FORAGING BEHAVIOUR OF NON-BREEDING POMARINE SKUAS *STERCORARIUS POMARINUS* IN THE NORTH SEA IN SUMMER

VOLKER DIERSCHKE & JAN-PETER DANIELS

Dierschke V. & Daniels J.-P. 2002. Foraging behaviour of non-breeding Pomarine Skuas *Stercorarius pomarinus* in the North Sea in summer. Atlantic Seabirds 4(2): 53-62. From late May to mid September 2000, the unusual event of a summer assemblage of up to 16 Pomarine Skuas occurred on the island of Helgoland (German Bight, North Sea). Most of the birds were immatures in second and third calendar-year, which moulted primaries, tail feathers and wing coverts. The Pomarine Skuas usually foraged by kleptoparasitism of Black-legged Kittiwakes *Rissa tridactyla* carrying food to the breeding colony. Success of attacks was higher with Black-legged Kittiwakes compared to other victims (e.g. Sandwich Tern *Sterna sandvicensis* and Arctic/Common Tern *S. paradisaea/hirundo*), placing Pomarine Skuas between Arctic Skuas *Stercorarius parasiticus* (preferably hunting terns) and Great Skuas *Catharacta skua* (unable to kleptoparasitise terns and attacking Black-legged Kittiwakes less often than Arctic and Pomarine Skuas do). When chasing Black-legged Kittiwakes, age of Pomarine Skuas and size of the hunting group (sometimes including Herring Gulls *Larus argentatus*) did not affect the success rate, but with larger group size the success per group member decreased. The unusual occurrence of a group of moulting Pomarine Skuas suggests that the sea around Helgoland holding many seabirds during the breeding season is usually under-exploited by skuas.

Institut für Vogelforschung "Vogelwarte Helgoland", Inselstation, P.O. Box 1220, D-27494 Helgoland, Germany, E-mail: volker-ifv@t-online.de

INTRODUCTION

Because of their pelagic distribution, little is known about the foraging behaviour of skuas during the non-breeding season. Foraging at sea was studied intensively in Great Skua *Catharacta skua* and Arctic Skua *Stercorarius parasiticus* which breed in or close to seabird colonies and to a large degree depend on kleptoparasitism on seabirds like gannets, gulls, terns and auks (reviewed by Furness 1987a, 1987b). In breeding Pomarine Skuas *Stercorarius pomarinus*, foraging is more restricted to terrestrial habitats, where rodents are the most important prey (Glutz von Blotzheim & Bauer 1982). Furthermore, Pomarine Skuas occur in much lower numbers along the coastlines of northwestern Europe than Arctic Skuas (Meltofte 1979; Platteeuw *et al.* 1994, Camphuysen 1999), limiting possibilities to observe foraging behaviour from the shore during migration. Knowledge about foraging of Pomarine Skuas at sea is low (Furness 1987b) and restricted to anecdotal records (summarised in Glutz von Blotzheim & Bauer 1982). In summer 2000, the unusual occurrence of a

group of moulting immatures at the offshore island Helgoland (North Sea) gave opportunities to study kleptoparasitic behaviour of Pomarine Skuas.

METHODS

From early July to mid September 2000, we observed hunting behaviour of Pomarine and Arctic Skuas from the beaches of the offshore island Helgoland in the southeastern North Sea (54° 11' N, 07° 55' E). For any kleptoparasitic encounter we recorded species and age of the victim and all members of the hunting group. The outcome of an encounter was rated as successful when the attacked bird disgorged or dropped prey, irrespective of the success of any member of the hunting group to obtain it. Rapid flights of a skua towards another bird were not treated as an attack if the skua gave up clearly before any possible physical contact. Foraging modes other than kleptoparasitism were recorded anecdotally. Counts of Pomarine Skuas were obtained from the ornithological log of the Institut für Vogelforschung (1975-2000) and from the Ornithologische Arbeitsgemeinschaft Helgoland (1990-2000).

RESULTS

Unusual summer occurrence in 2000 On Helgoland, Pomarine Skuas are very rare spring migrants, but they regularly occur in small numbers during autumn migration from late July to October (Fig. 1). The influx of Pomarine Skuas observed along the European coastline between Sweden and Portugal in autumn 1999 (van den Berg 1999) was not noticed at Helgoland (Fig. 2). Apart from some migrants, two immature Pomarine Skuas (second and third calendar-year, respectively) were present at Helgoland from late May 2000 onwards, and were joined by a growing number of conspecifics in the second half of June (Fig. 1). The unusual summer occurrence peaked on 14 July with 16 birds, of which only one was adult (11 in second calendar-year, 4 in third calendar-year). Numbers remained high until mid August, but varying percentages of age classes suggest some degree of individual turnover. The number of adults never exceeded two. The assemblage of Pomarine Skuas decreased to six birds in the second half of August and disappeared in the first half of September. From June to August, several birds were moulting primaries, tail feathers and wing coverts, creating a very ragged appearance.

Foraging behaviour From June to early August, most Pomarine Skuas rested on the beach, from where they occasionally started their hunting excursions. In the second half of August and in September, the flock of resting birds remained mostly on the sea. During foraging, Pomarine Skuas were seen to patrol along

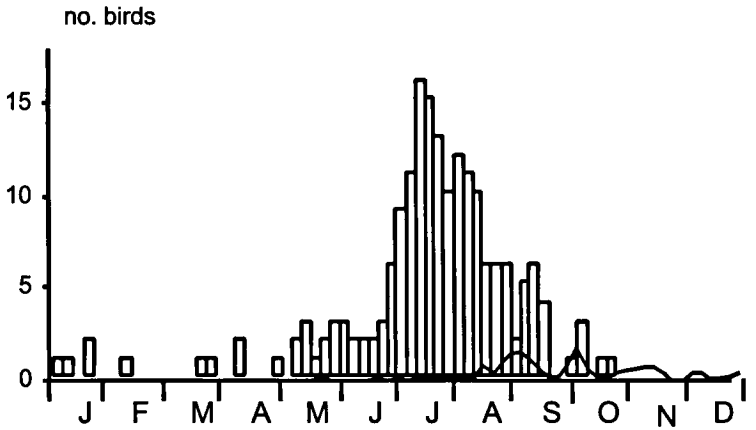


Figure 1. Occurrence of Pomarine Skuas on Helgoland in 2000 (maximum counts per five-day-period, n = 187; columns) and in 1995-1999 (average no. of birds per day, n = 444; continuous line).

Figuur 1. Voorkomen van Middelste Jagers rond Helgoland in 2000. Maximum aantal per vijfdaagse periode (n = 187; staafdiagram) en het gemiddelde aantal per dag gedurende 1995-1999 (n= 444; ononderbroken lijn).

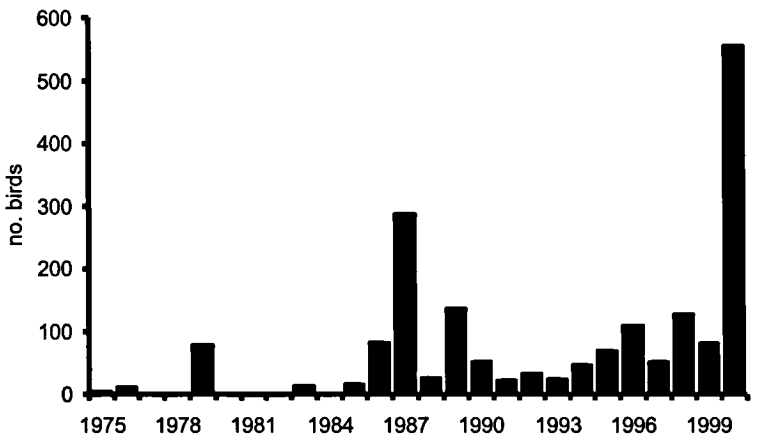


Figure 2. Annual totals of Pomarine Skuas observed on Helgoland. Individuals present for more than one day are considered for each day recorded.

Figuur 2. Aantal rond Helgoland waargenomen Middelste Jagers. Pleisterende exemplaren werden elke dag van hun aanwezigheid meegeteld.

Table 1. Species attacked by Pomarine and Arctic Skuas and success of attacks from July to September 2000. Species attacked while swimming or sitting on the beach are marked with asterisks.

Tabel 1. Door Middelste en Kleine Jagers aangevallen vogelsoorten tussen juli en september 2000. Soorten die werden aangevallen, terwijl zij in zee zwommen of op het strand stonden, zijn met een asterisk gemerkt.

Aggressor	Pomarine Skua				Arctic Skua			
	n	success			*n*	success		
Host		yes	no	%		yes	no	%
Northern Gannet *Morus bassanus*	3	0	3		1	0	1	
Great Cormorant *Phalacrocorax carbo**	1	0	1		1	0	1	
Mallard *Anas platyrhynchos**	1	0	1					
Common Eider *Somateria mollissima**	6	0	6					
Common Scoter *Melanitta nigra**	1	0	1					
Red-breasted Merganser *Mergus serrator**	1	0	1					
Honeybuzzard *Pernis apivorus*	2	0	2					
Oystercatcher *Haematopus ostralegus**	6	0	6					
Golden Plover *Pluvialis apricaria**	1	0	1					
Sanderling *Calidris alba**	1	0	1		1	0	1	
Redshank *Tringa totanus**	2	0	2					
Greenshank *T. nebularia**	3	0	3					
Turnstone *Arenaria interpres**	1	0	1					
Pomarine Skua *Stercorarius pomarinus*	3	0	3					
Black-headed Gull *Larus ridibundus*	4	0	4		1	0	1	
Common Gull *L. canus*	2	0	2		1	0	1	
Herring Gull *L. argentatus*	7	0	7					
Great Black-backed Gull *L. marinus*	4	0	4		2	0	2	
Black-legged Kittiwake *Rissa tridactyla*	208	63	145	30	22	4	18	22
Common/Arctic Tern *Sterna hirundo/paradisaea*	5	1	4		7	3	4	
Sandwich Tern *S. sandvicensis*	29	3	26	10	13	2	11	18
Carrion Crow *Corvus corone*	2	0	2					

the stretch of sea 0.5-5 km from the seabird colony, mainly in the west to north sector. However, arrivals from nearly all destinations indicate that hunting excursions were directed to other areas as well. All species attacked are listed in Table 1. Most victims were Black-legged Kittiwakes *Rissa tridactyla*, the most abundant breeding species on Helgoland (7968 occupied nests in 2000). Attacks were only directed against Black-legged Kittiwakes approaching the colony, while birds flying towards the sea were ignored. The only other seabirds frequently attacked were Sandwich Terns *Sterna sandvicensis*, which do not breed at Helgoland, although several hundred migrants or non-breeders were present throughout the summer. Whereas gulls and terns were always attacked in flight, chases against ducks were directed against swimming birds. Waders were attacked either on the ground or chased in flights close to the beach surface. On several occasions it was noted that Pomarine Skuas swallowed

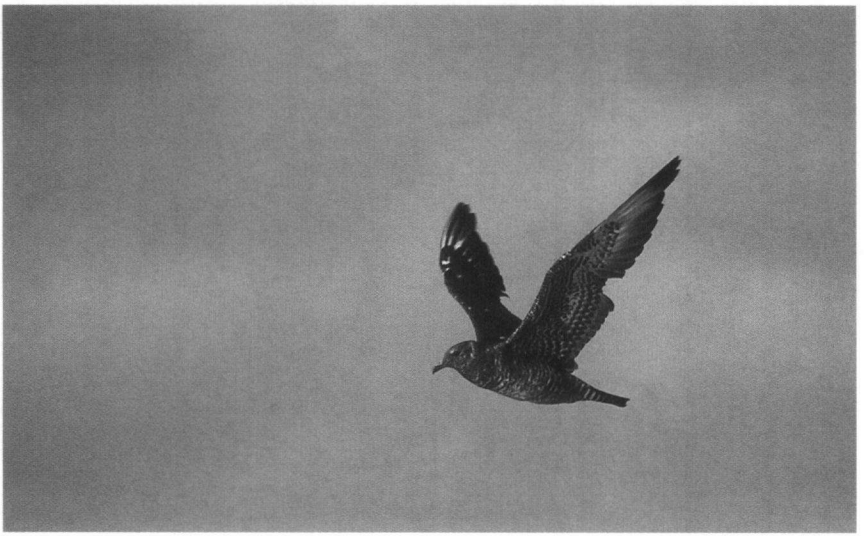
Table 2. Composition of hunting groups in attacks against Black-legged Kittiwakes on Helgoland from July to September 2000.
Tabel 2. Samenstelling van jagende groepen bij aanvallen op Drieteenmeeuwen op Helgoland, juli-september 2000.

Number of birds in attack group						Success	
Pomarine Skua	Arctic Skua	Herring Gull	Lesser Bl. backed Gull	Great Black-backed Gull	*n*	yes	no
1	-	-	-	-	160	45	115
2	-	-	-	-	16	7	9
3	-	-	-	-	5	0	5
4	-	-	-	-	1	0	1
5	-	-	-	-	1	1	0
1	1	-	-	-	2	0	2
1	-	-	1	-	1	1	0
1	-	1	-	-	13	7	6
1	-	-	-	1	1	0	1
1	-	1	1	-	1	0	1
1	-	2	-	-	2	0	2
1	-	3	-	-	1	0	1
2	-	1	-	-	2	1	1
2	-	-	-	1	1	1	0
3	-	1	-	-	1	0	1
5	-	1	-	1	1	1	0

pieces of kelp *Laminaria* spp. which they took from the shoreline. On 31 July, a flock of seven Pomarine Skuas was foraging much in the manner of Little Gulls *Larus minutus* by taking prey from the water surface.

A freshly disgorged pellet found on 14 July contained mainly vertebrae of Ammodytidae and Clupeidae, the main diet of Black-legged Kittiwake chicks on Helgoland in 2000 (A.-K. Dierschke pers. comm.). The pellet also contained otoliths of Sprat *Sprattus sprattus*, remnants of Blue Mussel *Mytilus edulis* shells and two spikes of sea urchins.

Hunting success Success rate of chases by Pomarine Skuas was 30% with Black-legged Kittiwakes, but significantly lower with Sandwich Terns (10%; $X^2 = 5.04$; $P = 0.025$). Compared to Pomarine Skuas, Arctic Skuas were more successful with Sandwich Terns (18%) and less successful with Black-legged Kittiwakes (22%), but differences were not significant between skua species (Black-legged Kittiwake $\chi^2 = 1.41$, $P = 0.235$; Sandwich Tern Fisher's exact test $P = 0.637$). Arctic Skua success rates did not differ between Black-legged Kittiwakes and Sandwich Terns (Fisher's exact test $P = 1.000$). The high success of Arctic Skuas chasing Arctic/Common Terns *Sterna paradisaea/hirundo* (3 out of 7 against 1 out of 5, Table 1) further indicates that Arctic Skuas do better chasing smaller host species than Pomarine Skuas.



Immature Pomarine Skua, note the ragged appearance Onvolwassen Middelste Jager met sterk gesleten kleed *(J.-P. Daniels)*

When looking on attacks of single hunting Pomarine Skuas on Black-legged Kittiwakes only, age did not seem to affect the rate of success. Birds in second calendar-year (28%) were only slightly less successful than birds in third calendar-year (34%; $\chi^2 = 0.56$, $P = 0.456$).

The number of birds involved in an attack did not much influence the outcome, as groups of Pomarine Skuas were only slightly more successful (35%) than single birds (28%; $\chi^2 = 0.43$, $P = 0.510$) against Black-legged Kittiwakes. Slightly more successful than groups of Pomarine Skuas (35%) were mixed-species groups (42%; $\chi^2 = 0.24$, $P = 0.627$), in which Pomarine Skuas were joined by gulls and Arctic Skuas (Table 2). Attacks of mixed-species groups were always initiated by a Pomarine Skua. The success per group member declined from 0.28 prey/attack in single Pomarine Skuas ($n = 160$) to 0.23 in groups of two birds (including gulls, $n = 32$), 0.03 in three birds ($n = 11$) and 0.08 in 4-7 birds ($n = 5$). When hunting in mixed groups, prey was secured by Herring Gulls *Larus argentatus* in five incidents, obtained by Pomarine Skuas in two incidents and shared between both species in another two incidents. If multiple chasing was a result of a short come of host birds, then

group hunting might increase towards the end of the breeding season of Black-legged Kittiwakes if there are decreasing numbers of food-carrying birds flying to the colony (Furness 1978). This could not be proven, as group hunting tended to be more common in July (25% of all attacks against Black-legged Kittiwakes, $n = 157$) than in August (15%, $n = 46$; $\chi^2 = 1.88$, $P = 0.170$), but note that the number of Pomarine Skuas was already lower in August (Fig. 1).

DISCUSSION

During the breeding season, the many thousand of adult seabirds carrying food to their offspring in the Helgoland colony can be regarded as a rewarding foraging opportunity for skuas, which specialised in kleptoparasitism of seabirds. But although occurring in tens or even hundreds of individuals per day during autumn migration, skuas are scarce from May to August. The presence of a group of Pomarine Skuas in summer 2000 indicates that a number of skuas is able to exist around Helgoland, but in almost all years this large food resource is not used and thus appears to be under-exploited. Such a situation was also found in the western Mediterranean Sea, where only few skuas occur despite high numbers of gulls and terns as potential hosts (Paterson 1986). That conditions at Helgoland are suitable for skuas is also indicated by success rates in kleptoparasitism which are similar to those of non-breeding Arctic Skuas observed in the Mediterranean Sea (Paterson 1986, Arcos 2000) and off South Africa (Furness 1983).

The high number of Pomarine Skuas present at Helgoland in summer 2000 is surprising as this species is usually rare in summer in the North Sea according to both ship- and land-based counts (Fig. 3, Camphuysen 1999). Immature non-breeders are thought to remain at sea in the North Pacific and North Atlantic in summer, but also visit the Arctic breeding grounds (Furness 1987a, Malling Olsen & Larsson 1997). Perhaps the high numbers in summer 2000 are connected with the influx of Pomarine Skuas to northern and western Europe in autumn 1999 (Van den Berg 1999), which might also be responsible for a number of records at Helgoland in late autumn 1999 and winter 1999/2000 (see above). At Helgoland, summer occurrences of Pomarine Skuas were observed before only twice. In 1979, an adult and an immature bird were present on the beach from late June throughout July (Kuschert 1981). In 1987, up to 31 birds were counted between early August and mid September, but with much higher turnover of individuals and less bond with the beach (V.D. and F. Stühmer pers. obs.).

In this study, Pomarine Skuas mainly attacked Black-legged Kittiwakes, the most abundant seabird species around Helgoland in summer. As

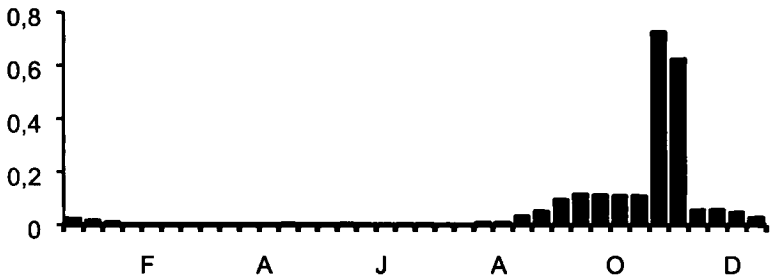


Figure 3. Pomarine Skuas per hour per 10-day period, based on seawatches along the Dutch coast 1972-2000 (n = 76191 hours of observation, 5551 Pomarine Skuas observed, source CvZ/NZG, unpubl. data).

Figuur 3. Middelste Jagers per uur per 10-daagse periode, op basis van zeetrektellingen aan de Nederlandse kust, 1972-2000 (n= 76191 waarnemingsuren, 5551 Middelste Jagers, CvZ/NZG ongepubl. materiaal).

the expectation of success was found to correlate with the selection of host species in studies on Arctic Skuas (Taylor 1979, Arcos 2000), another reason to attack Black-legged Kittiwakes probably is the higher rate of success compared to Sandwich Terns, which should be suitable hosts because of their very accessible way to carry fish in the bill. However, manoeuvrability is less developed in Pomarine than in Arctic Skuas and might therefore limit the exploitation of the more agile terns. Therefore, with respect to the best fitting host species, Pomarine Skuas are placed between Arctic Skuas (which in other studies often or even exclusively attack terns; Taylor 1979, Bélisle 1998, Arcos 2000) and Great Skuas (which are unable to kleptoparasitise terns and attack Black-legged Kittiwakes less than Arctic Skuas do; Furness 1978). Because the Pomarine Skuas observed in this study were moulting part of their flight feathers, it is possible that their manoeuvrability was reduced and perhaps the selection of hosts species was shifted in favour of Black-legged Kittiwakes rather than terns.

Group hunting of Pomarine Skuas did not increase the success rate per host attacked. This is in line with Arctic Skuas during spring migration in the Mediterranean Sea (Arcos 2000), but in contrast to Arctic Skuas during migration in Scotland (Taylor 1979) and eastern Canada (Bélisle 1998). However, as in Arctic Skuas during breeding in Iceland (Arnason & Grant 1978), the success of an individual group member decreased with increase of the number of individuals involved in a hunting event.

Age differences in the success rate of Arctic Skuas were reported in the Mediterranean Sea in the non-breeding season (Paterson 1986), but the author only grouped birds into adults and "juveniles". In this study, it was possible to compare birds in second and third calendar-year, but no difference in success rate was found when attacking Black-legged Kittiwakes. Perhaps experience is not a crucial factor anymore when a Pomarine Skua is already one year old, but larger sample sizes are required to allow a more detailed analysis.

Occasionally, Pomarine Skuas were observed foraging other than attacking seabirds. Hunting waders at or close to the beach might compare to predation on small seabirds and phalaropes which is thought to be an important mode of feeding for Pomarine Skuas wintering off West Africa (Furness 1987a). It remains unclear for what reason Pomarine Skuas ingested pieces of kelp. Perhaps this is related to the intake of carrion as reported from the shoreline of the German North Sea coast (Gloe 1987).

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FOERAGEERGEDRAG VAN NIET-BROEDENDE MIDDELSTE JAGERS *STERCORARIUS POMARINUS* IN DE NOORDZEE IN DE ZOMER

Van eind mei tot half september 2000 verzamelden zich ongewoon veel Middelste Jagers *Stercorarius pomarinus* in de Duitse Bocht rond het eiland Helgoland. De meeste van de maximaal 16 exemplaren waren onvolwassen (2e en 3e kalenderjaar) en zij vertoonden rui van de slagpennen, staartveren en bovenvleugeldekveren. De jagers leefden vooral van het voedsel dat door Drieteenmeeuwen *Rissa tridactyla* in de broedkolonie werd aangevoerd (kleptoparasitisme). Het succes van hun aanvallen was bij Drieteenmeeuwen aanmerkelijk hoger dan bij de andere vogels die werden belaagd (bijv. Grote Stern *Sterna sandvicensis*, noordse/dief *S. paradisaea/hirundo*). Daarmee zou de Middelste Jager gerangschikt kunnen worden tussen de Kleine Jager *S. parasiticus* (die vooral sterns bejaagd) en de Grote Jager *S. [Catharacta] skua* (weinig succesvol bij sterns, minder vaak Drieteenmeeuwen aanvallend dan de kleinere jagersoorten). Bij de jacht op Drieteenmeeuwen hadden de leeftijd van de jagers, noch de grootte van de aanvallende groep (waarin soms ook Zilvermeeuwen participeerden) invloed op het succespercentage. In grotere groepen nam het individuele foerageersucces echter aanmerkelijk af. Het ongebruikelijke, maar kennelijk succesvolle voorkomen van een ruiende groep Middelste Jagers in de zomer in de zuidelijke Noordzee suggereert dat de Duitse Bocht voor deze soort een geschikt overzomeringsgebied zou kunnen vormen.

REFERENCES

Arcos J.M. 2000. Host selection by Arctic Skuas *Stercorarius parasiticus* in the North-western Mediterranean during spring migration. Ornis Fennica 77: 131-135.

Arnason E. & Grant P.R. 1978. The significance of kleptoparasitism during the breeding season in a colony of Arctic Skuas *Stercorarius parasiticus* in Iceland. Ibis 120: 38-54.

Bélisle M. 1998. Foraging group size: models and a test with jaegers kleptoparasitizing terns. Ecology 79: 1922-1938.

Van den Berg A.B. 1999. WP reports. Dutch Birding 21: 351-359.
Camphuysen C.J. 1999. Jagers in de Nederlandse kustwateren. Graspieper 19: 53-65.
Furness B.L. 1983. The feeding behaviour of Arctic Skuas Stercorarius parasiticus wintering off South Africa. Ibis 125: 245-251.
Furness R.W. 1978. Kleptoparasitism by great skuas (Catharacta skua Brünn.) and arctic skuas (Stercorarius parasiticus L.) at a Shetland seabird colony. Anim. Behav. 26: 1167-1177.
Furness R.W. 1987a. The skuas. T & AD Poyser, Calton.
Furness R.W. 1987b. Kleptoparasitism in seabirds. In: Croxall J.P. (ed) Seabirds: feeding ecology and role in marine ecosystems: 77-100. Cambridge Univ. Press, Cambridge.
Gloe P. 1987. Raubmöwen (Stercorariidae) im zweiten Halbjahr 1985 in Schleswig-Holstein und Hamburg. Corax 12: 94-122.
Glutz von Blotzheim U.N. & Bauer K.M. 1982. Handbuch der Vögel Mitteleuropas. Band. 8. Akademische Verlagsgesellschaft, Frankfurt a. M.
Kuschert H. 1981. Das Vorkommen der Raubmöwen (Stercorariidae) auf Helgoland unter besonderer Berücksichtigung des Einfluges im Sommer 1979. Vogelwelt 102: 121-132.
Malling Olsen K. & Larsson H. 1997. Skuas and jaegers. A Guide to the Skuas and Jaegers of the World. Pica Press, Sussex.
Meltofte H. 1979. Forekomsten af kjover Stercorarinae ved Blåvandshuk 1963-1977. Dansk. Orn. Foren. Tidsskr. 73: 297-304.
Paterson A.M. 1986. Kleptoparasitic feeding by migrating skuas in Malaga Bay, Spain. Ringing & Migration 7: 51-55.
Platteeuw M., van der Ham N.F. & den Ouden J.E. 1994. Zeetrektellingen in Nederland in de jaren tachtig. Sula 8: 1-203.
Taylor I.R. 1979. The kleptoparasitic behaviour of the Arctic Skua *Stercorarius parasiticus* with three species of tern. Ibis 121: 274-282.