

Feeding areas and local movement patterns of post-breeding Greylag Geese *Anser anser* in South Sweden

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Abstract

Greylag Geese *Anser anser* mostly selected one field type, neglecting all other available types. After the breeding season they started to feed on grasslands, turned to peas during the end of July or the middle of August, and then shifted to wheat stubble in the first half of September. Only two other field types, barley stubble and newly-sown cereals, were occasionally selected. Most of the time they never showed any interest in oat stubble, newly-sown cereals and newly-sown rape. Rape stubble and ploughed fields were never used. Fields with high-energy food accounted for about 95% of all geosedays each autumn. The exploitation rate of large fields (>17 ha) with peas or wheat stubble was much higher than that of smaller fields with the same crop. Distances between roosts and feeding areas were normally less than 5 km. In October the activity pattern, characterized by two daily feeding periods,

began to weaken, with some geese staying on the feeding grounds all day. In November all geese spent the whole day on the feeding grounds. The length of time spent on the feeding grounds per day increased from about 200 min. in mid-August to more than 400 min. in early October. The marked families not only stayed in the study area the whole autumn but moreover, they rarely moved between different gathering areas. There were no significant differences between families and pairs without young with respect to the time they were present and the number of times they moved between different gathering areas. Subadults moved between gathering areas significantly more often than did mature birds.

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Introduction

Like other goose populations the Greylag Goose population in Sweden and in other parts of northwestern Europe has increased markedly in recent years (e.g. Fog et al. 1984, Madsen 1986, 1991, Rutschke 1987). New areas have been colonized in southern Sweden, and in southern Skåne a breeding population of several hundred pairs has become established over the last two decades (Persson 1990), with late summer/autumn gatherings amounting to several thousand individuals.

The general pattern of occurrence of Greylag Geese in late summer/autumn gatherings has been studied in Denmark (Madsen 1986, 1987), West Germany (Hummel 1982) and East Germany (Rutschke 1982, Rutschke et al. 1982, Rutschke & Schulze 1985). Rutschke et al. (1982) distinguished between summer flocks (Sommer-Sammelplatz-Verbände) and autumn flocks (Frühherbst-Rastplatzverbände) and noted that many gathering places are used both in summer and autumn. However, nothing was known about the composition

and stability of the autumn gathering flocks.

Although the field and food preferences of Greylag Geese have been examined in several studies (Hudec & Rooth 1970, Newton & Campbell 1973, Dubbeldam 1978, Madsen 1985a), detailed information from summer and autumn gatherings are lacking. Data on the general activity rhythms indicate that there is a general diurnal pattern with two feeding periods in summer, autumn, and winter (Rutschke 1982, Rutschke et al. 1982, Witkowski 1983, Rutschke & Schulze 1985, Amat 1986).

The aim of this study was to characterize the preferred feeding areas, daily activity and local movement patterns of Greylag Geese in a gathering area in southern Sweden in late summer and autumn. More specifically, we wanted to identify the factors involved in determining the choice of feeding areas, daily activity patterns and local movements of different categories (families, pairs without young, subadults) in the gathering areas.

Study area

The study was carried out in SW Skåne, in southernmost Sweden. The study area (Fig. 1) included a western (Yddingen, Fjällfotasjön, Klosterviken, Börringesjön and Björkesåkrasjön) and an eastern (Sövdesjön, Snogeholmssjön, Ellestadsjön and Krageholmssjön) lake area with breeding populations of Greylag Geese, and a shallow coastal bay, Foteviken, used only during the nonbreeding season. The lakes are situated in an agricultural district and are partly surrounded by woodland and pastures. Foteviken is surrounded by large areas of intensively grazed shore meadows with intensively cultivated agricultural areas nearby.

SW Skåne is an agricultural area mainly characterized by large fields. Clay soils dominate although sandy soils are present in some areas. The main crops are cereals (mainly autumn-sown), oil-plants (rape), peas and, in some districts, sugar beet. Potatoes and carrots are grown on sandy soils. Root crops are lacking in the western lake area. The field preferences of the geese were studied in the western lake area (Fig. 2). The field types in this area are presented in Fig. 4.

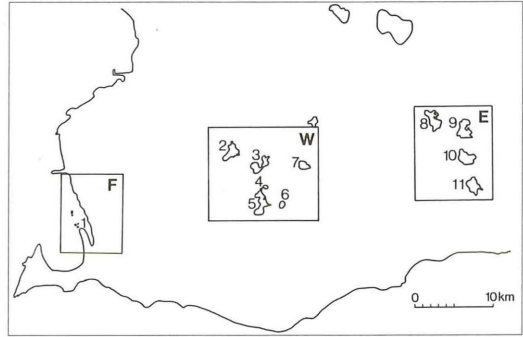


Fig. 1. Study area.
Undersökningsområde.

F: Foteviken area, W: Western lake area (*västra sjöområdet*), E: Eastern lake area (*östra sjöområdet*). 1: Foteviken, 2: Yddingen, 3: Fjällfotasjön, 4: Klosterviken, 5: Börringesjön, 6: Havgårdssjön, 7: Björkesåkrasjön, 8: Sövdesjön, 9: Snogeholmssjön, 10: Ellestadsjön, and 11: Krageholmssjön.

Material and methods

We visited all goose haunts in the study area (Fig. 1) once a week from mid-July to mid-December, 1985 to 1987. During every visit the number of geese at each locality was counted, and the flocks were checked for neck-banded individuals.

At the special study area (Fig. 2), which was visited at least twice a week, we noted the fields in which the geese were feeding. Both morning and evening observations were made. The crops present in the fields in the special study area and any changes in the state of the fields (e.g. if a field had been harvested, ploughed or sown) were recorded.

To characterize daily activity patterns one of the flocks was followed from one hour before sunrise until one hour after sunset for one day each week. These observations included its time of arrival at a feeding ground and its time of departure.

During the summers of 1985, 1986 and 1987 we neck-banded a total of 436 breeding Greylag Geese, both adults and goslings, at the lakes Yddingen, Fjällfotasjön, Klosterviken, Börringesjön and Snogeholmssjön (Fig. 1). These marked birds were used to study local movements.

Total number of goosedays (GD) was estimated as follows: $GD = \sum g_i d_i$, where g_i = number of geese counted on day i , and d_i = half the number of days between the counts immediately before and immediately after day i (for the first and last count each autumn d_i was the number of days to the following and preceding count,

respectively). The number of goosedays in a specific field or field type was estimated in a corresponding way.

Results

The post-breeding population

The post-breeding population in SW Skåne started to increase in mid-July, when the first geese began to return after moulting (Fig. 3). It rapidly increased to around 5000 by middle to late August, reaching a maximum of about 7000 in mid-September, before the autumn migration. It thereafter decreased to about 500 by the end of October. In contrast to the increase that occurred during the latter half of August in 1985 and 1986, a marked decrease occurred during the corresponding period in 1987.

Table 1. Number of breeding pairs in the lake areas in 1985-1987. From Persson (1990).

Antal häckande par i de båda sjöområdena 1985-1987. Från Persson (1990).

Breeding area	1985	1986	1987
Western lake area <i>Västra sjöområdet</i>	125	205	275
Eastern lake area <i>Östra sjöområdet</i>	?	?	140

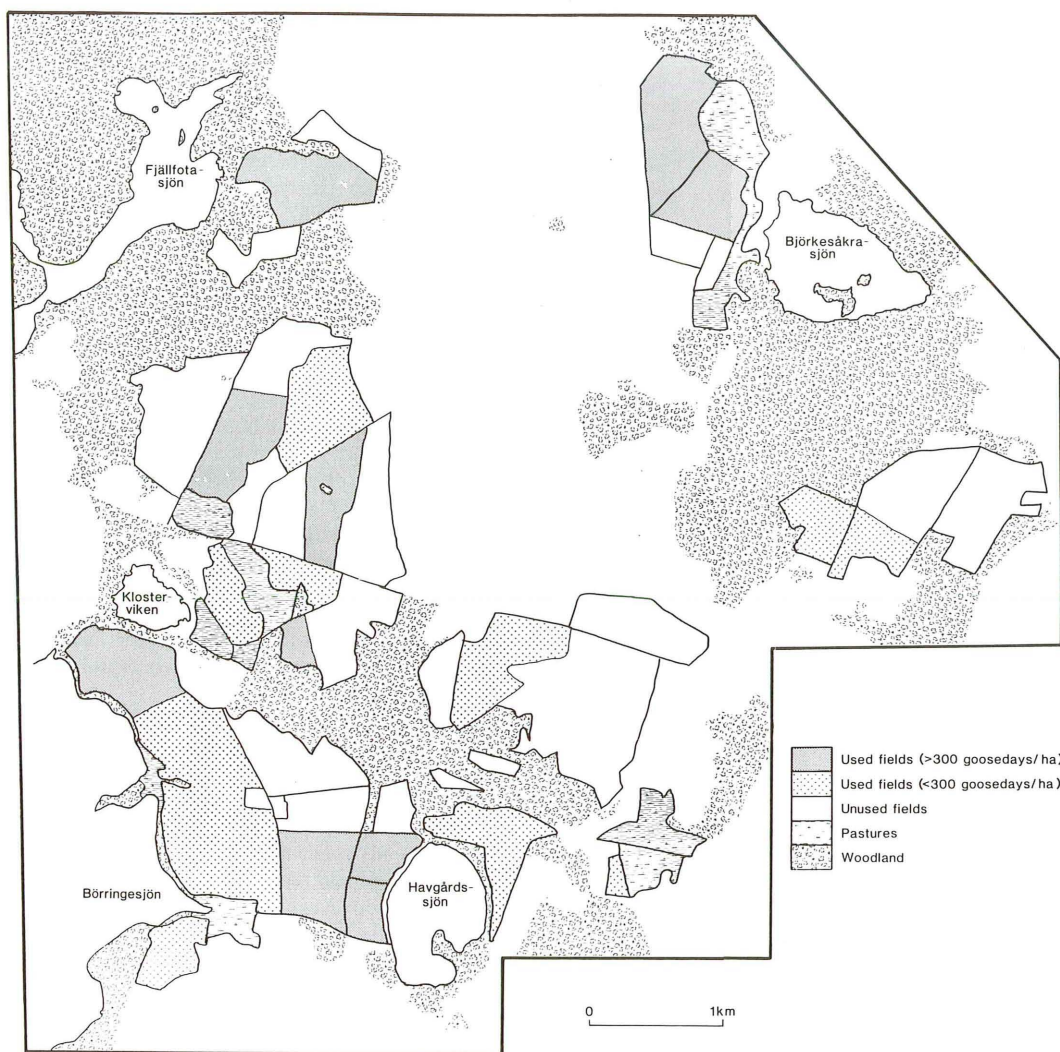


Fig. 2. Special study area in 1985-1987. The main part of the unspecified area consists of an agricultural district with small farms and fields (not used by the geese).

Område för intensivstudier 1985-1987. Merparten av det ospecificerade området består av ett jordbruksdistrikt med små gårdar och fält (vilket ej unyttjades av gässen).

The post-breeding population in SW Skåne was split among three areas (Fig. 1), each of which had one large flock or two to three subflocks. Peak numbers in the two inland areas (6400-6500 geese) had decreased by 90% by the 16th, 13th and 22nd of October during the autumns of 1985, 1986 and 1987, respectively. At the coastal area (Foteviken) the geese stayed until much later in the autumn.

In mid-August 1985, 1986 and 1987 the number of geese in the western lake area, including the Foteviken area, was eight, nine and four times the respective number of breeding pairs in the western area (Fig. 3 compared with Table 1). In 1987, crop growth and harvest times were delayed 3-4 weeks, so counts in the first week of September that year were comparable to those made in mid-August during the other years. At

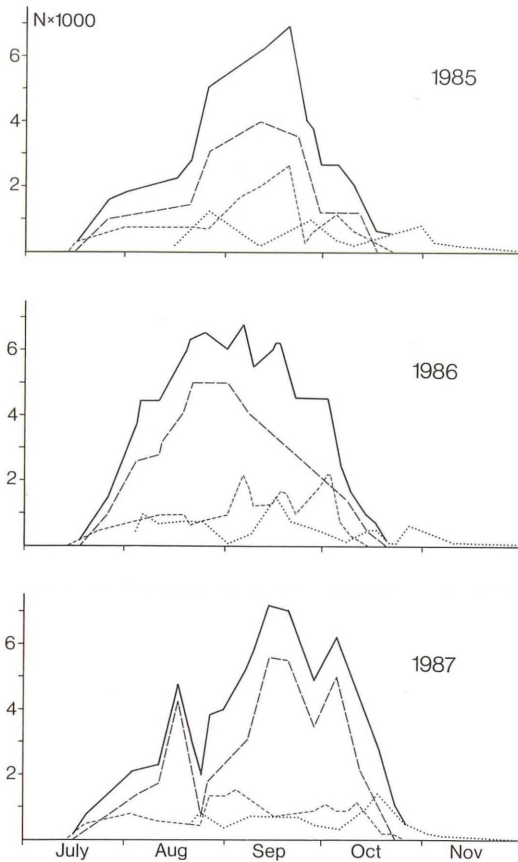


Fig. 3. Numbers of Greylag Geese in SW Skåne during the autumns of 1985, 1986 and 1987, over the whole study area (solid line), and in the Foteviken area (stippled line), the western lake area (broken line, short strokes) and the eastern lake area (broken line, long strokes).

Antalet grågäss i sydvästra Skåne under höstarna 1985, 1986 och 1987 i hela undersökningsområdet (heldragen linje), samt i Foteviksområdet (prickad linje), västra sjöområdet (streckad linje, korta streck) och östra sjöområdet (streckad linje, långa streck).

that time (first week of September 1987) the number of geese was eight times the number of breeding pairs. The number of geese in the eastern lake area in mid-August 1987, was about 30 times the number of breeding pairs in that area (Fig. 3 compared with Tab. 1).

Field choice

The type of field chosen by the geese was basically determined by the types available at a given time (Fig. 4). In the early part of autumn the geese used grasslands,

but turned to pea fields as soon as the peas started to ripen (Fig. 4, Table 2). The geese began to feed on peas long before the fields were harvested, in August or September, and they continued to do so until the wheat fields were harvested in late August or early September. Thereafter the geese turned to the stubble to eat grain spill, using other field types only temporarily, e.g. newly-sown fields. In 1987, when the wheat harvest was delayed, the geese fed on barley stubble and peas in September.

The geese mostly selected one field type, neglecting all other available types (Table 2). The geese never chose grassland when other field types (except ploughed fields) were available. Most of the time they never showed any interest in oat stubble, newly-sown cereals and newly-sown rape. Rape stubble or ploughed fields were never used. The level of exploitation of peas, measured as number of goosedays/ha used area, was always high (Table 3). About half of the area with wheat stubble was used each year, with an exploitation rate of about 50% of that of the pea fields. In 1985 the geese used one field of barley stubble and one of oat stubble, with both fields being subjected to very high exploitation rates. During the other two years barley stubble was used to the same extent as wheat stubble, whereas oat stubble was rarely used.

Overall, wheat stubble was the most heavily utilized field type and accounted for about 40% of all goosedays each autumn (Table 4). Pea fields were next in importance, while barley and oat stubble were only important in some years.

The geese usually concentrated in one of the largest fields of a selected field type, neglecting other fields with the same crop except when disturbed on the preferred field. The preferred pea and wheat stubble fields were significantly larger than other available but unused fields (Table 5). The exploitation rate of large fields (>17 ha) with peas or wheat stubble was much higher than that of smaller fields with the same crop (Table 6). Similarly, the geese tended to prefer large fields with barley stubble over small ones (Table 5, not statistically significant). For oat stubble there was no significant difference in the size of used and unused fields; however, the number of fields with this crop was relatively low. Each autumn the ten most heavily used fields accounted for 90-100% of all goosedays.

In general, Greylag Geese fed on fields close to their roosts; distances between daytime roosts (and night roosts) and feeding areas were normally less than 5 km (Table 7). Only a few longer distances were recorded (in 1987). The geese flew significantly longer distances to pea fields than to wheat stubble ($\text{Chi}^2 = 11.92$, $P < 0.01$).

Table 2. Field type preference (D) in the special study area in 1986 and 1987 according to the Jacobs' index (Jacobs 1974): $D=(r-p)/(r+p-2rp)$, where r represents the proportion of geese in a given field type, and p is the proportion of the total (harvested) area consisting of that field type. The index ranges from -1 (total avoidance) to +1 (one field type selected).

Grågässens preferens för olika fälttyper (D) i intensivstudieområdet 1986 och 1987 enligt Jacobs index (Jacobs 1974): $D=(r-p)/(r+p-2rp)$, där r är andelen gäss på en given fälttyp och p är andelen av hela området som består av den fälttypen. Indexet sträcker sig från -1 (totalt undvikande) till +1 (endast en fälttyp utnyttjas).

1986	15-22.7	23.7-18.8	19-28.8	1-8.9	11-26.9	29.9	2-3.10	6-10.10
Grassland <i>Gräsmark</i>	+1	-1	-1	-1	-1	-1	-1	-1
Peas <i>Ärtor</i>	-	+1	+1	+0.24	-1	-1	-	-
Wheat stubble <i>Vetestubb</i>	-	-	-1	-0.33	+1	+0.31	-1	+0.89
Barley stubble <i>Kornstubb</i>	-	-	-1	+0.03	-1	-1	+1	-0.63
Oat stubble <i>Havrestubb</i>	-	-	-1	-0.78	-1	-1	-1	-1
Rape stubble <i>Rapsstubb</i>	-	-1	-1	-1	-	-	-	-
Newly-sown cereals <i>Nysådd höstsäd</i>	-	-	-	-1	-1	+0.85	-1	-0.62
Ploughed fields <i>Plöjda fält</i>	-	-	-1	-1	-1	-1	-1	-1
1987	15.7-10.8	11.8	12-19.8	22-31.8	4-8.9	14-28.9	2-23.10	
Grassland <i>Gräsmark</i>	+1	+0.78	-1	-1	-1	-1	-1	
Peas <i>Ärtor</i>	-	-0.28	+1	+0.96	+0.65	-0.39	-	
Wheat stubble <i>Vetestubb</i>	-	-	-	-	+0.18	+0.56	+1	
Barley stubble <i>Kornstubb</i>	-	-	-	-	-	+0.49	-1	
Oat stubble <i>Havrestubb</i>	-	-	-	-	-	-1	-1	
Rape stubble <i>Rapsstubb</i>	-	-	-	-1	-1	-1	-1	
Newly-sown cereals <i>Nysådd höstsäd</i>	-	-	-	-	-1	-1	-1	
Newly-sown rape <i>Nysådd raps</i>	-	-	-	-0.70	-1	-0.02	-1	
Ploughed fields <i>Plöjda fält</i>	-1	-1	-1	-1	-1	-1	-1	

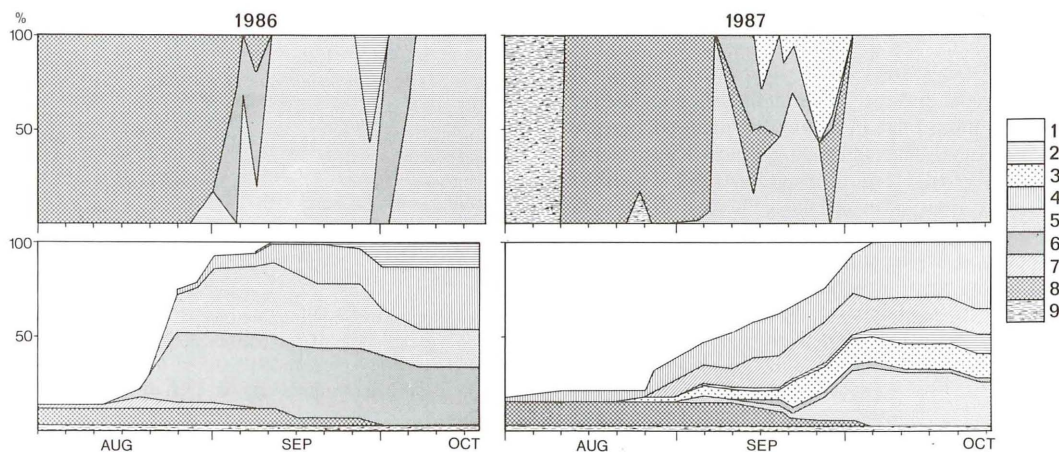


Fig. 4. Field choice of Greylag Geese (upper diagram) in relation to the availability of different field types (lower diagram) in the examined area in 1986 and 1987. Field choice is measured as the percentage of the total number of geese observed in a particular field type during the regular counts. The lower diagram shows the percentage of each field type each day. 1107 and 1080 ha were under observation during 1986 and 1987, respectively. Key: (1) Unharvested fields, (2) Newly-sown cereals, (3) Newly-sown rape, (4) Ploughed fields, (5) Wheat stubble, (6) Barley/oat stubble, (7) Rape stubble, (8) Peas, and (9) Grassland.

Grågässens fältval (övre diagrammet) i förhållande till de olika fälttypernas tillgänglighet (undre diagrammet) i det intensivstuderade området 1986 respektive 1987. Fältvalet beräknades som procentandelen av det totala antalet gäss som under de regelbundna inventeringarna sågs på respektive fälttyp. Det undre diagrammet visar områdets fördelning på olika fälttyper dag för dag. Åren 1986 och 1987 omfattade undersökningsområdet 1107 respektive 1080 ha. Nyckel: (1) Oskördat, (2) Nysådd stråsäd, (3) Nysådd raps, (4) plöje, (5) vetestubb, (6) Korn/havrestubb, (7) rapsstubb, (8) ärtor och (9) gräsmark.

Table 3. Use of different field types in the examined area in the autumns of 1985, 1986 and 1987, estimated as the percentage of total area used by Greylag Geese and as the level of exploitation, in number of goosedays/ha used area. Number of used fields in brackets.

Grågåsens utnyttjande av olika fälttyper i intensivstudieområdet höstarna 1985, 1986 och 1987 beräknat dels som procentandelen av den totala arealen som utnyttjades och dels som exploateringsgraden i antalet gåsdagar/ha utnyttjad areal. Antalet utnyttjade fält anges inom parentes.

Year	Total area (ha)	Used area %	Exploitation (goosedays/ha)
År	Total yta (ha)	Utnyttjad yta %	Exploatering (gåsdagar/ha)
Peas	85	70	81 (3)
Årtor	86	100	100 (2)
	87	140	54 (3)
Wheat stubble	85	306	50 (5)
Vetestubb	86	469	53 (7)
	87	367	64 (6)
Barley stubble	85	219	29 (1)
Kornstubb	86	328	38 (3)
	87	48	66 (2)
Oat stubble	85	58	59 (1)
Havrestubb	86	112	3 (1)
	87	21	0 (0)
Rape stubble	85	250	0
Rapsstubb	86	61	0
	87	311	0

Daily activity pattern

In late summer and early autumn the geese visited the feeding grounds once in the morning and once in the evening (Fig. 5). They left the night roost at sunrise and flew directly to the feeding grounds. After 2-4 hours of feeding they returned to the lake or the sea to drink, bath and preen. They generally rested on the shores of the day roost or on adjacent fields, sometimes grazing with low intensity for shorter periods. In the evening they returned to the feeding grounds and stayed until about half an hour after sunset. On average, the geese fed for a shorter time (50 min. less) in the evening than in the morning.

In October, the activity pattern with two daily feeding periods began to weaken, with some geese staying on the feeding grounds all day (Fig. 5). In November, all geese spent the whole day on the feeding grounds.

The length of time spent on the feeding grounds per day increased from about 200 min. in mid-August to more than 400 min. in early October (Fig. 6). In 1987, when the harvest was delayed, the geese spent a significantly shorter time per day on the feeding grounds in late September and early October than they did during the corresponding period in 1986 (Fig. 6, $P < 0.001$).

Table 4. Field-type utilization, estimated as the percent of the total goosedays spent in each of the field types in the special study area in the autumns of 1985, 1986 and 1987.

Fältutnyttjandet beräknat som procentandelen av totala antalet gåsdagar som tillbringades på respektive fälttyp i intensivstudieområdet höstarna 1985, 1986 och 1987.

	1985	1986	1987	Mean Medel	Range Variation
Number of goosedays	78 070	80 260	77 860		
Antal gåsdagar					
Pastures Gräsmark	3.8	2.5	7.6	5	2-8
Peas Årtor	18.9	35.9	38.4	31	19-38
Wheat stubble Vetestubb	38.1	43.4	39.6	40	38-43
Barley stubble Kornstubb	23.7	15.1	5.4	15	5-24
Oat stubble Havrestubb	15.5	0.4	0	5	0-16
Newly-sown cereals	0	2.7	0	1	0-3
Nysådd höstsäd					
Newly-sown rape	0	0	9.0	3	0-9
Nysådd raps					

Table 5. Mean size of used and unused fields for each of the main field types in the study area in 1985-1987. Number of fields in brackets.

Genomsnittlig storlek för av grågässen utnyttjade resp outnyttjade fält av de viktigaste fälttyperna i intensivstudieområdet 1985-1987. Antalet fält anges inom parentes.

	Mean size +- SE (ha) of the fields.	P for difference (t-test)	
	Medelstorlek +- SE (ha) för fälten		
	Used Utnyttjade	Unused Outnyttjade	
		P för skillnad (t-test)	
Peas Årtor	31.3+-6.9 (7)	9.7+-2.2 (9)	<0.01
Wheat stubble Vetestubb	35.6+-5.1 (18)	20.8+-2.8 (16)	<0.01
Barley stubble Kornstubb	30.0+-7.0 (6)	23.8+-4.8 (17)	ns
Oat stubble Havrestubb	19.0 (2)	21.2+-9.9 (7)	ns

Table 6. Average exploitation rate (goosedays/ha) for different field-size categories of peas and wheat stubble in the study area, 1985-1987. The proportion (%) of the total area of each field type is presented in brackets for each of the field-size categories.

Genomsnittlig exploateringsgrad (gåsdagar/ha) för olika storlekskategorier av fält med årtor resp. vetestubb inom intensivstudieområdet 1985-1987. Andelen (%) av den totala arealen av varje fälttyp som tillhörde respektive storlekskategori anges inom parentes.

	Field size (ha)		Fältstorlek (ha)	
	0.5-16.5	17.0-33.0	33.5-49.5	50.0-66.0
Peas Årtor	24 (18)	244 (22)	339 (38)	174 (22)
Wheat stubble Vetestubb	5 (10)	85 (26)	86 (19)	98 (45)

Table 7. Distribution of distances flown by Greylag Geese from daytime roosts, in the western lake area, to fields with peas and wheat stubble, 1986 and 1987. Number of flocks in brackets. Differences between roosts were analysed using Chi-square.

Procentuell fördelning av sträckor som grågässen flög mellan fält med ärtor respektive vetestubb och dagvilolokaler i det västra sjöområdet 1986 och 1987. Antalet flockar anges inom parentes. Skillnader mellan vilolokaler analyserades med Chi².

	Distances between roost and fields		<i>Avstånd viloplats-fält</i>		No. of geese counted <i>Antal inräknade gäss</i>
	<1 km	1-2 km	ca 4 km	ca 9 km	
<i>Peas Ärtor</i>					
Björkesåkrasjön	-	-	88 (24)	12 (3)	8097 (27)
Klosterviken	46 (11)	9 (2)	45 (9)	-	5330 (22)
Börringesjön	60 (6)	40 (3)	-	-	2829 (9)
<i>Wheat stubble Vetestubb</i>					
Björkesåkrasjön	45 (19)	12 (5)	43 (18)	-	12805 (42)
Klosterviken	100 (8)	-	-	-	2856 (8)
Börringesjön	100 (5)	-	-	-	1230 (5)

Chi² = 38.47 (P<0.001) for difference in number of flocks on pea fields

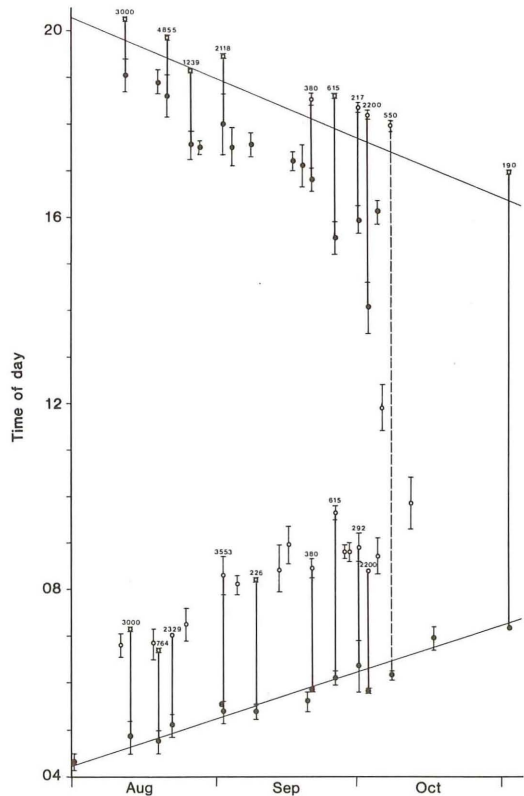
för skillnader i antal på ärtfält

Chi² = 12.23 (P<0.05) for difference in number of flocks on wheat stubble

för skillnader i antal på vetestubb

Fig. 5. Autumn feeding activity of Greylag Geese in relation to sunrise and sunset. Each symbol represents the mean value for all geese (numbers above each line) arriving at (filled symbols) or leaving (open symbols) the feeding grounds in one day. A vertical line between two symbols represents the time spent on the feeding grounds (a broken line means that some of the geese stayed on the feeding grounds all day, while the others visited the roost in the middle of the day). The figure includes material from the autumns 1985, 1986 and 1987.

Grågässens födosöksaktivitet under hösten i förhållande till soluppgång och solnedgång. Varje symbol representerar medelvärde för samtliga gäss (antalet anges ovanför respektive linje) som anlände till (fylld symbol) eller som lämnade (ofylld symbol) födosöksområdena under en dag. En vertikal linje mellan två symboler representerar tiden som tillbringades på födosöksområdena (en streckad linje betyder att en del av gässen stannade här hela dagen, medan andra besökte sovplatsen mitt på dagen). Figuren innefattar observationer från höstarna 1985, 1986 och 1987.



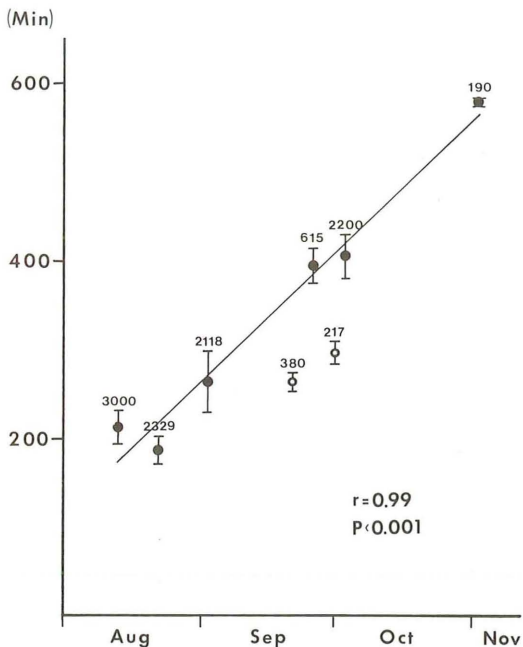


Fig. 6. Amount of time per day spent by Greylag Geese on feeding grounds at different times during the autumn. The figure includes data from 1986 (filled symbols) and 1987 (open symbols), but only data from 1986 were used to calculate the regression line. Accumulated totals of individuals in the flocks studied shown for each mean value.

Längden av grågässens vistelse på födosöksområdena vid olika tidpunkter på hösten. Figuren innefattar uppgifter från 1986 (fyllda symboler) och 1987 (ofyllda symboler), men endast material från förstnämnda år har använts för att beräkna regressionslinjen. Sammanlagda antalet individer i de studerade flockarna anges för varje medelvärde.

Roost sites

The types of roost sites preferred by the geese differed between night and day. In the evening they usually chose the nearest lake, whereas during the day they sometimes passed over several lakes to reach a preferred roost site. The most preferred daytime roost (Lake Björkesåkrasjön) was normally used by more than 50% of all geese in the western area (Table 8). Next in importance was Lake Klostersviken, usually with about one third of all geese. Lake Börringesjön was only used extensively in early autumn. Lake Yddingen was not used, while Lake Fjällfotasjön was only used as a night roost.

Table 8. Relative differences in the use of various lakes as daytime roosts by Greylag Geese during 1986-1987 in the western area. Other lakes in this area (Yddingen, Fjällfotasjön and Havgårdssjön) were not used. Number of counts in brackets.

Relativa skillnader i grågässens utnyttjande av olika sjöar som dagvilolokal i det västra sjöområdet 1986-1987. Övriga sjöar inom detta område (Yddingen, Fjällfotasjön och Havgårdssjön) utnyttjades inte. Antalet inventeringar anges inom parentes.

		Percent of total number on each lake Procentuell fördelning mellan sjöarna			No. of geese counted Antal inräknade gäss
		Björkes- åkrasjön	Kloster- viken	Börringe- sjön	
1986	Aug	72	3	25	4796 (7)
	Sep	55	29	16	13177 (10)
	Oct	70	30	0	1711 (5)
1987	Aug	26	59	15	4773 (10)
	Sep	53	41	6	8954 (8)
	Oct	54	38	8	4516 (6)

Table 9. Frequency of movements between the three autumn gathering areas in 1985-1987 of marked Greylag Geese from different breeding localities (number of movements per family, pair and subadult and 10-day period of observation). Number of each category in brackets. Mean+SD.

Frekvens av förflyttningar mellan de tre koncentrationsområdena 1985-1987 för märkta grågäss från olika häcklokaler (antalet registrerade förflyttningar per familj, par resp. subadult och 10-dagarsperiod). Antalet familjer, par och subadulter anges inom parentes.

	Families Familjer	Pairs Par	Subadults Subadulter
Western lake area Västra sjöområdet			
Yddingen	0.21+0.17 (31)	0.20+0.15 (11)	0.45+0.30 (15)
Fjällfotasjön	0.16+0.18 (12)	0.18+0.10 (6)	0.62+0.44 (17)
Klostersviken	0.12+0.14 (16)	0.22+0.23 (13)	0.33+0.34 (16)
Börringesjön	0.19+0.18 (7)		
Eastern lake area Östra sjöområdet			
Snogeholms- sjön	0.01+0.02 (15)	0.02+0.04 (5)	0.34+0.39 (6)

The preference for Björkesåkrasjön is reflected in the longer distances flown between this roost and the feeding grounds compared with the other roosts (Table 7).

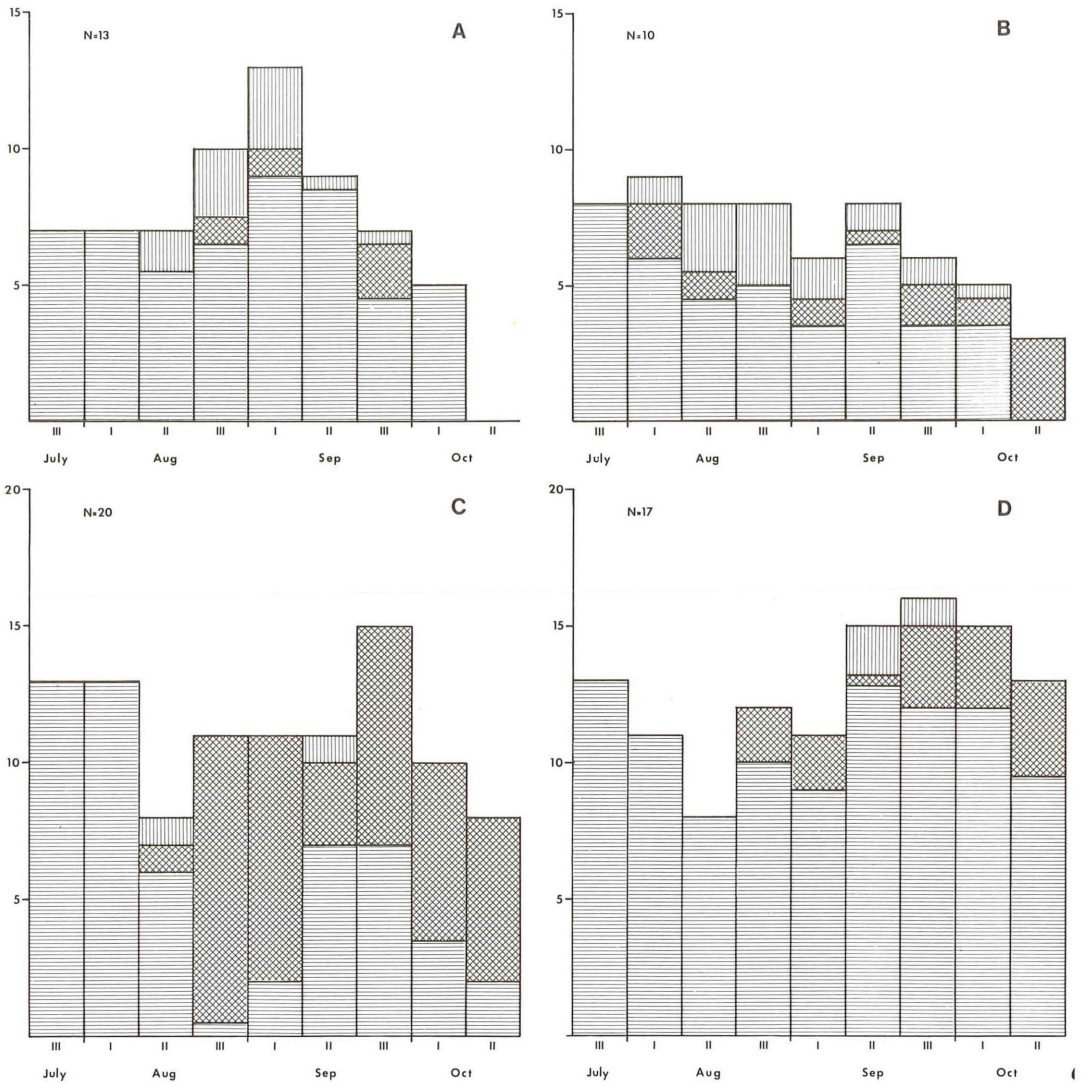


Fig. 7. Tendency of Greylag Goose families to stay in the breeding area in autumn, measured as the number of families observed (out of the total marked at selected breeding localities) during 10-day periods in the western lake area (horizontal lines), the eastern lake area (vertical lines) and the Foteviken area (cross-hatched). In cases where a family was seen in two gathering areas during a 10-day period, it was counted as half a family in both areas. Marked families from (A) Yddingen and Fjällfotasjön 1985, (B) Yddingen and Fjällfotasjön 1986, (C) Yddingen och Fjällfotasjön 1987 and (D) Klosterviken och Börringesjön 1987. N=number of marked families.

Grågåsfamiljernas tendens att stanna kvar i häckningsområdet under hösten beräknat som antal familjer (av antalet märkta vid utvalda häckningslokaler) sedda under 10-dagarsperioder i västra sjöområdet (horisontalstreckat), östra sjöområdet (vertikalstreckat) och Fotevikensområdet (korsstreckat). I de fall då en familj sågs i två områden under en 10-dagars period räknas den som en halv familj i vardera området. Märkta familjer från (A) Yddingen och Fjällfotasjön 1985, (B) Yddingen och Fjällfotasjön 1986, (C) Yddingen och Fjällfotasjön 1987 och (D) Klosterviken och Börringesjön 1987. N = antalet märkta familjer.

Local movement patterns

The marked families not only stayed in SW Skåne the whole autumn (Fig. 7) but moreover, they rarely moved between different gathering areas (Table 9). On average, families from the western lake area moved once every eight weeks, whereas families from the eastern area (Lake Snogeholmssjön) remained in their breeding area until they left the country on autumn migration. Only once was a family from this lake seen outside the eastern area; they were resting in Foteviken in October 1987.

There were no significant differences between families and pairs without young with respect to the time they were present and the number of times they moved between the three gathering areas (Table 9). Subadults moved between gathering areas significantly more often than did mature birds.

In 1987 families from the two lakes in the western area that were not used as daytime roosts (Yddingen and Fjällfotasjön) showed a greater tendency to move to the coast (Foteviken) compared with families from the lakes that were also used as roosts (Klosterviken and Börringesjön, Fig. 7). The difference in distribution was highly significant in both August ($\text{Chi}^2 = 12.27, P < 0.001$) and September ($\text{Chi}^2 = 12.18, P < 0.001$). Similarly the distribution of families from Yddingen and Fjällfotasjön in 1986 was significantly different from that in 1987 ($\text{Chi}^2 = 10.74, P < 0.01$ and $\text{Chi}^2 = 11.54, P < 0.01$ in August and September, respectively). Although most families leaving the western lake area moved to Foteviken, some also visited the eastern area.

In the western lake area most families had visited each of the three daytime roosts on at least a few occasions (Table 10); still, they showed a marked preference for their breeding lake if it was used as a regular roost (Klosterviken).

Discussion

Field choice and food selection

In autumn, Greylag Geese have been reported to select stubble in Denmark (Madsen 1985a), the Netherlands (Dubbeldam 1978, Voslamber 1989) and Scotland (Newton & Campbell 1973, Bell 1988). They have been found to feed on a variety of other food items as well, such as *Scirpus* rhizomes, potatoes, sugar beet, winter wheat, seed-grass and rape (Dubbeldam 1978, van der Reest 1988, Voslamber 1989). Ripe seed battered down by rain was a preferred food source in some Swedish areas (Nilsson & Persson 1988).

The energy contents of grasses, cereal grains and peas are of the same order of magnitude, i.e. 18–19 kJ/g dry matter (Lantbrukshögskolan 1975), but the percentage of dry matter is much higher in cereal grains

than in grasses, being 83% and 20%, respectively (Lantbrukshögskolan 1975, Eriksson et al. 1976). Digestibility is much higher for grains than for grasses (Owen 1980). Geese can assimilate 69–89% of the energy content of cereal grains (Storey & Allen 1982, Madsen 1985b, Joyner et al. 1987), but only 25–40% of the energy content of grasses (Owen 1980, Madsen 1985b, Buchsbaum et al. 1986). The lowest energy values of grasses are found in winter and the highest ones during the growing season, especially in spring.

Using mean values of digestibility it can be estimated that a grazing Greylag Goose must consume about 10 times as much food (wet weight) as a grain-feeding one to gain the same amount of metabolisable energy. Although it is much easier to find grasses than spilled grain, it takes much longer for a goose to obtain the daily ration on grasslands than on stubble.

Raveling (1979) calculated that Cackling Canada Geese *Branta canadensis* needed only 2 hours to collect their daily food requirements when feeding on cereal grains, but more than 8 hours when grazing. In the second part of August in our study, a grazing flock spent 880 min. on the feeding grounds versus an average of only 220 min. for geese feeding on stubble at the same time. Accordingly, geese in this study preferred high-energy foods, i.e. peas and cereal grains. Usually geese not only take energy content into account but protein content as well (Owen 1975, Harwood 1977, Sedinger & Raveling 1984, Iedema & Kik 1985, Lorenzen & Madsen 1985). Thus it should be noted that peas are much richer in protein than are cereal grains, i.e. 27% and 12–13% of the dry weight, respectively (Eriksson et al. 1976). The need for a high-protein food is most marked during spring (Raveling 1979) and moulting (Coleman & Boag 1987).

Factors other than food availability can have a major influence on the choice of feeding areas. These factors include safety, a good all-round view, a minimum of human disturbance and short flying distances. Accordingly, Greylag Geese preferred large fields in open, sparsely wooded country with few roads and buildings in the vicinity of suitable roosting places, and where shooting and other disturbances were minimal. We only rarely found the geese fly more than 5 km to feed, a result also obtained by Newton & Campbell (1973), but see Bell (1988). The use of stubble may also be influenced by the accessibility of grain on the fields (cf. Sugden 1976, Clark et al. 1986). Moreover, the geese showed a high tendency to return to a field where they had previously fed safely. This explains why the geese fed on so few fields each autumn.

Food supply and autumn migration

Throughout the autumn the geese compensated for the decreasing availability of grain in the stubble (most of

Table 10. Use of different daytime roosts in relation to breeding locality, measured in terms of the total number of observations of marked Greylag Goose families at the various daytime roosts in the western lake area during 1985-1987. Number of marked families seen at least once in brackets.

Utnyttjandet av olika dagvilolokaler i förhållande till vilken häcklokal fåglarna kom ifrån, mätt som sammanlagda antalet observationer av märkta grågåsfamiljer på de olika dagvilokalerna i västra sjöområdet 1985-1987. Antalet märkta familjer som setts åtminstone vid ett tillfälle anges inom parentes.

Breeding locality <i>Häckningslokal</i>	No. of marked families <i>Antal märkta familjer</i>	Daytime roost <i>Dagvilolokal</i>			Total no. of observations <i>Summa observationer</i>
		Klosterviken	Böringesjön	Björkesåkrasjön	
Klosterviken	18	116 (18)	24 (10)	21 (13)	161
Böringesjön	7	30 (6)	9 (5)	3 (3)	42
Fjällfotasjön	12	13 (10)	12 (8)	11 (6)	36
Yddingen	31	31 (18)	10 (6)	19 (11)	60

the grain eventually germinated) by increasing the length of their daily feeding periods. In 1987 the harvest was delayed, and consequently the supply of grain spill late in the season was better than in 1986. The geese spent a shorter time on the feeding grounds in late September and early October in 1987 than in 1986, and they left the inland areas a little later during autumn in 1987 than in 1985 and 1986. However, almost all geese left long before they had to stay all day long on the feeding grounds to satisfy their daily food requirements.

The geese left the inland areas between the end of September and the end of October, while minor flocks stayed a few weeks longer at a nearby coastal locality, as was also reported by Madsen (1985a) in Denmark. Foteviken is the only area in SW Skåne that still has extensive areas of *Scirpus maritimus*. Their rhizomes comprise the dominant food of Greylag Geese on their wintering grounds (Amat 1986, Caldron et al 1991, Dick et al. 1991) as also used to be the case on staging areas in the Netherlands (Loosjes 1974). A staging area on the Swedish west coast (Getterön) provides large beds of *Scirpus maritimus*. The Greylag Geese stay there through December, feeding mainly on *Scirpus* rhizomes (M. Forsberg, in litt).

Madsen (1985a) suggested that Greylag Geese left the inland areas due to exploitative competition with large flocks of Pink-footed Geese *Anser brachyrhynchus*. However, we found a similar time-table for Greylag migration in Skåne in the absence of Pinkfeet. In SW Scania it is perhaps instead the Bean Geese that interact with the Greylags in a corresponding way.

Greylag Geese in Skåne could probably stay longer into the autumn than they actually do if they switched to other food sources, e.g. potatoes or sugar beet, once the spilled grain becomes depleted. From mid-October to late November, Greylag Geese show a high preference for sugar-beet spill in the Netherlands (Dubbeldam & Poorter 1982, Voslamber 1989). Sugar beet is a com-

mon crop in Skåne, and is a preferred food of Bean Geese and Canada Geese in October-November (Nilsson & Persson 1984, 1991). Sugar-beet spill was not utilized by these species until quite recently; for example, it was not being used in Skåne 30 years ago (Markgren 1963). Greylag Geese in SW Skåne have also to some extent started to utilize sugar beet (own unpubl. obs). Starting in autumn 1988 an increasing number of Greylag Geese was exploiting harvested sugar-beet fields at Foteviken. Geese are quite apt to modify their feeding habits, as is exemplified by the evolution of potato-eating in British Greylag Geese (Kear 1963).

Local movement pattern

The number of geese in the western lake area (incl. Foteviken) in mid-August of 1985 and 1986 and in early September of 1987 was 8-9 times the number of breeding pairs in this area. Paludan (1973) estimated that autumn numbers in Denmark were about seven times the number of breeding pairs. Thus the autumn population in the western area in early autumn can be locally recruited. Later in the autumn the population at Foteviken increased as a result of geese arriving from other areas. The fact that the maximum number of geese in the eastern lake area in autumn was at least 30 times the number of breeding pairs indicates that the majority came from other breeding areas.

Rutschke (1982) found that Greylag Geese from the same breeding locality tend to stay together in the autumn. Similar behaviour has previously been reported for Canada Geese in North America (Raveling 1969). This tendency toward subflocking can explain why the distributions of marked goose families differed in the western area in 1987: The geese from Lake Böringesjön and Lake Klosterviken use their breeding lakes for roosting, whereas the Greylag Geese from the other lakes shift between brooding sites and are thus probably more inclined to move to the coast.

The families from the western lake area probably changed between different gathering areas in response to food shortage. Geese in the eastern lake area probably have ample food supply throughout the autumn, whereas in the western area, there may be temporary food shortages, especially in early autumn. These assumptions are supported by the fact that the total number of goosedays in the autumns of 1985-1987 has been on the same order of magnitude in the western area (Table 4), whereas it has increased markedly in the eastern lake area (Fig. 3). Moreover, geese disturbed by the farmers have fewer alternative fields to feed on in the western lake area. Many of the families from the western area that were found outside this region in early autumn returned later, indicating that they were temporarily looking for better foraging areas.

Even when geese could not find suitable fields close to their roost, they rarely flew more than 5 km between the roost and a better feeding ground. Instead they changed to another roost in another gathering area, flying a longer distance in one day instead of flying a little longer four times each day. This behaviour might change in the future if the number of geese in autumn continues to increase. Greylag Geese in East-Central Scotland have increased their flying distances between roost and feeding grounds, apparently in response to an increase in the number of geese (Bell 1988). The mean distance between roost and feeding grounds in NE Scotland was 10.7 km, with 68% of all Greylags feeding 8-22 km from their roost (Bell 1988).

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Sammanfattning

Furageringsområden och lokala rörelsemönster hos icke häckande grågäss i södra Sverige.

I likhet med andra gäss har grågäsen i Sverige och i andra delar av nordvästra Europa ökat kraftigt i antal under senare år (t.ex. Fog et al. 1984, Madsen 1986, 1991, Rutschke 1987). I södra Skåne har under de två senaste årtiondena ett häckbestånd på flera hundra par etablerats (Persson 1990, Tabell 1) och under sensommaren/hösten finns här koncentrationer på flera tusen fåglar (Fig. 3).

Målsättningen med denna undersökning var att karaktarisera de av grågäsen utnyttjade furageringsområdena, gässens dagliga aktivitetsmönster samt deras lokala rörelser i ett koncentrationsområde i södra Sverige under sensommaren och hösten. Speciellt ville vi identifiera de faktorer som påverkar valet av furageringsområde och de lokala rörelserna.

Undersökningsområdet (Fig. 1) omfattade två sjöområden med häckande grågäss samt en grund havsvik som endast utnyttjades under icke häckningstid. Alla gåslokaler inom undersökningsområdet besöktes en gång i veckan från mitten av juli till mitten av december 1985-1987. Vid varje besök räknades antalet gäss på de olika lokalerna samtidigt som flockarna genomsöktes efter halsringmärkta individer. Intensivstudieområdet (Fig. 2) besöktes minst 2 gånger i veckan och här noterades också var gässen furagerade. Inom detta område registrerades dessutom vilken gröda som fanns på respektive fält, samt när någon förändring skedde, t.ex. skörd, plöjning eller sådd. För att karaktarisera det dagliga aktivitetsmönstret följdes en gång i veckan en av flockarna från en timme före soluppgången till en timme efter solnedgången. Under somrarna 1985-1987 halsringmärkte vi i Yddingen, Fjällfotassjön, Klosterviken, Böringsesjön och Snogeholmssjön totalt 436 häckande grågäss, såväl föräldrar som gässlingar, vilka sedan utnyttjades för att studera de lokala rörelserna.

Resultat

I början av hösten furagerade gässen på gräsmarker, men skiftade till ärtfält så snart som ärtorna började mogna (Fig. 4). Följaktligen började gässen ta ärtor långt innan fälten skördades och fortsatte att göra så tills vetefälten tröskats i slutet av augusti eller början av september. Därefter skedde det mesta av födosöket på vetestubbar där gässen utnyttjade spillsäden (Tabell 2-4).

Vanligtvis valde gässen en fälttyp och undvek alla andra tillgängliga fälttyper (Tabell 2), samtidigt som de koncentrerade sig till ett av de största fälten av den valda fälttypen (Tabell 5 och 6). Dessutom utnyttjade gässen vanligtvis fält i närheten av vilolokalen; avståndet mellan denna och furageringsområdet var vanligtvis mindre än 5 km (Tabell 7).

Gässen lämnade nattvilolokalen vid soluppgången och flög direkt till furageringsområdena (Fig. 5). Efter 2-4 timmars födosök återvände de till sjön eller havet för att dricka, bada och putsa sig. Vanligtvis vilade de på stränderna eller på något intilliggande fält och ibland betade de med låg intensitet under kortare perioder. På kvällen återvände de till furageringsområdena och kvarstannade där till ungefär en halvtimme efter solnedgången. I oktober började detta aktivitetsmönster med två dagliga födosöksperioder försvagas, gässen stannade längre tid på fälten och en del gäss stannade hela dagen (Fig. 5 och 6). I november tillbringade gässen hela dagen på furageringsområdena. På kvällen valde gässen vanligtvis den närmaste vilolokalen, medan de på dagen ibland flög över flera lokaler för att nå en viss lokal. Vanligen hyste Björkesåkrasjön en oproportionerligt stor andel av de rastande gässen under dagen (Tabell 8).

De märkta familjerna stannade i huvudsak kvar i sydvästra Skåne under hela hösten, vanligen inom samma koncentrationsområde (Fig. 7, Tabell 9). Familjerna i det västra sjöområdet skiftade i genomsnitt var åttonde vecka, medan familjerna från det östra området stannade kvar där tills de lämnade landet på höstflyttning. De subadulta fåglarna skiftade däremot betydligt oftare mellan de olika koncentrationsområdena. I det västra området besökte de flesta familjerna de tre olika dagvilolokalerna vid åtminstone några tillfällen (Tabell 10), men de visade en klar preferens för sin häckningslokal om den också utnyttjades som en regelbunden vilolokal (Klosterviken).

Diskussion

Genom att använda genomsnittliga publicerade värden på födans energivärde kan det beräknas att en grågås då den betar gräs måste konsumera omkring 10 gånger så mycket föda (våtvikt) som då den äter spillsäd eller ärtor för att erhålla samma mängd utnyttjbar energi.

Även om det är mycket lättare att finna gräs än spillsäd tar det mycket längre tid för en gås att få ihop dagsrationen på gräsmark jämfört med på stubb. Följaktligen föredrog gässen högenergiföda, dvs ärtor och sädeskärnor. Eftersom det har visat sig att gäss i allmänhet väljer föda med ett högt proteininnehåll, bör det också framhållas att ärtor är mycket rikare på protein än sädeskärnor.

Genom hela hösten kompengade gässen den minskande tillgängligheten på spillsäd på stubbarna genom att förlänga tiden som de dagligen tillbringade på furageringsområdena. Nästan alla gäss lämnade dock landet långt innan de behövde stanna på furageringsområdena hela dagen för att få ihop dagsbehovet. Grågässen skulle förmodligen kunna stanna betydligt längre under hösten om de skiftade till en annan födokälla så snart resurserna på stubbarna var uttömda. De senaste åren har detta börjat ske i mindre skala vid Foteviken, där en flock gäss börjat utnyttja spill av sockerbetor och där gässen också stannat kvar längre på hösten i större antal än tidigare.

Antalet gäss i det västra sjöområdet (inkl. Foteviksområdet) var i mitten av augusti 1985 och 1986 samt i början av 1987 8-9 gånger större än antalet häckande par i detta sjöområde. Därmed kan höstpulationen i det västra området under den tidiga hösten vara lokalt rekryterad. Senare under hösten ökade antalet vid Foteviken genom att fåglar anlände från andra häckningsområden. Antalet vid höstmaximum i det östra sjöområdet var däremot åtminstone 30 gånger antalet häckande par, vilket indikerar att majoriteten av gässen i detta område kom från andra häckningsområden.

Familjerna från det västra sjöområdet skiftade förmodligen mellan olika koncentrationsområden som svar på födobrist. Gässen i det östra området kan förmodligen finna föda under hela hösten, medan det kan uppstå tillfälliga bristperioder i det västra, speciellt under tidig höst. Många av familjerna från det västra området som observerades utanför detta område under tidig höst återvände senare, vilket indikerar att de tillfälligtvis sökt bättre furageringsområden.

Även när gässen inte kunde finna lämpliga furageringsområden nära vilolokalen flög de sällan mer än 5 km från denna till något lämpligt fält. Istället skiftade de över till en annan vilolokal i ett annat koncentrationsområde. De flög därmed en längre sträcka en dag istället för att fyra gånger dagligen flyga något längre sträckor.