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

HET VOEDSEL VAN OP DE DUITSE KUST BROEDENDE STORMMEEUWEN

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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.*

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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

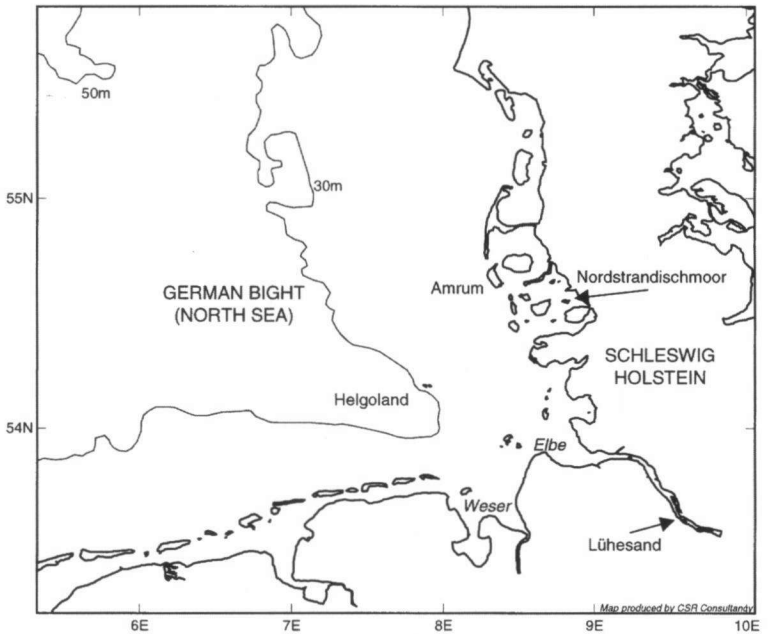


Figure 1. Location of the three colonies studied.
Figuur 1. Ligging van de drie bestudeerde kolonies.

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

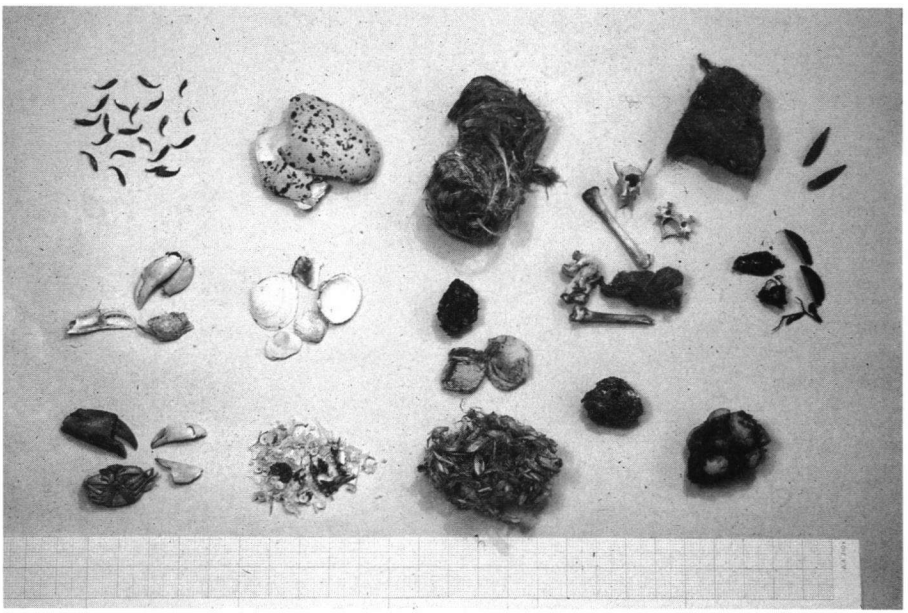


Figure 2. Examples of different types of (items in) pellets. Top row, from left to right: jaws from Nereis worms, egg shells, chick remains, hairs of small mammals, land snails (Clausiliidae); middle row: Carapace and extremities of Liocarcinus holsatus, *bivalve shells,* Empetrum nigrum *berries and 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

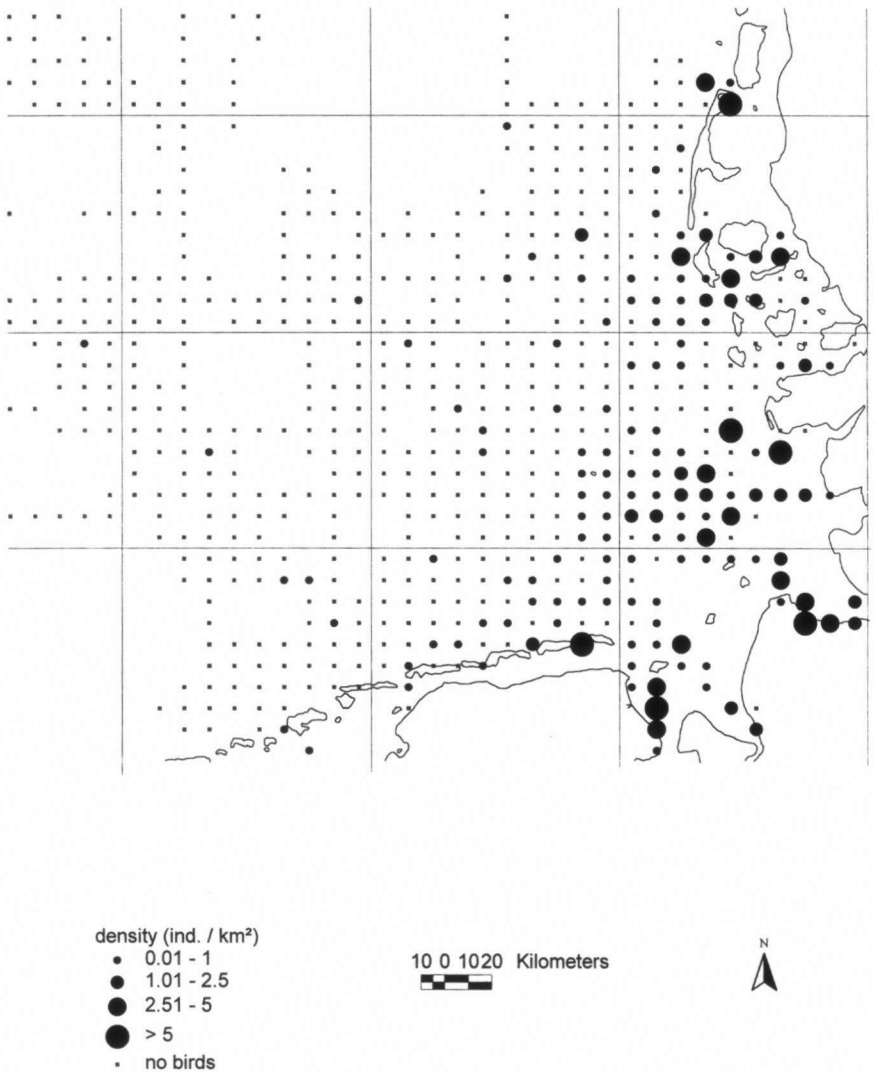


Figure 3. Distribution of Common Gulls in the German Bight during the reproductive season (May to July). Density values given are means for the years 1993-98.

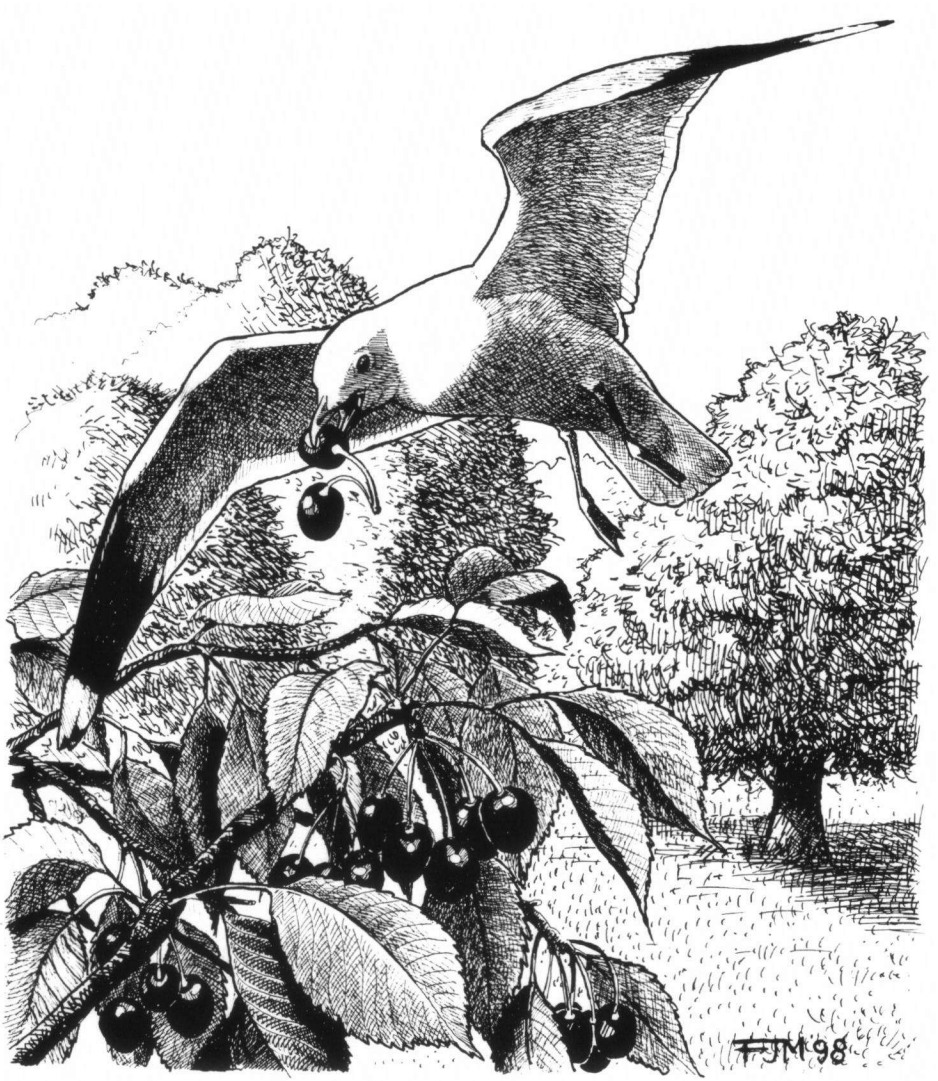
Figuur 3. Verspreiding van Stormmeeuwen in de Duitse Bocht in de broedtijd (mei-jul), gemiddeld over de jaren 1993-98.

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.

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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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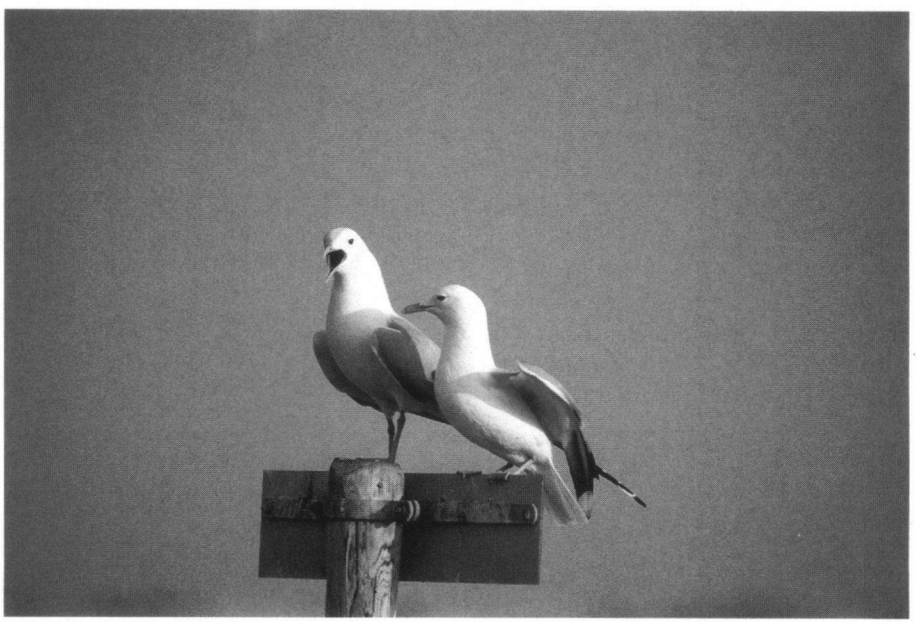

Common Gulls *Stormmeeuwen* (C.J. Camphuysen)