

## Arrival patterns of Greylag Geese *Anser anser* in the Guadalquivir Marismas



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*Studies of neck-banded Greylag Geese in southwestern Spain reveal that there are two subpopulations, one Baltic and one Norwegian, which possess completely different timing with respect to their autumn migration. By 22 November, more than 80% of all neck-banded Baltic Greylags, but only one quarter of the Norwegian ones, were spotted. All Baltic geese arrive before New Year, while the arrival of Norwegian Greylags continues until the end of February. Differences were also found between marking areas, age groups, and breeding lakes.*

The Guadalquivir Marismas have long been known as the most important wintering area for Greylag Geese *Anser anser* within the Atlantic flyway. Although the number of Greylags has increased dramatically during the 1980s in some wintering areas, such as Villafáfila in northern Spain (Rodríguez & Palacios 1991) and the Verdrongen Land van Saeftinghe in the Dutch Delta (Castelijns *et al.* 1991), about 80,000 migrate annually to winter in southwestern Spain (Calderón *et al.* 1991).

In the 1960s, the Greylags were reported to start arriving in southwestern Spain in the second half of September, with the main influx at the end of October or in November, and to reach a peak by the end of November (Bernis 1964, Paludan 1965). A decade later, Sánchez *et al.* (1977) stated that the number of wintering geese increased gradually from September to January. Another decade later, Amat (1986) showed, by aerial counts, that numbers also increased substantially between mid-December and mid-January. At the same time, he noted that large flocks of geese were grazing on pastures in wet winters where they had never been observed before.

Had these two observations, that geese arrived after the end of November, and that they used pastures both in dry and wet winters, the same foundation? Had a new group of Greylag Geese selected southwestern Spain as their winter quarters? Or, had this group of geese, along with the general population increase within the flyway (cf. Madsen 1987), become so numerous that they no longer passed unnoticed? Do geese from dif-

ferent parts of the breeding range have different time-tables for their autumn migration? Questions like these could not be studied until neck-banding programmes had been initiated on the breeding grounds.

The aim of this study was to examine whether Greylag Geese from different parts of the breeding range arrive significantly earlier or later than others, or whether we have to seek other explanations for the fact that the autumn arrival of geese in the Guadalquivir Marismas extends over at least three months.

### Methods

The practice of using neck collars with engraved codes on Greylag Geese started in Germany in 1976 (Litzbarski 1982); in this project, most of the ringing has been done at Lake Gülper See (52°N), just outside Berlin. The Nordic countries followed with a joint programme in 1984 (Nordic Greylag Goose Working Group 1988); a large number are marked as breeding birds in Scania (55°N), southernmost Sweden (e.g. Nilsson & Persson 1991) and these geese are treated separately from other Swedish birds. In Norway in 1990, the marking areas were spread from Oslo (59°N) in the south, to Porsanger (70°N) in the north. In western Poland, a project started in the middle of the Barycz valley (51°N) in 1988 (Witkowski 1991). And finally, 25 birds were neck-banded in Oostvaardersplassen (52°N), The Netherlands, in 1990 (Menno Zijlstra in litt.).

It is impossible to study the arrival of indi-

vidually marked Greylag Geese in southwestern Spain throughout the whole wintering area. Instead, one has to select parts that are representative in time and space, while accounting for the possibility that geese can move into the study area from other parts of the wintering range.

In 1989-90, the study area consisted of an approximately 1 km wide zone from La Rocina to Lucio del Lobo along the northern border of the Doñana National Park (37°N), together with Lucio del Cangrejo Grande as well as all arable land north of Lucio del Lobo that was within a flying range of 5 km from this roost. The following winter (1990-91), the study area included the ricefields at Hato Blanco and in the Cantarita area.

The study area was checked from 1 October to 28 February, daily during the last week of October and the first three weeks of November, and between two and five times a week during the rest of the season. At every visit, flocks were checked for the occurrence of neck-banded individuals. Nearly all marked birds found were identified.

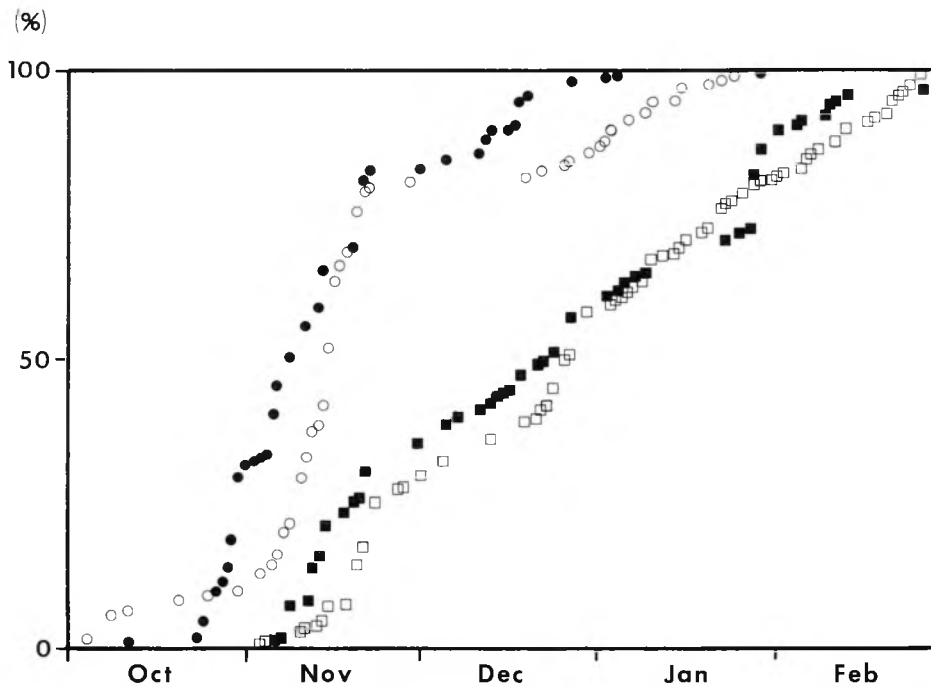
To obtain information about the movements of geese within the whole wintering

**Table 1. Number of neck-banded Greylag Geese from different marking areas sighted in the study area in 1989-90 and 1990-91.**

	1989-90	1990-91
Norway	212	158
Scania	75	122
Germany	68	72
Sweden	14	16
Poland	7	10
Denmark	6	8
The Netherlands	-	4
Finland	1	2
Baltic subpopulation	172	235
Norwegian subpopulation	211	157
Total	383	392

range, parts outside the study area were visited on irregular intervals. These visits were planned to give a maximum number of readings per visit. Material was supplemented by sightings made by other persons.

During normal conditions, neck collars are readable at a distance of up to 500 m, sometimes even more. This distance can, however, be considerably reduced in unfavourable weather such as glaring sunshine, high wind, haze or rain. In this study, some difficulties



**Figure 1. Cumulative number of first-sightings in the study area of neck-banded Greylag Geese from the Baltic (circles) and Norwegian (squares) subpopulation in the winter 1989-90 (open symbols) and 1990-91 (filled symbols). Total numbers sighted are given in Table 1.**

were experienced at the end of November and during the first three weeks of December 1989.

Comparisons between arrival patterns (first-sightings) were made using Mann-Whitney U-tests (Sokal & Rohlf 1981).

## Results

A compilation of readings made by volunteer observers in the winter of 1988-89 showed that geese neck-banded in Norway differed from the others in their timing of arrival in southwestern Spain. On that account, the neck-banded individuals sighted in the study area in 1989-90 and 1990-91 (Table 1) were divided into two subpopulations, one Norwegian and one Baltic. Some of the Greylags neck-banded as moulting birds in Norway originate from abroad; these birds have been counted among the Baltic population in this study (Table 1).

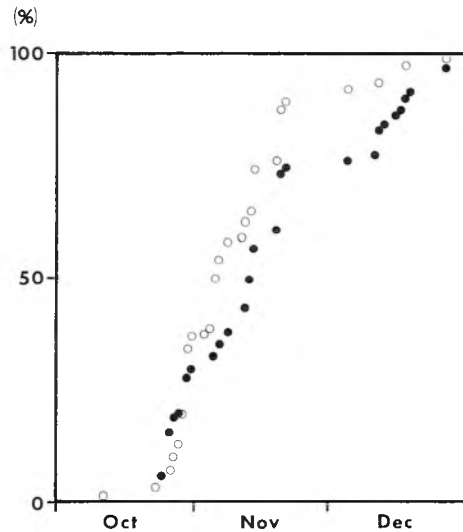
Only a small proportion of the Baltic subpopulation arrived until the end of October (Fig. 1). Then followed a four-week period during which more than 70% of the first-sightings were obtained and, by 22 November, more than 80% of the final number had been seen. The rest were found during December and January.

The Norwegian Greylags had a completely different arrival pattern (Fig. 1). The first few birds arrived during the first November week, whereafter followed a two-week period during which 25% of all first-sightings were obtained. After that, the number of first-sightings increased more or less continuously until the end of February.

The arrival patterns were similar during the two seasons, the only difference being between the exact timing. This feature can be seen in the median dates, which for the Baltic subpopulation were 15 and 8 November, respectively, and for the Norwegian 27 and 24 December, respectively. Consequently, the

**Table 2. Number of neck-banded Greylag Geese from Scania and Germany, respectively, that arrived before the first main influx in the winters 1988-89, 1989-90 and 1990-91. Total number sighted each season is given in brackets.**

	Scania	Germany	$\chi^2$	<i>P</i>
1988-89	6 (37)	1(61)	7.38	<0.01
1989-90	13 (75)	0(68)	13.0	<0.001
1990-91	4(122)	0(72)	2.41	n.s.



**Figure 2. Cumulative number of first-sightings in the study area of neck-banded Greylag Geese from Scania (open symbols) and Germany (filled symbols) in the winter 1990-91. Total numbers sighted are given in Table 1.**

difference in median dates between the subpopulations in 1989-90 and 1990-91 was much the same, being 42 and 46 days respectively.

It is, however, not only between the subpopulations one finds differences, but also between different segments of the Baltic one. The Scanian Greylags were seen earlier than the German ones, although only significantly in 1990-91 (Fig. 2;  $N_1 = 122$ ,  $N_2 = 72$ ,  $U = 5142.5$ ,  $P < 0.05$ ). Before the first main influx in late October, almost only Scanian birds were found (Table 2). For Scanian Greylags no differences were found between birds neck-banded as adults and birds in their fourth winter ( $P > 0.9$ ), so data from all birds older than three years were grouped. Birds older than three years were, however, sighted in 1989-90 significantly earlier than birds in their second or third winter ( $N_1 = 39$ ,  $N_2 = 24$ ,  $U = 610$ ,  $P < 0.05$ ; median dates were 12 and 16 November, respectively) as well as in 1990-91 ( $N_1 = 68$ ,  $N_2 = 33$ ,  $U = 1446$ ,  $P < 0.02$ ) when median dates were 5 and 14 November. Among German Greylags no such differences between old and young birds were found in 1989-90 ( $N_1 = 53$ ,  $N_2 = 12$ ,  $U = 338$ ,  $P > 0.5$ ) nor in 1990-91 ( $N_1 = 61$ ,  $N_2 = 7$ ,  $U = 225.5$ ,  $P > 0.5$ ).

Most of the Scanian neck-banded adults breed in four lakes situated close to one an-

other in the western lake area (see Nilsson & Persson 1991). Of these four, only Klosterviken and Börringesjön have suitable feeding areas nearby in summer and autumn, which makes them useful for roosting after the end of the breeding season. In 1990-91, adults from these lakes were sighted significantly earlier than adults from the other two ( $N_1 = 28$ ,  $N_2 = 15$ ,  $U = 294$ ,  $P < 0.05$ ; median dates were 30 October and 8 November respectively). Such a comparison was not possible during the first winter, as the number of sighted adults from Lakes Yddingen and Fjällfotasjön was too low.

### Discussion

How well are the true arrival patterns reflected by first-sightings? Evidence comes from three sources: field observations of arriving geese, movements into the study area of marked birds from other parts of the wintering range, and last-sightings in autumn staging areas.

In the studied seasons, the observed arrival pattern of Greylag Geese in the Guadalquivir Marismas was characterized by the first geese appearing in September, followed by a slow increase in numbers until the end of October. The majority arrived in two large waves during the four-week period from 26 October to 22 November. Such a wave usually continues some days, but can be as short as 30 hours in duration. In November 1991, for instance, more than 30,000 geese arrived between the afternoon of the 21st and the evening of the 22nd. Between and after these waves, a more diffuse influx was noted, at least until mid-February.

Consequently, the observed seasonal increase in the number of marked Baltic Greylags in the study area reflects very well the observed overall arrival pattern. The Norwegian Greylags on the other hand, seem to arrive partly during the second main influx (a quarter), but mainly thereafter (three quarters).

In total, six marked Greylag Geese, three each from Scania and Germany, were sighted in other parts of the wintering range before being seen in the study area. All cases date from mid-November 1989 to early January 1990, a period characterized by bad conditions for field-work. However, these delayed first-sightings did not change the results.

Available information from The Netherlands gives examples of Baltic Greylags seen up to mid-December and Norwegian ones up to mid-January, that were later sighted in the study area (Nordic Greylag Goose Working Group unpubl.). Some Scanian geese have also been reported staging in early December in mid-Spain, while a number of Norwegian ones have been reported with last-sightings up to 31 January from Villafáfila (41°N). In that connection, one should note that although Villafáfila has become a staging and wintering area of great importance for Greylags, especially for Norwegian ones (Persson 1992), the frequency of readings is still extremely low.

Therefore, it can be concluded that there are good reasons to accept the observed arrival patterns as good reflections of the true one. Naturally, one ought to bear in mind that most geese are not seen until a day or more after their arrival, and some not until after some weeks.

Differential migration patterns have also been reported in some other populations, e.g. in the Dark-bellied Brent Goose *Branta bernicla* (Lambeck 1990) and in the Taiga Bean Goose *Anser fabalis* (Nilsson & Pirkola 1991), but very little is known about the causes. Suggested explanations mainly relate to differences in feeding conditions among staging areas and to differences in feeding abilities among age groups as well as individuals. To find the causes of the observed patterns in this study, it seems most profitable to examine feeding conditions in the main staging areas in late summer and early autumn, the available time for fattening, as well as food quality.

*Financial support for the study was obtained through the Swedish Institute. For indispensable help with the field-work, as well as for sightings of neck-banded Greylag Geese in the Guadalquivir Marismas, I am grateful to several persons, especially to J.J. Chans, L. Garcia and C. Urdiales. Ian Snowball improved the English.*

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