ORNIS SVECICA 11:171–180, 2001

Large gulls as predators of passerine landbirds migrating across the southeastern North Sea

VOLKER DIERSCHKE

Abstract

The predation by large gulls on passerines migrating across the southeastern North Sea was studied on the offshore island Helgoland throughout 1999; 15,307 pellets of Herring Gull *Larus argentatus* and Great Black-backed Gull *L. marinus* were examined. The main prey was fish and crustaceans, but during migratory seasons of passerines (March to May, August to November) up to 7% of the pellets contained remnants of passerines (mainly thrushes *Turdus* spp. and Starlings *Sturnus vulgaris*, but few species of <50 g body mass). For half-month periods, the number of pellets containing passerines correlated with the number of passerines stopping over on Helgoland for both size categories of <50 g and >50 g. Pellets containing passerines were mainly found during weather conditions favourable for migration, when many birds were aloft, rather than during adverse conditions. Based on the number of large gulls present, an estimated 5200 passerines might have fallen victim to gulls during the year. Although some passerines may be scavenged rather than captured, gulls must be important potential predators for passerines migrating across the sea.

Volker Dierschke, Institut für Vogelforschung "Vogelwarte Helgoland", Inselstation Helgoland, Postfach 1220, 27494 Helgoland, Germany. E-mail: Volker-ifv@t-online.de

Received 1 October 2000, Accepted 1 June 2001, Editor: A. Hedenström

Introduction

Strategies of migratory bird flight are often discussed regarding the energy cost of the flight, e.g. distances between stopover sites or migration in relation to weather situations (Alerstam 1990, Piersma & van de Sant 1992, Klaassen & Biebach 2000). Another important factor during migration is predator avoidance which may cause birds to migrate at night or at high altitudes. Migration along coastlines is thought to be risky because many raptors also concentrate along coastlines during their own migration (Ulfstrand et al. 1974, Aborn 1994). Raptors, especially falcons, also hunt migrating passerines at sea, either based from coastal islands (Eleonora's Falcon *Falco eleonorae*) or occasionally during their own migratory flight (e.g. Merlin *Falco columbarius*) (Walter 1979, own obs.). When crossing stretches of sea, passerines may also fall victim to gulls which are often seen to attack migrants (summarized by Macdonald & Mason 1973, Glutz von Blotzheim & Bauer 1982, and hunting method described by Alerstam 1990), leading to the assumption that this kind of food acquisition is commonly occurring in Great Black-backed Gulls *Larus marinus* and Herring Gulls *L. argentatus* during migration of passerines (Vauk & Prüter 1987). Based on these incidents and on observations of passerines ascending to higher flight altitudes during sea crossings at dawn, gulls are supposed to be the most important passerine predators when crossing seas (Macdonald & Mason 1973, Bourne 1980). In a study addressing which factors influence stopover decisions during the migration across an ecological barrier (German Bight, North Sea), predation was thought to be of considerable importance (Delingat & Dierschke 2000). In this context the extent of passerine predation by gulls during the crossing of this stretch of sea can be assessed by examining a large sample of pellets produced by Herring and Great Black-backed Gulls on the offshore island of Helgoland throughout the year.

Methods

The island of Helgoland (1.5 km^2) is situated 43 km off the German Wadden Sea coast (54° 11' N, 07° 55'

Table 1. Monthly average numbers of large gulls counted on Helgoland during spring tides (every 15 days) 1992–1998 and maximum numbers in 1999 (Institut für Vogelforschung unpubl. data). Data in addition to the bi-weekly counts are included also for the Lesser Black-backed Gull.
Månadsvisa medelvärden av antalet större trutar räknade på Helgoland vid springflod (var 15:e dag) åren 1992–1998 samt maximiantal 1999 (Institut für Vogelforschung opubl. Data). Data utöver fjortondagarsräkningarna presenteras även för silltrut.

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Herring Gull	1992–1998	963	1137	1017	924	564	510	477	665	902	1173	1525	1499
Gråtrut	(SD)	(779)	(589)	(615)	(412)	(177)	(138)	(117)	(97)	(209)	(605)	(820)	(880)
Larus argentatus	1999	527	1403	896	985	308	330	445	650	599	2203	510	410
Great Black-backed Gull	1992–1998	686	385	142	345	242	520	484	1362	1957	986	970	972
Havstrut	(SD)	(742)	(219)	(110)	(158)	(37)	(282)	(175)	(453)	(443)	(339)	(440)	(649)
Larus marinus	1999	163	214	93	132	109	210	425	582	970	1140	264	262
Lesser Black-backed Gull	1992–1998	1	2	25	90	112	158	421	731	348	66	4	5
Silltrut	(SD)	(2)	(2)	(29)	(53)	(58)	(42)	(297)	(546)	(231)	(74)	(5)	(12)
Larus fuscus	1999	1	6	11	50	40	132	100	360	150	90	3	1

E). About 200 pairs of Herring Gulls breed on Helgoland, and in addition several thousand other large gulls are present on Helgoland during the nonbreeding season (Table 1). Herring and Great Black-backed Gulls, and few Lesser Black-backed Gulls *Larus fuscus* roost on piers of a total length of 7 km. From 22 January to 14 December 1999, a total of 15,307 pellets of large gulls were examined on seven piers visited on average every five days. The smaller pellets of Kittiwakes *Rissa tridactyla* were not considered in this study.

Pellets were classified according to their predominant kind of prey based on the largest proportion of visible remnants (see Table 2). Most pellets consisted of only one kind of prey, and this was especially true when birds had been eaten. When containing remnants of birds, pellets were examined more closely and prey species were determined as precisely as possible by feather coloration, bill and feet. For further calculations, passerines were grouped into small (<50 g body mass) and large birds (>50 g). In the latter group, Starlings were sometimes treated separately because their seasonal pattern with large post-breeding assemblages of juveniles differs much from other passerine migrants.

Results of pellet examination were compared to the sum of resting birds counted or estimated on Helgoland daily, and to those trapped in a standardized program in the trapping garden of the Vogelwarte Helgoland with three funnel traps (see Moritz

Table 2. Diet composition of large *Larus* species on Helgoland according to pellet contents in 1999 (percentages). Each pellet was assigned to only one category according to its predominant prey.
Näringsval hos större trutar Larus *på Helgoland enligt analyser av spybollar under 1999 (procent). Varje spyboll klassades bara till en byteskategori beroende på dominerande inneehåll.*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
No. pellets *antal spybollar*	119	324	2087	894	558	566	1074	1400	3811	2740	1599	135
Fish *fisk*	41.2	62.7	69.3	19.7	31.7	53.2	47.5	72.0	61.2	22.5	24.5	10.4
Crustaceans *kräftdjur*	7.0	13.9	6.9	44.5	43.0	32.3	37.1	17.9	33.2	55.3	35.9	15.6
Molluscs *blötdjur*	4.0	9.6	10.3	15.7	14.0	6.0	2.7	2.7	1.8	4.3	2.5	1.5
Polychaetes *havsborstmaskar*		1.2		7.2	0.4			0.1	<0.1			
Algae *alger*	1.0		6.7	2.5			2.0	1.1	1.7	0.6	2.8	3.7
Garbage *avfall*		1.5	0.3	0.2	0.7	0.2	0.7	0.6	0.9	4.5	1.9	3.0
Kelp flies *tångflugor*				0.6		0.9	0.1	1.4	0.3	8.3	23.7	42.2
Other *annat*		0.3	0.1	1.9	8.2	1.4	0.7	2.8	0.3	0.3	0.1	1.5
Non-passerines *icke-tättingar*	6.5	10.8	1.5	1.1	0.5	4.9	9.4	1.2	<0.1	0.3	1.6	20.7
Passerines *tättingar*			4.8	6.7	1.4	1.1		0.1	0.6	4.0	7.1	1.5

Table 3. Monthly totals of passerines found in pellets of large gulls on Helgoland in 1999.
Månadvisa totalsummor för tättingar återfunna i spybollar hos större trutar på Helgoland 1999.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
species <50 g													
White Wagtail													
Motacilla alba	0	0	0	0	0	0	0	0	1	0	0	0	1
Meadow Pipit													
Anthus pratensis	0	0	0	0	0	0	0	0	0	1	0	0	1
Dunnock													
Prunella modularis	0	0	2	0	0	0	0	0	0	0	0	0	2
Robin													
Erithacus rubecula	0	0	1	1	0	0	0	0	0	0	0	0	2
Common Redstart													
Phoenicurus phoenicurus	0	0	0	0	1	0	0	0	1	0	0	0	2
Northern Wheatear													
Oenanthe oenanthe	0	0	0	0	1	0	0	0	2	0	0	0	3
Garden Warbler													
Sylvia borin	0	0	0	0	0	1	0	0	1	0	0	0	2
Common Whitethroat													
Sylvia communis	0	0	0	0	0	0	0	1	1	0	0	0	2
Great Tit													
Parus major	0	0	0	0	0	0	0	0	0	1	0	0	1
Chaffinch													
Fringilla coelebs	0	0	2	0	0	0	0	0	0	1	0	0	3
Brambling													
Fringilla montifringilla	0	0	0	0	0	0	0	0	0	0	1	0	1
Greenfinch													
Carduelis chloris	0	0	0	0	0	0	0	0	0	1	0	0	1
Linnet													
Carduelis cannabina	0	0	1	0	0	0	0	0	0	0	0	0	1
Subtotal species <50 g	**0**	**0**	**6**	**1**	**2**	**1**	**0**	**1**	**6**	**4**	**1**	**0**	**22**
species >50 g													
Ring Ouzel													
Turdus torquatus	0	0	0	0	1	0	0	0	0	0	0	0	1
Blackbird													
Turdus merula	0	0	36	12	0	0	0	0	0	15	32	2	97
Fieldfare													
Turdus pilaris	0	0	0	0	1	0	0	0	0	0	1	0	2
Redwing													
Turdus iliacus	0	0	5	6	0	0	0	0	0	32	6	0	49
Song Thrush													
Turdus philomelos	0	0	11	5	0	0	0	0	3	12	3	0	34
Redwing/Song Thrush													
T. iliacus/philomelos	0	0	3	2	0	0	0	0	1	3	1	0	10
Starling													
Sturnus vulgaris	0	0	20	9	0	3	0	0	0	29	62	0	123
Subtotal species >50 g	**0**	**0**	**75**	**34**	**2**	**3**	**0**	**0**	**4**	**91**	**105**	**2**	**316**
Unidentified passerines	0	0	18	25	4	2	0	1	11	14	7	0	82
Total	**0**	**0**	**99**	**60**	**8**	**6**	**0**	**2**	**21**	**109**	**113**	**2**	**420**

1982 for methods). To evaluate the effect of weather on gull predation on passerines, the weather factors wind force, cloud cover and visibility were compared between the overall migration period of large passerines (1 March to 30 April and 20 September to 30 November, respectively) and the occurrence of large passerines in gull pellets (pooled data of the weather present at the finding of each pellet). The difference in the distribution to the categories of weather data between the day of the migratory period and the birds found in pellets was tested by χ^2-tests and omitting null categories. The exact date of

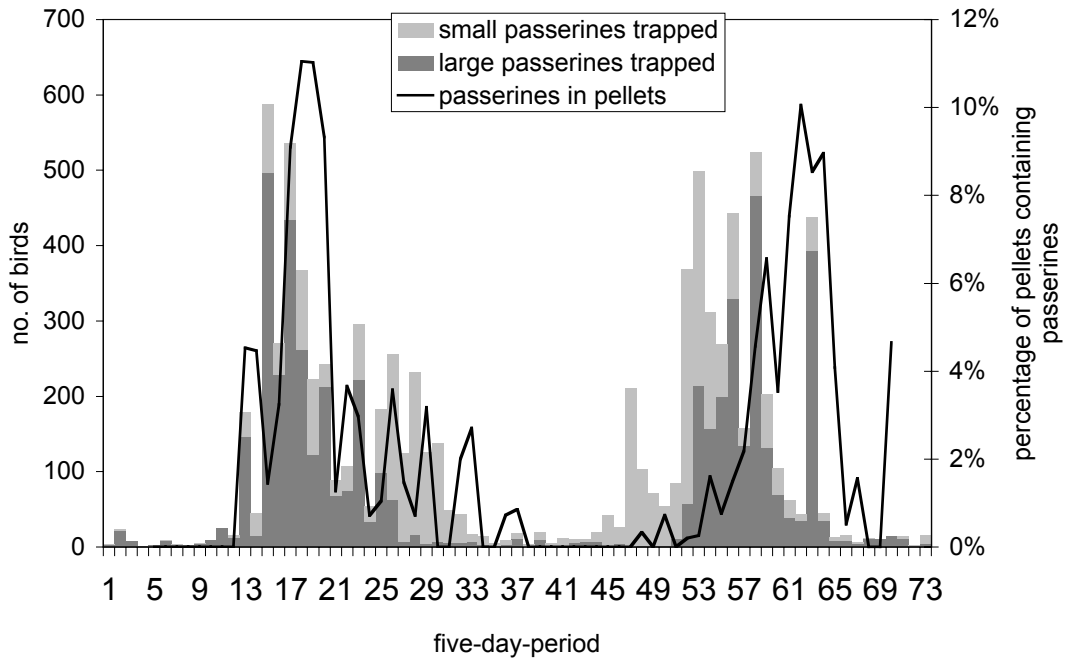

Figure 1. Totals of large and small passerines caught in the trapping garden and the percentage of pellets containing remnants of passerines per five-day-period.
Totalantal stora och små tättingar fångade i fångstträdgården på Helgoland och procentuella andelen spybollar från trutar som innehåller rester av tättingar per femdagarsperiod.

pellet production was unknown, therefore average weather conditions for the preceeding two and three days (including the day of finding) were used for calculations.

Results

According to the pellets, the diet of large gulls varies by season (Table 2). Main prey were fish and crustaceans, but kelp fly larvae found in wrack beds of the island were of considerable importance during storms from October to December (Table 2). In winter months with stormy weather, remnants of seabirds were found in a large proportion of pellets. Non-passerine birds eaten by gulls in late spring and summer (Table 2) were exclusively chicks of Kittiwakes and Guillemots *Uria aalge*. Both species breed numerously on the cliffs of the island (Hüppop 1997).

During the study, 420 out of 15,307 (2.7 %) gull pellets found contained remnants of passerine birds. A total of 19 species could be identified, but the number of prey species involved was probably higher because the identity of prey was unknown in 82 pellets. Three species of thrushes and the Starling were most often found in pellets, while small species (<50 g) occurred only occasionally (Table 3). Although small passerines made up 69.5 % of the total of 58,336 passerines (excluding Starling and corvids) counted or estimated during stopovers on Helgoland from August to November on a daily basis, only 10.1 % of remnants belonged to this size class in gull pellets. In addition, some non-passerine birds classified as migrants rather than seabirds were preyed upon (two Water Rails *Rallus aquaticus*, five Moorhen *Gallinula chloropus*, one Redshank *Tringa totanus*, one Common Snipe *Gallinago gallinago* and two Great Spotted *Woodpeckers Dendrocopos major*).

Passerines were found in pellets only during their migratory seasons (Table 2 and 3), mostly in March/April and October/November, coinciding with the passage of large passerines (body mass >50 g; Figure 1). In both small and large passerines (excluding Starling), the number of pellets found per half month period (August to November; n = 8) correlates with the number of resting birds counted on the island (small passerines: R_S = 0.852, P = 0.007; large

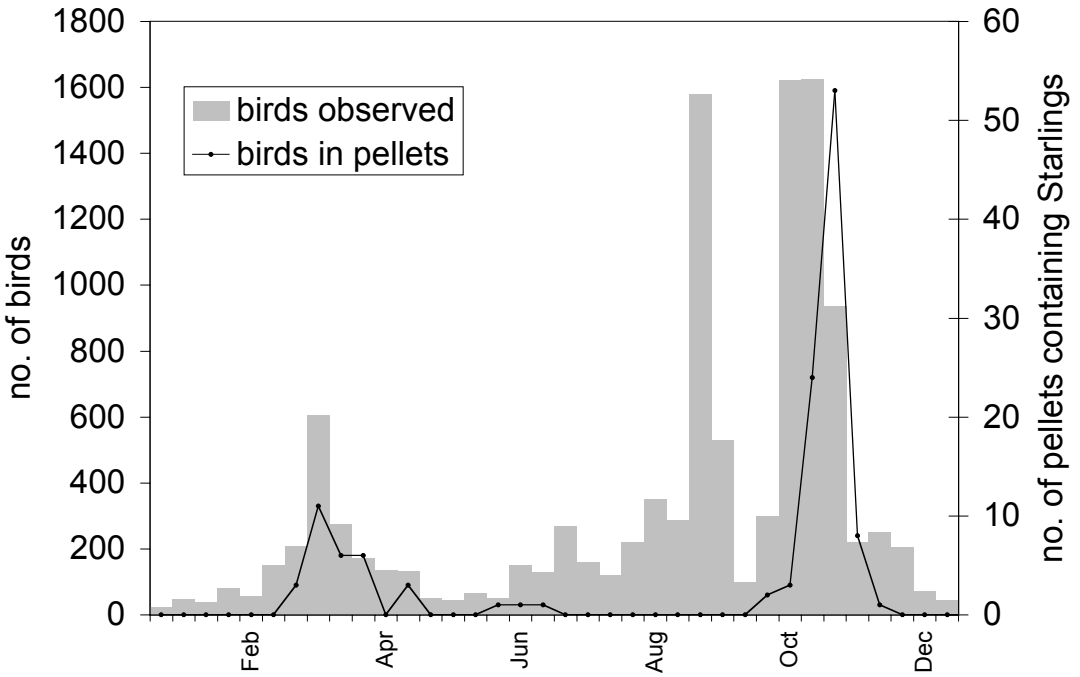

Figure 2. Maximum numbers of Starling observed on Helgoland per ten-day-period in 1999 and the respective number of pellets containing remnants of Starlings.
Maxantal observerade starar på Helgoland per tiodagrsperiod under 1999 samt respektive antal spybollar innehållande rester av stare.

passerines: $R_S = 0.927$, $P = 0.007$). The number of pellets containing Starlings coincide with the seasonal pattern of occurrence of this species (Figure 2). However, no correlation between bird occurrence and birds found in pellets was evident on a finer scale, e.g. between the percentage of Blackbirds or Redwing/Song Thrush in the diet of gulls and the number of birds of the respective species trapped at the bird observatory (Table 4). There is no explanation for the exceptionally high number of pellets (37) containing Starlings on 3 November. There was no large-scale passage or unusual weather recorded those days. In general, there was no indication that passerines were more often captured by gulls during weather conditions adverse to migration. When compared to the overall occurrence of weather conditions during thrush and Starling migration (1 March to 30 April and 20 September to 30 November), pellets containing large passerines were found in periods with less wind and clearer skies, and with good visibility in most cases (Figure 3, Table 5).

Discussion

The contents of the large sample of pellets collected on Helgoland in 1999 reflect the large spectrum of prey taken by Herring and Great Black-backed Gulls (Glutz von Blotzheim & Bauer 1982). A high degree of opportunism in food selection was apparent. Prey available only for brief periods was found in high percentages in pellets temporarily, such as polychaetes during swarming (April), seabird chicks during rearing (June to July) and kelp fly larvae during mass occurrence (October to November). The same holds true for passerine birds, which were found exclusively during passerine migratory periods. Passerine predation by gulls thus seems to be opportunistic because it occurs during periods of high availability.

The many incidents observed of migrating passerines captured by large gulls at sea (Macdonald & Mason 1973, Glutz von Blotzheim & Bauer 1982), also around the island of Helgoland (own obs.), suggest that the passerines found in gull pellets on Helgoland were predated by the gulls. As there is no information about the body condition of the passer-

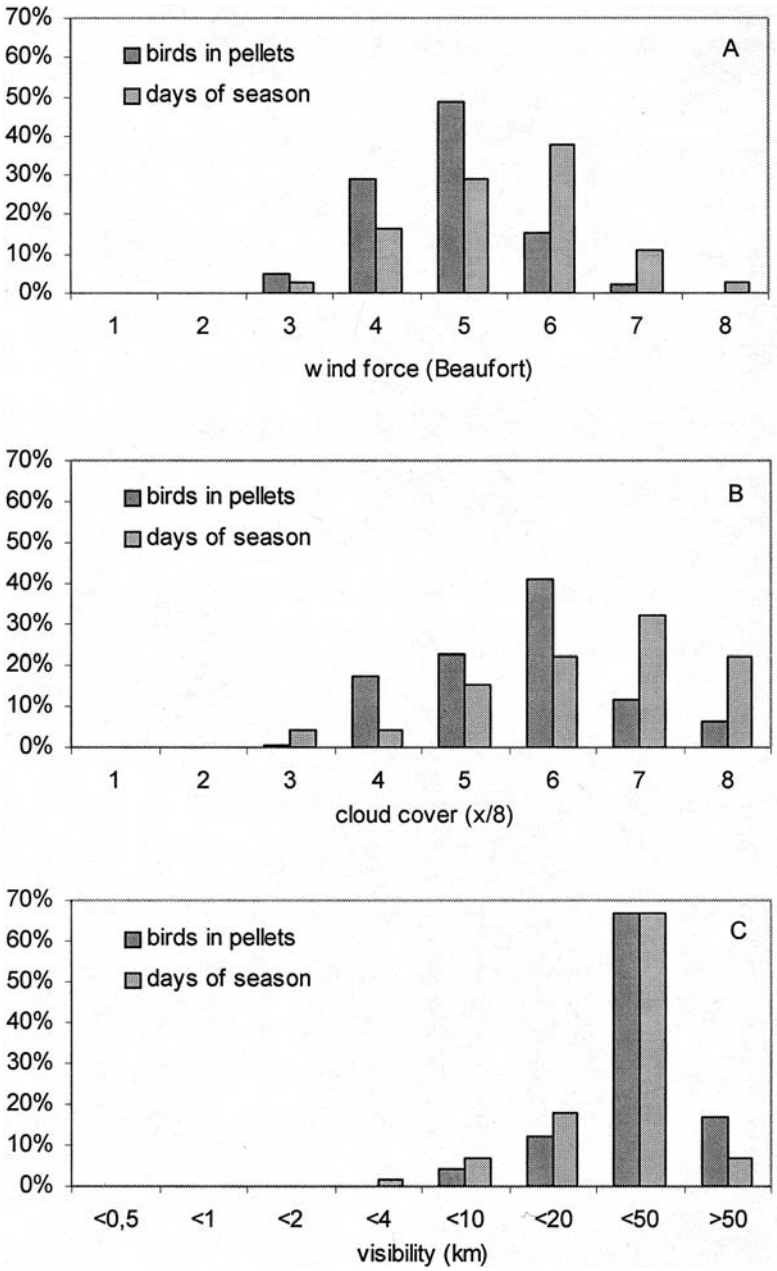

Figure 3. Weather conditions occuring on days in the autumn migratory period of Starlings and thrushes (20 September – 30 November, n = 72; expressed as the average of day of finding and the preceeding day) and at each finding of a pellet containing remnants of Starling or thrushes (average values for two days; n = 199). A: wind force, B: cloud cover and C: visibility. For statistics see Table 5. Nearly the same results were found when using three-day-periods and during spring migration (not shown, but see Table 5).

Väderförhållanden under perioden för starars och trastars flyttning under hösten (20 september–30 november, n= 72; beräknat för dag då spyboll hittades och dagen före) samt väderförhållandet vid påträffandet av spybollar innehållande rester av stare eller trastar (medelvärden för två dagar; n= 199). A: vindstyrka, B: molntäcke, C: sikt. Statistik presenteras i Tabell 5. I stort sett identiskt resultat erhölls då analysen baserades på tre dagars medelvärden samt under vårflyttningen.

Table 4. Spearman rank correlations between percentage of pellets containing remnants of Blackbirds and Redwing/Song Thrush, respectively, and the number of trapped birds of the respective species at the Helgoland bird observatory on either the same day or the same and preceeding day of pellet collection. Days with less than 40 pellets were omitted from the analyses.
Spearman rankkorrelationer mellan procentuell andel spybollar innehållande koltrast eller rödvinge-/taltrast och antalet fångade fåglar av respektive art vid Helgolands fågelstation samma dag eller dagen före spybollen insamlades. Dagar med färre än 40 spybollar uteslöts.

Species *Art*	Season *säsong*	n	Same day *samma dag* R_S	P	Same + preceeding day *samma + följande dag* R_S	P
Blackbird *Koltrast*	spring (4 Mar – 4 Apr)	17	-0,319	0,211	-0,075	0,774
	autumn (6 Oct – 26 Nov)	30	-0,070	0,711	-0,038	0,842
Redwing and Songthrush	spring (4 Mar – 9 May)	23	-0,056	0,799	0,196	0,371
Rödvinge och taltrast	autumn (13 Sep – 14 Nov)	37	0,179	0,288	0,122	0,470

ines taken, it is impossible to judge whether especially weak birds are selected by hunting gulls. The usual method of capture by forcing a passerine onto the sea surface (Alerstam 1990) may indicate that birds in good condition could be able to escape such attacks by flying upwards (own obs., see also Hedenström & Rosén 2001). It is possible that many or even most passerines were exhausted and alighted on the water before taken by gulls, and finally, it cannot be excluded that gulls scavenged on passerines which were already dead. However, despite being in the digestive tract of a gull for a while, the feathers found in the pellets looked rather intact and differed from feathers of birds washed ashore. Therefore, it is unlikely that the gap between peak migration of passerines and the peak of birds in pellets (Figure 1) is due to dead birds taken after weeks of drifting in the sea.

The high proportion of passerines in the diet of large gulls has not been described before. On Helgoland, few or no passerines at all were found in stomachs or pellets in most earlier studies (Table 6), compared to up to 7 % of pellets containing passerines in April and November 1999. These two months

Table 5. Bonferroni corrected significance levels of differences in distributions of weather conditions during the period of thrush and Starling migration and at the finding of large passerines in pellets. Average conditions for two- and three-day-periods (including the day of finding) were calculated. Sample sizes are 61 days and 111 birds in pellets in spring and 72 days and 199 birds in pellets in autumn.
Bonferronikorrigerade av signifikansnivåer för skillnaderna mellan väderbetingelser under trast- och starflyttningsperioden och förekomsten stora tättingar i funna spybollar. Genomsnittliga förhållanden för två- och tredagarsperioder (inklusive dagen då spybollen hittades) beräknades. Stickprovsstorlek var 61 dagar och 111 fåglar i spybollar för våren och 72 dagar och 199 fåglar i spybollar för hösten.

	two days			three days		
	χ^2	df	P	χ^2	df	P
Spring migration *Vårflyttning* (1 Mar – 30 Apr)						
Wind force *vindsstyra*	20.06	4	<0.01	17.37	3	<0.01
Cloud cover *molnighet*	5.04	6	n.s.	13.65	6	n.s.
Visibility *sikt*	11.92	4	n.s.	7.03	4	n.s.
Autumn migration *Höstflyttning* (20 Sep – 30 Nov)						
Wind force *vindstyrka*	35.53	4	<0.01	9.11	4	n.s.
Cloud cover *molnighet*	35.00	4	<0.01	13.55	4	<0.05
Visibility *sikt*	7.07	3	n.s.	7.74	3	n.s.

Table 6. Proportions of passerine birds in the diet of large gulls on Helgoland. Pellets collected from May to September may in part originate from Lesser Black-backed Gulls.
Proportionen tättingar i dieten hos större trutar på Helgoland. Spybollar som samlades in från maj till september kan delvis härröra från silltrut.

Species and method *Art och metod*	n	Season *Säsong*	No. passerines *Antal tättingar*	% passerines *% tättingar*	Source *Källa*
Herring Gull *Gråtrut*					
Stomachs *magar*	198	Jan–Dec	7	3.5 %	Löhmer & Vauk 1970
Stomachs *magar*	351	Oct–Apr	4	1.1 %	Prüter 1986
Pellets *spybollar*	148	Jun–Jul	0	0.0 %	A.-K. Dierschke in prep.
Great Black-backed Gull *Havstrut*					
Stomachs *magar*	54	Aug–Apr	1	1.8 %	Kock 1974
Stomachs *magar*	134	Oct–Apr	1	1.1 %	Prüter 1986
large gulls *trutar*					
Pellets *spybollar*	784	Aug–Sep	0	0.0 %	Löhmer & Vauk 1969
Pellets *spybollar*	126	Mar	15	11.9 %	Geiß 1994
Pellets *spybollar*	167	Apr	3	1.8 %	Geiß 1994
Pellets *spybollar*	130	May	3	2.3 %	Geiß 1994
Pellets *spybollar*	15307	Jan–Dec	420	2.7 %	this study (details Table 2)
Pellets *spybollar*	176	Dec–Jan	0	0.0 %	Wurm & Hüppop in prep.
Pellets *spybollar*	57	Feb	1	1.8 %	Wurm & Hüppop in prep.

were characterized by very low numbers of large gulls present compared to the average of the years before (Table 1). Because the size of gull roosts on Helgoland is closely connected to the activity of fishing vessels around the island (Hüppop & Wurm 2000) and because discards are an important food of large gulls at Helgoland (Löhmer & Vauk 1970, Kock 1974, Garthe 1993), the low activity of human fisheries during this study (own obs.) is possibly a reason for the high proportion of passerines in the diet of gulls in April and November. An even higher proportion of passerines was found only in a small sample of pellets in March 1993 (11.9 %, Table 6), also in a period of low human fisheries activity (O. Hüppop pers. comm.).

Consistent with an earlier review of passerine predation by gulls (Macdonald & Mason 1973), the majority of passerines taken by large gulls were thrushes and Starlings. Despite their higher abundance smaller passerines were found in pellets only occasionally. One might argue that the later migration in spring and the earlier passage in autumn of small passerines (Figure 1) less often brings these species into adverse weather conditions which was supposed to be advantageous for gulls when hunting migrating passerines (Macdonald & Mason 1973). The results of the present study do not confirm a higher occurrence of passerines in pellets during bad weather. In contrast, more pellets containing passerines were found during periods of good conditions for migration when many passerines were on the wing and therefore available for gulls. It is possible that smaller passerines are better in manoeuvrability compared to larger species (see Hedenström & Rosén 2001), making catching more difficult for gulls. It seems more reasonable that small birds are not a profitable prey for large gull species.

Because only part of the gull roosts on Helgoland are accessible, and the number of pellets produced by a gull during a given period is unknown, it is difficult to estimate the total number of passerines taken by large gulls. Assuming that a pellet is produced every two days, and that maximum values of the bi-weekly gull counts are representative for the whole month, the percentages of passerines found in pellets result in c. 2000 passerines captured during spring migration (March to June) and c. 3200 passerines from August to December. Compared to the number of 420 passerines actually found, the estimate of c. 5200 passerines captured seems reasonable. Unfortunately, the total number of passerines migrating over the German Bight and the number of birds killed by other causes during migration are difficult to estimate. But the birds taken by gulls compare to the number of birds trapped in the trapping garden (in 1999: 8557 passerines year round)

or found as victims of feral cats (in 1999 at least 308 passerines). Furthermore, 782 Sparrowhawks *Accipiter nisus* and 119 Merlins *Falco columbarius* were observed on Helgoland in 1999. Most Sparrowhawks and Merlins pass the island quickly, therefore the number of passerines taken by them is probably lower compared to predation by gulls. In the light of these considerations large gulls appear to be significant predators for migrating passerines. Therefore, it makes sense for passerines to adapt migratory strategies to this danger by avoiding flights close to the sea surface during daylight (Bourne 1980).

Acknowledgements

Invaluable assistance during the collection and examination of gull pellets was given by M. Brandt, C. Brehm, S. Engel, A. Fischer, N. Markones, C. Pott, A. Sobottka, M. Vischer and H.-J. Wendel. Unpublished data of pellet contents were kindly supplied by S. Wurm. F. Bairlein, M. Götz and O. Hüppop kindly commented on the manuscrtipt. Financial support was given by the „Freunde und Förderer der Inselstation der Vogelwarte Helgoland e.V.". Weather data were obtained from Deutscher Wetterdienst.

References

Aborn, D. A. 1994. Correlation between raptor and songbird numbers at a migratory stopover site. *Wilson Bull.* 106: 150–154.

Alerstam, T. 1990. *Bird migration.* Cambridge University Press, Cambridge.

Bourne, W. R. P. 1980. The midnight descend, dawn ascent and re-orientation of land birds migrating across the North Sea in autumn. *Ibis* 122: 536–540.

Delingat, J. & Dierschke, V. 2000. Habitat utilization by Northern Wheatears *Oenanthe oenanthe* stopping over on an offshore island during migration. *Vogelwarte* 40: 271–278.

Garthe, S. 1993. Quantifitierung von Abfall und Beifang der Fischerei in der südöstlichen Nordsee und deren Nutzung durch Seevögel. *Hamburger Avifaun. Beitr.* 25: 125–237.

Geiß, J. 1994. Die Bedeutung der Helgoländer Fischerei für die See- und Küstenvögel. *Thesis Univ. Hamburg.*

Glutz von Blotzheim, U. N. & Bauer, K. M. 1982. *Handbuch der Vögel Mitteleuropas. Vol. 8.* Akad. Verlagsges., Wiesbaden.

Hedenström, A. & Rosén, M. 2001. Predator versus prey: on aerial hunting and escape strategies in birds. *Behav. Ecol.* 12: 150–156.

Hüppop, O. 1997. Langzeit-Veränderungen der Brutbestände Helgoländer See- und Küstenvögel. *Seevögel* 18: 38–44.

Hüppop, O. & Wurm, S. 2000. Effects of winter fishery activities on resting numbers, food and body condition of large gulls *Larus argentatus* and *L. marinus* in the southeastern North Sea. *Mar. Ecol. Prog.* Ser. 194: 241–247.

Klaassen, M. & Biebach, H. 2000. Flight altitude of trans-Sahara migrants in autumn: a comparison of radar observations with predictions from meteorological conditions and water and energy balance models. *J. Avian Biol.* 31: 47–55.

Kock, K.-H. 1974. Nahrungsökologische Untersuchungen an Mantelmöwen (*Larus marinus*) auf Helgoland. *Helgoländer wiss. Meeresunters.* 26: 88–95.

Löhmer, K. & Vauk, G. 1969. Nahrungsökologische Untersuchungen an übersommernden Silbermöwen (*Larus argentatus*) auf Helgoland im August/September 1967. *Bonner Zool. Beitr.* 20: 110–124.

Löhmer, K. & Vauk, G. 1970. Ein weiterer Beitrag zur Ernährung Helgoländer Silbermöwen (*Larus argentatus*). *Vogelwarte* 25: 242–245.

Macdonald, S. M. & Mason, C. F. 1973. Predation of migrant birds by gulls. *Brit. Birds* 66: 361–363.

Moritz, D. 1982. Langfristige Bestandsschwankungen ausgewählter Passeres nach Fangergebnissen auf Helgoland. *Seevögel* 3, Suppl.: 13–24.

Piersma, T. & van de Sant, S. 1992. Pattern and predictability of potential wind assistance for waders and geese migrating from West Africa and the Wadden Sea to Siberia. *Ornis Svecica* 2: 55–66.

Prüter, J. 1986. Untersuchungen zum Bestandsaufbau und zur Ökologie der Möwen (Laridae) im Seegebiet der Deutschen Bucht. *PhD thesis Univ. Hannover.*

Ulfstrand, S., Roos, G., Alerstam, T. & Österdahl, L. 1974. Visible bird migration at Falsterbo, Sweden. *Vår Fågelvärld, Suppl.* 8.

Vauk, G. & Prüter, J. 1987. *Möwen.* Niederelbe-Verlag, Otterndorf.

Walter, H. 1979. *Adaptations to prey and habitat in a social raptor.* University of Chicago Press, Chicago.

Sammanfattning

Trutar som predatorer på flyttfåglar i sydöstra Nordsjön

Flyttfåglar utsätts för många faror under flyttningen. Predatorer kan specialicera sig på förbiflyttande fåglar som t ex hos eleonorafalken *Falco eleonorae*, medan vissa fågelpredatorer själva är flyttfåglar och således jagar under flyttningsresan. På Helgoland förekommer stora mängder gråtrut *Larus argentatus* och havstrut *L. marinus*, vilka huvudsakligen livnär sig på restavfall från fisket som förekommer runt ön. I den här studien samlades 15307 spybollar in från de två trutarterna under 1999 och analyserades med avseende på innehåll (Tabell 1). Det visade sig att under vår och höst, då stora mängder flyttande tättingar passerar Helgoland, innehöll likaså trutarnas spybollar rester av fåglar (Figur 1). Trutarnas huvudsakliga föda var fisk och kräftdjur, men under

flyttningsperioderna (mars–maj, augusti–september) innehöll upp till 7% av spybollarna rester av fåglar (Tabell 2). Materialet delades upp i två storlekskategorier bestående av mindre tättingar (<50 g) och större arter som trastar och stare (>50 g). Artbestämda byten redovisas i Tabell 3. Förekomst av stare i spybollar sammanföll tydligt med starens förekomst på Helgoland (Figur 2), medan ingen signifikant korrelation förelåg mellan procentuell andel av koltrast och rödvinge/taltrast i spybollarna i relation till fångstsiffror vid fågelstationen på ön (Tabell 4). Analys av förekomst av fågelrester i spybollarna i relation till olika väderfaktorer visade en signifikant inverkan av vindstyrka (vår och höst) och molntäcke (endast höst), medan sikt ej verkade förklara variationen av fåglar som trutbyten.

De större arterna (trastar och stare) var betydligt vanligare som byten än de mindre tättingarna (Tabell 3), vilket kan bero på den relativa manövreringsförmågan mellan trutarna och bytesarterna (trastar har sämre manövreringsförmåga än små tättingar) eller att trutarna selektivt jagar större byten p g a bytets profitabilitet (= näringsutbyte i relation till kostnaden att fånga det). Slutligen jämförs proportionen tättingar återfunna i spybollar hos trutar med andra studier (Tabell 6). Det kan inte uteslutas att fågelresterna som återfanns i spybollarna har konsumerats som kadavaer snarare än att trutarna verkligen fångat levande fåglar (såsom antas i denna uppsats). Flera observationer av lyckade jakter på levande fåglar av trutar har emellertid gjorts, vilket stödjer antagandet att trutar faktiskt jagar fåglar opportunistiskt under flyttningen.