OFFSHORE FORAGING OF MEDITERRANEAN GULLS *LARUS MELANOCEPHALUS* IN PORTUGAL DURING THE WINTER

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Movements and behaviour of Mediterranean Gulls *Larus melanocephalus* were observed along the Atlantic coast of central Portugal in December 2001. The observations suggest that at least part of the Mediterranean Gull population wintering in central Portugal feeds extensively at sea and possibly during the night. In the morning, Mediterranean Gulls flew in straight lines towards the coast, where they settled on water to roost in flocks of several tens of birds. Because there were no gulls near the coast at sunrise, it is assumed that these arrivals were Mediterranean Gulls that had spent the night out at sea. With an estimated 'ground speed' corrected for wind speed, it was estimated that the birds could have covered several tens of kilometres offshore between sunrise and the peak of coastal arrivals. One late afternoon, there were no roosting birds at the coast, but foraging birds were observed which were apparently successful. The question is raised whether the foraging activity is solely restricted to the hours around sunrise and sunset, or whether it is truly nocturnal. Changes in prey availability resulting from vertical migrations in the water column may have influenced diurnal patterns in foraging activity of the gulls. Alternatively, the possible utilisation of discards cannot be ruled out, since night-active purse seine vessels normally discharge discards early morning. However, outside the breeding season, the Mediterranean Gull is so far only known to attend trawlers during the day.

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INTRODUCTION

The Mediterranean Gull *Larus melanocephalus* has undergone a spectacular expansion of its breeding range in the last decades, from its main quarters in the Black Sea (over 90% of the world population, Nanikov 1996) towards north and western Europe (Meininger & Beckhuis 1990). The winter distribution of Mediterranean Gulls along the Atlantic coasts of western Europe, Northwest Africa and along the Mediterranean coasts, has been documented with a colour-ringing program (e.g. Baccetti *et al.* 1999, Boschert & Dronneau 1999, Meininger *et al.* 1999, Varga *et al.* 1999).

Little is known of the foraging ecology of the Mediterranean Gulls outside the breeding season, when the species apparently shifts from terrestrial to coastal and marine food sources. Although the marine environment is

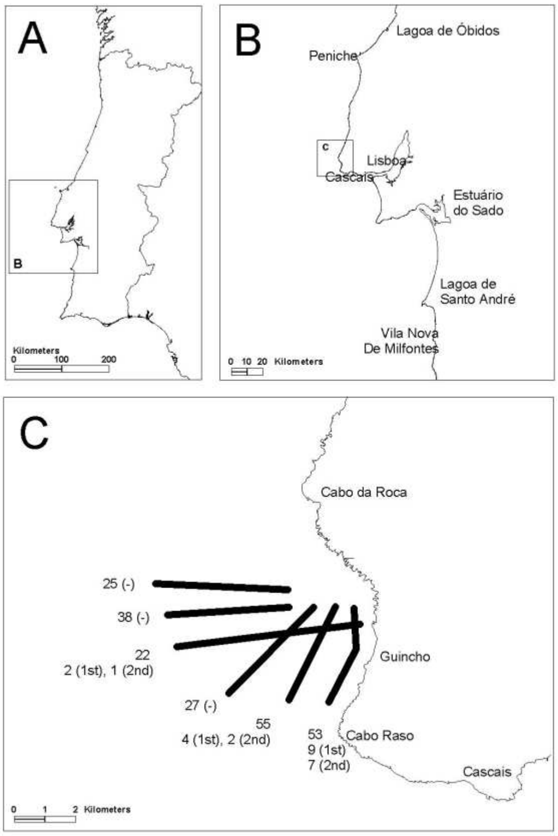

Figure 1. A. Overview of Portugal; B. Portuguese coast with names of lagoons and settlements; C. schematic flight paths of Mediterranean Gulls flying towards the coast of Cabo Raso near Cascais, early morning 29 Dec 2001 (total number per flight path and the number of first and second year birds). (-) = no age identification.

Figuur 1. A. Overzicht van Portugal; B. Kust van Portugal met namen van lagunes en in de tekst genoemde plaatsen buiten de Cascais regio; C. schematische weergave van vliegbanen van Zwartkopmeeuwen, 's morgens 29 december 2001 naar de kust van Cabo Raso nabij Cascais (totaal aantal per vliegbaan en aantal eerste- en tweedejaars vogels). (-) = geen leeftijdsdeterminaties.

considered important for the wintering Mediterranean Gulls (Snow & Perrins 1998), the information on the diet and feeding habits in winter is sparse.

In early autumn (Jul-Oct), along the west coast of France, large numbers of Mediterranean Gulls occur in temporarily used stop-over sites. These birds feed mainly in shallow coastal waters and on rocky plateaus on tube worms during low tide. Small numbers are seen to forage at sea, often in association with Sandwich Terns *Sterna sandvicensis* and Common Terns *S. hirundo* near the coast (Le Gall & Robreau 1999). Apart from this, large numbers forage here on terrestrial food sources inland on freshly ploughed fields (Hoogendoorn *et al.* 1999), just as in the breeding period. Most reports on offshore foraging come from the Mediterranean, where large numbers are found wintering (Snow & Perrins 1998). Recent studies revealed that Mediterranean Gulls profit from discards produced by offshore fishing vessels (Arcos 2001, Arcos *et al.* 2001, Arcos & Oro 2002.). Just as in autumn in France, large numbers of wintering birds in the Mediterranean forage close the coast on mudflats, and opportunistically on fallen olives in plantations (Baccetti & Smart 1999). Nearshore and onshore foraging is most prominent during bad weather, with the same birds foraging offshore under more favourable conditions (J.M. Arcos *pers. comm.*). In conclusion, wintering Mediterranean Gulls commonly forage in marine areas, but this has thus far received little attention.

In December 2001, the behaviour of Mediterranean Gulls along the Atlantic coast of central Portugal has been studied and details are reported in this paper. Observations included counts of flying birds arriving near the coast, of birds roosting along the coast and studies of the foraging behaviour of Mediterranean Gulls at sea. The results were compared with observations of other seabirds in the area.

METHODS AND STUDY AREA

Observations were made of Mediterranean Gulls flying over sea along the coast near Cascais, central Portugal on three mornings and one late afternoon (Table 1, Fig. 1). On 20, 24 and 27 December the observations were carried out from Cabo Raso, a rocky cliff *c.* 5m a.s.l. On 29 December, observation were done 1.5km further to the north, close to the nearest roosts of Mediterranean Gulls near Guincho on a rocky cliff of *c.* 10m a.s.l.. On 23 December, observations of Mediterranean Gulls were made also near Vila Nova de Milfontes. Two other coastal sites were visited during the last week of December 2001, but no Mediterranean Gulls were found there (Lagoa de Santo André on 23 Dec 2001 at 17.15 and Lagoa de Óbidos on 28 Dec 2001 at 17.30). Special attention was paid to Mediterranean Gulls flying out at sea near Cabo Raso and Guincho. In order to discover the birds in time (i.e. on the horizon), a 30x telescope and 10x binoculars were used. Observations of flying and roosting birds were logged per minute. On 29 December 2001, the age of all birds near Guincho was determined (first year, second year and adult; Grant 1986). Only birds flying at <1 km distance were close enough to be properly aged. The third morning (29 Dec), also flight paths were classified in five direction-distance classes relative to the coast (Fig. 1).

RESULTS

Flight movements in the morning towards the coast On the morning observations conducted from Cabo Raso, attention was drawn to Mediterranean Gulls flying in small flocks far out to sea and towards the coast. The birds were discovered by telescope at an estimated distance of about 4 km. The birds flew in straight lines to the coast, where they settled behind the surf to roost in flocks of up to several tens of birds. When approaching the coast, some birds turned to fly parallel to the shoreline (Fig. 1c). Eventually, these birds joined the scattered flocks resting on the water in front of the beaches of Guincho, between Cabo da Raso and Cabo da Roca. The timing of the observations was different on 20 and 29 December, but the early morning flights of Mediterranean Gulls were apparently very similar in scale and timing (Table 1). On 24 December, however, the arrival seemed delayed (Fig. 2) and the first flocks arrived at 10.48, perhaps as a result of strong offshore winds. On this day, due to the strong wind, the birds flew with powerful wing beats low over the water, in line formations with small inter-individual distances. On average the flocks were larger than on the other days (Table 1), when the birds flew in broad, scattered fronts with large inter-individual distances of several up to a few tens of metres.

In the morning of 29 December near Cascais, 135 out of a total of 220 birds could be aged (61.4%): 11.9% 1st year, 7.4% 2nd year and 80.7% adults. Proportionally many 1st year birds were observed in the two flight path categories nearest and parallel to the coast (Fig. 1c). In Vila Nova de Milfontes the proportion of first year birds was estimated to be around 10%.

Roosting along the coast during the day As soon as the Mediterranean Gulls arrived at the coast, they settled on the water behind the surf. Most birds landed near widely scattered flocks of tens to a few hundreds of Lesser Black-backed Gulls *Larus graellsii*. The Mediterranean Gulls usually kept some distance from the flocks of Lesser Black-backed Gulls. Small numbers joined floating flocks of a few tens of Black-headed Gulls *Larus ridibundus*. When roosting, the birds floated usually just behind the surf or up to a few hundred metres behind it. In the morning of 29 December 2001, however, a flock of over 100 individuals was seen afloat at over 1.5 km from the coast. Smaller concentrations could easily have been missed at this distance. In the early morning of 24 December, there were no birds on the water near the coast (10:10h; Table 2). Similarly,

Table 1. Number of Mediterranean Gulls flying towards the coast (n) between Cabo Raso and Guincho (Cascais, central Portugal) and wind conditions on three mornings in December 2001.
Tabel 1. Aantal Zwartkopmeeuwen vliegend naar de kust (n) tussen Cabo Raso en Guincho (Cascais, midden Portugal) en de heersende wind op drie ochtenden in december 2001.

morning	observation time	time of flight movements	*n*	inter-quartile range flock sizes (25-75%)	wind (B)
20 Dec	10:00-11:00	10:00-11:00	55	2.0 – 5.75	E 4
24 Dec	10:10-12:30	10:48-11:55	84	2.0 – 8.25	E 6
29 Dec	8:10-10:50	8:10-9:00	4	(2.0)	E 2-3
		9:00-10:00	49	1.0 – 3.0	E 2-3
		10:00-10:50	82	1.0 – 4.0	E 2-3

Table 2. Number of Mediterranean Gulls roosting locally on water near Guincho (Cascais, central Portugal), on three mornings in December 2001.
Tabel 2. Aantal Zwartkopmeeuwen rustend ter plekke op het water nabij Guincho (Cascais, midden Portugal), op drie ochtenden in december 2001.

morning	time	total number of birds	individual flock sizes
20 Dec	11:45	106	94, 2, 10
24 Dec	10:10	0	-
	12:25	74	16, 5, 26, 12, 15
29 Dec	8:10	0	-
	10:50	>140 (220)	10, 30, >100

early morning of 29 December 2001 (8:10h) the complete strip of coast near Cabo Raso to Cabo da Roca was checked and no roosting birds were seen anywhere.

With a few exceptions, Mediterranean Gulls near Guincho always roosted on water. Only solitary birds or small flocks settled on rocks, often joining small flocks of Yellow-legged Gulls *Larus michahellis*. Such flocks were often disturbed by people on the beach. On 23 December 2001 between 13.00 and 14.45 hour in Vila Nova de Milfontes a flock of 320 birds was present on the water of the river near the centre of the village. Some birds were standing on tidal river flats, but here too nearly all birds were seen floating on the water.

Foraging behaviour of gulls in the late afternoon In the late afternoon of 27 December 2001 only a few Mediterranean Gulls were present on the water

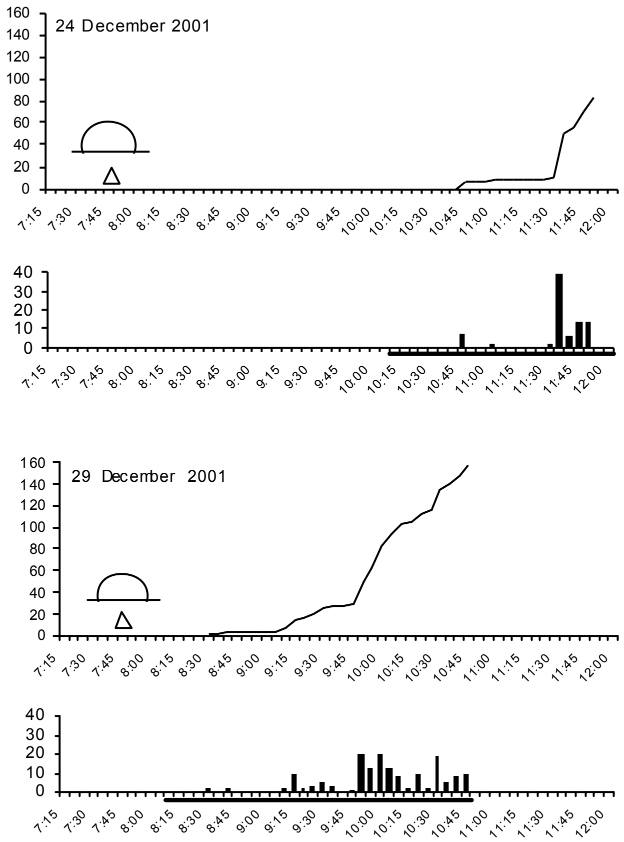

Figure 2. Timing of Mediterranean Gulls flying towards the coast of Cabo Raso near Cascais, W coast of Portugal in the morning of 24 and 29 December 2001. The line is a cumulative graph of flying birds approaching the coast per 5-minute period and reflects increasing numbers roosting locally. Sunrise is indicated. Bars depict the numbers of flying birds per 5-minute period. The black bar along the x axis indicates the observed period.

Figuur 2. Naar de kust vliegende Zwartkopmeeuwen bij Cabo Raso bij Cascais (westkust Portugal), in de morgen van 24 en 29 december 2001. De lijn is een cumulatieve weergave van het aantal vogels 5min^{-1} dat naar de kust vliegt en weerspiegelt het toenemende aantal dat ter plaatse op het water rust. Het moment van zonsopkomst is aangegeven. De staafdiagram geeft het aantal langsvliegende vogels 5min^{-1}. De zwarte balk onder de x-as geeft de waarnemingsperiode weer.

along the coast of Guincho. Most birds had probably already left the area to forage at sea. At 16:45h a flock of 6 Mediterranean Gulls was performing remarkable acrobatic flights low over the water and headed off the coast to fly out far at sea until it was out of sight. At 17:05h, 3 adult Mediterranean Gulls were seen searching, flying against the moderate NW wind. The birds deployed several foraging techniques: shallow plunge diving, surface dipping, pattering and surface seizing (*cf.* Ashmole 1971). The three birds stayed in close contact with eachother. Between 17:10-17:20, these birds were joined by three Lesser Black-backed Gulls, which foraged in more or less the same manner. After 17:20 the Mediterranean Gulls left the foraging spot and continued flying low over the water in search flight far at sea until they were out of sight. At 17:30 a flock of 35 Lesser Black-backed Gulls was foraging in the same spot. At 17:40 three adult Mediterranean Gulls, possibly the same birds as before, were observed foraging among the flock of Lesser Black-backed Gulls.

On this late afternoon at 16:30 it was observed that large numbers of gulls flew out to sea (mainly Lesser Black-backed Gulls and Yellow-legged Gulls). At 17:45, with the sky almost completely dark, large numbers of gulls were soaring high in the sky far at sea (>2km). Meanwhile, Lesser Black-backed and Yellow-legged Gulls were actively foraging along the coast and with success given the frequent inter- and intraspecific kleptoparasitic pursuits. Black-headed Gulls were only seen foraging in small flocks within 500m from the coast.

DISCUSSION

Vila Nova de Milfontes was known as a wintering site for Mediterranean Gulls along the Alentejo coast (Moore 1998), but the coast near Cabo Raso and Guincho had not previously been identified as such. Recent observations of large concentrations suggest a sharp increase in the winter population of Mediterranean Gulls in Portugal (e.g. 1100 birds in December 1998 roosting on salinas near Faro in south Portugal; P. Rock unpubl. data). Very little was known about their (winter) feeding habits in this area. The species was believed to occur mainly in estuaries and salinas along the coasts, but not offshore (Farinha & Costa 1999). The observations described here suggest that at least part of the Mediterranean Gull population wintering along the central coast of Portugal feeds offshore and presumably mainly during the night.

During four winters of study, the mean (± SD) proportion of adult birds in Portugal was 40.7 ± 25.8 in a studied wintering population of 334–1315 individuals per season (Moore 1992). This is a much lower proportion than found in the present study. Offshore foraging is only indirectly indicated by observations of sudden appearances of large flocks, closely linked to storm conditions, along the coast east of Cascais (Moore 1992) and near Vila Nova de Milfontes (Moore 1998). In these large flocks, adults were relatively numerous, suggesting that adult birds may forage further offshore than younger individuals (in line with the observations presented here).

Mediterranean Gulls are known to forage up to several tens of kilometres from their nesting colonies (Meininger *et al.* 1991). Similar distances should not be a problem for these gulls in winter. Assuming straight flight and constant speed, the Mediterranean Gulls seen to arrive early morning from offshore foraging locations may have travelled at least several kilometres away from the coast. With an estimated ground speed based on allometric equations in relation to wind speed for medium-sized gulls (Spear & Ainley 1997), under the assumption that the birds started to fly back to the coast around sunrise, a maximum flight distance can be estimated. On 29 December, with an estimated minimum 'ground speed' of 39 km h^{-1} (taking into account the 2–3 B winds), the birds could have covered at least 75 km in the two hours between sunrise and their arrival near Guincho (10:00 hour). The late arrival of birds on 24 December could be explained by an estimated ground speed of only 21 km h^{-1} (strong headwinds). Under the conditions observed, the birds should have needed over 3.5 h to cover the same distance as calculated earlier. On 24 December the largest numbers started to arrive near Guincho after 11:30, which is indeed *c.* 3.5 h after sunrise. The calculated distances would allow the gulls to cover the whole continental shelf near Cabo Raso (shelf break at 30-80 km from the coast). The continental shelf can be characterised as relatively shallow (up to ca. 200 m deep), with a high productivity resulting from the abundance of sediments and nutrients carried by the Tagus River and upwelling caused by the Eastern Boundary Currents off the Iberian Peninsula (Borges *et al.* 1997). This is considered to be a very important spawning area for different species of fish, with Sardine *Sardina pilchardus* as the most abundant species, and the area holds an important (purse seine) fishery (Afonso & Carmo-Lopes 1994).

The absence of birds on the coast in the early morning and the timing of the movements observed indicate that the birds spent the night out at sea and this raises the possibility of nocturnal foraging. The birds seem to leave their coastal roosts well before sunset. In the late afternoon, the Mediterranean Gulls were foraging near the coast with large numbers of Lesser Black-backed and Yellow-legged Gulls. It is not clear where these gulls were preying upon, but diurnal patterns in prey availability must be driving factors for timing of their foraging activities. Daily migrations up and down the water column are widely described in literature for many marine (prey) organisms, consisting of many species of fish, crustaceans and squid. These migrations towards the surface usually have two peaks: one after sunset and one at dawn (Blaxter & Hunter 1982), and this might explain the observed activity pattern of the gulls. Further offshore, where there are no observations, commercial fisheries could play a role. The utilisation of discards further at sea, where night active purse seine vessels reject large amounts of discards in early morning (Stratoudakis & Marçalo 2002), can not be ruled out.

It is interesting to compare the foraging activities of Mediterranean Gulls with that of other seabirds feeding near Cabo Raso. At least several hundreds of Balearic Shearwaters *Puffinus mauretanius* were foraging during the day, both in the morning and in the afternoon. The shearwaters operated in flocks of up to 10 individuals, performing regular pursuit plunge-dives (*cf.* Ashmole 1971). In contrast to the foraging gulls, where the foraging activity continued in the dark, the shearwaters completely stopped foraging a quarter after sunset. The same applied for the activity of the large numbers of Northern Gannets *Morus bassanus* present. This species mainly foraged in large temporarily feeding concentrations (occasionally >1500 birds). One such flock, seen north of Cabo da Roca, was associated with a pod of Common Dolphins *Delphinus delphis*. It is of interest to note that dipping or shallow plunge diving Mediterranean Gulls and other gulls commenced or continued feeding in the dark, while deep (pursuit) plunge diving species stopped foraging. Recent studies with logger-equipped Northern Gannets and Northern Fulmars *Fulmarus glacialis* confirm that the plunge diving technique is not used at night (Garthe & Furness 2000, Garthe *et al.* 1999). Obviously, deep diving species that use visual cues to detect prey while still airborne require more light than surface feeding birds such as gulls.

Mediterranean Gulls can be characterised as gentle fliers, able to hang in the wind, hover and make sudden, subtle manoeuvres to catch shallow pelagic prey in the water by surface dipping and surface seizing. Mediterranean Gull could profit from small prey available at the water surface in a natural situation, but could as well utilise resources of food made available in the night around the strong lights of purse seiners, just as Adouin's Gulls *Larus audouinii* (Arcos & Oro 2002). In the NW Mediterranean, however, where Mediterranean Gulls are the second most numerous species attending trawlers during the day, it is not known to show up around purse seiners in the night (Arcos & Oro 2002). Within the Mediterranean, contrary to the observations described here, the gulls returned to the coast to roost in the evening (J.M. Arcos *pers. obs.*).

The question can be posed why offshore feeding gulls return to the coast to roost. The risks for roosting gulls to become disturbed, attacked or kleptoparasitised all seem greater near the coast than further offshore (excluding the completely unknown risks for underwater attack). Mediterranean Gulls at sea are constantly at risk for kleptoparasitic attacks by Parasitic Skuas *Stercorarius parasiticus*, and in the NW Mediterranean these gulls were preferred as victims over other gull species in the area (Arcos 2000). Parasitic

Skuas are much more numerous in coastal waters than offshore, and attacks are therefore more likely to occur in nearshore waters. Nearer the coast, it will be easier to escape from adverse weather conditions simply by settling on land or by seeking shelter behind headlands. The avoidance of predation might motivate the birds not to roost on land as a default. Apart from the presence of terrestrial mammalian predators, there is the danger to fall victim to Peregrine Falcons *Falco peregrinus* and other raptors (Oro 1996; Oliveira 1984; pers. observ.). Roosting Mediterranean Gulls are clearly alert and afraid of aerial predators. In Vila Nova de Milfontes, all Mediterranean Gulls took wing in response to a soaring Buzzard *Buteo buteo*. The availability of undisturbed beaches near Guincho and Cabo Raso is restricted, as this part of coast of Portugal mainly consists of steep cliffs and rocks and many recreational activities occur on the beaches.

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OP ZEE FOERAGEREN VAN ZWARTKOPMEEUWEN *LARUS MELANOCEPHALUS* IN DE WINTER IN PORTUGAL

In december 2001 zijn op drie ochtenden en één namiddag waarnemingen verzameld van Zwartkopmeeuwen *Larus melanocephalus* vliegend over zee en rustend langs de kust nabij Cascais (tussen Cabo Raso en Guincho), Centraal-Portugal. Op basis van de vliegbewegingen van en naar de kust lijkt het erop dat tenminste een deel van de populatie Zwartkopmeeuwen overwinterend langs de kusten van Portugal uitsluitend op zee zijn voedsel vindt. Hetzelfde gaat op voor de grote aantallen overwinterende Kleine Mantelmeeuwen *Larus graellsii*. Gedurende drie ochtenden werd gezien hoe Zwartkopmeeuwen van grote afstand van zee naar de kust kwamen gevlogen om achter de branding op het water te landen en in groepen van meest enkele tientallen exemplaren te gaan rusten. Het is waarschijnlijk dat op de waargenomen dagen de vogels de nacht op zee hebben doorgebracht en niet aan de kust, aangezien in de ochtend daar geen enkele Zwartkopmeeuw werd aangetroffen. Op grond van de aanname dat de vogels op de drie waarneemochtenden vanaf het moment van zonsopkomst naar de kust begonnen te vliegen (ondersteund door aanwijzingen), is berekend dat de vogels tientallen kilometers kunnen hebben afgelegd voordat zij bij de kust werden waargenomen. Mogelijke redenen om in de ochtend terug naar de kust te vliegen om daar te rusten, kunnen predatievermijding en het gemakkelijk kunnen ontvluchten van slechte weersomstandigheden zijn. Het risico om gekleptoparisiteerd te worden door met name kleine jagers is echter aan de kust wel groter. De reden om predatie te vermijden is, naast verstoring door recreatie van mensen, mogelijk ook een verklaring voor het feit dat de vogels langs het bestudeerde deel van Portugal niet of nauwelijks op het land rusten. Tijdens de waarnemingen in de namiddag werden geen rustende Zwartkopmeeuwen waargenomen. Wel werd op dit tijdstip foerageergedrag gezien, waarbij de vogels naar alle waarschijnlijkheid succesvol waren. De vraag kan gesteld

worden of het foerageergedrag van de Zwartkopmeeuwen alleen beperkt is tot een periode rond zonsopkomst en zonsondergang. Het ligt voor de hand te veronderstellen dat er ook 's nacht wordt gefoerageerd. Waarschijnlijk liggen veranderingen in voedselbeschikbaarheid ten gevolge van verticale migratie van prooien in de waterkolom ten grondslag aan de dagelijkse timing van het foerageergedrag van de meeuwen. Een alternatieve voedselbron is dat vogels op zee profiteren van vissersschepen overboord gezette visresten. Het gaat hierbij vermoedelijk om purse-seiners, visserschepen die 's nachts actief zijn en 's ochtends vroeg 'schoon schip maken'. Deze visserschepen hebben het gemunt op grote scholen van jonge haringachtigen (o.a. sardines) voor de vismeelindustrie. De vissen worden 's nachts met behulp van grote lampen naar het oppervlak gelokt en vervolgens ingesloten door een groot staand net dat door middel van een tweede schip om de scholen heen getrokken wordt.

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HERRING GULL *LARUS ARGENTATUS* WINTER DIET AT THE WESTERN BALTIC SEA COAST: DOES ICE COVER MAKE A DIFFERENCE?

STEFAN GARTHE, KATJA WIENCK & INSA CASSENS

Garthe S., Wienck K. & Cassens I. 2003. Herring Gull *Larus argentatus* winter diet at the western Baltic Sea coast: does ice cover make a difference? Atlantic Seabirds 5(1): 13-20. *The diet of Herring Gulls* Larus argentatus *at Kiel Fjord, Baltic Sea, was assessed from pellets collected in a very cold winter (1995-96), in a very mild winter (1997-98) and in spring 1996 for comparison. Bivalves (mainly* Mytilus edulis*) were the most frequently occurring food item in all three periods. Gastropods (chiefly* Littorina spec.*) and crustaceans (mainly* Carcinus maenas*) were following next. Stones and different types of plant material were also quite frequently present in the pellets. Differences between the three periods were not very marked. Crustaceans, algae, grass and stones were most abundantly found in the cold winter. Oligochaetes occurred only in spring. Stones were quite common in the pellets both by frequency and by mass. In the cold winter 1996, mean stone mass comprised 47% of total pellet mass. It is concluded that Herring Gulls did not alter their diet in the cold winter to a major extent.*

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INTRODUCTION

Apart from the breeding season, the winter is considered to be the most demanding time for seabirds, especially because of bottlenecks in food availability (see e.g. Cairns 1992 for a review). Enhanced mortality during this period, partially, but not always enforced by human activities, has been described for many waterbird species (e.g. Meininger *et al.* 1991; Camphuysen *et al.* 1996). This might be particularly so for birds which are living in variable winter climates such as the Baltic Sea (Rheinheimer 1996). There, they are subjected to strongly varying water temperatures and ice cover. It is plausible that such conditions may in general influence food availability. Whereas pelagic species such as auks might avoid ice coverage, Herring Gulls *Larus argentatus* feeding extensively at the shore may be much more affected by severe winter conditions. In cold winters, coastlines become covered by ice; in very cold winters such as the winter 1995-96, also large offshore areas of the southwestern

Juvenile Herring Gull Juveniele Zilvermeeuw *(Stefan Garthe)*

Baltic Sea become ice-covered (Strübing 1996a, 1996b). In order to investigate whether diet changes do occur along with the ambient conditions, we compare the food spectrum of Herring Gulls at the western Baltic Sea coast between a very cold winter with considerable ice coverage and a very mild winter with hardly any ice.

MATERIAL AND METHODS

Diet was assessed from pellets during three markedly different situations. First, in the cold winter 1995-96, Kiel Fjord was nearly completely covered by ice for several weeks. Pellets were collected around the coldest period, on 25 February and 19 March 1996. Ice disappeared around the end of March (Strübing 1996b), and diet was studied again in spring on 16 May. Third, pellets were gathered in the very mild winter 1997-98 on 2 February, 9 February and 6 March 1998, with only very little ice near Kiel Fjord. Pellets were collected at two roosts at the Baltic Sea coast close to Kiel, Germany. At these sites, several tens to a few hundreds of Herring Gulls roosted, with a few Great Black-backed Gulls *Larus marinus*. It was impossible to distinguish between the pellets of the two species but the probability of finding Great Black-backed Gull pellets was less than 10% according to relative bird numbers. Pellets were dried and the contents subsequently analysed to the nearest possible taxon following Kubetzki *et al.*

Table 1. Composition (prey occurrence in %) of pellets collected in 1996 and 1998.
Tabel 1. Voedselsamenstelling (voorkomen in %) op basis van braakballen verzameld in 1996 en 1998.

	cold winter		spring	mild winter		
	25 Feb 1996	19 Mar 1996	16 May 1996	2 Feb 1998	9 Feb 1998	6 Mar 1998
Pellets (*n*)	26	37	75	23	18	36
Bivalves	88	97	87	100	89	94
Gastropods	35	32	21	52	50	19
Polychaetes	8	8	7	9	6	3
Oligochaetes	-	-	8	-	-	-
Crustacea	27	11	29	-	-	-
Fish	8	3	5	-	-	-
Insects	-	3	1	-	-	-
Birds	4	3	-	-	-	-
Mammals	-	3	-	-	6	-
Algae	46	57	13	22	28	17
Grass	42	38	5	13	-	17
Other plant material	12	19	23	9	6	17
Garbage	19	19	11	22	6	6
Stones	65	73	53	78	61	64

(1999). Because of the high proportion of stones in most pellets we estimated their percentage by mass per pellet from a subsample of the pellets collected.

RESULTS

Bivalves were the most frequent food type in the pellets in all three periods investigated (Table 1, Fig. 1), with the Blue Mussel *Mytilus edulis* as the main species throughout the study, but many other species were also found. Bivalves, especially Blue Mussels, made up the bulk of the diet also by mass since most of the pellets contained hundreds of fragments. Gastropods (chiefly *Littorina* spec.) and crustaceans (mainly *Carcinus maenas*) ranked second and third. Stones and different types of plant material were frequently present in the pellets. Differences between the three periods were not very marked. Crustaceans, algae and grass were found significantly more often in the cold winter than in the mild winter (χ^2_1-test of independence, $P < 0.001$ in all three cases). Oligochaetes occurred only in the spring pellets, whereas stones ($P < 0.05$), algae and grass (both $P < 0.001$) were detected more often in the cold winter compared to the following spring (χ^2_1-test of independence). Stones were quite common in the pellets both by frequency (Table 1, Fig. 1) and by mass. In

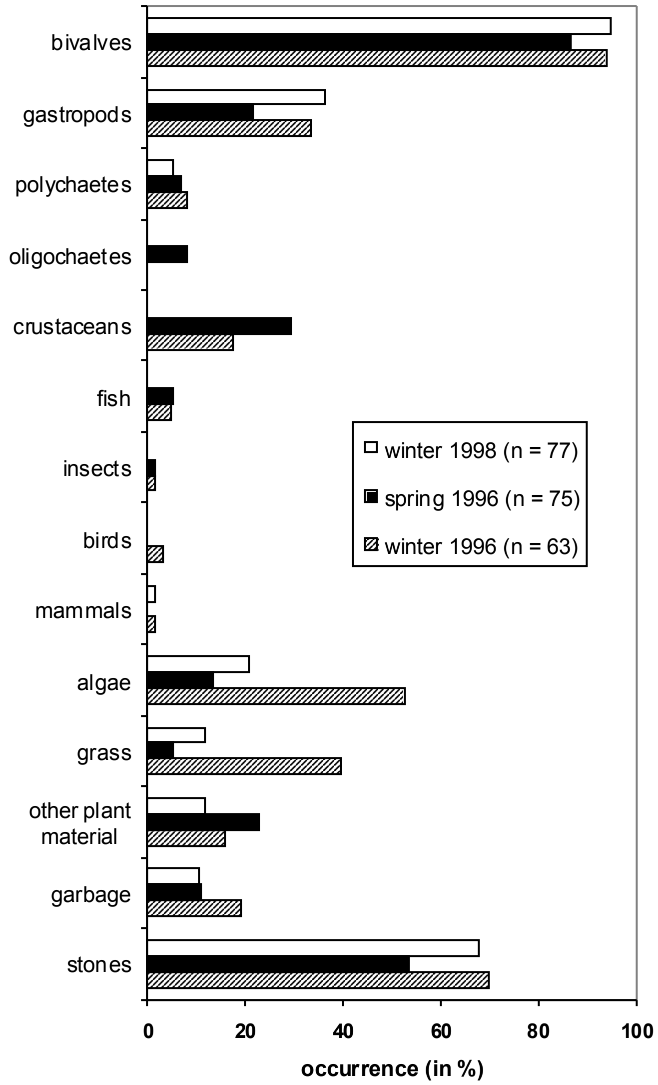

Figure 1. Composition (prey occurrence in %) of pellets collected in the cold winter of 1996, in spring 1996 and in the mild winter of 1998.
Figuur 1. Voedselsamenstelling (voorkomen in %) op basis van braakballen verzameld in de koude winter van 1996, in het voorjaar van 1996 en in de zachte winter van 1998.

the cold winter 1996, mean stone mass comprised 47% (range 0-96%; n = 50) of total dry pellet mass; values for spring 1996 (mean = 9%, range 0-52%; n = 20) and winter 1998 (mean = 15%, range 0-80%; n = 47) were lower.

DISCUSSION

The food choice of Herring Gulls apparent from pellet analysis differed little between the three periods. This is remarkable in so far as the ambient conditions differed fundamentally. The winter of 1995-96 had the highest "ice values" since 1963 (http://www.bsh.de/Meereskunde/Eisdienst/) and have not been reached since then. The same "ice values" ranked close to zero in the mild winter of 1997-98.

Movements of gulls in winter, mostly connected to cold spells, are a common phenomenon in northern Germany (e.g. Prüter 1982; Garthe 1996) so that it is probable that at least some birds leave the area when there is insufficient food. Leege (1943), reporting about the cold winter 1941-42 on the East Frisian Islands, found that Herring Gulls left the ice- and snow-covered Wadden Sea for the mainland because no prey was available at all on the tidal flats. Regular mid-month counts over the years in the study area (count area: Laboe-Bottsand) showed that numbers of Herring Gulls at Kiel Fjord in the cold winter studied were within the range of observations from other years whereas those from the mild winter were lower than usual (Fig. 2; J. Kieckbusch and B. Struwe-Juhl pers. comm.). It remains uncertain whether the birds could meet their energy requirements in the cold winter because pellet analysis does not allow food consumption to be calculated in gulls (e.g. Duffy & Jackson 1986). However, although Herring Gulls are considered to be generalists feeding opportunistically, the birds that produced pellets in the cold winter largely took the same prey as birds staying in the study area in the mild winter. It appears that the birds were able to get food which was thought to be out of reach for them due to ice coverage. As one example, we observed frequent attempts of Herring Gulls stealing mussels from Eider Ducks (*Somateria mollissima*) which might have compensated for reduced food availability. However, such behaviour has also been observed in other, less cold winters (pers. obs.). In contrast to our study, Spaans (1971) showed that percentages of anthropogenic food items increased during periods of deteriorating food availability in the Dutch Wadden Sea area. It is possible that the bivalves, especially Blue Mussels, differed in their origin between the contrasting winters. However, this has not been traced back. Usually, bivalves are exploited by gulls in the littoral zone of the Baltic Sea, particularly in the subtidal on stony beaches and sand banks or when wind causes low tides. Herring Gulls also exploit discards and

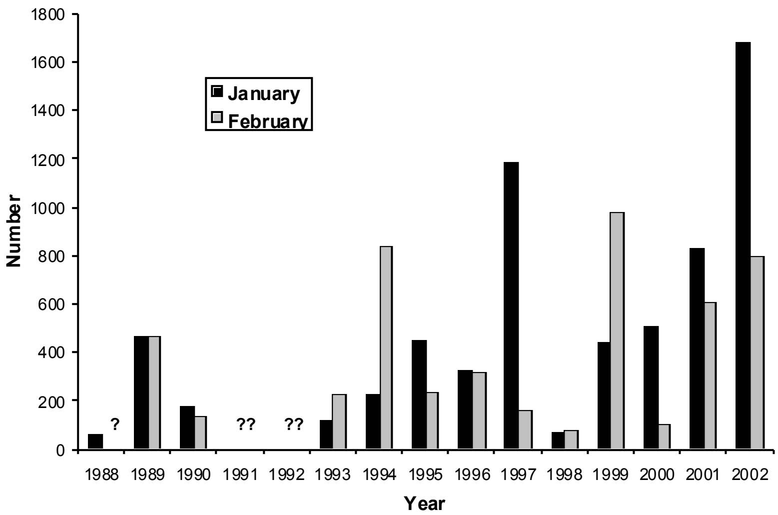

Figure 2. Numbers of Herring Gulls counted during regular mid-month waterbirds counts in the study area (Laboe-Bottsand). Data courtesy of J. Kieckbusch and B. Struwe-Juhl.

Figuur 2. Aantallen Zilvermeeuwen op basis van maandelijkse tellingen in het onderzoeksgebied (Laboe-Bottsand). Gegevens van J. Kieckbusch en B. Struwe-Juhl.

offal from set net fishing boats and trawlers in the Baltic Sea. Although such food remains have also been found in Kiel Fjord, proportions in pellets were much higher further east in the Baltic Sea (Garthe & Scherp *in press*).

Probably the most striking result was the high proportion of stones in the pellets of Herring Gulls. One explanation could be that the gulls took stones to suppress hunger. However, stones have also been found in many pellets in spring 1996 (this paper) and in up to 7% of the pellets collected during the second half of 1999 (Garthe & Scherp *in press*), always at the western Baltic Sea coast. Such observations have neither been made at recent diet studies at the North Sea coast (Hüppop & Wurm 2000; Kubetzki & Garthe *in press*) nor have stones been mentioned to any major extent as stomach content of gulls in the literature (e.g. Vauk & Prüter 1987; Cramp & Simmons 1983). Although stones are sometimes attached to Blue Mussels in the study area, this alone can hardly explain the high percentage (by mass) of stones in the pellets.

It is concluded that Herring Gulls were able to survive in the cold winter 1995-96 without the need and/or the possibility to alter diet to a major extent.

ACKNOWLEDGEMENTS

U. Kubetzki helped with the analysis of food remains. K. Strübing (BSH, Hamburg) provided information on the ice situation. J. Kieckbusch and B. Struwe-Juhl provided data collected by the Ornithologische Arbeitsgemeinschaft für Schleswig-Holstein & Hamburg e.V. U. Kubetzki, M.F. Leopold and an anonymous referee commented on the first draft of this paper. We thank all of them very much.

HET VOEDSEL VAN ZILVERMEEUWEN *LARUS ARGENTATUS* IN DE WINTER IN DE WESTELIJKE OOSTZEE: MAAKT EEN PAK IJS IETS UIT?

De prooikeuze van Zilvermeeuwen *Larus argentatus* in de Kieler Bocht (Oostzee) werd onderzocht aan de hand van braakballen in een zeer koude winter (1995/96), in een zachte winter (1997/98) en in het voorjaar van 1996. Tweekleppigen (hoofdzakelijk Mosselen *Mytilus edulis*) werden het meest frequent aangetroffen in elk van de onderzoeksperioden (tabel 1, figuur 1), op de voet gevolgd door slakken (vooral *Littorina* spp.) en kreeftachtigen (vooral Strandkrabben *Carcinus maenas*). Daarnaast werden o.a. steentjes en allerlei plantaardig materiaal in de braakballen aangetroffen. De verschillen in voedselkeuze tussen de drie onderzoeksperioden waren niet bijzonder groot. Kreeftachtigen, algen, gras en steentjes werden het meest gevonden in de koude winter. Oligochaeten (i.c. regenwormen) werden alleen in het voorjaar in de braakballen gevonden. Geconcludeerd wordt dat Zilvermeeuwen hun menu in de koude winter niet substantieel behoefden aan te passen.

DIE WINTER-NAHRUNG VON SILBERMÖWEN *LARUS ARGENTATUS* AN DER WESTLICHEN OSTSEE-KÜSTE: MACHT EISBEDECKUNG EINEN UNTERSCHIED?

Die Winter-Nahrung von Silbermöwen *Larus argentatus* wurde anhand von Speiballen an der Kieler Förde, westliche Ostsee, untersucht. Die Proben wurden im sehr kalten Winter 1995/96, im sehr milden Winter 1997/98 und für Vergleichszwecke auch im Frühjahr 1996 gesammelt. Muscheln (vor allem Miesmuscheln *Mytilus edulis*) waren die am häufigsten gefundene Nahrung in allen drei Perioden. Schnecken (vor allem *Littorina* spec.) und Crustaceen (hauptsächlich Strandkrabben *Carcinus maenas*) waren die nächsthäufigsten Beutetiere. Steine und verschiedenes Pflanzenmaterial waren ebenfalls recht oft in den Speiballen vertreten. Unterschiede zwischen den drei Perioden waren nicht sehr markant. Crustaceen, Algen, Gras und Steine wurden am häufigsten im sehr kalten Winter gefunden. Oligochaeten (d.h. Regenwürmer) traten nur im Frühjahr auf. Steine waren relativ häufig in den Speiballen; im kalten Winter 1995/96 umfasste ihre mittlere Masse 47 % der gesamten Speiballen-Masse. Anhand der Studie zeigte sich, dass Silbermöwen ihre Nahrung im sehr kalten Winter nicht wesentlich gegenüber dem sehr milden Winter änderten.

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CHARACTERISTICS OF ATLANTIC PUFFINS *FRATERCULA ARCTICA* WRECKED IN THE NETHERLANDS, JANUARY-FEBRUARY 2003

KEES (C.J.) CAMPHUYSEN[1,2]

Camphuysen C.J. 2003. Characteristics of Atlantic Puffins *Fratercula arctica* wrecked in The Netherlands, January-February 2003. Atlantic Seabirds 5(1): 21-30. *An unprecedented 114 Atlantic Puffins were found dead in The Netherlands in a few weeks time, mostly early February 2003. The wreck coincided, but had no relation with the Tricolor oil incident in The Channel and numerous dead Puffins were found in Belgium and northern France as well. The stranding may have involved between 180 and 200 Atlantic Puffins and 51.1% were identified as first winter birds. The birds were clearly starved to death and a mass-stranding of unoiled, severely emaciated Little Auks and Razorbills occurred at the same time. Biometrics (wing length) pointed at British (North Sea?) colonies as a source; none of the casualties was ringed. The wreck coincided with an influx of birds, but the event lasted no more than a few days. Following this wreck, mass mortality of auks has been witnessed in the northern North Sea (Orkney, Shetland, and Norway), and these events may have been related. The event in 2003 was the largest influx and wreck of Puffins in 75 years in The Netherlands.*

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INTRODUCTION

Atlantic Puffins *Fratercula arctica* are scarce passage migrants and winter visitors in Dutch waters, with at most some tens of birds wintering in nearshore coastal waters and 4000-7000 individuals further offshore (Camphuysen & Leopold 1994). Strandings are sparse even in winter, but gradually increase in frequency from October through March (Bijlsma *et al.* 2001). Despite extensive beached bird surveys since the mid-1960s, numbers of Atlantic Puffins reported peaked at only 20 (1987/88) and 35 (1982/83, 1989/90) individuals in some winters, while in other years not a single corpse was found (Fig. 1). Ringing recoveries confirm that Dutch nearshore coastal waters are beyond the normal wintering range of this species (Harris 2002), although Atlantic Puffins breed relatively nearby and in considerable numbers on the British east coast (Lloyd *et al.* 1991). A wreck involving at least 150-200 dead Atlantic Puffins occurred in The Netherlands during February 2003. Although this was an insignificant number of casualties in relation to the North Sea wintering population of

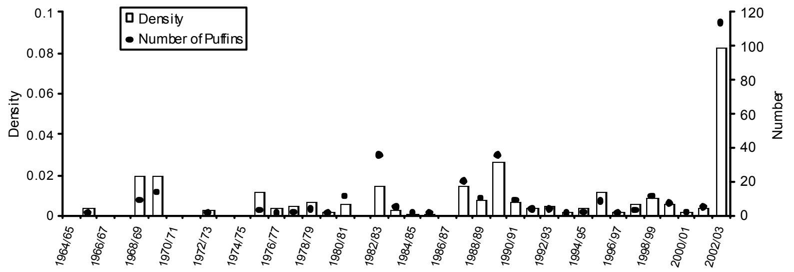

Figure 1. Mean density of Atlantic Puffins found dead in winter (Nov-Apr) along the North Sea coast in The Netherlands (bars) and total number of individuals recorded (dots), based on systematic beached bird surveys 1964/65 – 2002/03 (NZG/NSO unpubl. data).

Figuur 1. Gemiddelde dichtheid van 's winters gevonden Papegaaiduikers (nov-apr) (staafjes) en het totaal aantal gevonden individuen (stippen) langs de Nederlandse Noordzeekust, gebaseerd op systematische stookolieslachtoffer-tellingen 1964-2002/03 (ongepubl. data NZG/NSO).

Atlantic Puffins (Skov *et al.* 1995), this stranding comprised an unusually large number for The Netherlands, and the wreck extended to Belgium and northern France and was perhaps related to auk wrecks in Norway, Shetland and Orkney recorded at the same time or in the weeks immediately following this mass stranding (M. Heubeck, E. Meek, J. Bloggs *pers. comm.*). It was therefore considered useful to collect and examine Puffin corpses washed ashore in an attempt to characterise the birds and to make comparisons with birds collected in other (major) wrecks in the North Sea (Jones *et al.* 1984; Harris *et al.* 1991).

METHODS

Corpses were collected from beaches in The Netherlands during late January and early February 2003. Searching effort has not been complete and along the mainland coast many seabird corpses disappeared unrecorded as a result of bird collectors, clean-up operations and scavengers. As many as possible of the following measurements or observations were made: (a) bill length (tip to feathers and tip to nostril), (b) bill depth (at the gonys), (c) straight bill length (length of the cutting edge of the upper mandible), (d) head length, (e) wing length (maximum flattened chord), (f) tarsus length, (g) body mass, (h) age, based on the number of bill grooves, (i) sex and age by dissection (development and size of gonads, presence and size of bursa *Fabricii*), (j) physical condition (subcutaneous fat, deposited fat and breast muscle), (k) condition of some vital organs (liver, lungs, guts and kidney), and (l) stomach contents. Few corpses were intact or fresh enough for a complete examination.

Harris *et al.* (1991) used four age categories based on the appearance of the bill: (1) first-winter birds (no grooves), (2) immature (less than 2 grooves), (3) intermediate (2 grooves) and (4) adult (more than 2 grooves). In this study we documented the development of the beak by a description and high resolution digital photography. Four categories were recognised, that were slightly different from Harris *et al.* (1991): (1) first winter (dark brownish-red bill, no grooves, (2) immature type (orange bill tip, no or faint bill grooves), (3) sub-adult type (orange beak, 1-1.5 clear bill grooves), (4) adult type (orange beak, $\geq$ 2 clear bill grooves) (Fig. 2). Biometrics, descriptions of feet colour, and internal sex and age were analysed on the basis of these four categories. Some birds without a head were aged provisionally, but only as first winter birds and non-juveniles on the basis on the coloration of their feet (bluish grey or very pale yellow in first winter birds, yellow to bright orange in older categories).

Type 1 First winter

Type 2 Immature

Type 3 Subadult

Type 4 Adult

Figure 2. Examples of bill development in each of the age categories used for the analysis of stranded Atlantic Puffins in the 2003 wreck (J.A. van Franeker).
Figuur 2. Voorbeelden van snavels in de leeftijdscategorieën die zijn gebruikt bij de analyse van in 2003 aangespoelde Papegaaiduikers (J.A. van Franeker).

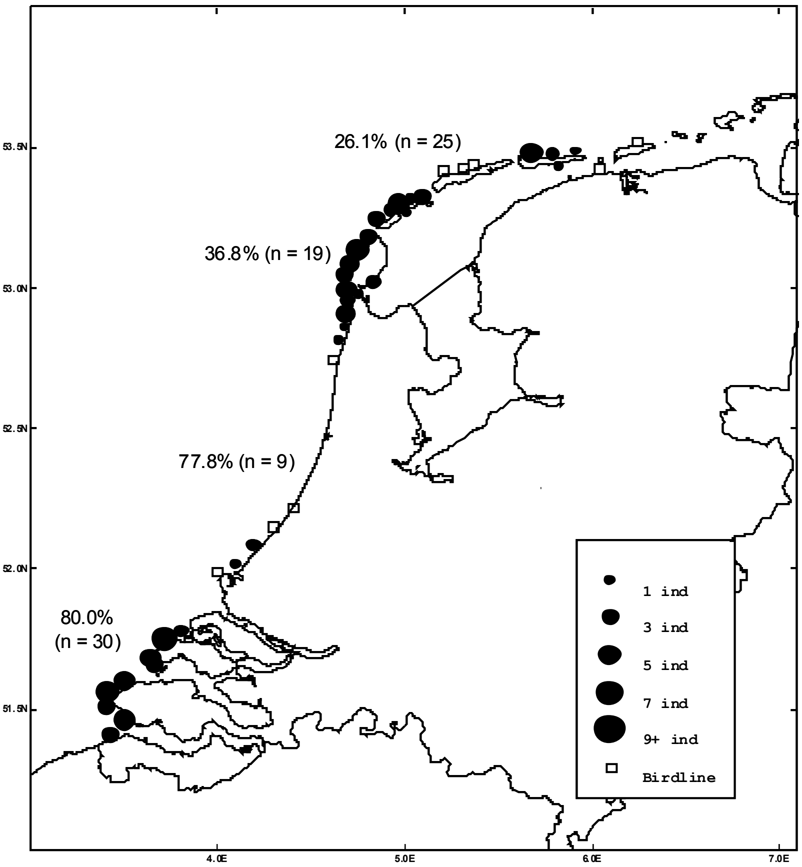

Figure 3. Reported corpses of Atlantic Puffins (n = 114, black symbols) and the proportion of first winter birds (see Table 1) during routine beached bird surveys in The Netherlands, and 12 dead birds reported on the national birdline (squares), January-February 2003.

Figure 3. Aantal kadavers van Papegaaiduiker (n = 114, zwarte cirkels) en het aandeel eerste-wintervogels (zie tabel 1), zoals doorgegeven tijdens de stookolieslachtoffertellingen in Nederland, en 12 dode vogels doorgegeven via de Dutch Birding vogellijn (vierkanten), januari-februari 2003.

RESULTS

In January and February 2003, 114 Atlantic Puffins were found during beached bird surveys (Fig. 3), of which 35% were oiled. A further 12 dead Atlantic Puffins were reported on the national birdline (www.dutchbirding.nl/). Most birds stranded and were found between 5 and 9 February 2003 in a period of calm weather with south-westerly winds, immediately following a three-week period with prevailing strong westerly winds and occasional westerly and north-westerly gales. The mean density of Atlantic Puffin corpses along the North Sea coast in February was 0.39 km^{-1}, whereas previous peak values between 1965 and 2003 were 0.14 km^{-1} in March 1970, 0.13 km^{-1} in March 1990, and 012 km^{-1} in March 1988. Most oiled birds were found in the Delta area, which was at the time affected by the *Tricolor* oil spill (oil leaking carrier that sunk off Dunkerque in France in December 2002), and many appeared to have become contaminated with oil only after death. Relatively low densities were found along the densely populated mainland coast (Zuid-Holland, Noord-Holland; Fig. 3), where corpses washing ashore are most likely to be removed by mammalian scavengers and beach clean-up operations. It is here that dedicated bird collectors were met, aiming specifically at these unusual auks. Their activities must have caused systematic surveys along the mainland coast to produce incomplete, biased data. Allowing for areas not covered (interpolation), removal by bird collectors, scavengers and beach clean-up operations (deploying densities measured in remote areas without mammalian scavengers over similar, nearby coastline with a high risk of corpse disappearance), 180-200 individuals probably washed ashore.

Of 114 Atlantic Puffins recorded, 88 could be aged and 51.1% of these were first winter birds. The proportion of first winter birds declined significantly from south to north when summarised over 4 subregions ($G_{adj} = 19.3$, df = 3, $P < 0.01$; Fig. 3). In all 12 first winter birds where the autopsy could be performed successfully a medium or large bursa *Fabricii* was found and the gonads were typical for first winter auks (oviduct straight and thin, non-structured ovary, thin, often bi-coloured testes). Eight birds were categorised as immatures (probably 3rd calendar year) and those that could be examined internally ($n = 3$) had a medium sized bursa *Fabricii* and slightly developed gonads (e.g. structured ovary). Of four subadults, one had a small bursa, but all had obviously further developed gonads than the two younger groups. Eleven out of 14 adults that could be examined did not have a bursa and the gonads were developed still further than in subadults. The ratio of males ($n = 10$) to females ($n = 14$) was not significantly different from equality (G_{adj}-test).

Biometrics of Atlantic Puffins found dead are summarised in Table 1. The differences between age groups were significant for bill length tip to

Table 1. Bill length (tip-feathers), bill depth (gonys), length of cutting edge of upper mandible, head, tarsus, wing length and body mass (g), in Atlantic Puffins in four age categories based on the number of bill grooves.

Tabel 1. Snavellengte (punt-bevedering), snaveldiepte (gonys), lengte van de snijrand van de bovensnavel, kop, tarsus, vleugellengte en gewicht (g) van Papegaaiduikers per leeftijdscategorie (gebaseerd op het aantal snavelgroeven).

	Bill length	Gonys depth	Cutting edge	Head	Tarsus	Wing	Mass
First winter							
mean ± SE	37.3 ± 0.4	16.9 ± 0.3	31.2 ± 0.3	76.3 ± 0.6	26.7 ± 0.2	149.6 ± 0.8	250.0 ± 8
min	33.7	14.9	29.6	74	25	142	235
max	40.9	19.5	33.5	79	30	162	280
n=	22	20	20	10	26	27	5
Immature							
mean ± SE	40.7 ± 0.3	23.3 ± 0.5	32.2 ± 0.4	78.3 ± 0.3	26.6 ± 0.3	156.1 ± 1.3	-
min	39.7	21.2	30.1	78	25	151	-
max	41.6	24.9	34.4	79	28	163	-
n=	7	8	8	3	9	8	-
Subadult							
mean ± SE	41.8 ± 0.8	24.4 ± 0.6	31.8 ± 0.7	78.3 ± 1.4	26.5 ± 0.3	159.5 ± 1.8	-
min	38.9	21.8	30.0	76	26	154	-
max	44.1	26.4	34.7	82	27	162	-
n=	6	6	6	4	4	4	-
Adult							
mean ± SE	43.7 ± 0.5	27.3 ± 0.4	32.3 ± 0.4	79.0 ± 0.7	26.9 ± 0.3	161.3 ± 1.3	275.0 ± 19
min	39.4	24.1	28.7	76	26	152	245
max	45.5	29.5	35.0	83	29	168	310
n=	16	17	14	13	13	13	3

feathers (ANOVA $F_{3,47}$ = 40.8, P< 0.001), gonys depth ($F_{3,47}$ = 173.4, P< 0.001), and wing length ($F_{3,48}$ = 26.2, P< 0.001), but *not* for cutting edge, head and tarsus (Table 1). Only five first winter birds and three adults were weighed (Table 1). No trace of fat (either subcutaneous or deposited) was found in 13 first winter birds, 4 immatures or subadults and 8 adults sufficiently intact for internal inspection, while the breast muscles in all of these were lean to very lean. One adult bird found on 29 January 2003 in Zeeuws Vlaanderen (near the Belgian border) was in exceptionally good condition when it died, with maximum fat stores and healthy organs. This bird was entirely covered with 2cm of heavy bunker oil from the *Tricolor* spill and its lungs were filled with oil.

None of the birds were moulting primaries, secondaries or tail feathers. Moult of contour feathers (belly, sides, neck and or back) was encountered

Table 2. Wing length of Atlantic Puffins from selected colonies in the North Atlantic (Harris 1984) and wing length of subadults and adults found wrecked in 2003.

Tabel 2. Vleugellengte van Papegaaiduikers in een aantal kolonies in de Noordzee (Harris 1984) en vleugellengte van subadulte en adulte vogels, die gevonden zijn tijdens de 2003-stranding.

Origin	sample	mean	SE	range
Skomer, Wales (52°N)	209	159.3	0.23	152-171
Isle of May, Scotland (56°N)	1615	161.8	0.14	149-176
Hermaness, Shetlands (61°N)	197	161.4	0.28	151-173
Lovunden, Norway (66°N)	190	167.7	0.28	158-178
Svalbard, Norway (78°N)	48	183.8	?	175-195
Adult birds, 2003 wreck, NL	13	161.3	1.3	152-168
Subadult birds, 2003 wreck, NL	4	159.5	1.8	154-162

occasionally in non-juveniles, but not scored systematically. Excessive feather wear was observed in 16 individuals (2 unaged, 3 immatures, 11 first winter birds), where part of or entire flight feathers were worn away to such an extent that only the shaft remained (Fig. 4).

DISCUSSION

The number of stranded Atlantic Puffins, however unusual for the area where the wreck was observed, was miniscule compared to wintering numbers in the North Sea (75,000 in Feb-Mar; Skov *et al.* 1995). Most Atlantic Puffins were clean (unoiled) or were presumed oiled after death, and all examined were starved with the notable exception of a single adult bird referred to above. Several features characterised this wreck: the weather had not been particularly severe in the southern North Sea, the stranding took place over a period of only a few days, and a mixture of adult, immature and first winter Atlantic Puffins washed ashore. It is interesting to note the clear north to south increase in the proportion of first winter birds, even on this scale (only 300 km distance).

It is difficult to determine the breeding origin of stranded auks on the basis of biometrics alone, but without ringing recoveries there is no other option. Unfortunately, in the absence of reference material, first winter birds and younger immatures are usually of little help with this. The wing measurements of adult and sub-adult Atlantic Puffins in this study are similar to *F. arctica grabae* of the British population (Table 2; Harris 1984). One (unsexed and unaged) Atlantic Puffin found dead possessed a wing length of 176 mm, just

Figure 4. Excessive flight feather wear in a juvenile Atlantic Puffin (#NSO 203008.001 C.J. Camphuysen).
Figuur 4. Extreem gesleten vleugelpennen van een juveniele Papegaaiduiker (#NSO 203008.001 C.J. Camphuysen).

within the range of the large Isle of May sample. On the basis of biometrics alone, there is no reason to believe that the Atlantic Puffins found in the Dutch wreck came from much further a field than the northern UK: there is no evidence of an influx from (sub)arctic breeding populations.

The excessive feather wear is a phenomenon that is rarely observed in (starved) auks in winter (pers. obs.). In the affected Atlantic Puffins examined here, no further abnormalities were observed. The patterns of wear (often completely asymmetrical and with a very strong contrast between affected and non-affected feathers) excluded the possibility that the Puffins were simply approaching their normal flight and tail-feather moult (Oct-Apr, most often Jan-Feb; Cramp 1985).

With the exception of one heavily oiled adult bird (probably unrelated to the wreck), all Atlantic Puffins that could be examined were extremely underweight. Adults were 67% the mass of birds returning to the Isle of May in March (Jones *et al.* 1984). First winter birds were 90% the mass of fledglings from that colony whereas young continue to grow through the first winter and would be more likely to weigh somewhere near 400 g (in which case the wrecked birds weighed two-thirds of the expected body mass). The absence of any fat in more or less complete corpses and the deterioration of the breast muscles confirmed that the birds had starved to death. Such body condition is typical for wrecked auks (Jones *et al.* 1984; Harris *et al.* 1991).

This wreck coincided with, but was unrelated to a major oil incident in The French Channel (the *Tricolor* oil spill off Dunkerque). Atlantic Puffins penetrated deep into the Channel upon their arrival and appeared to have died swiftly, whether oiled or not. There were numerous sightings of Atlantic Puffins in The Netherlands, mainly in early February, and at the time when the casualties washed ashore. After 10 February, that is immediately following the wreck, very few Atlantic Puffins were observed and few fresh corpses were found. The observations suggest one single mass-displacement of weakened auks from areas further north in the North Sea. The most recent, similar wreck involving Atlantic Puffins in The Netherlands occurred as long ago as in December 1929, nearly 75 years ago (Haverschmidt 1930).

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KARAKTERISTIEKEN VAN IN NEDERLAND AANGESPOELDE PAPEGAAIDUIKERS *FRATERCULA ARCTICA*, JANUARI-FEBRUARI 2003

Eind januari en begin februari 2003 werden in korte tijd 114 Papegaaiduikers *Fratercula arctica* gevonden tijdens tellingen op de Nederlandse kust. De stranding viel min of meer samen met de door een lek in het schip *Tricolor* veroorzaakte olieramp, maar had daar verder niets mee te maken. Toch werden ook in België en Noord-Frankrijk meer Papegaaiduikers dan normaal gevonden. In totaal is het bij deze stranding vermoedelijk om tenminste 180-200 Papegaaiduikers gegaan, waarvan 51% als juveniel kon worden gedetermineerd. De vogels waren sterk vermagerd en vermoedelijk door verhongering en verzwakking om het leven gekomen. Helaas werden er geen geringde Papegaaiduikers gevonden, maar de biometrische gegevens wezen op de Britse Eilanden als de meest voor de hand liggende plaats van herkomst. Het hele evenement, de invasie en de sterfte, vond zijn beslag in enkele dagen. De sterfte van alkachtigen die vervolgens in Orkney, Shetland en langs de Noorse kust werd gerapporteerd staat wellicht in verband met de gebeurtenissen in de zuidelijke Noordzee, zodat de werkelijke sterfte misschien aanzienlijk grootschaliger is geweest. Sinds 1929 waren er niet meer zoveel Papegaaiduikers in Nederland aangespoeld.

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A SIMPLE PHOTOGRAMMETRIC TECHNIQUE FOR ESTIMATING EGG VOLUME FROM FIELD MEASUREMENTS

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Michel P. & Thompson P.M. 2003. A simple photogrammetric technique for estimating egg volume from field measurements. Atlantic Seabirds 5(1): 31-34.
We compared direct and indirect methods for estimating egg volume in the Northern Fulmar Fulmarus glacialis *and developed a simple photogrammetric technique. We found that more variability in measured egg volume was explained by a photogrammetric estimate of cross-sectional area (78%), in comparison to an ellipsoidal formula derived from field measurements of egg length and breadth (61%), or a published formula (53%) that had been used in previous studies of this species. In future, this photogrammetric technique could also allow measurements of complex shape indices and reduce handling and disturbance at the nest.*

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Egg quality and size are highly variable between and within species, and are often expressed in terms of volume (Davis 1975; Furness 1983; Ollason & Dunnet 1988; Petersen 1992; Kern & Cowie 1996; Weidinger 1996; Jager *et al.* 2000; Bradzinki *et al.* 2002). Egg volume can be measured directly by water displacement (Preston 1974; Székely *et al.* 1994; Kern & Cowie 1996), but this technique can be time consuming and cause additional disturbance in the field. Empirical studies have therefore tended to use a variety of formulae to estimate egg volume (V) from simpler field measurements such as length (L) and breadth (B). Hoyt's (1979) formula, where k_v is a constant that varies between species and within populations (Preston 1974; Kern & Cowie 1996), has been the most widely used of these (Weidinger 1996; Narushin 1997; Potti 1999; Jager *et al.* 2000; Bradzinki *et al.* 2002). However, such ellipsoidal formulae tend to simplify the shape of the egg to only two parameters (Preston 1974; Székely *et al.* 1994; Kern & Cowie 1996); further field methods can be developed to provide more accurate estimates of egg volume that take account of variations in egg shape.

As part of a study on variation in egg size of the Northern Fulmar *Fulmarus glacialis* we compared previously published formulae for estimating egg volume, and developed a simple photogrammetric technique for obtaining more accurate estimates of egg volume from field measurements. During July 2002, the volumes of 19 eggs were estimated directly by water displacement. Each egg was placed in an empty graduated flask, and filled to 250 ml with water, using a second graduated flask. Egg length and breadth were also measured to the nearest 0.01 mm using callipers, and photographs were taken at right angles to the long axis of the egg using a digital camera (Canon D30), with 100-300 mm lens. All photographs were taken with the zoom lens set at approximately 100 mm. The cross-sectional area of each egg was calculated from photographs, using the UTHSCSA ImageTool ver. 3.0, (available free from the University of Texas Health Science Centre at http://ddsdx.uthscsa.edu/dig/itdesc.html). The software's measurement scale was calibrated to the egg length obtained from field measurement. Ten repeat measurements of the same photograph indicate that the CV on these measurements was <1%. Similarly, repeat estimates of cross-sectional area based upon five photographs of the same egg taken from different distances and heights had a CV of <1%.

Direct estimates of volume were then used to derive formulae for predicting volume, first, from field measurements of length (L) and breadth (B) and, second, from photographic estimates of cross-sectional area (CSA). Regression analyses were used to compare estimates of volume based upon these and previously published formulae, with those measured directly by water displacement.

The strongest relationship found was between measured volume and the cross-sectional area obtained from the image analysis. Variability in this photogrammetric estimate of cross-sectional area explained 78% of the variation in measured egg volumes (Table 1). The relationship we derived based upon field measurements of length and breadth explained less (61%) of the variability in measured egg volume, but still proved a better predictor of volume in this species than the general equations proposed by Romanoff & Romanoff (1949) and Hoyt (1979) (Table 1).

Previous studies of egg size variation in this population of fulmars have used Romanoff & Romanoff's (1949) generalised equation (Ollason & Dunnet 1988). Although this and Hoyt's (1979) methods provided a reasonable estimate of egg volume, more variability could be explained by deriving new equations specifically for this species. In future, additional eggs could be measured to improve this estimate for application in further studies. However, the most accurate estimates of egg volume were obtained by using photographs of the egg with field measurements of egg length. Consequently, this technique should provide greater power for exploring the causes and consequences of egg size variation both in this and other species. It also provides a useful alternative to direct measurements of egg volume that would require more handling and

Table 1. Results of the regression analyses comparing the performance of the different formulae used to predict egg volume (V) from measurements of egg length (L), egg breadth (B) and cross-sectional area (CSA).
Tabel 1. Resultaten van de regressie-analyses die de zeggingskracht vergelijken van verschillende formules om het eivolume (V) te voorspellen aan de hand van eilengte (L), eibreedte (B) en oppervlak van een dwarsdoorsnede (CSA).

Formula	R^2	$F_{1,16}$	P	Source
$V = 0.0002(CSA)^{1.6433}$	0.78	58.87	<0.001	This study
$V = 0.0063 (LB)^{1.1753}$	0.61	25.14	<0.001	This study
$V = 0.85 (\pi LB^2)/6$	0.53	18.61	<0.001	Romanoff & Romanoff (1949)
$V = 0.51(LB^2)$	0.53	18.61	<0.001	Hoyt (1979)

consequent disturbance to the birds. In future, images could also be analysed to obtain more complex indices of shape. For example, there has been recent interest in the influence of egg shape on incubation efficiency (e.g. Liker *et al*. 2001), but measuring complex properties such as sphericity and ovoidness has previously proved difficult to achieve in the field (Mänd *et al.* 1986; Petersen 1992; Narushin 2001). Finally, the technique could be further developed by attaching two laser pointers to the camera, so that parallel laser beams at known distance apart can be seen on the photograph and used to calibrate the measurement scale in ImageTool. Eggs could thus be photographed in the nest, and egg-volume or shape estimated with minimal disturbance at the nest site.

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EEN EENVOUDIGE FOTOGRAMMETRISCHE METHODE VOOR DE BEPALING VAN HET EIVOLUME AAN DE HAND VAN METINGEN IN HET VELD

De auteurs hebben een vergelijking gemaakt van directe en indirecte methoden om het eivolume bij Noordse Stormvogels *Fulmarus glacialis* te bepalen. Ze hebben een eenvoudige fotogrammetrische methode ontwikkeld om het eivolume aan de hand van een foto van de dwarsdoorsnede te bepalen. Ze vonden dat de variatie in gemeten eivolume beter werd verklaard met deze fotogrammetrische schatting van de dwarsdoorsnede van een ei (78%) dan door twee andere methoden: 1) een ellipsoïdale formule die is afgeleid van metingen van lengte en breedte van een ei (61%) en 2) gepubliceerde algemene formules die zijn gebruikt bij eerdere studies naar de Noordse Stormvogel (53%). De fotogrammetrische methode zou in de toekomst metingen van complexe vormen mogelijk moeten maken. De methode leidt bovendien tot minder verstoring bij het nest.

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FLESH-FOOTED SHEARWATER *PUFFINUS CARNEIPES* AND WHITE-FACED STORM PETREL *PELAGODROMA MARINA* AT DYER ISLAND, SOUTH AFRICA

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Underhill, L.G., Calf, K.M., Crawford, R.J.M., du Toit, M., Waller, L. & Whittington, P.A. 2003. Flesh-footed Shearwater *Puffinus carneipes* and White-faced Storm Petrel *Pelagodroma marina* at Dyer Island, South Africa. Atlantic Seabirds 5(1): 35-37. *A Flesh-footed Shearwater* Puffinus carneipes *and a White-faced Storm Petrel* Pelagodroma marina *were caught, measured and ringed at Dyer Island, South Africa, in September and October 2001, respectively. The Flesh-footed Shearwater was the second record on land for Dyer Island, and the first to be ringed in southern Africa. The White-faced Storm Petrel was the fourth record for South Africa, the three earlier observations being sight records.*

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Dyer Island (34°41'S, 19°25'E), South Africa, 55km west of Cape Agulhas, is the easternmost island in the Atlantic Ocean. This note reports two vagrant seabirds which occurred on the island.

Flesh-footed Shearwater *Puffinus carneipes* - At 01:00 h on 9 October 1999, a Flesh-footed Shearwater was found on the ground within the housing compound. It allowed an approach to within 1 m, but flew off within a few minutes. A second bird was found close to midnight on the night of 18–19 September 2001. It was a dark, misty night with complete cloud cover and occasional light drizzle. The shearwater was on the ground immediately underneath a four-shelf mist net, within 10 m of the place where the 1999 record occurred. It seems likely that it flew into the net without being caught, had dropped to the ground, and was found before it took off. It was ringed (SAFRING 640578) and released. Wing length was 330 mm, exposed culmen

41.9 mm, bill width 6.6 mm, bill depth 11.1 mm, total head length 89.4 mm, tarsus length 55.6 mm. There was no primary moult.

The nearest Flesh-footed Shearwater breeding colony is at St Paul Island (38°43'S, 77°29'E), 5100km to the east (del Hoyo *et al*. 1992). It is a fairly common visitor to South African waters, more abundant in winter than in summer; most records are from beyond the continental shelf on the east coast, well offshore in the Agulhas Current (Ryan 1997a). Flesh-footed Shearwaters have being seen from land in South Africa only once; on 2 April 1990, two were seen close inshore in False Bay (Fraser & McMahon 1990).

White-faced Storm Petrel *Pelagodroma marina* - A White-faced Storm Petrel was caught in a mist net at 02:00 h on 23 October 2001, a blustery night. The net was about 20 m away from the shore. The bird was ringed (SAFRING BC45262) and released. Wing length was 158 mm, culmen 15.3 mm, total head 40.7 mm, tarsus 23.5 mm, foot length 49 mm, tail length 125 mm, body mass 40g. There was no brood patch, and no primary moult.

The nearest White-faced Storm Petrel breeding colonies to South Africa are at Tristan da Cunha and Gough Island, 2600km to the west, southern Atlantic Ocean (del Hoyo *et al*. 1992). In the northern Atlantic, it breeds on islands in the Selvagens Archipelago and in the Cape Verde Islands (Hagemeijer & Blair 1997). The bulk of the population breeds in Australia and New Zealand (del Hoyo *et al*. 1992).

In spite of the fact that the nearest colonies are relatively close to South Africa, there are only three earlier records; all were made 70km to 100km off the Cape Peninsula, in May 1991, May 1993 and April 1995 (Ryan 1997b). It is believed that the Tristan da Cunha and Gough Island birds migrate mostly northwards into the tropical Atlantic Ocean, spreading west almost to South America and east almost to Angola (Cramp & Simmons 1977; Harrison 1983). The birds reaching South Africa are probably from these colonies. Outside the breeding season, this is a species of warm oceanic waters; it is therefore perhaps not surprising that it is so rare along the west coast of South Africa, with its cold Benguela Upwelling System.

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AUSTRALISCHE GROTE PIJLSTORMVOGEL *PUFFINUS CARNEIPES* EN BONT STORMVOGELTJE *PELAGODROMA MARINA* OP DYER ISLAND, ZUID-AFRIKA

Op Dyer Island (34°41'Z, 19°25'O), een eilandje op ongeveer 55 km ten westen van Kaap Agulhas voor de Zuid-Afrikaanse kust, werden twee zeldzame stormvogels aan land aangetroffen, gevangen en geringd. Australische Grote Pijlstormvogels, waarvan de dichtstbijzijnde kolonies zich 5100 km oostelijker bevinden (St Paul), werden gevonden op 9 oktober 1999 en 18-19 september 2001. Een Bont Stormvogeltje, met de dichtstbijzijnde kolonies op Tristan da Cunha (2600 km westelijker), werd gevangen en geringd op 23 oktober 2001. Beide soorten werden tot dusverre zelden of nooit in de buurt van het vasteland van Zuid-Afrika vastgesteld.

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News and notices

BOOK REVIEWS

BLOMDAHL A., BREIFE B. & HOLMSTRÖM N. 2003. *Flight identification of European Seabirds.* Christopher Helm, London. ISBN 0-7136-6020-1. Price £ 38,=, 374pp, ca 650 photographs, softback.

Since I heard that two of the authors of the Swedish *Sjöfågelboken* were compiling an English and extended version, I have been eagerly waiting for the result. This spring, *Flight identification of European Seabirds* finally appeared. The main part of this book deals with the identification of flying seabirds that may be seen while seawatching from European shores. The authors use a broad definition of seabirds, ranging from divers to auks. They follow the species list in *BWP*, so you won't find a description of Cory's and Scopoli's Shearwater, nor Baltic Gull in this book. On the other hand, you will find descriptions of for instance Yellow-legged and Pontic Gulls in this book.

A short introduction and a chapter 'Basics of identification' are followed by the species accounts, which are divided into the following sections, depending on the species: size, silhouette, flight and flocking, plumage and bare parts, subspecies and geographical variation, voice, and note. Apart from a good description of size and silhouette, often in comparison with more common species, the authors describe plumage characters visible only at long range separately from characters that are visible under good viewing conditions.

Most species accounts are well-written with many years of seawatching experience shining through. It's a pity though, that the authors don't describe the differences under different viewing conditions in more detail, e.g. how to separate a Herring Gull from a Lesser Black-backed Gull when looking against the sun. Furthermore, they neither describe the colour morphs of Northern Fulmar nor how to separate Magnificent Frigatebird from the other frigatebirds. On the other hand, you will read how to separate Lesser from Greater Scaup, or Ring-necked Duck from Tufted Duck.

Every species account is completed with a fine selection of pictures, ranging from one for Red-billed Tropicbird to eleven for Arctic Skua, showing different sexes, ages and plumages. Atlantic Puffin is one of the exceptions; only summer plumage birds are shown, while winter plumage birds and juveniles would be more instructive for identification purposes. The several photographs illustrating differences between species at a glance are especially informative. It's a pity, however, that some pictures are slightly out of focus, while others are a shade too blue. Although most captions provide extra information to the pictures, it's a riddle to me how you can age flying Little Auks or auks generally.

Despite the (minor) flaws I highly recommend this guide, not least for the sound advice: *"So do not worry about not being able to identify every bird - you are in good company. You are not an unskilled birder because of that, but rather a reliable birder with a clean conscience as you show that you are self-critical."*

Steve Geelhoed

WERNHAM, C., TOMS, M., MARCHANT, J., CLARK, J., SIRIWARDENA, G. & BAILLIE, S. (eds) 2002 *The Migration Atlas: the movements of the birds of Britain and Ireland*. T & AD Poyser, London. ISBN 0-7136-6514-9. 884 pp, more than 1000 maps. Price £55,=.

"*In every sense, this book is a truly collaborative venture, and a magnificent tribute to all involved.*" In his foreword to *The Migration Atlas,* Ian Newton pays tribute to all those people involved in producing this fine and eagerly awaited book. Drawing on the mammoth BTO ringing dataset of more than half a million recoveries spanning nearly a whole century, and data from other historical and contemporary sources, *The Migration Atlas* provides the first comprehensive reference source detailing the seasonal movements of British and Irish birds.

The book is split into two sections: The first being a general introduction to bird migration, including five chapters on the methods of studying migration, the history of ringing in Britain and Ireland, the ecology of migration, how ringing data are analysed and interpreted, and finally a synthesis of data to investigate any broad patterns. The second section forms the bulk of the book and presents detailed accounts of 188 species movements and shorter accounts for 73 species. The combination of these two comprehensive sections makes this both an excellent textbook and reference guide.

The Atlas provides a coherent source of information detailing the small-scale and large-scale seasonal movements of each species shown in clearly presented maps. Novel data are presented suggesting that the migration routes and wintering areas of some species are not entirely as we thought. For example there is evidence to suggest that some Manx Shearwater individuals over-winter off the coast of France and the Iberian Peninsula rather than undertake trans-Atlantic or transequatorial migration. The maps show every data point, with ringing and recovery sites joined by a shortest distance straight line. For common species there may be an argument for removing some of this detail as interpretation can become confusing. However, this has been addressed to some extent for those species that are very common with a wide British and Irish distribution such as the Great Cormorant and Black-headed Gull, with maps being split into distinct geographical regions, and movements presented separately, making interpretation much easier.

While much of the species accounts comprise maps and tables, the accompanying text, contributed by many of the leading ornithologists in Britain and Ireland, provides an excellent background to the historical and current distributions of each species. The expansion of the range of the Northern Fulmar is documented, and suggestions for spatio-temporal analyses to investigate potential changes in the geographical range of species such as the Northern Gannet, particularly in relation to climate change are proposed. Conservation issues are highlighted, such as the high mortality suffered by Roseate Terns possibly as a result of trapping at their wintering grounds in Ghana.

In addition to bird movements, the atlas shows how causes of recovery can be geographically distinct and provide an insight into the predominant anthropogenic activities in areas, with startling statistics such as 72% of Northern Gannet recoveries in the North Sea comprising oiled birds, while 69% of Northern Gannet recoveries in the open sea are birds accidentally caught in fishing gear or depredated by humans.

It is clear that for many pelagic seabird species there are gaps in our current knowledge, with the winter movements of as many as 50% of the 20 seabird and gull species studied, remaining unknown. With many species of seabird such as Northern Fulmar and Atlantic Puffin being almost exclusively ringed only in the breeding season at a small selection of remote colonies, the question of the origins of individuals observed at sea in British and Irish waters outside of the breeding season is highlighted and discussed. The authors' recognition of gaps in our knowledge, and methods of closing these gaps is one of the strengths of this book. For example, the authors suggest that remote sensing studies may be a good way of determining movement patterns of wide ranging seabird species such the Great Skua.

This accomplished Poyser publication, detailing the seasonal movements of British and Irish birds, builds on and complements previous work published in the two breeding bird atlases and the *Winter Atlas*. In compiling data from many sources to generate a comprehensive overview of species movements, the authors have produced an invaluable reference source for conservation scientists, policy-makers and ornithologists alike, and have provided a progressive way forward to understanding bird movements more fully.

Claire McSorley