Site tenacity and turnover rate of staging and wintering Bean Geese *Anser fabalis* in southern Sweden

LEIF NILSSON and HAKON PERSSON

Site tenacity and turnover rate among staging and wintering Bean Geese were studied by observing neck-banded individuals in southernmost Sweden. Bean Geese from different breeding areas in northern Finland and in southern Sweden were found on all sites, but in significantly different proportions. Most individuals showed a marked site tenacity, 69% being seen at only one site in the same season. Bean Geese recorded during two consecutive seasons were generally seen in the same area. About 50% of Finnish-marked Bean Geese stayed for less than ten days, the longest period being 120 days. Southwest Skåne functioned as a major staging and wintering area for an appreciable Bean Goose population while simultaneously serving as a more short-term stopover area for Bean Geese on passage.

A characteristic feature of large goose flocks is their regular appearance and utilization of staging and wintering localities (e.g. Owen 1980, Rutschke 1987). It appears that tradition may be important in the maintenance of these regular patterns, but to obtain detailed information requires that the flocks contain individually recognizable geese, whose movements and whose tendency to stay in staging and wintering areas can be studied. Until now, however, no such analyses have been made.

By neck-banding geese it is possible to study

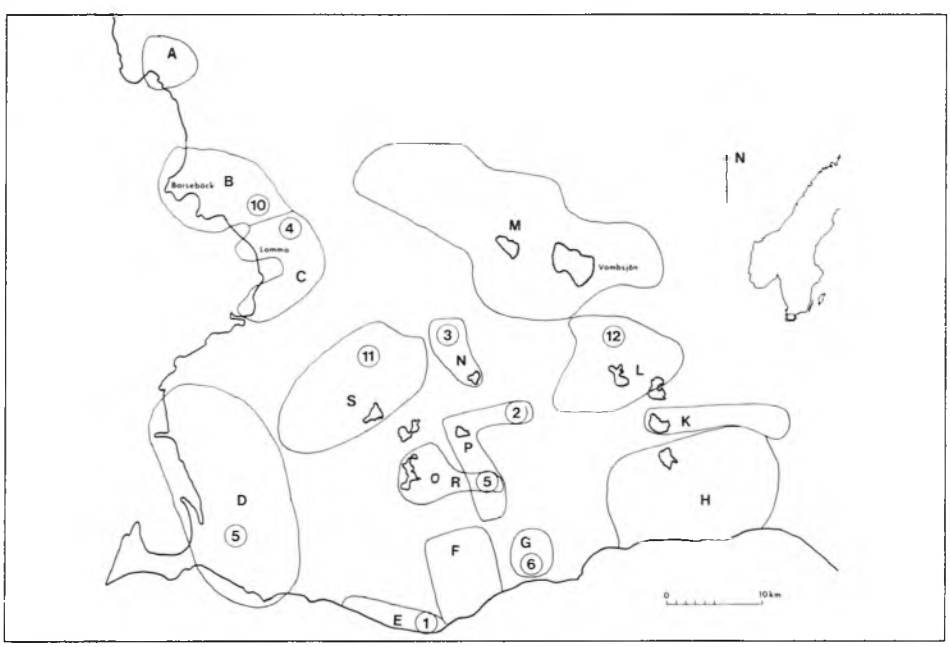

Figure 1. Spread of neck-banded Bean Geese from Vombsjön in SW Skåne during the first season after marking. The number of individuals observed in each Bean Goose area (denoted by letters) are given. Feeding areas used by geese from the same roost or group of roosts are delineated. Lakes are stippled.

how staging and wintering sites are utilized by various species and to get an insight into individual patterns that may influence the overall pictures obtained from surveys. In the Nordic countries Bean Geese have been marked with neck collars since 1977 to study their migration patterns (Nilsson 1984, Nilsson & Pirkola 1986), and similar studies have been undertaken in the former GDR since 1971 (Litzbarski 1979).

Southwest Skåne is an important staging and wintering area for Taiga Bean Geese *Anser f. fabalis*, with as many as 25,000 individuals observed monthly (Nilsson & Persson 1984, Nilsson 1988). Neck-banding has shown that a large proportion of these Bean Geese emanate from breeding areas in northern Finland (Nilsson 1984, Nilsson & Pirkola 1986).

In this paper observational data obtained on neck-banded Bean Geese in southwest Skåne were analyzed in order to establish their degree of site tenacity and to estimate the turnover rate of the staging and wintering population. We have also determined the patterns with which geese from different breeding areas are distributed. Emphasis here was placed on ascertaining whether geese from specific breeding areas form recognizable subflocks and use different localities in autumn and winter or, alternatively, whether mixed flocks are formed.

Study area

Southwest Skåne is an agricultural area mostly with fertile soils. The landscape contains several small and medium-sized lakes that, together with some shallow coastal bays, offer good roosts for the geese. The main crops in the area are grains (mainly wheat but also barley and rye), rape and sugar beet. Wheat and barley are to a large extent autumn-sown. Potatoes are locally important on sandy soils. The distribution of Bean Goose roosts in southwest Skåne and the main feeding areas are shown in Figure 1 (for further details see Nilsson & Persson 1984).

Material and methods

In November 1977-80, 156 Bean Geese were caught with cannon nets and neck-banded in southwest Skåne, mainly at Lake Vombsjön (Fig. 1). During 1978-87, a total of 466 Bean Geese (both breeding pairs with their young and non-breeding immatures) was neck-banded in the breeding areas of northern Finland. A large proportion of the Bean Geese from Finland was later recorded staging and wintering in southwest Skåne (Nilsson 1984, Nilsson & Pirkola 1986). In addition to these birds, 18 Bean Geese were neck-banded on moulting grounds in northern Norway in 1979. All Bean Geese were marked with orange neck-bands with three-digit codes readable through a telescope at distances of up to 300-400 m.

Staging and wintering geese in southwest Skåne were counted around the middle of each month from October-March 1977-78 to 1986-87 (Nilsson 1988). In connection with these counts, which covered all potential goose areas, we surveyed flocks with a telescope (20-60 x77) in search of neck-banded geese (in general, about 80% of the observed geese could be checked). In addition to these counts, goose flocks in the Vomb area during 1977-78 to 1980-81 and in the Barsebäck area during 1982-83 to 1986-87 were checked twice a week.

In all, we obtained 464 readings on 106 individuals marked in southwest Skåne and 777 reading on 189 individuals marked in Finland. In addition, 230 other readings were obtained where the three-digit codes were incompletely read.

Neck-band losses can potentially influence the results. Unfortunately we have no possibility to check for neck-band losses in the present sample. We are confident that neck-band losses will have little influence in the present study as most observations refer to geese seen during the first two seasons after marking. From a similar study of neck-banded Greylag Geese *Anser anser* we found a return rate of about 90% over the first year after marking but for longer periods we noted a few neck-band losses (unpublished data).

Statistical analysis of distribution patterns of observations of marked geese were undertaken by means of Chi-squared analysis testing for difference of data sets in contingency tables.

Results

Local distribution of marked geese

Marked Bean Geese were regularly found at all sites in southwest Skåne, but the proportion of marked individuals at different sites deviated significantly from an even distribution (Ch^2 = 35.6, df = 8, $P<0.001$, Table 1, Fig. 1). The marking area (Lake Vombsjön, M) yielded the highest frequency of marked geese during 1977-80, as well as in later years, by which time most locally marked birds had disappeared. When excluding this area, we still get an uneven

Table 1. Frequency of neck-banded Bean Geese (number of marked geese recorded per 1000 checked individuals) in different areas in southwest Skåne during 1977-78 to 1986-87. Site locations are shown in Figure 1.

Sites	Marked geese/1000 ind	Total checked
A-C	2.2	201 200
D	1.2	41 300
E-G	0.8	37 100
H-K	0.4	58 300
L	1.1	125 200
M	2.4	249 000
N	2.0	14 500
P-R	1.5	46 900
S	1.2	57 700
Total	1.8	831 200

distribution ($Ch^2 = 34.7$, df = 7, $P<0{,}001$). The frequency of marked Bean Geese was also high at the coastal site (Barsebäck-Lomma, B,C), which was commonly used by geese moving from the Vomb area to the coast (Fig. 2). In contrast, the frequency of marked geese in the southeastern part of southwest Skåne (H,K) was much lower.

Seventy-nine Bean Geese marked at Lake Vombsjön in November were later observed in southwest Skåne during the same season. Forty were only seen in the Vomb area, whereas 39 were spread over southwest Skåne (Fig. 1). Most of them moved to the southwest, and 27 individuals were found at coastal sites during winter periods when snow covered inland parts

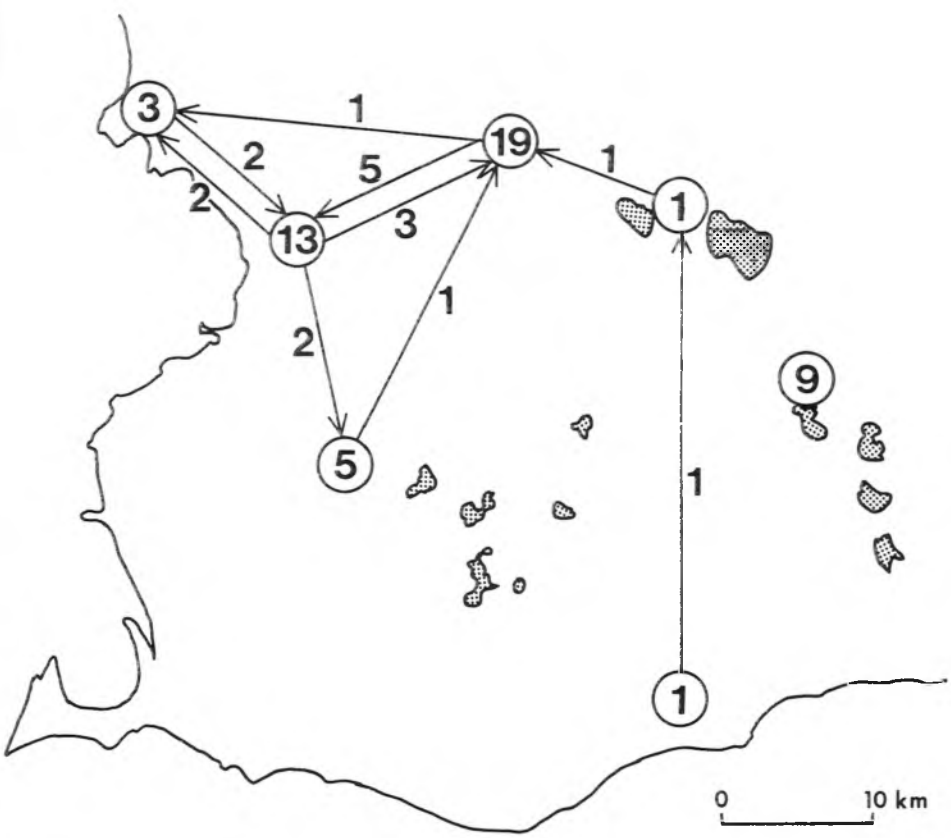

Figure 2. First and last observations of marked Bean Geese in the Vomb area (M in Fig. 1) during 1977-78 to 1980-81. Cross-hatched columns refer to geese marked the same season.

Table 2. Observations at Lake Vombsjön (M, Fig. 1) and at other roosts in southwest Skåne (percent in brackets) of Bean Geese marked in at Lake Vombsjön and in northern Finland during 1977-78 to 1986-87. The figures refer to the number of individuals observed at each site. Observations of geese marked at Vombsjön during the season they were marked are omitted.

Sites	Marked at Vombsjön	Marked in Finland
Vombsjön	50 (39)	85 (23)
Other sites	76 (61)	281 (77)
Number of individuals	52	189

Table 3. Distribution of marked Bean Geese from marking places in two counties of northern Finland among sites of southwest Skåne during autumn. A given individual was noted no more than once for each site in the same season.

Sites	Marking area	
	Lappi	Oulu
A-C	27	68
D	8	2
E-G	8	1
H-K	2	14
L	19	28
M	24	38
N	8	8
P-R	7	10
S	11	16
Total number of individuals	69	120

of Skåne. During cold periods marked geese tended to move to the coast, whereas movements inland were noted during milder periods.

Local distribution of Bean Geese from different areas

The general distribution of Bean Geese marked at Lake Vombsjön differed from that of the geese marked in northern Finland (Table 2, $Ch^2 = 12.8$, df = 1, $P<0.001$). Geese marked at Vombsjön staged in the marking area to a significantly greater extent than did birds marked in Finland. Geese marked in two counties of northern Finland were noted in all subareas (roosts) during the autumn but in significantly different proportions (Table 3, $Ch^2 = 27.3$, df = 8, $P<0,001$). In some roosts geese from one county dominated markedly, whereas at other roosts geese were found in the proportions that would be expected based on the total number of marked birds observed in southwest Skåne.

Site tenacity

Bean Geese recorded in southwest Skåne during two consecutive seasons were generally seen in the same area. Thus of 25 Bean Geese marked at Lake Vombsjön which returned to southwest Skåne, 60% were first seen in the Vomb area in the autumn after the marking. A similar proportion of Finnish-marked geese were first relocated in the same area of Skåne during each of the two consecutive seasons (67% of 35).

Most Bean Geese were found at only a few sites, 40% being seen only at one site (Table 4). Considering observations during the same season only, 69% of all the individuals were only seen at one site (418 observations). In autumn (October-December) 85% of the individuals were seen only at one locality (251 observations). Most shifts within the same winter were related to hard weather. The mean number of sites visited by Bean Geese per year was 1.40, whereas the mean number visited over two years and over three or more years was 2.06 and 2.97, respectively. One individual was encountered in the same area (two adjacent sites) for nine seasons.

Table 4. Number of sites visited by marked Bean Geese in southwest Skåne. For Bean Geese marked in SW Skåne, only individuals seen later than one month after marking are included. For geese marked in Finland only individuals marked before 1985 are included.

Number of seasons seen	Number of sites visited						
	1	2	3	4	5	6	Total
1	55	23	5	0	0	0	83
2	14	35	10	4	0	0	63
3	3	7	5	3	0	1	19
4-9	1	3	3	9	1	0	17
Total	73	68	23	16	1	1	182

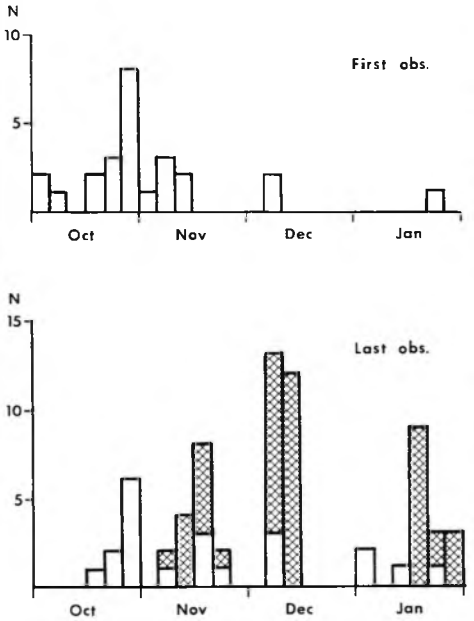

Figure 3. First and last observations of marked Bean Geese in the Barsebäck-Lomma areas (B,C in Fig. 1) during 1982-83 to 1986-87.

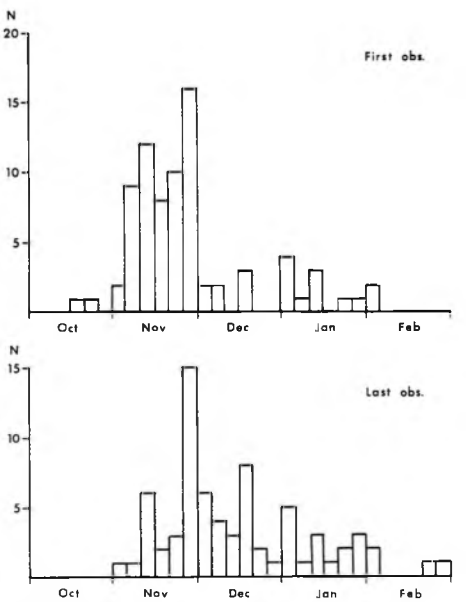

Figure 4. Length of stay in the Barsebäck-Lomma areas (B,C in Fig. 1) during 1982-83 to 1986-87 for Bean Geese marked in Finland and in southwest Skåne.

Arrival pattern

Although the majority of the Bean Geese were first seen in October and November (Figs 3 and 4), 31% of all marked individuals seen in southwest Skåne did not appear until January or February. The majority of the Bean Geese seen during two consecutive seasons were first sighted in southwest Skåne during the same part of the season both years (Table 5). For 16 Bean Geese seen in autumn during two consecutive years of intensive observations, the mean difference in arrival time was 13.5±3.1 days. The geometric mean arrival in the second year was 0.5 days earlier than that in the first year.

Marked Bean Geese tended to arrive later during the last five years (50 new arrivals in November and 31 in October) than during the first five years (30 in November and 27 in October). The difference, however, was not significant ($Ch^2 = 1.1$, df = 1, n.s.).

Length of stay and turnover rate

In the Barsebäck area, the number of new arrivals was highest in the last 5-day period of November (Fig. 4). The number of departures was also highest during this period. Most geese stayed in the area for only a short period (Fig. 5), the median being ten days. A small number of geese remained for longer periods of up to 80 days. Only 20 of 55 individuals marked in the Oulu district of northern Finland stayed for more than ten days in the Barsebäck area, whereas 14 of 18 Bean Geese from Finnish Lapland stayed for a longer period, the difference being significant ($Ch^2 = 10.2$, df = 1, $P<0.02$).

Of the 25 locally marked geese observed in

Table 5. Arrival period in southwest Skåne during the second season for Bean Geese recorded in two consecutive seasons. Observations from 1986-87 are not included owing to the abrupt departure of the Bean Geese with the onset of extreme winter weather.

Arrival period year 1	Arrival period in year 2 Oct/Nov	Jan/Feb	Total
Oct/Nov	26	15	41
Jan/Feb	11	17	28
Total	37	32	69

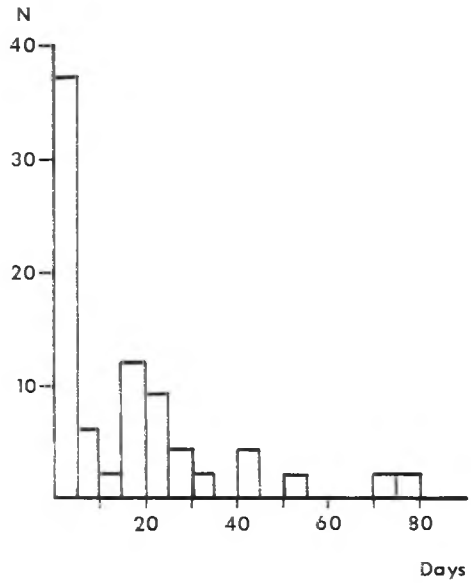

Figure 5. Proportion (in %) of initial numbers of Finnish-marked Bean Geese remaining in southwest Skåne as a function of time (n = 384).

the Vomb area during the years after marking, 12 remained for less than five days, and two remained as long as 90 days. Similarly, for the whole of southwest Skåne, about 50% of the Finnish-marked Bean Geese stayed for less than ten days, the longest period recorded being 120 days. For Bean Geese arriving in southwest Skåne in October, November, and December there were no significant differences in the proportions staying for different lengths of time (Ch^2 = 2.2, df = 4, n.s., Table 6.)

Discussion

Distribution patterns of Bean Geese as related to their origin

Migrating geese use traditional staging and wintering areas. It is generally thought that these traditions are transferred to the young when the geese migrate south in family groups (e.g. Owen 1980). Goose families assemble at special gathering places in the breeding areas during late summer (Rutschke 1987, Nilsson & Persson in prep.), and these summer flocks often congregate to form larger flocks in autumn. Thus geese from various parts of the breeding areas tend to also appear together in the staging and wintering areas, far from the breeding areas, forming subflocks in the larger concentrations (Anderson & Joyner 1985, Raveling 1969, 1979).

In the present study Bean Geese from different breeding areas in northern Finland were found at all sites in southwest Skåne. On the other hand, geese from one of the main Finnish marking areas occurred at some sites more frequently than did geese from the other Finnish marking area, whereas at other sites geese from the two marking areas occurred in the proportions in which they had been marked. A similar pattern was found when considering all of southern Sweden, in which cases southwest Skåne was treated as a unit (Nilsson & Pirkola 1986). Thus although geese from the same breeding area tended to occur together in many cases, there was no clear pattern of subflocking in southwest Skåne, which was characterised by flocks from separate breeding areas using parts of the staging and wintering areas (cf. Anderson & Joyner 1985, for the Canada Goose).

Site tenacity

The Bean Geese using Skåne as a staging and wintering area were found to have a strong site tenacity. The majority of Bean Geese were only seen at one or two roost sites during any given season. Such geese were, however, sighted at several feeding areas connected with the same roost, the actual field choice differing between years, depending on the availability of suitable crops (Nilsson & Persson 1984, in prep.). Geese returning during several consecutive seasons were usually seen first in the roost area that they had been observed in the first year, even if shifts subsequently occurred. In many cases, the first sightings of particular geese for the season were

Table 6. Length of stay in southwest Skåne for Bean Geese arriving in October to December.

	Number of observations			
		Length of stay months		Total
First observation	<1	1-2	>2	
Oct	20	13	25	58
Nov	33	15	32	80
Dec	20	6	15	41
Total	73	34	72	179

made in the same fields during each of a number of years, indicating a high degree of site tenacity.

In general, when individual geese visited two sites during the same season the shift could be attributed to winter movements from inland to coastal sites during periods of inclement weather, especially snow (cf. also Nilsson & Persson 1984, in prep.). In addition, a few shifts were apparently related to disturbances caused by intensive hunting.

Turnover rate

Our observations on neck-banded Bean Geese in southwest Skåne have revealed that this staging area was used by some geese that stayed for a long period and that did not leave the area until hard winter weather forced them away (Nilsson 1988) as well as by a large number of geese that stayed for a much shorter period. Geese belonging to these two groups were also found to partly emanate from different breeding areas in northern Finland. Bean Geese from the northernmost breeding areas in Finnish Lapland showed a tendency to remain in SW Skåne for longer periods than those from the Oulu district, further south in northern Finland.

Thus geese use southwest Skåne for different reasons, depending on the location of their breeding area. From the counts performed over several years it has been well established that southwest Skåne is an important late autumn and winter area for 20,000-30,000 Bean Geese (Nilsson & Persson 1984, Nilsson 1988). It was also known that an additional 20,000-30,000 Bean Geese rested in southern Sweden, leaving the country before or with the onset of cold weather in areas north of Skåne (Nilsson & Pirkola 1986). However, these counts gave no indication that a considerable number of resting Bean Geese stayed for short periods in southwest Skåne, as has now been documented by the intensive observations on neck-banded geese made in the present study. This investigation has shown that the area functioned as a major staging and wintering area for an appreciable Bean Goose population while simultaneously serving as a more short-term stopover area for Bean Geese in passage.

Financial support for the study during 1977-80 was obtained through the Nordic Council for Wildlife Research, whereas studies in the years from 1980/81 were supported by the National Environmental Protection Board. The Bean Goose marking project has been run as a joint Finnish/Swedish venture since 1981. Bean Geese were captured on breeding areas in Finland by a team led by M.K. Pirkola.

References

Anderson, D.R. & Joyner, D.E. 1985. Subflocking and winter movements of Canada Geese in southern Illinois. *J. Wildl. Manage.* 49:422-428

Litzbarski, H. 1979. Erste Ergebnisse der Beringung und farbigen Kennzeichnung von Saatgänsen *Anser fabalis* in der Deutschen Demokratischen Republik. *Vogelk.* 25: 101-123.

Nilsson, L. 1984. Migrations of Fennoscandian Bean Geese *Anser fabalis*. *Swedish Wildlife Research* 13:83-106.

Nilsson, L. 1988. Staging and wintering goose populations in South Sweden 1977-78 to 1986-87. *Wildfowl* 39:88-97.

Nilsson, L. & Persson, H. 1984. Non-breeding distribution, numbers and ecology of Bean Goose *Anser fabalis*. *Swedish Wildlife Research* 13:107-170.

Nilsson, L. & Pirkola, M.K. 1986. The migration pattern of Bean Geese *Anser fabalis* in the Baltic area. *Vår Fågelvärld Suppl.* 11:147-153.

Owen, M. 1980. *Wild Geese of the World.* B.T. Batsford, London.

Raveling, D.G. 1969. Roost sites and flight patterns of Canada Geese in winter. *J. Wildl. Manage.* 33:319-330.

Raveling, D.G. 1979. Traditional use of migration and winter roost sites by Canada Geese. *J. Wildl. Manage.* 43:229-235.

Rutschke, E. 1987. *Die Wildgänse Europas.* VEB Deutscher Landwirtschaftsverlag, Berlin.

Leif Nilsson and Hakon Persson, Dept. of Animal Ecology, Ecology Building, S-22362 Lund, Sweden.