between the ingestion of prey items was 2.5 ± 2.5 hrs during daylight hours (range 0.35-6.8 hrs, $n = 5$, see below), so that mass determination following Wilson *et al.* (1992) is predicted to be accurate to at least 15% (see Methods and Wilson *et al.* 1995). The calculated median prey mass was 136 ± 20g ($n = 11$, range 58 ± 9g - 973 ± 146 g) and the median daily food intake was 254 ± 38g ($n = 5$, range 120 ± 18g - 1425 ± 214 g). Analysis of the long-term variations in stomach temperature indicated that the bird spent 57% of its time at sea resting and 43% of its time flying and plunge-diving. Mean (± SD) abdominal temperature was 39.8 ± 0.31 °C when the bird was resting and 41.2 ± 0.74 °C when the bird was flying/plunge-diving. These temperature sets are significantly different ($t = 3.51$,

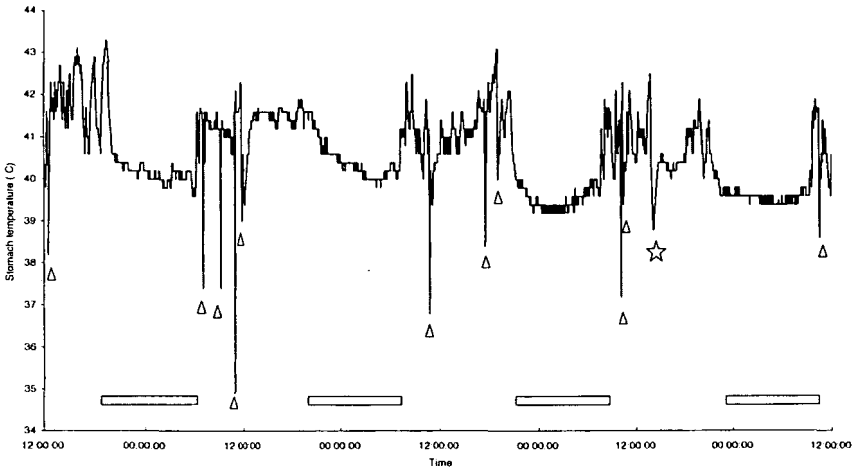

Figure 1. Long term variation in the stomach temperature of a Cape Gannet at sea. The black bars indicate night. The triangles indicate prey ingestion. The temperature drop indicated by an asterisk was ignored, as both decrease and increase in the stomach temperature were slow and thus did not fit the definition of a PDER-event after Wilson et al. (1992).

Figuur 1. Variaties in de maagtemperatuur bij een Kaapse Jan van Gent op zee. De zwarte balken geven de nacht aan, de driehoekjes geven het effect van ingeslikte prooien aan. De temperatuurafname aangegeven met een sterretje werd genegeerd, omdat zowel de afname als toename traag verliepen en daarom niet voldeden aan criteria voor een 'precipitous drop and exponential rise' volgens Wilson et al. (1992).

$P < 0.001$), confirming that the frequency distribution of abdominal temperature was bimodal. Combining activity data and feeding rates, we finally determined mean catch per unit effort values of 0.96 ± 0.14 grams of prey taken per minute for foraging periods (high activity and abdominal temperature level) and of 0.41 ± 0.06g of prey taken per minute for the entire foraging trip.

DISCUSSION

Foraging effort and feeding rates as determined above are key values necessary for a comparative assessment of seabird foraging strategies (Perry & Pianka 1997). In this respect, it is interesting to notice that all previous investigations

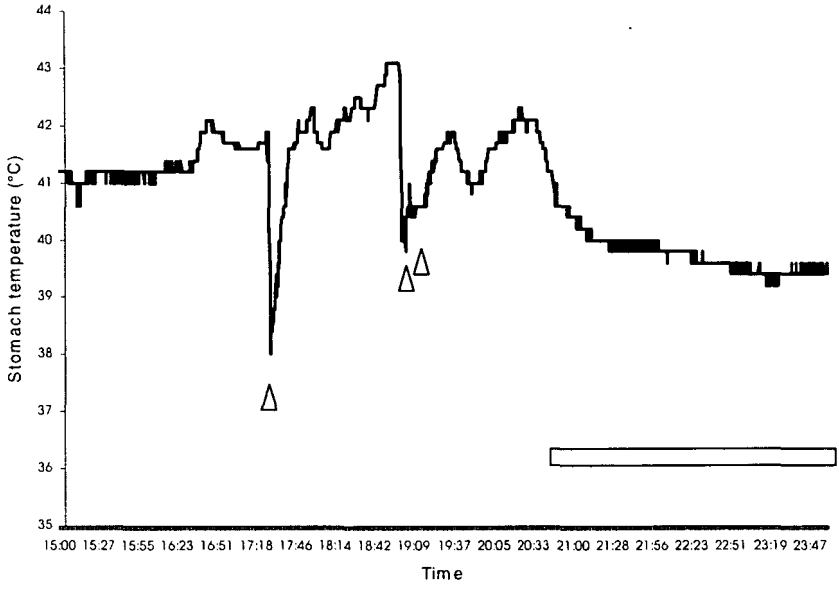

Figure 2. Short term variations in the stomach temperature of a Cape Gannet at sea. The black bar indicates night. The arrows indicate prey ingestion - the first arrow shows a typical feeding event involving a single prey item, whereas the second and third arrows show a feeding event that may have resulted from the ingestion of more than one prey item. The final temperature decrease is related to the activity level of the bird and does not mark prey ingestion (see also Fig. 1).

Figuur 2. Korte termijn veranderingen in maagtemperatuur bij een Kaapse Jan van Gent op zee. De zwarte balken geven de nacht aan, de pijlen wijzen op het effect van ingeslikte prooien. De eerste pijl staat bij een typisch geval (een enkele prooi), terwijl de tweede en derde pijl momenten aangeven waarop verscheidene prooien werden ingeslikt. Het uiteindelijke daling in temperatuur hangt samen met de activiteit van de vogel en wordt niet veroorzaakt door nieuwe ingeslikte prooien (zie ook Fig. 1).

attempting to determine such features in seabirds at sea necessitated deployment of combined, elaborate telemetric techniques (Chappell *et al.* 1993; Wilson & Grémillet 1996; Grémillet 1997; Wanless *et al.* 1998). Our method delivers comparable data via an internal, but non-implanted data logger, thus incurring no problems with aero/hydrodynamic drag, nor potential surgery shock. No detrimental effect has been shown for birds equipped with stomach temperature loggers; the digestive tract is not damaged in any way, and the device is usually ejected by the bird in normal pellet regurgitations (Wilson *et al.* 1998).

Therefore, we consider that this method minimises potential measurement artefacts while maximising relevant data collection. However, we wish to stress some limitations of the above analysis: (1) the time budget analysis suggested in this paper can be easily applied to power fliers such as gannets or cormorants, or in other seabirds for which locomotion is clearly related to higher metabolic rates. However, this may be more difficult in gliding fliers such as albatrosses, for which abdominal temperature levels are much more stable (Weimerskirch & Wilson 1992); (2) abdominal temperature levels cannot help detect plunge-diving activity in foraging Gannets, preventing further calculations based on different metabolic rates for flying and plunging birds (Garthe *et al.*, in press); (3) further measurements of the stomach temperature in Sulidae fed with fish of known mass are still required to validate our calculations of individual prey mass; and (4) previous dietary studies conducted on Cape Gannets (Batchelor & Ross 1984) determined a mean mass of 34g for prey items taken by the birds, which is *c.* one quarter of the value given above. The value reported by Batchelor & Ross (1984) is likely to be an underestimate. This is due to the fact that their data are based on regurgitated stomach contents, in which the mass of single prey items may be already reduced via digestion. However, we have to consider that PDER-events (Fig. 2) recorded during the present study may be related to the ingestion of more than one prey item. This is more likely to explain the important discrepancy between mean and maximum prey masses calculated above compared with those given by Batchelor & Ross (1984), as well as the small number of feeding events (2.2 per day on average) recorded during this study.

ACKNOWLEDGEMENTS

This study was supported by the Institut für Meereskunde Kiel and the Percy FitzPatrick Institute of African Ornithology, University of Cape Town. Many thanks are due to Cape Nature Conservation for allowing research to be conducted at the Bird Island Nature Reserve. We also thank D. Adelung, J. Lenz, R.W. Siegfried and R.P. Wilson for their extensive support. We are particularly grateful to A.L. Plös for her help during field work.

SAMENVATTING

Van veel vliegende zeevogels zoals jan van genten Sulidae kan basale informatie over het foerageergedrag, over bijvoorbeeld het aantal en de frequentie van stootduiken worden vergaard door waarnemingen te doen op volle zee. Aanvullende informatie kan worden verzameld door de vogels met allerhande elektronische apparaten de zee op te laten vliegen. Zo zijn we met de huidige technische kennis in staat om satellietzenders of VHF radiozenders te ontwerpen die gemakkelijk door een vliegende vogel vervoerd kunnen worden, maar ook zijn er tal van apparaatjes ontwikkeld waarmee allerhande activiteiten van de vogels worden geregistreerd. Er zit uiteraard een grens aan wat met vogels kan worden meegegeven; het mag allemaal niet te zwaar worden. In dit artikel wordt het functioneren en worden de resultaten besproken van een apparaatje met een gewicht van 16g, waarmee temperatuurveranderingen in de maag van bijvoorbeeld de Kaapse Jan van Gent *Morus capensis* konden worden vastgelegd. In oktober 1992 werden twee Kaapse Jan van genten van Bird

Island (Zuid Afrika) met dergelijke *loggers* uitgerust. De belangrijkste componenten waren een quartz-uurwerk, een PT100 thermometer, een geheugenchip (RAM) van 128 Kbytes, van stroom voorzien door een 6V lithium batterij. Het apparaatje werd aan de vogel 'toegediend' door het in een aangeboden vis te verstoppen. Bij terugkeer op het nest werd de vogel vervolgens gedwongen om de maaginhoud op te braken, waardoor de verzamelde gegevens eenvoudig konden worden uitgelezen.

Acute afnamen in temperatuur, gevolgd door een exponentiële toename werden geïnterpreteerd als voedselopname (het inslikken en opwarmen van koude prooidieren). Daarnaast werden ook geleidelijke en dikwijls langdurige veranderingen van temperatuur geregistreerd, die bijvoorbeeld het gevolg waren van opwarming door langdurige activiteit (bijvoorbeeld vliegen).

Bij de eerste vogel werden gegevens verzameld over een periode van in totaal 104 uren. Een dergelijke periode komt overeen met één enkele foerageertrip, die bij 'ongestoorde' soortgenoten vogels gemiddeld ongeveer 90 uren besloeg. In totaal werden in dit tijdsbestek 11 ingeslikte prooien geregistreerd, alle opgedoken tijdens daglicht (07:30-19:00u), waarvan 73% voor het middaguur (12:00u) werd bemachtigd. De eerste prooi werd al na 25 minuten opgedoken, waaruit bleek dat de afstand tot de eerste voedsel-*patch* buitengewoon gering was. De gemiddelde tijd (± SD) tussen verschillende prooien bedroeg 2.5 ± 2.5 uren (range 0.35-6.8 uren). Op basis van de 'klap' in de maagtemperatuur kon de grootte van de prooi worden ingeschat en deze bedroeg gemiddeld 136 ± 20g (range 58 ± 9g - 973 ± 146g). De mediane dagelijkse voedselopname bedroeg 254 ± 38g (n = 5, range 120 ± 18g-1425 ± 214g). Het bleek dat de vogel 57% van de tijd rustend op zee had doorgebracht en 43% van de tijd vliegend en stootduikend. De gemiddelde temperatuur van de ingewanden beliep 39.8 ± 0.31°C in perioden van rust en 41.2 ± 0.74°C in tijden van activiteit (vliegen of stootduiken).

Het aardige van de gevolgde methode is dat er bij de vogel uitwendig geen apparaatjes behoefden te worden aangebracht waardoor het dier in zijn bewegingen gehinderd werd. Bovendien werd een object ingebracht zonder het te implanteren, zodat er geen *surgery shock* kon zijn opgetreden. Al met al is deze methode een uiterst veelbelovende en bovendien diervriendelijke manier, waarmee belangrijke gegevens over de voedselstrategieën en voedselopnames van vrij in het wild levende zeevogels kunnen worden verzameld.

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THE DIET OF COMMON GULLS *LARUS CANUS* BREEDING ON THE GERMAN NORTH SEA COAST

HET VOEDSEL VAN OP DE DUITSE KUST BROEDENDE STORMMEEUWEN

ULRIKE KUBETZKI[1,2], STEFAN GARTHE[1,2] & OMMO HÜPPOP[1]

[1]Institut für Vogelforschung "Vogelwarte Helgoland", Inselstation, P.O. Box 1220, D-27494 Helgoland, Germany; [2]Institut für Meereskunde, Abteilung Meereszoologie, Düsternbrooker Weg 20, D-24105 Kiel, Germany (present address), e-mail ukubetzki@ifm.uni-kiel.de

The diet of Common Gulls Larus canus *was analysed from pellets and faeces during the breeding period in 1995. Three geographically well-separated colonies were selected: one located close to the open North Sea (Amrum Island), one at the inner edge of the Wadden Sea (Nordstrandischmoor Island), and one in the tidal river Elbe (Lühesand Island). The birds fed upon a large variety of food types. In the two colonies adjacent to the sea, prey types from the tidal flats were most numerous (mainly crustaceans, polychaetes, bivalves). Gadids and Smelt* Osmerus eperlanus *were the fish identified most often, whereas discards from fisheries were relatively important during the early incubation period on Amrum and Nordstrandischmoor. Terrestrial food was also taken (earthworms, insects) but was less important. On Lühesand, in contrast, Common Gulls fed predominantly on terrestrial food (earthworms, insects, mammals and fruits). These birds hardly utilised the river Elbe and associated freshwater tidal flats. The diet changed in all three colonies over the breeding period. The proportion of mammals increased while that of fish and bivalves (only the two colonies close to the coast) decreased. On Lühesand, a considerable proportion of the pellets consisted of cherry stones during the chick-rearing period. Common Gulls were relatively widely distributed in the inner German Bight but all major concentrations were located close to land, chiefly in front of the mouths of the rivers Elbe and Weser. Common Gulls (up to 150 individuals) regularly attended the inshore shrimping vessels.*

Kubetzki U., Garthe S. & Hüppop O. 1999. The diet of Common Gulls *Larus canus* breeding at the German North Sea coast. Atlantic Seabirds 1(2): 57-70.

INTRODUCTION

Numbers of Common Gulls *Larus canus* have increased substantially over the last few decades along the German North Sea coast, as have other gulls in the southern North Sea (Behm-Berkelmann & Heckenroth 1991; Hälterlein 1996). Improved protection at the breeding sites, the utilisation of fishery waste and changes in the food web leading to better availability of small-sized fish have been generally suggested as possible reasons for the increase of gulls (Hüppop

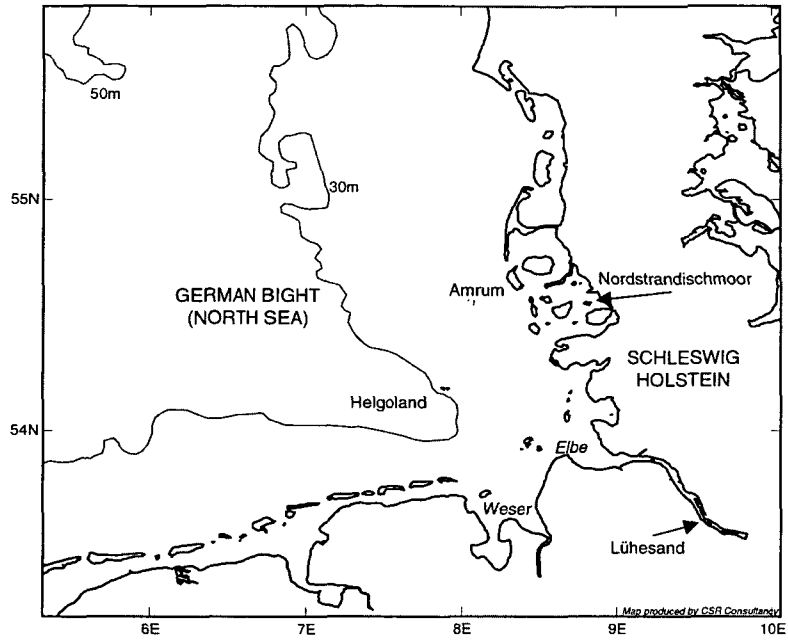


Figure 1. Location of the three colonies studied.
Figuur 1. Ligging van de drie bestudeerde kolonies.

et al. 1994). However, the different gull species in the German Bight differ substantially in at-sea distribution, habitat use and diet in the breeding season. Whereas Lesser Black-backed Gulls *Larus fuscus* forage largely at sea, Herring Gulls *Larus argentatus* and Black-headed Gulls *Larus ridibundus* are primarily restricted to the intertidal zone in summer, where they mainly take marine invertebrates (Gorke 1990; Noordhuis & Spaans 1992; Freyer 1995; Garthe *et al.* 1995; Garthe 1998). Apart from two studies at the lower river Elbe (Nicklas 1983; Berliner *et al.* 1995), no study exists on the diet of breeding Common Gulls in the German Bight. The at-sea distribution of Common Gulls during the breeding season (Skov *et al.* 1995; Garthe 1997) suggests that some breeding birds should forage at sea outside the Wadden Sea, being possibly intermediate in their distribution between the marine Lesser Black-backed Gulls and the coastal Black-headed Gulls. We therefore investigated the diet of Common Gulls at three different breeding sites on the German North Sea coast. Subsequently, we discuss the extent to which marine habitats are used during foraging (including fishing vessels) and how Common Gulls differ in this respect from the other three gull species.

METHODS

Three geographically well-separated breeding colonies were selected for the study (Fig. 1). Amrum Island (54°40'N, 8°21'E) is located close to the open North Sea. Nordstrandischmoor Island (54°33'N, 8°49'E) is situated near the mainland coast in the Wadden Sea. Lühesand Island ('Pionierinsel'; 53°35'N, 9°36'E) lies inland, in the tidal lower river Elbe west of Hamburg, some 50-60 km from the open sea. Diet was analysed from pellets and faeces collected during the egg-laying period (second half of May) and the chick-rearing period (late June/early July). Pellets were dried and subsequently analysed using binocular microscopes. Faeces were deep-frozen and dissolved in alcohol before analysis. Food objects were identified using (binocular) microscopes. All food remains were identified to the lowest possible taxon. Whenever possible, fish were identified from their otoliths using Härkönen (1986) and reference collections. Oligochaetes and polychaetes were identified by their setae and jaws using Friedrich (1938), Hartmann-Schröder (1971, 1982) and Dernedde (1993). Body feathers were neglected since they are swallowed often by the birds when preening (Glutz von Blotzheim & Bauer 1982). For more details of analyses see Kubetzki (1997). The distribution of Common Gulls in the German Bight was obtained by counting seabirds from research vessels, ferries and other boats, following methods described by Tasker *et al.* (1984) and Garthe & Hüppop (1996). In order to assess the extent to which Common Gulls follow fishing vessels in the German Bight, we analysed 136 counts of seabirds at commercial fishing vessels between May and July 1993-97 from our seabirds at sea database.

RESULTS

Common Gulls fed upon a large variety of food types (Tables 1-3, Fig. 2). There are, however, some differences between the frequencies of occurrence in pellets and faecal samples. Single pellets contained up to seven prey types (e.g. molluscs, polychaetes, earthworms, fish, insects and grass in one pellet; Tables 1, 3). In the two colonies adjacent to the sea, crustaceans and insects were found most frequently, followed by bivalves and fish (apart from grass). Gadids and Smelt were the fish identified most often. On Lühesand, terrestrial food such as earthworms, insects, small mammals and fruit were found most frequently in the diet. Food apparently caught in the river Elbe was rare. The diet changed in all colonies over the breeding period. The proportion of mammals increased while that of fish and bivalves decreased. On Lühesand, a considerable proportion of the pellets consisted of cherry stones during the chick-rearing period. On Amrum and Nordstrandischmoor, polychaetes and crustaceans were the prey found most often in faecal samples, followed by bivalves and insects (Table 2).

Table 1. Frequency of occurrence of prey items in pellets collected in colonies on Amrum, Nordstrandischmoor and Lühesand during egg-laying and chick-rearing.
Tabel 1. Voorkomen van prooien in braakballen verzameld in drie broedkolonies gedurende de eileg (egg-lay.) en bij opgroeiende kuikens (chick-r.).

colony	AMRUM		NORDSTR.		LÜHESAND	
period	egg-lay.	chick r.	egg-lay.	chick-r.	egg-lay.	chick-r.
pellets (*n*)	90	110	96	68	97	107
Mollusca						
BIVALVIA	29%	14%	19%	4%	-	-
Mytilus edulis	6%	-	3%	-	-	-
Cerastoderma edule	14%	4%	15%	3%	-	-
Macoma balthica	2%	-	-	-	-	-
Ensis spp.	2%	3%	-	1%	-	-
Spisula spp.	1%	1%	-	-	-	-
unidentified	19%	6%	8%	-	-	-
GASTROPODA	4%	2%	10%	6%	6%	-
Hydrobia spp.	1%	2%	9%	4%	-	-
Littorina spp.	-	1%	4%	1%	-	-
land snails, unid.	-	-	-	-	6%	-
Annelida						
POLYCHAETA (*Nereis*)	27%	4%	7%	-	-	-
OLIGOCHAETA (*Lumbricus*)	13%	36%	8%	1%	72%	49%
Arthropoda						
CRUSTACEA	58%	18%	54%	50%	-	5%
Carcinus maenas	38%	12%	43%	47%	-	-
Liocarcinus spp.	24%	5%	18%	1%	-	-
Carcinus/Liocarcinus	1%	2%	3%	1%	-	-
Eupagurus bernhardus	4%	1%	3%	-	-	-
Crangon crangon	1%	-	-	4%	-	-
Eriocheir sinensis	-	-	-	-	-	5%
barnacles unid.	-	-	1%	-	-	-
unidentified	-	-	1%	1%	-	-
INSECTA	37%	50%	43%	50%	72%	50%
Vertebrata						
PISCES (see Table 3)	28%	9%	18%	7%	5%	6%
AVES	1%	21%	19%	19%	10%	4%
egg shells	1%	20%	19%	19%	10%	3%
unidentified	-	1%	-	-	-	1%
MAMMALIA	1%	10%	1%	10%	10%	30%
Plant material						
grass	48%	61%	42%	75%	72%	55%
fruits	1%	7%	-	-	4%	25%
cereal	12%	1%	10%	1%	20%	-
Garbage	1%	3%	5%	-	7%	2%

Table 2. Frequency of occurrence of prey items in all faeces samples collected in the three colonies during egg-laying and chick-rearing.
Tabel 2. Voorkomen van prooiresten in faeces verzameld in de drie broedkolonies gedurende de eileg (egg-lay.) en bij opgroeiende kuikens (chick-r.).

colony	AMRUM		NORDSTR.		LÜHESAND	
period	egg-lay.	chick r.	egg-lay.	chick-r.	egg-lay.	chick-r.
samples (*n*)	19	22	15	23	17	20
Mollusca						
BIVALVIA	37%	41%	13%	35%	-	-
Mytilus edulis	16%	14%	7%	9%	-	-
Cerastoderma edule	26%	36%	7%	17%		
unidentified	11%	23%	13%	17%	-	-
GASTROPODA, *Hydrobia*	-	-	7%	17%	-	-
Annelida						
POLYCHAETA (*Nereis*)	68%	64%	40%	65%	-	-
Nereis diversicolor	21%	23%	7%	22%	-	-
Nephtys hombergii	11%	5%	-	13%	-	-
Arenicola marina	26%	23%	20%	39%	-	-
Lanice conchilega	21%	32%	7%	4%	-	-
Scoloplos armiger	11%	14%	7%	13%	-	-
unidentified	-	-	11%	-	-	-
OLIGOCHAETA (*Lumbricus*)						
Lumbricus spp.	32%	9%	7%	4%	76%	60%
Arthropoda						
CRUSTACEA	68%	41%	60%	78%	6%	10%
Carcinus maenas	21%	-	27%	8%	-	-
Liocarcinus spp.	11%	-	-	-	-	-
Carcinus/Liocarcinus	32%	32%	33%	46%	-	-
Eupagurus bernhardus	-	-	-	8%	-	-
Eriocheir sinensis	-	-	-	-	-	10%
unidentified	11%	14%	-	70%	6%	-
INSECTA	42%	45%	33%	13%	94%	65%
Echinodermata						
Asterias rubens	11%	9%	-	4%	-	-
Vertebrata						
PISCES	11%	14%	27%	9%	18%	-
AVES						
egg shells	-	-	-	-	6%	5%
MAMMALIA	-	-	-	-	-	25%
Plant material						
grass	47%	23%	27%	-	88%	45%
fruits	-	23%	-	30%	6%	55%
cereal	-	-	-	-	41%	50%
garbage	-	-	7%	-	-	-

Table 3. Number of pellets (n) from the breeding colonies on Amrum and Nordstrandischmoor (both periods) in which fish species / groups were identified. Fish length (cm) is also estimated for specimens of which otoliths were well-preserved.

Tabel 3. Aantal braakballen (n) van de kolonies op Amrum en Nordstrandischmoor (beide perioden) waarvan vis tot op groep- of soortniveau kon worden gedetermineerd. Vislengtes (cm) zijn gegeven op basis van braakballen waarin weinig gesleten otolieten werden aangetroffen.

	AMRUM	NORDSTR.	
number of pellets	*n*= 200	*n* =164	fish length (cm)
Dab *Limanda limanda*	4	-	9, 14, 14, 20
Sole *Solea solea*	1	-	17
Cod *Gadus morhua*	-	4	11, 17-18
Whiting *Merlangius merlangus*	1	-	7
unid. gadids	3	1	
Smelt *Osmerus eperlanus*	4	4	3x 10, 11, 11-12, 12
unid. clupeoids	2	-	
unid. sandeels	1	-	16
unid. dragonets	3	-	
Sand Goby *Pomatoschistus minutus*	1	-	

In contrast, insects, oligochaetes, cereal and fruit were recorded most often in faeces from Lühesand.

Common Gulls are relatively widely distributed in the inner German Bight, particularly near the mouths of the rivers Elbe and Weser (Fig. 3), often associated with fronts. Only few Common Gulls were registered close to the North Frisian Islands and offshore. All major concentrations were located close to land (Fig. 3). Common Gulls attended only the shrimping vessels regularly, the maximum concentration comprising 150 individuals (Table 4). The gulls were rare, or absent, at the three other, mainly offshore, types of fishing vessels. Garthe (1997) estimated that 7-17 % (1993 and 1994, respectively) of all Common Gulls were attending trawlers.

DISCUSSION

Diet studies using pellets are subject to considerable bias, under-representing easily digestible components (such as annelids) and over-representing less digestible matter (such as molluscs; e.g. Brown & Ewins 1996). Considering this and differences in energy content and digestibility of prey items, we suggest the following prey types as being the most important for Common Gulls during this study: On Amrum, polychaetes, fish, crustaceans early in the incubation

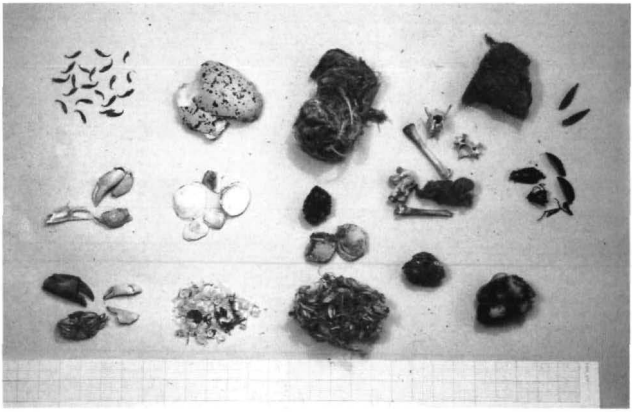


Figure 2. Examples of different types of (items in) pellets. Top row, from left to right: jaws from Nereis worms, egg shells, chick remains, hairs of small mammals, land snails (Clausiliidae); middle row: Carapace and extremities of Liocarcinus holsatus, *bivalve shells,* Empetrum nigrum *berries and fruit stones, bones of large mammals (carrion), insects; bottom row: Carapace and extremities of* Carcinus maenas, *fish, cereal, grass pellets with insect remains, cherry stones.*

Figuur 2. Voorbeelden van prooiresten in braakballen. Boven vlnr: Nereis kaken, eiderschalen, resten van kuikens, haren van zoogdieren, landslakken; midden: poten van zwemkrab Liocarcinus holsatus, *schelpen,* Empetrum nigrum, *botjes van grote zoogdieren (aas), insecten; onder: poten van strandkrab* Carcinus maenas, *visresten, zaden, grasbraakbal net insectenresten, kersenpitten.*

period, polychaetes, earthworms and fish during chick-rearing. At Nordstrandischmoor, crustaceans, fish and polychaetes early in the incubation period; crustaceans and polychaetes in the chick-phase. At Lühesand, earthworms, fish and insects early in the incubation period, mammals, earthworms and fruits during chick-rearing. Although insects were frequently found in pellets, we do not consider them to be of prime importance for Common Gulls because they are only present in pellets in traces (very small amounts).

Common Gulls apparently have a wide food spectrum. Birds from both colonies located close to the North Sea fed not only on marine prey but also

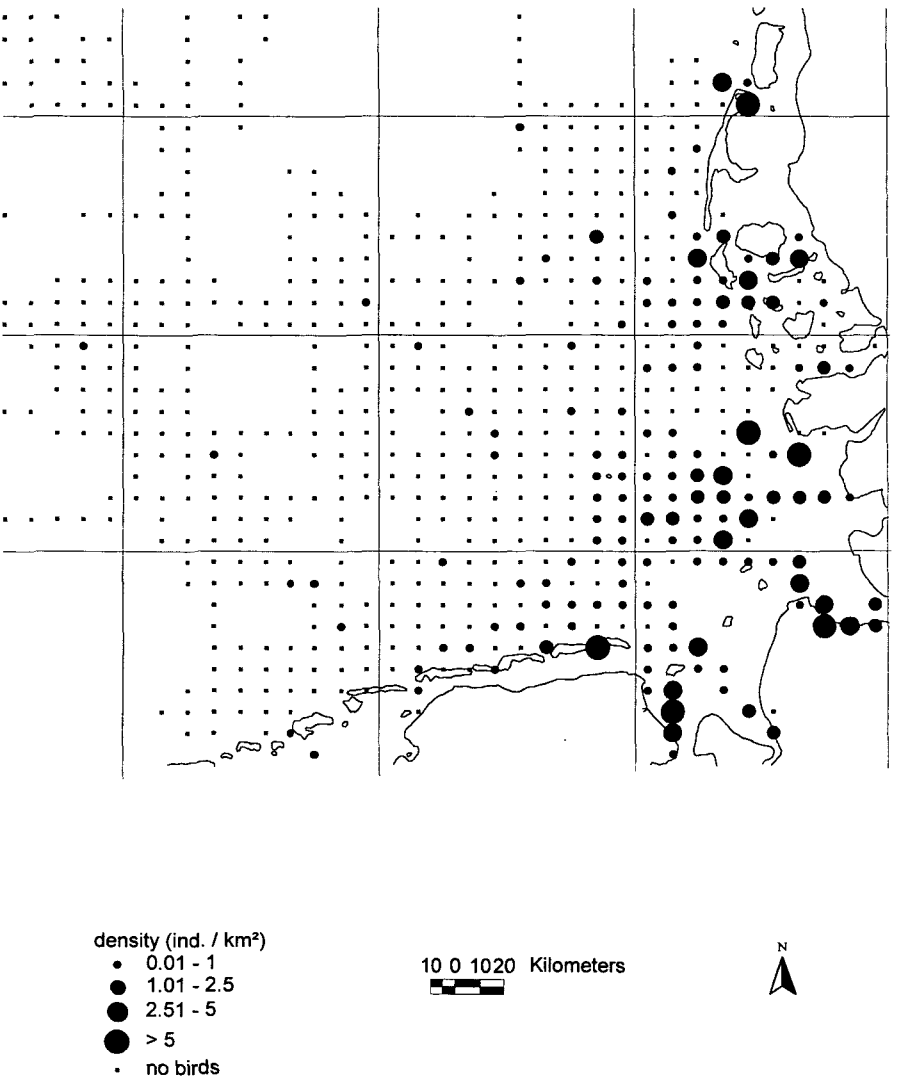


Figure 3. Distribution of Common Gulls in the German Bight during the reproductive season (May to July). Density values given are means for the years 1993-98.

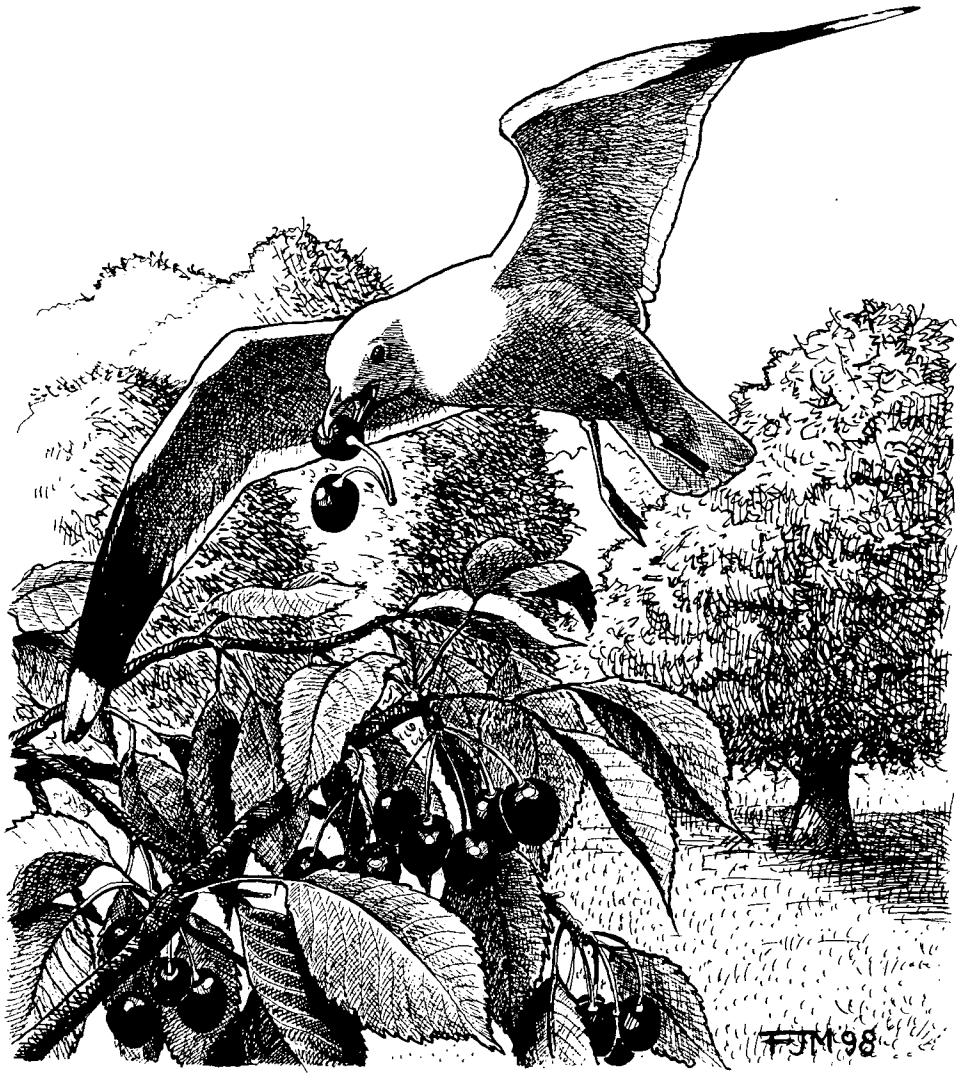
Figuur 3. Verspreiding van Stormmeeuwen in de Duitse Bocht in de broedtijd (mei-jul), gemiddeld over de jaren 1993-98.

took considerable amounts of terrestrial food. This contrasts with the sympatrically breeding Lesser Black-backed Gulls (Amrum) and Herring Gulls (both islands), which feed almost exclusively on marine prey (Freyer 1995; Garthe *et al.* unpubl. data). Since Lühesand is essentially an inland site, being situated some 60 km from the North Sea coast, it is not surprising that Common Gulls at this site fed predominantly on terrestrial food. It is surprising, however, that these birds hardly utilised the river Elbe and associated freshwater tidal flats, as do Herring Gulls breeding on the same island, taking chiefly freshwater crustaceans and fish (Hüppop & Hüppop 1998). These clear differences in diet composition between Common Gulls and larger gulls breeding in the same colonies indicate relatively little dietary overlap. More substantial overlap between Common and Herring Gulls (as well as Black-headed Gulls) was found by Dernedde (1994) on tidal flats near Sylt.

The most frequent prey categories differ substantially between the colonies and the breeding stages, suggesting different prey availability. This was particularly apparent on Lühesand where the proportion of cherries in the diet increased from 4% to 25% of all pellets over the breeding season (Table 1). This can be explained by the specific location of the colony close to large cherry tree plantations. Sweet cherries generally ripen around mid-June, sour cherries at the beginning of July. Berliner *et al.* (1995 and pers. comm.) found cherries in over 60% of the pellets from mid-June to late July. Hence, Common Gulls apparently partly changed from foraging on grassland, where e.g. earthworm availability was reduced due to the growing grass, to the tree plantations within the breeding season. The increase of fruit in pellets from Amrum is also due to the fact that *Empetrum nigrum* berries ripen in June in, and around, the colony, and were taken by several birds as food.

Based on the presumed origin of the prey (outlined in Kubetzki 1997), it is estimated that 20-40% of all pellets from Amrum and Nordstrandischmoor during egg-laying contained objects from discards, compared with about 10-15% during chick-rearing. On both islands, prey from land and from the tidal flats were represented much more often than discards. Compared with studies on the other three gull species breeding at German North Sea colonies, Common Gulls are considered intermediate in their utilisation of discards from fish trawlers: less than Lesser Black-backed Gulls (Freyer 1995) but more than Black-headed Gulls (Gorke 1990; Hartwig *et al.* 1990) and Herring Gulls (Prüter *et al.* 1988; Freyer 1995). The relatively small numbers, even at the inshore shrimper fleet (Table 4; Walter & Becker 1994), may be due to the small breeding population relative to those of Black-headed and Herring Gulls (e.g. Südbeck & Hälterlein 1997).

But do Common Gulls also take food at sea other than from fishing vessels, as suggested by Garthe (1997)? We believe that Smelt, Herring/Sprat,



Common Gull picking cherries *Stormmeeuwen kersenplukkend* (F.J. Maas)

Tabel 4. Common Gulls as ship-followers of different commercial fishing fleets in the German Bight, May-July, 1993-97.
Tabel 4. Stormmeeuwen als scheepsvolgers bij verscheidene commerciële vissersvloten in de Duitse Bocht, mei-juli, 1993-97.

type of vessel	number of vessels	presence	mean	maximum
shrimper	59	64%	19.0	150
set net vessel	13	0%	-	-
beamtrawler	55	7%	0.4	10
ottertrawler	9	0%	-	-

sandeels and possibly a small proportion of crustaceans were captured at the sea surface. The proportion of other pelagic prey might be higher in Common Gull diet but most plankton species are not detectable in pellets and faeces due to digestion. Nevertheless, compared to the at-sea distribution, the proportion of pelagic prey in the diet of Common Gulls is surprisingly low. One can only speculate whether the colonies studied may be representative for all colonies in the German Bight, or whether perhaps birds from colonies located close to the mouths of the rivers Elbe and Weser do feed more often at sea (as indicated by the high densities in Fig. 3).

It is concluded that Common Gulls are foraging generalists, coping well with fluctuating food availability. The existence of colonies in bogs and moors in northern Germany (Thies 1978), far from the coast, further supports this conclusion. However, some of these inland colonies have disappeared (Berndt 1995) and the large colonies at the Baltic Sea coast are showing strong declines (Hartwig & Prüter 1990). This is being counteracted to some extent by increases at the North Sea coast (Behm-Berkelmann 1991, Kubetzki 1997). Further studies should aim to link spatial and temporal foraging patterns, diet and reproductive parameters to elucidate the reasons for these trends.

ACKNOWLEDGEMENTS

R. Hawmann (Vincent-Lübeck-Gymnasium, Stade), R. Kruse (Nordstrandischmoor) and H. Löffler and G. Quedens ('Öömrang Ferian', Amrum) provided access to the study areas and were helpful in many other ways. M. Berliner, T. Freyer and T. Metelmann helped with the fieldwork. T. Dernedde, C.J.N. Winter and M.F. Leopold helped with the identification of otoliths and other food remains. V. Dierschke provided seawatching data from the 'Ornithologische Arbeitsgemeinschaft Helgoland'. D. Adelung allowed use of the facilities of the 'Institut für Meereskunde' (Kiel) for diet analyses. R.P. Wilson critically read an earlier version of the manuscript and improved our English. M.F. Leopold kindly commented on the first draft. The "Verein der Freunde und Förderer der Inselstation der Vogelwarte Helgoland" supported the project financially.

ZUSAMMENFASSUNG

Die Nahrung von Sturmmöwen *Larus canus* wurde in der Brutzeit 1995 in drei Brutkolonien der deutschen Nordseeküste anhand von Speiballen und Kotproben analysiert. Die Lage der Kolonien

unterscheidet sich deutlich. Während sich die Insel Amrum im Übergangsbereich zwischen Wattenmeer und offener See befindet, liegt die Hallig Nordstrandischmoor an der Grenze des Wattenmeeres zum Festland. Lühesand ist eine Insel in der tidebeeinflußten, limnischen Unterelbe. Die Vögel nutzen eine Vielzahl von Nahrungstypen. In den beiden seewärts gelegenen Kolonien war Nahrung aus dem Watt am häufigsten (vor allem Crustaceen, Polychaeten und Muscheln). Gadiden und Stint Osmerus eperlanus waren die Fischarten, die am häufigsten nachgewiesen werden konnten. Nebenprodukte der Fischerei, vor allem Discards (= ungenutzter Beifang), waren zumindest in der Eiablagephase der beiden Nordseekolonien von Bedeutung. Terrestrische Nahrung wurde ebenfalls genutzt (Regenwürmer, Insekten). Auf Lühesand erbeuteten Sturmmöwen ihre Nahrung hingegen fast ausschließlich an Land (Regenwürmer, Insekten, Säugetiere, Früchte); die Elbe mit ihren Süßwasserwatten wurde kaum genutzt. In allen drei Kolonien veränderte sich die Nahrungszusammensetzung im Verlauf der Brutzeit. Generell stieg der Anteil an Säugetieren, während der von Fischen und Muscheln abnahm. Auf Lühesand beinhalteten während der Jungenaufzuchtsphase eine große Menge an Speiballen Kirschkerne.

Sturmmöwen waren in der inneren Deutschen Bucht relativ weit verbreitet; die größten Konzentrationen fanden sich in Landnähe vor den Mündungen der Flüsse Elbe und Weser. Nur die küstennah fischenden Garnelenkutter wurden regelmäßig von Sturmmöwen zur Nahrungssuche aufgesucht (bis zu 150 Individuen). Zugbewegungen von Sturmmöwen bei Helgoland waren relativ stark ausgeprägt im März und April (nach Norden), schwach im Juli (nach Süden) und zeigten einen weiteren starken Gipfel im November (nach Süden).

SAMENVATTING

Het voedsel van Stormmeeuwen *Larus canus* werd in het broedseizoen van 1995 in drie verspreid liggende kolonies in de Duitse Bocht onderzocht aan de hand van braakballen en uitwerpselen. De kolonie van Amrum bevond zich in het overgangsgebied tussen de Noordzee end e Waddenzee, Hallig Nordstrandischmoor bevindt zich in het grensgebied tussen Waddenzee en vasteland, Lühesand is een kolonie op een eilandje in de rivier de Elbe en dit gebied wordt nog juist door het getij beïnvloed. De Stormmeeuwen maakten gebruik van een grote verscheidenheid van voedselbronnen. Stormmeeuwen in de beide aan de kust gesitueerde kolonies foerageerden vooral in de Waddenzee en braakten dus vooral resten van kreeftachtigen Crustacea, borstelwormen Polychaeta en schelpdieren Bivalvia uit. De meest gegeten vissen waren kabeljauwachtigen en Spiering *Osmerus eperlanus*. Visafval, afkomstig van vissersschepen in het gebied, werd regelmatig aangetroffen in de broedperiode, maar veel minder nadat de jongen uitgekomen waren. Meeuwen van beide kolonies zochten ook voedsel op het land (regenwormen, insecten). Op Lühesand zochten de broedende Stormmeeuwen vrijwel uitsluitend op het land (regenwormen, insecten, kleine zoogdieren en vruchten); de rivier de Elbe met haar droogvallende zandplaten werd vrijwel niet door foeragerende vogels bezocht. In elk van de kolonies veranderde de prooikeuze in de loop van het broedseizoen. Over het algemeen nam het percentage zoogdieren in het dieet toe, terwijl dat van vis en schelpdieren afnam. Op Lühesand bevatten veel braakballen in de kuikenfase kersenpitten, waaruit bleek dat de Stormmeeuwen vaste gasten waren van de omliggende kersenboomgaarden.

Stormmeeuwen zijn wijd verbreid in de Duitse Bocht, maar de grootste aantallen komen in de kustwateren en in het Waddengebied voor, vooral in de mondingen van de Elbe en de Weser. Alleen garnalenkotters vlak onder de kust werden door Stormmeeuwen bezocht (maximaal 150 exemplaren tegelijkertijd) Doortrek van Stormmeeuwen in de Duitse Bocht (waarnemingen Helgoland) is sterk in maart en april (noordwaarts), zwak in juli (zuidwaarts) en opnieuw sterk in november (zuidwaarts).

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Common Gulls *Stormmeeuwen* (C.J. Camphuysen)

FEATHER LICE FROM SOOTY SHEARWATERS *PUFFINUS GRISEUS* IN THE FAROE ISLANDS

VEERLUIZEN BIJ GRAUWE PIJLSTORMVOGELS VAN DE FAERØER EILANDEN

JENS-KJELD JENSEN[1], RICARDO L. PALMA[2] & BERNARD ZONFRILLO[3]

[1]*Fr-270 Nólsoy, Faroe Islands;* [2]*Museum of New Zealand Te Papa Tongarewa, P.O. Box 467, Wellington, New Zealand;* [3]*Ornithology Group, I.B.L.S., University of Glasgow, Glasgow, G12 8QQ, Scotland, U.K.*

Seven species of lice (Insecta: Phthiraptera) *were found on 41 dead Sooty Shearwaters* (Puffinus griseus) *collected from two localities around the Faroe Islands in 1997. Four species* (Ancistrona vagelli, Austromenopon paululum, Halipeurus diversus *and* Trabeculus hexakon) *are regarded as regular ectoparasites on Sooty Shearwaters. The other three species* (Halipeurus gravis gravis, Naubates harrisoni *and* Saemundssonia peusi) *are treated as natural stragglers from other petrels. Possible explanations for the transferral of the three straggling louse species from their regular hosts to Sooty Shearwaters are discussed.*

Jensen J.-K., R.L. Palma & B. Zonfrillo 1999. Feather lice from Sooty Shearwaters *Puffinus griseus* in the Faroe Islands. Atlantic Seabirds 1(2): 71-76.

INTRODUCTION

Sooty Shearwaters *Puffinus griseus* are common autumn migrants in Faroese waters, arriving around late August and departing in early October (Bloch & Sørensen 1984). From evidence of feather lice from a single bird found dead in Scotland, Zonfrillo (1988) speculated that Sooty Shearwaters in the north Atlantic may have their origins in the Falkland Islands. This was due to the presence of lice typical of the Great Shearwater *Puffinus gravis* suggesting that the lice had transferred through physical contact between individuals of these two species of shearwaters at a place where both species bred. The Falkland Islands were then the only known locality in the south Atlantic Ocean where Great Shearwaters breed alongside large numbers of Sooty Shearwaters. Since the publication of Zonfrillo's (1988) paper, Sooty Shearwaters have been found breeding on islands of the Tristan da Cunha group (Ryan *et al.* 1990). Here, we report further records of Great Shearwater lice from Sooty Shearwaters collected in the Faroe Islands. We now believe that the Tristan da Cunha group seems a more likely place where host-switching of Great Shearwater lice to Sooty Shearwaters has occurred.

MATERIALS & METHODS

On 14 August 1997, 35 dead Sooty Shearwaters were collected following fishing activities on Bill Bailey's Bank, around 100 km south-west of the Faroe Islands (62°N, 7°) and another six birds were collected similarly from around 15 km north of the Faroes on 15 October 1997. On collection, all birds were immediately wrapped individually for subsequent skinning and delousing. The resulting feather lice were first preserved in alcohol and then slide-mounted for identification following the technique published by Palma (1978). This material is now deposited in both the Natural History Museum, Tórshavn, Faroe Islands, and in the Museum of New Zealand Te Papa Tongarewa, Wellington, New Zealand.

RESULTS

Seven species of lice were collected belonging to six genera, *Ancistrona, Austromenopon, Halipeurus, Trabeculus, Naubates* and *Saemundssonia.* Numbers of birds infested by each louse species in the 35 bird sample, are recorded in Table 1. Numbers of lice, subdivided according to sex and status, collected from the sample of six northern birds are shown in Table 2.

DISCUSSION

Four of the seven louse species collected in this study have been recorded previously from Sooty Shearwaters (Pilgrim & Palma 1982; Palma & Barker 1996) and are regarded as regular parasites on this host. *Ancistrona vagelli* (J.C. Fabricius 1787), here recorded for the first time on a Sooty Shearwater from the north Atlantic Ocean, is also found on many other petrel species (Kéler 1952; Pilgrim & Palma 1982) and on Great Shearwaters (Foster *et al.* 1996). In the Faroe Islands it is common on Northern Fulmars *Fulmarus glacialis* (Jensen pers. obs.). *Austromenopon paululum* (Kellogg & Chapman 1899) is common on Sooty and Great Shearwaters (Pilgrim & Palma 1982; Foster *et al.* 1996) as well as on many other species of *Puffinus* (see Price & Clay 1972), including Manx Shearwaters *Puffinus p. puffinus* (Fowler & Shaw 1990). *Halipeurus diversus* (Kellogg 1896) is very common on Sooty Shearwaters but also lives on several other species of *Puffinus* (Edwards 1961; Fowler & Shaw 1990). It is the only species of *Halipeurus* that parasitises Sooty Shearwaters regularly. Finally, *Trabeculus hexakon* (Waterston 1914) is widespread on many petrel species of the genera *Puffinus*, *Pterodroma* and *Procellaria* (Pilgrim & Palma 1982), including Great Shearwaters (Foster *et al.* 1996).

The remaining three louse species are not regular parasites of Sooty Shearwaters. The first, *Halipeurus gravis gravis* Timmermann 1961, is commonly

Table 1. Lice from 35 Sooty Shearwaters collected at sea on Bill Bailey's bank, North Atlantic, on 14 August 1997 and the number of birds upon which each species was present.

Tabel 1. Veerluizen van 35 Grauwe Pijlstormvogels verzameld op Bill Bailey's Bank in het Noord-Atlantische gebied op 14 augustus 1997 en het aantal vogels waarop elke soort werd aangetroffen.

Louse species	*An. vagelli*	*Au. paululum*	*H. diversus*	*H. gravis gravis*	*N. harrisoni*	*S. peusi*	*T. hexakon*
Birds infested	1	5	34	1	2	8	10

found on Great Shearwaters (Foster *et al.* 1996). Although the species *H. gravis* also lives on the Flesh-footed Shearwater *Puffinus carneipes* and the Pink-footed Shearwater *P. creatopus*, these populations are distinguished as the subspecies *H. gravis priapulus* Timmermann 1961. Thus, the Great Shearwater is the only known regular host for the subspecies *H. g. gravis*. Zonfrillo (1988) recorded one pair of *H. g. gravis* on a Sooty Shearwater, while Fowler & Shaw (1990) found one *H. g. gravis* among 230 deloused Manx Shearwaters. These louse records, and the two specimens we report here from Sooty Shearwaters in the Faroes, must be regarded as natural stragglers, i.e. transferring without human agency, on the Sooty and Manx Shearwaters. A second species, *Naubates harrisoni* Bedford, 1930 lives on a number of *Puffinus* species (Pilgrim & Palma 1982; Fowler & Shaw 1990) including the Great Shearwater (Foster *et al.* 1996). The two specimens of *N. harrisoni* we found on two Sooty Shearwaters from the Faroes represent the first record of this louse on this host, but they should be regarded as stragglers until further records suggest otherwise. Finally, *Saemundssonia peusi* (Eichler 1949) is a regular parasite of Cory's Shearwaters *Calonectris diomedea*. However, this louse has also been recorded on Great Shearwaters (Foster *et al.* 1996; Palma pers. obs.) despite the fact that this shearwater is also a host to *Saemundssonia puellula* Timmermann 1965 (see Palma 1994). The apparent regular presence of two different species of *Saemundssonia* on Great Shearwaters is unusual. A larger sample of Great Shearwaters needs to be systematically deloused to reveal the frequency and abundance of both *S. peusi* and *S. puellula* on this host, as these two louse species are likely to compete for a very similar niche. As many as 45 specimens of *Saemundssonia peusi* were found on 10 (24 %) of the 41 Sooty Shearwaters examined in this study. They represent the first record of this louse from this host. However, these are unusually high numbers of both lice and birds for an association probably due to natural straggling.

The finding of *Naubates harrisoni* and *Halipeurus gravis gravis* on Sooty Shearwaters, both of which are regular parasites of Great Shearwaters, suggests physical contact at a locality where both shearwaters breed or perhaps at

Table 2. Status and sex of lice from six Sooty Shearwaters collected at sea 15 km north of the Faroe Islands on 15 October 1997. M = male, F = female and Ny = nymphs.

Tabel 2. Geslacht van veerluizen bij zes Grauwe Pijlstormvogels verzameld op 15 km ten noorden van de Faerøer Eilanden op 15 oktober 1997. M= mannetje, F = vrouwtje, Ny = larve.

Au.paululum			*H .diversus*			*H. gravis gravis*			*S.peusi*			*T. hexakon*		
M	F	Ny	M	F	Ny	M	F	Ny	M	F	Ny	M	F	Ny
-	3	-	-	1	1	-	-	-	-	-	-	-	-	-
2	3	6	36	35	35	-	-	-	9	1	4	-	-	-
4	5	1	17	22	23	-	-	-	-	-	-	-	-	-
5	1	-	1	5	9	-	-	-	-	-	-	-	-	-
3	-	1	11	7	10	1	-	-	-	-	-	3	1	-
5	2	7	14	26	16	-	-	-	3	9	2	-	-	-

sea on the feeding grounds. Sooty Shearwaters have recently colonised Tristan da Cunha, where they have been found breeding (Ryan *et al.* 1990). A Sooty Shearwater shot off the Faroe Islands on 9 March 1977 had been ringed off the coast of southern Africa on 6 May 1968 (Jensen pers. obs.). This evidence strongly suggests that Sooty Shearwaters from around the Faroe Islands either come from Tristan da Cunha or at least visit it on a regular basis. The Falkland Islands hold around 50-100 breeding pairs of Great Shearwaters and many thousands of Sooty Shearwaters (Woods & Woods 1997). The number of Sooty Shearwaters breeding on Tristan da Cunha is also very small in comparison to the millions of Great Shearwaters estimated to breed there (Ryan *et al.* 1990).

Our records of *Saemundssonia peusi* on Sooty Shearwaters, a louse regularly associated with Cory's Shearwaters and now with Great Shearwaters, suggest that Cory's Shearwaters visit Great Shearwater and Sooty Shearwater colonies in the south Atlantic Ocean. Ryan *et al.* (1990) reported sightings of Cory's Shearwaters off Tristan da Cunha, although none has yet been found ashore. An alternative explanation is that Sooty Shearwaters and Great Shearwaters may sometimes come to land on islands in the north Atlantic Ocean where Cory's Shearwaters breed. Considering that Tristan da Cunha has been prospected and colonised by Sooty Shearwaters, these birds may be doing the same in the northern hemisphere. Salomonsen (1965) suggested that new genotypes of the Northern Fulmar (*Fulmarus glacialis)* were responsible for the rapid colonisation and expansion of this species' range in the north Atlantic. A similar set of circumstances may be operating with Sooty Shearwaters in its gradual colonisation of more islands in the Atlantic Ocean.

ACKNOWLEDGEMENTS

We thank Dorete Bloch, Natural History Museum, Tórshavn for the loan of equipment, and Mr. P.J. Simonsen and Mr. M. Sørensen for providing the birds.

SAMENVATTING

Op basis van de vondst van veerluizen die karakteristiek zijn voor de Grote Pijlstormvogel *Puffinus gravis* op een kadaver van een Grauwe Pijlstormvogel *P. griseus*, dood aangetroffen in Schotland, veronderstelde Bernie Zonfrillo (1988) dat de in onze omgeveing doortrekkende Grauwe Pijlen van de Falkland Eilanden afkomstig zouden kunnen zijn. Tot dan toe, was het te zamen voorkomen van beide soorten alleen van deze eilandengroep bekend. Sindsdien werd echter bekend dat de Grauwe Pijlstormvogel ook op Tristan da Cunha broedt. Grauwe Pijlstormvogels zijn algemene doortrekkers rond de Faerøer Eilanden van augustus tot begin oktober en in dit artikel worden veerluizen beschreven die op 41 exemplaren werden aangetroffen, verzameld rond de Faerøer Eilanden op 14 augustus 1997 (35) en op 15 oktober 1997 (6). In totaal werden zeven soorten veerluizen aangetroffen. *Ancistrona vagelli, Austromenopon paululum, Halipeurus diversus* en *Trabeculus hexakon* kunnen op Grauwe Pijlstormvogels als algemene ectoparasieten beschouwd worden. De overige drie soorten (*Halipeurus gravis gravis, Naubates harrisoni* en *Saemundssonia peusi*) zijn 'dwaalgasten' die vaker op andere soorten stormvogelachtigen voorkomen. Eerstgenoemde is typisch voor de Grote Pijlstormvogel, de tweede komt op meerdere soorten pijlstormvogels voor, maar opnieuw ook vaak op de Grote Pijlstormvogel. *Saemundssonia peusi*, tenslotte, is een veerluis die geregeld bij de Kuhls Pijlstormvogel *Calonectris diomedea* voorkomt, maar die ook is aangetroffen bij de Grote Pijlstormvogel. De vondsten van *Halipeurus gravis gravis* en *Naubates harrisoni* suggereren dat Grote en Grauwe Pijlstormvogels geregeld fysiek contact maken, op de broedplaatsen of misschien op zee tijdens het foerageren. Tristan da Cunha, de belangrijkste kolonie Grote Pijlstormvogels in het Atlantische gebied, is nog maar kort geleden gekoloniseerd door Grauwe Pijlstormvogels en deze populatie is nog klein. Op de Falkland Eilanden, waar duizenden Grauwe Pijlstormvogels broeden, komen slechts 50-100 paren Grote Pijlstormvogels voor. Een verdere aanwijzing voor de herkomst van de hier doortrekkende Grauwe Pijlstormvogels (en dat zij in elk geval in de buurt van Tristan da Cunha komen) is de vondst van een bij Zuid-Afrika geringd exemplaar op de Faerøer Eilanden. De vondst van *Saemundssonia peusi* op een Grauwe Pijlstormvogel zou een aanwijzing kunnen zijn dat Kuhls Pijlstormvogels op de Zuid-Atlantische eilanden aan land gaan, of dat Grote en Grauwe Pijlstormvogels soms de kolonies van de Kuhls Pijlstormvogel bezoeken.

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THE SIZE OF THE BREEDING POPULATION OF MANX SHEARWATERS *PUFFINUS PUFFINUS* ON BARDSEY (WALES) IN 1996

HET AANTAL NOORDSE PIJLSTORMVOGELS BROEDEND OP BARDSEY (WALES) IN 1996

A.F. SILCOCKS

5 Brunswick Avenue, Strathfield, 2135 New South Wales, Australia.

In late May and early June 1996 a whole- island survey of Manx Shearwaters was undertaken on Bardsey. All apparently occupied burrows (AOB) were counted, resulting in a total of 6927 AOBs. An additional survey of shearwaters nesting amongst gorse bushes was carried out using a call playback technique and revealed an additional 101 pairs. A comparison of the accuracy of the two censusing techniques revealed a disparity of under 10% in a selected survey area. A future monitoring program for the Manx Shearwaters on Bardsey is proposed.

Silcocks A.F. 1999. The size of the breeding population of Manx Shearwaters *Puffinus puffinus* on Bardsey (Wales) in 1996. Atlantic Seabirds 1(2): 77-84

INTRODUCTION

Bardsey is a small island of 179 ha. lying about 3 km off the Llyn peninsula in Gwynedd, Wales. It comprises three main physiographical areas: a hill rising to 167 m above sea level and sloping steeply to the sea on its western flank; a more fertile lowland zone (which, until recently, had been intensively farmed); and a mainly-bare southern promontory. Bardsey is a UK National Nature Reserve, where farming is an important conservation tool, although nowadays practiced much less intensively than in the past. Despite the importance of the Manx Shearwater *Puffinus puffinus* as a breeding species, few attempts have been made at a whole-island census. The objective of the work reported here was to obtain a good estimate of the total number of pairs of Manx Shearwaters breeding on Bardsey in 1996. By using repeatable methods the estimate obtained may be used as a baseline for monitoring future population trends.

METHODS

The counting unit was the apparently occupied burrow (AOB). All fieldworkers were trained to identify and apply the criteria for assessing burrow occupancy: faeces and/or feathers at the entrance or inside; a smooth burrow floor

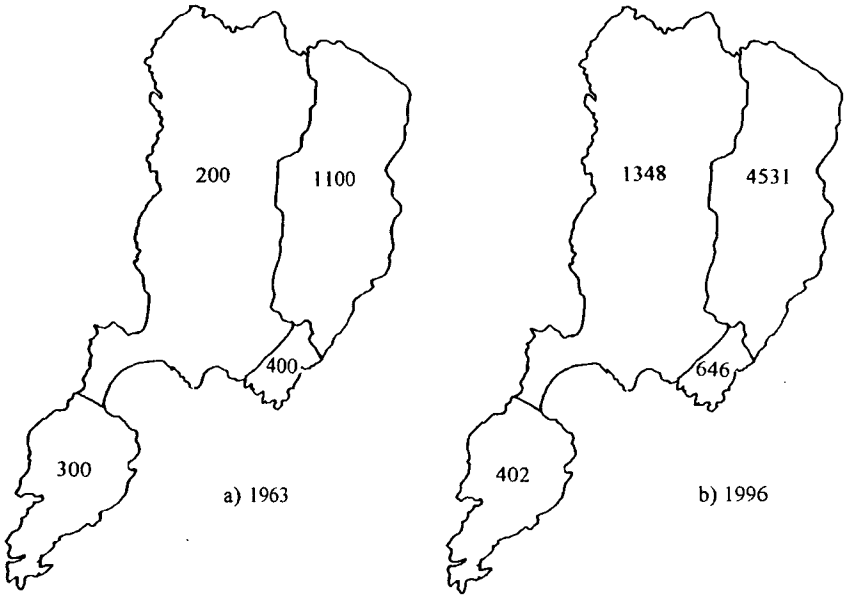

Figure 1. The numbers of Manx Shearwater AOBs on Bardsey by area in 1963 (a) and 1996 (b).

Figuur 1. Aantallen Noordse Pijlstormvogel (bezette holen) per deelgebied op Bardsey in 1963 (a) en in 1996 (b).

compacted by the waddling birds whose feet often left two worn grooves. A major complication was the presence of rabbit *Oryctolagus cuniculus* burrows, so a combination of the above features coupled with the absence of rabbit droppings formed the criteria for an AOB. For those occupied burrows that divided underground (where this could be seen), only one AOB was counted.

The survey was conducted between 20 May and 8 June 1996, a time when the shearwaters were incubating. This timing was considered to be optimum for two reasons: it was before the time when bracken *Pteridium aquilinum* growth would have made a count of AOBs impossible, and it was when prospecting and non-breeding birds visit a colony (Brooke 1990). The lowlands were counted relatively easily as most burrows are in the walls that separate the fields. Two surveyors walked on either side of the wall and examined each burrow. The AOBs along each stretch of wall were marked on a large-scale map. A check was then made of the open fields.

Table 1. Population estimates of Manx Shearwaters on the south end of Bardsey, using visual and call playback techniques (excluding areas of gorse) in 1996.
Tabel 1. Schattingen van de op de zuidpunt van Bardsey broedende aantallen Noordse Pijlstormvogels, gebruik makend van visuele technieken en afgespeelde geluidsopnames (met uitsluiting van een gebied bedekt met gaspeldoorn) in 1996.

area *gebied*	visual AOB count *telling van zichtbare holen*	playback total *respons op geluid*
open ground *open terrein*	35	30
walls *muren*	270	249
total *totaal*	305	279

Table 2. Changes in numbers of Manx Shearwater AOB totals at different areas on Bardsey in 1963 and 1996.
Tabel 2. Verandering in het aantal bezette nestholen van Noordse Pijlstormvogels in verschillende delen van Bardsey in 1963 en in 1996.

count zone *telgebied*	AOB total 1963 *bezette holen, 1963*	AOB total 1996 *bezette holen 1996*	% change 1963-96 *verandering (%)*
west coast *west kust*	200	1348	574%
mountain *bergend*	1100	4531	312%
Pen Christin	400	646	62%
south end *zuidkust*	300	402	32%
total *totaal*	2000	6928	246%

Three fieldworkers who were allowed to clamber over the steep east face surveyed the entire mountain. Here the colonies are fairly small and distinct, being restricted to the areas of deeper soil. The surveyors were able to cover each area fairly easily by walking about 3 m apart, pointing out the burrows that they detected in order to prevent duplication. Once an area had been counted the number of AOB's was marked as accurately as possible on a large scale map. A series of paths and sheep tracks served as good boundaries to aid counting.

On Bardsey's lowlands, Manx Shearwaters often nest under low gorse *Ulex europaeus* bushes, burrowing into the densest part and nesting at ground level. In these areas, it is not possible to census using visual clues, so here the technique of James and Robertson (1985) was used. This entails playing a recorded male shearwater's call and recording any response. An attempt to test the accuracy of the AOB count against the call playback was made. The south

end was chosen as it is an easily demarcated area and has a large enough population to make reasonable comparisons.

RESULTS

Figure 1b shows the recorded zonal distribution of the 6927 AOBs recorded. In addition, gorse areas yielded 51 responses to a taped recording. Applying the same correction factor (1.98) used by James and Robertson (1985) indicates an estimated 101 AOBs. On the south end the AOB count was 305, 35 in the open ground and 270 in the walls (see Table I). The corrected playback method estimated the south end population at 279 pairs, with 30 in the open ground and 249 in the walls.

DISCUSSION

Comparison of 'visual' and 'playback' estimates revealed an approximate 9% difference. This suggests that the 1996 Bardsey figure of nearly 7000 pairs derived from the 'visual' method could be a slight overestimate. Two factors militate against complete accuracy: first, the small differences between observers; and second, the possibility of double occupancy of individual burrows that divided underground. Walsh *et al.* (1995) suggested that large colonies might best be surveyed using capture-recapture of chicks in burrows, but this might be difficult on Bardsey's terrain and with widely scattered burrows. There might be some inconsistency also in the 'playback' method. Smart (1986) showed the importance of the timing of the census in relation to the stage of breeding cycle; on her study area on Bardsey. A sample of 106 burrows elicited between 35 and 42 responses during a week in June, and between 22 and 42 responses during a week in July. Gibbons and Vaughan (1998) highlighted a potential flaw of the 'playback' method in that some responses to the taped call of a male appeared to be of the female type. This was also thought to have occurred in this study, although the results have not been amended. Roberts and Jones (1996) reported a count of shearwater burrows in the Bardsey lowlands in June 1995. His figure of 1425 burrows compares with 1279 for the same area in the 1996 survey, a 10% discrepancy possibly due to a slightly different method in assessing an AOB. Roberts and Jones (1996) counted all burrows that had any sign of shearwater use, whereas this study attempted to assess regular use.

The Manx Shearwater population on Bardsey was first documented in 1901 by Alpin (1902), and the first population estimate was made in 1913 by Ticehurst (1919), who estimated the size of the colony at 30-40 pairs on the northern slopes of the mountain. Between 1930 and 1952, estimates varied

between 100 and 1000 pairs (see Jones 1988). The Bardsey Bird and Field Observatory was established in 1953, but only one previous whole-island survey has been documented between then and present day. Pratt (1964) estimated 2000 pairs by counting apparently occupied sites, although the precise definition of these was not stated. Neither is the exact delimitation of Pratt's counting zone

Manx Shearwaters *Noordse Pijlstormvogels* (F.J. Maas)

known, but a comparison of 1963 and 1996 data is shown in Table II. Thus there are three main population estimates: 30-40 pairs in 1913, 2000 pairs in 1963 and 6928 pairs in 1996. Whatever the errors involved in these estimates, there has certainly been a considerable increase in the numbers of breeders on Bardsey during the twentieth century.

Some factors act to suppress population size. For example, there was probably some egg collecting on Bardsey earlier this century. Although the last cat was removed from the island in 1994, some shearwaters were killed by cats (and possibly also by ferrets) earlier than this. A few birds, both adults and juveniles, are killed annually by being attracted to the lighthouse, and Peregrines *Falco peregrinus* and Ravens *Corvus corax* predate some. The effect of gulls, if any, is unknown. Whereas egg collecting may have been significant when the population was small, other potential impacts are probably of little significance now that cats have been removed.

It is not known how the numbers of shearwaters interact with those of rabbits. Rabbits were clearly very common on the island in years prior to the mid-1950s but following the introduction of myxomatosis in the 1950s, their numbers have fluctuated dramatically with successive outbreaks. While rabbits and shearwaters do co-exist, even sharing burrow entrances, they are not mutually dependent, and there may occasionally be hostile interactions. Shearwaters can excavate their own burrows, but the ready availability of extra burrows during myxomatosis outbreaks might have benefited the birds, especially young, prospecting individuals.

The major change on Bardsey since the 1930s has been the large scale emigration of the human population and the demise of agricultural practice. Earth and stone walls in the lowlands have fallen into disrepair, so encouraging shearwaters to burrow there. Of the 1750 pairs of shearwaters currently breeding in the lowlands, 94% nest in the walls. On the island's south end, by contrast, the population increase between 1963 and 1996 was small, possibly due to the destruction of several walls and banks there in the early 1970s. Roberts' (1983) analysis of retrap data from Bardsey-ringed shearwaters, showed that an increase in numbers had taken place between 1978 and 1981, although the calculation of absolute numbers was not possible.

Clearly, the population increased between 1963 and 1996, but the lack of surveys in the intervening years does not allow the conclusion that the population is currently increasing. If population growth over the 33 years were constant this would give an annual increase of 3.9%. Assuming that the annual mortality is similar to that of 10% on Skokholm (Brooke 1990), annual recruitment to the colony would be in the order of 13.5%, which could be sustained by the Bardsey population alone. Interchange of birds between colonies appears to be a regular occurrence, the scale of which has not yet been

ascertained. Up to 1996, 45 Skokholm-ringed birds were controlled on Bardsey, with five from Skomer and seven from Copeland; of the Bardsey-ringed birds, eighteen were recorded on Skokholm, and seven each from Skomer and Copeland. The finding of a Skomer-ringed chick breeding subsequently on Bardsey indicates that this movement is not confined to non-breeders.

The population of Manx Shearwaters on Bardsey is clearly a major conservation asset, and an important constituent of the National Nature Reserve, so its status is a matter of concern to the island's managers. It is proposed that future surveillance should comprise the following activities: (a) whole-island census at 10 year intervals of AOBs as described in this paper; (b) census of sample areas every two years; (c) a study to establish the productivity of breeders in a sample area; and (d) the ringing of chicks. Additional information might include an annual record of land use and agricultural activity, number of rabbits, and observations of predation by gulls, corvids and birds of prey. With Bardsey's population of shearwaters higher than 33 years ago, there seems no reason to doubt that there is potential for further expansion, especially since there is good scope for breeders in the *c.* 25 km of earth and stone banks and in the patches of deeper soil on the mountain. Whatever the future holds, the establishment of a sound monitoring system is crucially important in the conservation of Manx Shearwaters on Bardsey.

ACKNOWLEDGEMENTS

I would like to thank all those who assisted with the fieldwork: Ian Fisher and Malte Iden assisted on the hazardous east side of the mountain, while Jeremy Moore and the students of the Rural Resource Management Course helped in the lowlands. Peter Hope Jones, Dick Loxton and Steve Parr commented constructively on an earlier draft of this paper.

SAMENVATTING

Het eilandje Bardsey voor de kust van Wales is een natuurreservaat waar een kolonie Noordse Pijlstormvogels gevestigd is. Tot dusverre werd maar eenmaal eerder een poging ondernomen om de omvang van deze populatie vast te stellen met een integrale inventarisatie. Gekozen werd voor een methode die later gemakkelijk en precies herhaald kan worden en de veldwerkers werd geleerd hoe 'bezette nestholen' van pijlstormvogels (faeces en veren bij de nestingang en dikwijls duidelijk platgetreden grond met twee uitgesleten loopsporen van de binnenwaggelende vogels) kunnen worden onderscheiden van lege holen en van konijnenholen. Op sommige plaatsen, waar de vegetatie het zicht op de grond ontnam, werden geluidsopnames afgespeeld om de aanwezige broedvogels een reactie te ontlokken. De inventarisatie werd uitgevoerd tussen 20 mei en 8 juni 1996, de periode waarin de Noordse Pijlstormvogels hun ei uitbroeden. Uit een test, uitgevoerd op de zuidpunt van het eiland, bleek de visuele methode tot iets hogere uitkomsten te leiden dan het afspelen van bandjes (9% verschil; Tabel 1). In totaal werden 6927 bezette holen aangetroffen (Fig. 1). Ofschoon de visuele methode wellicht tot een overschatting van de populatie heeft geleid, is het duidelijk dat de kolonie op Bardsey sinds 1963 aanmerkelijk is gegroeid. Het broeden op Bardsey werd voor het eerst geconstateerd in 1901 (30-40 paren op de noordelijke hellingen) en schattingen tussen 1930 en 1953 varieerden van 100-1000 broedparen. Alleen in 1963 werd eveneens een volledige inventarisatie uitgevoerd en toen werd het bestand geschat op ongeveer 2000 paren.

Omdat er tussen 1963 en 1996 geen goede tellingen werden uitgevoerd is het onduidelijk of de kolonie tegenwoordig nog steeds groeit.

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NEW FEEDING TECHNIQUE OF GREAT CORMORANTS *PHALACROCORAX CARBO SINENSIS* AT BEAM TRAWLERS

NIEUWE FOERAGEERMETHODE VAN AALSCHOLVERS GEASSOCIEERD MET DE BOOMKORVISSERIJ

KEES (C.J.) CAMPHUYSEN

Netherlands Institute for Sea Research, P.O. Box 59, 1790 AB Den Burg, Texel, The Netherlands; CSR Consultancy, Ankerstraat 20, 1794 BJ Oosterend, Texel, The Netherlands, E-mail kees.camphuysen@wxs.nl

Since the mid 1980s, following a marked range expansion and dramatic population growth, continental Great Cormorants Phalacrocorax carbo sinensis, *increasingly use Dutch coastal waters as a feeding area. Fishing Great Cormorants are now commonly seen at sea within 15 km of the nearest coast and small numbers disperse further out to sea. Small beam trawlers, mainly targeting Brown Shrimp* Crangon crangon, *are the dominant fishery of these waters and Great Cormorants were soon seen to attend these vessels. Recent observations indicate that, in contrast to other ship-following seabirds, Great Cormorants forage continuously during the towing of nets, even when no discards are produced on board. It is suggested that these birds prey on disturbed fish or other prey, just behind the moving nets that rupture the bottom. This feeding technique has not previously been observed in any species of seabird in the North Sea.*

Camphuysen C.J. 1999. New feeding technique of Great Cormorant *Phalacrocorax carbo sinensis* at beam trawlers. Atlantic Seabirds 1(2): 85-90.

The continental race of Great Cormorant *Phalacrocorax carbo sinensis* typically inhabited inland wetlands in The Netherlands during most of the 20th century (Van Eerden & Gregersen 1995). The population increased from 4500 pairs in 1978 to 20 000 pairs in the early 1990s, while the number of colonies increased from five in 1978 to 27 in 1993. New colonies became established along the coast (e.g. Lok & Bakker 1988; Leopold & Van den Berg 1992; Camphuysen *et al.* 1995a; Van Dijken 1997; Koks & Hustings 1998) and several of these showed exponential growth. As a result, all recent accounts of the distribution and abundance of Great Cormorants in Dutch coastal waters are now inadequate and outdated (Platteeuw *et al.* 1994; Baptist & Wolf 1993; Camphuysen & Leopold 1994; Stone *et al.* 1995; Leopold & Camphuysen 1998; Camphuysen &

Leopold 1998). At present, Great Cormorants are particularly abundant between April and September, mainly within 15 km of the coast and in smaller numbers further offshore.

Since the mid-1980s, when Great Cormorants became common in the coastal zone, seawatchers have observed these birds in association with fishing vessels (Van der Ham pers. comm.). The first reported cases suggested that perhaps one or two birds attended some of these vessels, but later accounts indicated that Great Cormorants showed structural interest in beam trawlers working Dutch coastal waters. Sightings of tens of cormorants per trawler were reported and were assumed to be feeding on discarded fish along with other scavengers (mainly *Larus* gulls).

During a cruise on board sailing vessel *De Ruimte* on 12 June 1999, the feeding behaviour and foraging distribution of Great Cormorants was studied in detail off the mainland coast of Noord-Holland. Up to at least 50 cormorants attending a small beam trawler towing its gear, also being followed by several hundred *Larus* gulls and some Common Terns *Sterna hirundo*. At the time of the observations, the towing trawler was not sorting fish from the previous catch and was therefore not particularly attractive to scavengers. Typically for such conditions, the gulls and terns followed at some distance and height in a large loose flock. The cormorants, however, were very active. Birds were seen flying towards the beam trawler, landing in its wake and diving. Surfacing birds at some 500 m behind the vessel would take wing, fly towards the trawler again, land and dive. Surfacing and diving cormorants were visible in a broad path in the wake of the trawler and new flocks of birds arriving from several directions immediately joined the frenzy. There was no doubt that the birds were fishing successfully, given the head-up postures with extended throats of surfacing birds. As the trawler did not produce fishery waste, the birds must have been targeting alternative prey. A similar sighting, of seven Cormorants feeding in the wake of a towing shrimper, followed by nearly 500 non-feeding *Larus* gulls, was reported shortly afterwards (M.F. Leopold pers. comm.).

Shrimpers (or shrimp beam trawlers) of the 70-191 kW fleet operate 7 or 8 m beams on either side of the ship (Fig. 1), a vertical net opening of 0.5-0.65 m, a total gear mass of *c.* 760 kg on either side and a towing speed relative to the bottom of 2.5-3 knots (Lindeboom & De Groot 1998). Just in front of the net, a heavy chain loaded with 30-32 bobbins of modified rubber (210 mm diameter) rolling over the bottom is designed to chase Brown Shrimp *Crangon crangon* up from the sediment, most of which end up caught in the net. Beam trawlers targeting flatfish use heavier gear and have tickler chains in front of the net dragging through the bottom. The smaller type (191- 221 kW subfleet; including Eurokotters), also common in coastal waters, have an average towing speed of 3.6-4.5 knots and often operate 9 m beams with a total mass of 3900 kg

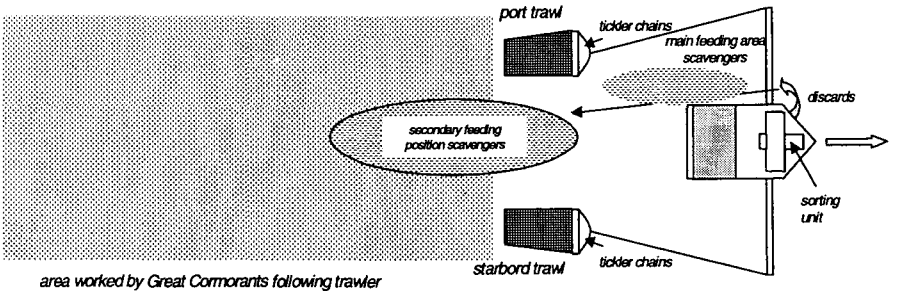
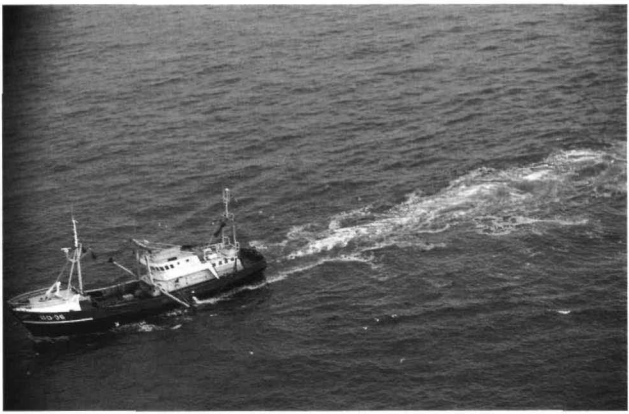


Figure 1. Schematic representation of towing beamtrawler or shrimper, showing port and starboard trawls, sorting unit, discards release, main and secondary feeding area for scavengers, and trail area worked by cormorants (see text).

Figuur 1. Schematische weergave van een vissende boomkor- of garnalenvisser, met het bakboord en stuurboord vistuig, de plaats waar vis wordt gesorteerd en waar ondermaatse vis (discards) in zee valt, de belangrijkste en secundaire posities voor visafval etende vogels en het kielzog waarin aalscholvers tijdens de trek actief zijn (zie tekst).

on either side of the ship. Both gear types disrupt the bottom to a certain extent, stirring up bottom dwelling organisms that will partly escape on either side of the gear. The result is a path of (partly) damaged organisms that is known to be harvested by benthic scavengers such as Common Starfish *Asterias rubens* and Hermit Crab *Pagurus bernhardus* (Fonds 1994), but fish that are only disturbed or escape are assumed to survive. There is little doubt that many of these will be rendered available in this path behind a shrimper or beam trawler and the observations of the foraging cormorants suggest that these birds target such prey. If so, the cormorants exploit a source of food that was not previously harvested and add (indirectly) to the fishing mortality caused by beam trawlers.

In order to obtain a better idea of the scale of use of small beam trawlers by foraging cormorants and to gain insight into their feeding techniques, documented sightings of foraging cormorants associated with beam trawlers are needed. In particular, information about the behaviour and foraging positions of cormorants in relation to the production of discards by the ship would be valuable. The latter can be deduced from the behaviour of other scavengers and from the position of the beams of the trawlers. Towing vessels



Aerial view of towing beam trawler *luchtfoto van boomkorvisser tijdens de vistrek* (C.J.) Camphuysen)

steam rather slowly, have lowered beams (nearly horizontally), with visible ropes, leading diagonally into the water behind the ship, and are often followed by seabirds. When the ship is sorting the previous catch during towing, some crew members are usually visible on deck and scavenging seabirds will form a feeding frenzy on one side of the ship and also in its wake (Camphuysen 1993b; Fig. 1). When there are no discards produced, gulls and other seabirds will follow at some distance in a loose flock and only occasionally dive to pick up something from the surface of the sea. Other activities of these vessels are net cleaning (steaming full speed with open nets dragged through surface waters), lifting the net (ship stationary, nets being hauled in), or just steaming (steaming full speed, nets on deck, beams upright). Routine information such as date, time, location, number of birds attending, position and behaviour of the cormorants should also be recorded.

Apparently, in the course of a successful adaptation to a new environment and a new prey spectrum, the continental Great Cormorant has developed a new foraging technique, entering a niche that was not previously

occupied by seabirds. Few authors have reported the presence of cormorants or Shags *Stictocarbo (Phalacrocorax) aristotelis* behind fishing vessels (e.g. Hillis 1971; Camphuysen 1993a), and very few were reported during extensive studies of the use of discards by seabirds in the North Sea (Camphuysen *et al.* 1995b). Ewins (1987) described how Black Guillemots *Cepphus grylle* swam or flew into the area behind hauling trawlers and suggested that these diving auks preyed on fish escaping from the net. Otherwise, deep-diving seabirds are not normally seen around fishing trawlers, and if the explanation of the observed behaviour is correct then this is a new phenomenon that is unique to beam trawling.

ACKNOWLEDGEMENTS

Bernard Spaans, skipper of "De Ruimte', is to be thanked for his permission to stay onboard. Mardik Leopold and Maarten Platteeuw kindly commented on an earlier draft of this note. Jim Reid corrected the English.

SAMENVATTING

De continentale vorm van de Aalscholver Phalacrocorax carbo sinensis *was in Nederland tot voor kort vooral een viseter in de binnenwateren. Nadat de populatie sinds 1978 snel in omvang is toegenomen vestigde de soort zich ook in de kustwateren. De afgelopen jaren zijn de aantallen langs de kust zo sterk toegenomen dat geen verspreidingsatlas nog een adquate beschrijving van hun voorkomen geeft. Zeetrektellers constateerden al snel dat Aalscholvers belangstelling vertoonden voor garnalenvissers en kleine boomkorvissers langs de kust. Tijdens een zeiltocht voor de Noord-Hollandse kust ontstond de mogelijkheid om zo'n groep Aalscholvers wat beter te bekijken. De dieren bleken in het kielzog te foerageren terwijl de trawler zijn netten over de bodem trok, maar geen visafval overboord zette. De overige scheepsvolgers deden daarom weinig anders dan 'meevliegen'. Geattendeerd op dit geval hebben andere waarnemers hetzelfde een week later gezien bij een garnalenvisser voor de Hollandse kust. De waarnemingen suggereren dat de aalscholvers profiteren van opgejaagde of misschien juist ontsnapte of licht beschadigde vis, vlak achter de netten, in het verruïneerde pad dat zo'n trawler op de bodem achterlaat. Dit is tevens een oproep aan waarnemers om het gedrag van Aalscholvers achter dergelijke vissersvaartuigen te beschrijven en te rapporteren. De Aalscholver lijkt zich in korte tijd met succes te hebben aangepast aan een nieuwe omgeving, nieuwe prooien en zich zelfs nieuwe foerageertechnieken eigen te hebben gemaakt.*

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News and notices

7TH SEABIRD GROUP CONFERENCE 2000

17 - 19 March 2000, WILHELMSHAVEN, GERMANY

The Seabird Group will start the new millennium by holding its 7th conference in Wilhelmshaven, north-west Germany, 17-19 March 2000. This will coincide with the EXPO by the Sea, the maritime section of EXPO 2000 in Hannover. The conference will be our first outside UK, and will be hosted by Institut für Vogelforschung 'Vogelwarte Helgoland'. We hope that the location will enable more continental seabird biologists to be able to join us, to make this a truly international meeting, and a suitable way to welcome the new millennium.

The main topic for the meeting will be *'Seabird Reproduction'*, but as in previous years, offers of papers on other aspects of the biology of marine birds will be most welcome.

The deadline for the submission of oral (< 20 min) or poster papers (maximum of 0.5 page, with title, name and postal address) is 15 November 1999. The conference language is English. Abstracts should be submitted to Peter H. Becker, preferably by e-mail: ifv@ifv-terramare.fh-wilhelmshaven.de (subject Seabird Group Conference), or by ordinary mail to:

Dr Peter H. Becker
Institut für Vogelforschung 'Vogelwarte Helgoland',
An der Vogelwarte 21,
D-26386 Wilhelmshaven,
Germany
Fax +49 4421 968955

You can reach Wilhelmshaven by train from airports in Bremen or in Hamburg, both of which have regular flights to London or Frankfurt. We plan excursions to Helgoland and to the Wadden Sea after the conference.

Registration of initial interest should be sent to Peter H. Becker, and details of registration and organisation will be available in September 1999, or on the conference homepage: http://home.t-online.de/home/O.Hueppop-IfV/seab2000.htm

De zevende Seabird Group Conference zal niet in Groot Brittannië worden georganiseerd, maar in Wilhelmshaven (Duitsland) van 17-19 maart 2000. Het thema van het congres is 'Zeevogel reproductie', maar lezingen over andere (zeevogel) onderwerpen zijn zoals gebruikelijk eveneens welkom. Aanbiedingen voor lezingen en posters moeten vóór 15 november 1999 ontvangen zijn bij Peter Becker.

TRENDS IN SEABIRD SYSTEMATICS: RECENT, SOMETIMES CONFLICTING DECISIONS OF BOURC AND CSNA

In the presentation of his list of Recent Holarctic Bird Species, Voous (1973) was convinced, after consultation with many ornithologists from all parts of the world, that the time had not arrived for an attempt to reach reasonable agreement on a list of bird species of the world. Today, more than 25 years and several world lists later, and while the enormous undertaking the Handbook of the Birds of the World (Del Hoyo *et al.*[in series]) is well under way, consensus has still not been reached. While Voous' lists (1973, 1977ab) have been the standard for many years, several amendments have been published by the BOU Records Committee (BOURC) and more recently by the Dutch committee for avian systematics (CSNA). For *Atlantic Seabirds*, a joint venture between a UK and a Dutch organisation, this means that different lists and sequences, even different systematic principles, have been adopted in either country.

The debate will go on, no doubt. Meanwhile, there is scope for confusion and there is an increasing risk for misunderstanding. For example, most ornithologists refer to the Lesser Black-backed Gulls *Larus fuscus* as a polytypic species that includes a very black, small and slender nominate race in the north and east of Europe, and two paler, bulkier races around the North Sea (*L.f. graellsii* and *L.f. intermedius*). The CSNA considers the Baltic Gull *L. fuscus* and Lesser Black-backed Gull *L. graellsii* as specifically distinct, and '*intermedius*' is considered conspecific with *graellsii* (Sangster *et al.* 1999). Similar decisions were published for the soft-plumaged petrel complex *Pterodroma mollis/maderia/feae*, for Cory's Shearwaters *Calonectris diomedea/borealis/edwardsii*, Manx Shearwaters *Puffinus puffinus/yelkouan/mauretanicus*, the herring gulls/yellow-legged gull complex *Larus argentatus/cachinnans/michahellis*. Previously, the BOURC has suggested changes to the British and Irish List (e.g. BOURC 1991, 1998). For example, *Sula bassana* was changed to *Morus bassanus*, a proposal adopted by CSNA only in 1997. The mediterranean subspecies of Manx Shearwater was accorded species status *Puffinus yelkouan* (including subspecies *mauretanicus*), while the nominate was now considered monotypic. However, CSNA has split this complex (for Europe) into three distinct taxa (Table 1; Sangster *et al.* 1999).

Attempts for a definitive (European) list are now under way, but there are no grounds for believing that consensus will be reached soon. We hope to regularly inform readers of *Atlantic Seabirds* of recent developments and decisions by various authorities in this section. In this first contribution, foregoing differences are highlighted. An overview of the main differences be-

Table 1. Nomenclature of seabird species as proposed by Voous 1977 and as currently in use in Britain (BOU 1998) and in The Netherlands (CSNA 1999).

Voous 1973	BOURC 1991, 1998	CSNA 1999
Soft-plumaged Petrel *Pterodroma mollis* (incl. subsp. *feae, madeira*, and *mollis*)		**Fea's Petrel** *Pterodroma feae;* **Zino's Petrel** *Pterodroma madeira;* **Soft-plumaged Petrel** *Pterodroma mollis*
Cory's or **Mediterranean Shearwater** *Calonectris diomedea* (incl. subsp. *diomedea, borealis* and *edwardsii*)	**Cory's Shearwater** *Calonectris diomedea* (incl. subspecies *diomedea, borealis* and *edwardsii*	**Cory's Shearwater** *Calonectris borealis;* **Scopoli's Shearwater** *Calonectris diomedea;* **Cape Verde Shearwater** *Calonectris edwardsii*
Common or **Manx Shearwater** *Puffinus puffinus* (incl. subsp. *puffinus, yelkouan* and *mauretanicus*)	**Manx Shearwater** *Puffinus puffinus* (monotypic) **Mediterranean Shearwater** *Puffinus yelkouan* (incl. subsp. *yelkouan* and *mauretanicus*)	**Manx Shearwater** *Puffinus puffinus* (monotypic); **Balearic Shearwater** *Puffinus mauretanicus;* **Yelkouan Shearwater** *Puffinus yelkouan*
Northern Gannet *Sula bassana*	**Northern Gannet** *Morus bassanus*	**Northern Gannet** *Morus bassanus*
Shag *Phalacrocorax aristotelis*	**European Shag** *Phalacrocorax aristotelis*	**European Shag** *Stictocarbo aristotelis*
Great Skua *Stercorarius skua*	**Great Skua** *Catharacta skua*	**Great Skua** *Stercorarius skua*[1]
Lesser-Black-backed Gull *Larus fuscus* (incl. subsp. *fuscus, intermedius* and *graellsii*)	**Lesser-Black-backed Gull** *Larus fuscus* (incl. subsp. *fuscus, intermedius* and *graellsii*)	**Lesser Black-backed Gull** *Larus graellsii;* **Baltic Gull** *Larus fuscus*
Herring Gull *Larus argentatus* (incl. many subspecies)	**Herring Gull** *Larus argentatus* (incl. many subspecies)	**Herring Gull** *Larus argentatus* **Pontic Gull** *Larus cachinnans* **Yellow-legged Gull** *Larus michahellis* **Armenian Gull** *Larus armenicus* **Heuglin's Gull** *Larus heuglini* **Vega Gull** *Larus vegae* **American Herring Gull** *Larus smithsonianus*
Gull-billed Tern *Gelochelidon nilotica*	**Gull-billed Tern** *Sterna nilotica*	**Gull-billed Tern** *Gelochelidon nilotica*

[1] Sangster *et al.* 1997 used *Catharacta skua*, but following subsequent phylogenetic analyses returned to *Stercorarius skua* (Sangster *et al.* 1998).

tween The British and the (new) Dutch list are summarised in Table 1, showing names proposed by Voous (1973), names used on the British List (BOURC 1998), and proposals by the CSNA (Sangster *et al.* 1999), which have recently been adopted by the Netherlands Ornithologists' Union (NOU).

Underlying the main differences are different systematic principles adopted by either committee. While CSNA has decided to use the Phylogenetic Species Concept (PSC), the BOURC is apparently still working along the lines of the Biological Species Concept (BSC), but it is not clear which taxonomic philosophy forms the basis of their decisions. In the absence of international consensus in these matters, we will have to live with different systems and conflicting lists.

Sinds de lijsten van Holarctische Vogels van Voous (1973, 1977ab) zijn er zowel in Groot Brittannië als in Nederland veranderingen doorgevoerd (BOURC 1998, Sangster et al. 1999). Omdat de commissies die dergelijke veranderingen voorstellen verschillende systematische principes voorstaan is er een steeds groter verschil tussen beide soortenlijsten ontstaan en daarmee een toenemende kans op verwarring door de gebruikers. Voor een tijdschrift dat door een Britse en een Nederlandse organisatie wordt geproduceerd is het uitblijven van internationale consensus een extra handicap. Er rest de redactie vooralsnog weinig anders dan de verschillen in beeld te brengen en in geval van twijfel middels bijvoorbeeld een voetnoot de benodigde duidelijkheid te verschaffen. In deze mededelingen worden de verschillen van drie lijsten (Voous, BOURC en CSNA voor wat betreft de echte zeevogels aangegeven.

BOURC 1991. Records Committee: Fifteenth Report (April 1991). Ibis 133: 438-441.
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Hoyo J. del, Elliott A. & Sargatal J. 1992-97. Handbook of the birds of the world, 1-4. Lynx editions, Barcelona.
Sangster G., Hazevoet C.J., Berg A.B. van den & Roselaar, C.S. 1997. Dutch avifaunal list: taxonomic changes in 1977-97. Dutch Birding 19: 21-28.
Sangster G., Hazevoet C.J., Berg A.B. van den & Roselaar, C.S. 1998. Dutch avifaunal list: species concepts, taxonomic instability, and taxonomic changes in 1998. Dutch Birding 20: 22-32.
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Voous K.H. 1973. List of recent Holarctic Bird Species, Non-passerines. Ibis 115: 612-638.
Voous K.H. 1977a. List of Recent Holarctic Bird Species: Passerines (part 1). Ibis 119: 223-250.
Voous K.H. 1977b. List of Recent Holarctic Bird Species: Passerines (part 2). Ibis 119: 376-406.
Voous K.H. 1980. Lijst van Europese broedvogels, inclusief Nederlandse Vogellijst. Limosa 53: 91-104.

The editors, C.J. Camphuysen & J.B. Reid

A BIBLIOGRAPHY OF THE PROCELLARIIFORMES OR PETRELS

This has been updated and now contains more than 13,600 fully key-worded papers and books with information on these birds. Also cited are about 3,000 other publications supposedly with data on tubenoses that I've yet to see. Most are quite short and minor items. They are listed alphabetically by country of publication, from Australia to Wales. Would any reader of *Atlantic Seabirds*

having access to a suitable library who could help fill some of these missing gaps, please contact me at one of the addresses below? The internet address is as before: http://www.zool.canterbury.ac.nz/jwbibpl.htm

Op internet is een electronisch literatuurbestand beschikbaar met ruim 13.600 titels van publicaties waarin stormvogelachtigen op zijn minst figureren. Dit bestand is geheel van trefwoorden voorzien en alle publicaties zijn in Nieuw Zeeland opgeslagen. In dit bestand zijn ook 3000 titels opgenomen (in alfabetische volgorde per land, van Australië tot Wales) waarvan geen exemplaar beschikbaar is. Lezers van Atlantic Seabirds *met toegang tot een goede bibliotheek worden hierbij opgeroepen om te helpen deze ontbrekende exemplaren te traceren en aan het bestand toe te voegen.*

John Warham, Zoology Department, University of Canterbury, P.B. 4800, Christchurch, New Zealand, j.warham@zool.canterbury.ac.nz

Northern Fulmar *Noordse Stormvogel* (C.J. Camphuysen)

Guidelines for contributors to *Atlantic Seabirds*

We welcome papers on any aspect of seabird biology. The geographical focus of the journal is the Atlantic Ocean and adjacent seas, but contributions are also welcome from other parts of the world provided they are of general interest. Manuscripts should be in English, and three copies of the text complete with tables and figures should be provided when submitted. Manuscripts should be printed on white paper, on only one side of the page, with double spacing and broad margins. Figures should have solid black lines on pure white paper. Scientific names of genera and lower taxa should be in italics but may be underlined when typed. Vernacular names of species should start with capitals, e.g. Northern Fulmar. Do not capitalise group names, e.g. grebes, gulls, corvids. Units and abbreviations should conform to the S.I. system where possible. Use 0.01 and not .01. Use 50%, not 50 percent. Details of statistical analysis, which should always be included, are type of test, the value of the relevant test statistic, the sample size and/or degrees of freedom and the probability level. Commonplace statistical abbreviations such as ANOVA, SD, SE, df, *t*-test, χ^2, *F*, *P*, *n*, *r*, r_S should be used. A post-fix to the test statistic symbol can be used to present the degrees of freedom, e.g. χ^2_3, $F_{12,34}$. and where appropriate, include a reference for the statistic used. Variables, mathematical formulas, and the Latin abbreviation *et al.* should be in italics but may be underlined in the draft version. Do not otherwise use italics or underlining.

The title should be short and concise, a proposal for a 'running head' is welcomed. Avoid too many subdivisions, do not use more than three different types of headings; do not number. Subdivisions should include: Abstract, Introduction, Methods, Results, Discussion, Acknowledgements, and References. The abstract should reflect both content and emphasis of the paper. The Introduction should be restricted to scope, purpose, and the rationale of the study. Limit the information on Material and Methods to what is essential to judge whether the findings are valid. Limit the Discussion to the main contributions of the study in relation to the findings of previous workers. Restrict speculation to what can be supported with reasonable evidence. Acknowledge only those who substantially contributed to the paper. Cited literature should be restricted to significant, published papers. Check your citations carefully against the reference list and vice versa. Examples of literature cited in the text: (O'Connor 1984), (Baudinette & Schmidt-Nielsen 1974) or, in case of more than two authors (Pettifor *et al.* 1988). References in the text should be in order of publication, e.g. (Brown 1974; Anthony *et al.* 1981). In the reference list the literature cited should be in alphabetical order. Titles should be given in the original language. Examples:

Asbirk S. 1978. Tejsten *Cepphus grylle* som ynglefugl i Danmark. Dansk Orn. Foren. Tidsskr. 72: 161-178.

Berger M. & J.S. Hart 1974. Physiology and energetics of flight. In: Farner D.S. & J.R. King (eds) Avian Biology, 4: 415-477. Academic Press, New York.

Greenstreet S.P.R. & M.L. Tasker (eds) 1996. Aquatic predators and their prey. Fishing News Books, Oxford.

Van Eerden M.R. & B. Voslamber 1995. Mass fishing by Cormorants *Phalacrocorax carbo sinensis* at lake IJsselmeer, The Netherlands: a recent and succesful adaptation to a turbid environment. Ardea 83: 199-212.

Provide a 'Samenvatting' in Dutch only if you or one of your friends masters this language; the text should not exceed 250 words. This summary must be easy to read, emphasising biologically relevant findings, while touching only slightly on methods.

Figures need to be definitive, but we prefer to receive raw data underlying figures on file (preferably Excel). Use Arial or Univers for lettering and realise that the diagram may have to be reduced in size. Photographs or slides need high contrast. Illustrations should be numbered in sequence of reference in the text. Legends for the figures should be added after the text, on separate, numbered sheets. Tables should be concise and self-explanatory, carrying a title at the top. Each table should be typed/printed on a separate sheet, numbered in Arabic numerals, with only horizontal lines.

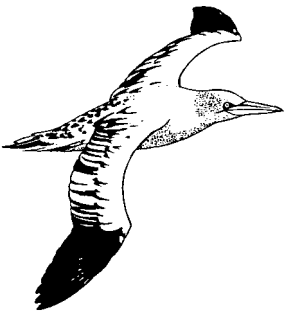
The text of accepted manuscripts should be provided on 3.5 inch diskette, readable for DOS computers, preferably as Microsoft Word file (release 97 or lower), otherwise as ASCII files. Diskettes should be accompanied with a final print produced by the authors. In the proof stage only essential corrections can be made. Corrected proofs should be returned *within two weeks* to the editor.

the **Seabird Group**

was founded in 1966 to circulate news of work in progress on seabirds and to promote research. It is run by an elected Executive Committee and maintains close links with the three major British national ornithological bodies – the British Ornithologists' Union, the British Trust for Ornithology, and the Royal Society for the protection of Birds.

Membership (£10 per annum, £9 if paid by banker's order, £5 for students) is open to all with an interest in seabirds. For details please contact the Membership Secretary (address below) – payment by banker's order halps the Group. Four issues of *Atlantic Seabirds* and three Newsletters are circulated to members each year.

Current Executive Committee Chair S. Wanless, Secretary J. Uttley, Treasurer J.C. Davies, Membership Secretary S. Russell, Editor of *Atlantic Seabirds* J.B. Reid, Newsletter editor M.L. Tasker, also A. Douse, J.D. Okill, E.K. Dunn and S. Sutcliffe.



Nederlandse Zeevogelgroep (NZG)

(Dutch Seabird Group), een sectie van de Nederlandse Ornithologische Unie, werd opgericht op 1 januari 1991, als voortzetting van de Club van Zeetrekwaarnemers (1972-1990) en het Nederlands Stookolieslachtoffer-Onderzoek (1977-1990). De Nederlandse Zeevogelgroep stelt zich tot doel: (1) het stimuleren van zeevogelonderzoek in en vanuit Nederland en (2) het uitwisselen van informatie met de uitgave van het tijdschrift, aanvankelijk *Sula*, vanaf 1999 *Atlantic Seabirds.*

Voor zover samenvallend met onderzoek aan zeevogels worden activiteiten aan zeezoogdieren mede in de doelstelling betrokken. Door een viertal werkgroepen wordt onderzoek gestimuleerd naar broedende zeevogels, de verspreiding van vogels en zoogdieren op open zee (offshore), strandingen, zeetrek en de gevolgen van olievervuiling. De contributie van de NZG bedraagt *f*25 per jaar.

Dagelijks bestuur Voorzitter en Nieuwsbrief redacteur M.F. Leopold, Secretaris J.A. van Franeker, Penningmeester Y. Hermes, Eindredacteur *Atlantic Seabirds* C.J. Camphuysen, en verder A.J. van Dijk, E.W.M. Stienen en C.J.N. Winter.

Atlantic Seabirds
vol 1 no. 2 (1999)

CONTENTS

News and notices

ISSN 1338-2511

Front cover: Common Gulls Stormmeeuwen *(C.J. Camphuysen)*