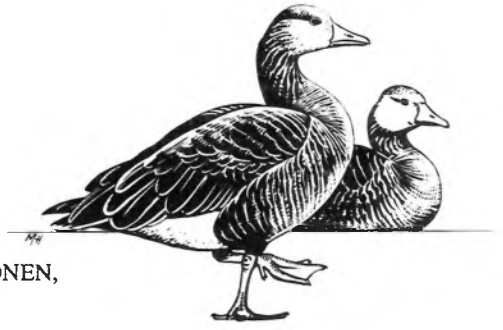
The Oostvaardersplassen as a key moulting site for Greylag Geese *Anser anser* in western Europe



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Since its formation in 1968, the Oostvaardersplassen has become the largest moulting site for Greylag Geese in western Europe. In recent years, over 30,000 non-breeding geese have been counted in the area. Geese breeding in the former German Democratic Republic (GDR) are observed most frequently during moult, while birds from Norway form the majority of colour-marked individuals in autumn and spring. The absence of moulting Norwegian Greylags is thought to be due to a difference in the timing of moult in geese belonging to different breeding grounds. This idea is based on a positive relation between arrival of moult in two successive years, a difference in day of arrival for geese from Sweden and the GDR, and a trend in mean hatching date with latitude. During moult, the Oostvaardersplassen is visited by geese ranging from 1 to 14 years. Improved data on the mortality rate of geese from the GDR are essential to study the relative abundance of geese from different age classes in the moulting flock.

Paludan (1965) gave the first description of moult migration in the Greylag Goose *Anser anser*. He reported a moulting place with about 3000 non-breeding Greylag Geese at Vejlerne, Denmark. Several other moulting sites for non-breeding Greylags have been reported since. Compiled data are presented in Table 1.

There have been records of moulting Greylag Geese in the Netherlands since 1957 (Lebret & Timmerman 1968, Ouweneel 1969). In Friesland, along the northeast shores of Lake IJsselmeer, numbers peaked in 1964 (6000 geese: Lebret & Timmerman 1968). In the Haringvliet, the highest number occurred in 1969 (11,000 geese: Ouweneel 1978). The establishment of these moulting areas for non-breeding Greylags in the Netherlands was surprising because they were outside the breeding range of the geese (Rutschke 1987).

Paludan (1965) banded moulting Greylags at Vejlerne, Denmark, and was able to report on the origin of the birds because 202 out of 892 bands were recovered. Three recoveries during the breeding season (from May to August) came from the German Democratic Republic, Sweden and Poland. The recent use of neck-collars gives an opportunity to study individual migration routes in more detail. In several countries there are banding programmes and sightings of marked geese in the Netherlands are used here to suggest the origin of the Greylags present.

Study area and methods

In 1968, the polder Southern Flevoland was reclaimed from Lake IJsselmeer in the Netherlands. In the lowest parts of the polder, an area with scattered ponds stayed behind with a water depth of less than 40 cm. Common reed *Phragmites australis* was sown over the polder, but did not germinate in the wettest parts. In the following years, grazing and grubbing by Greylag Geese had a great effect on the vegeta-

Table 1. Recent data from moulting sites of Greylag Geese in western Europe with reported numbers of moulting geese (adapted from Madsen 1987).

Vejlerne and Saltbaekvig, Denmark	5000	1980-83	Madsen 1986
Gotland, Sweden	3300-5400	1974-79	Von Essen & Beinert 1982
Frøya, Norway	5200	1985	Follestad *et al.* 1988
Vega, Norway	6000	1985	Follestad *et al.* 1988
Slonsk, Poland	2000	1980 (?)	Gromadski & Majewski 1984
Oostvaardersplassen, Netherlands	35000	1989	this study

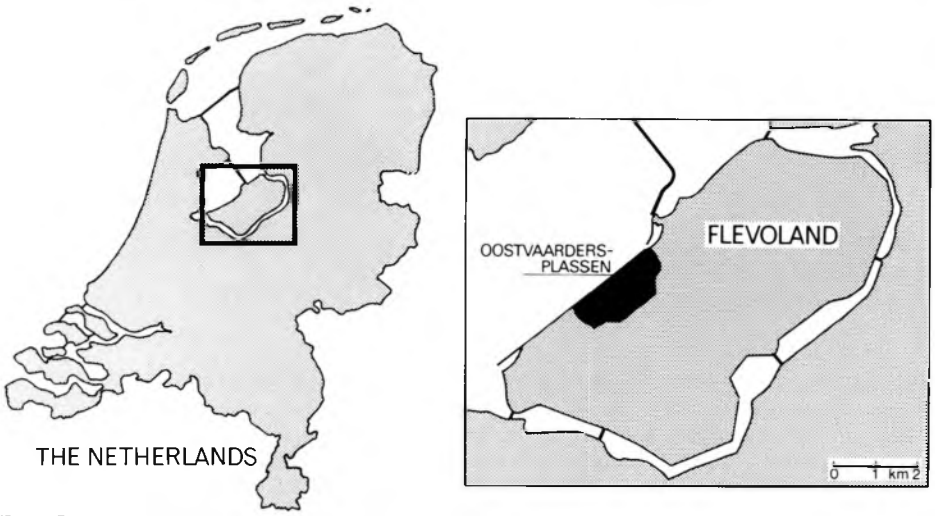

Fig. 1. Location of the Oostvaardersplassen, The Netherlands.

tion and the ponds stayed open (Poorter 1982). Eventually, they developed into a wetland of international standard: the Oostvaardersplassen (Fig. 1). Since 1975 the Oostvaardersplassen (5600 ha in total) consists of 3500 ha of freshwater reedmarsh, including 1060 ha of open water. Outside the reedswamp, the drier grounds are subject to various types of grazing management, which lead to a mosaic of good grassland, rough grazing, reeds and scattered bushes.

Goose counts

Prior to their moult, Greylag Geese spend a short period on agricultural land (mainly grass and cereals) outside the marsh, and can be counted by car. When moult starts, geese disappear into the reedswamp where observations are difficult due to inaccessibility and weariness of the moulting birds. This period, geese are counted from a high-winged plane, usually once at the middle of the moulting period. After the moult, there is again a short stay on agricultural land before the geese leave the area. During this period, geese are again counted by car. The total number is estimated from the maximum number counted during the moulting period. The number of breeding pairs is based on counts of nests from an airplane. Hatching dates are based on the first observation of goslings in our study area.

Marked birds

At present, there are banding programmes in several countries resulting in a large number of neck-collared birds from different breeding grounds (e.g. Rutschke 1982, Nordic Greylag Goose Working Group 1988).

Since 1986, a special effort has been made to read all neck-collared geese in our study area. Flocks are scanned with a 20-60x telescope almost daily and all marked individuals are noted. Data about banding date and banding site of the banded birds were kindly received from the banding crews. Age can be calculated of birds banded as gosling.

Calculations

The calculation of the length of stay of geese banded in different countries, was made for two periods before and after wing moult, in which geese used agricultural land and could be observed. We assumed that a neck-banded individual was present in the whole period between the first and last sighting in the given period. Per day the total number of neck-banded geese present was calculated.

For the duration of the moult, the longest interval between two sightings of each individual was calculated for the summers of 1987, 1988 and 1989. Because most geese stay in the area only a short period before and after moulting, the assumption was made that absence of at least 20 days represented periods in which the geese were moulting in the reeds.

The number of neck-banded geese alive in each age class was calculated from the number of banded geese in each class and from mortality rates. There are no good data on survival rate of neck-banded geese from the GDR available.

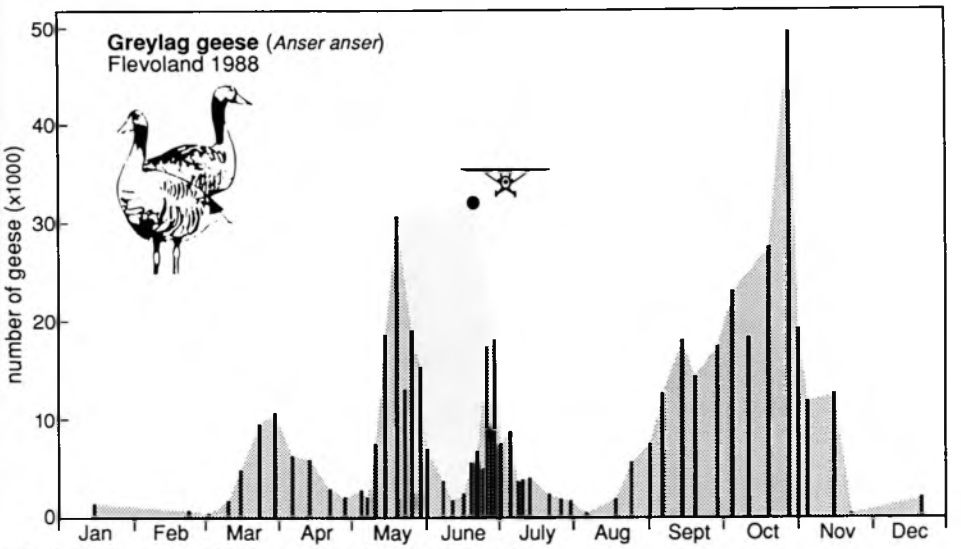

Fig. 2. Number of Greylag Geese counted in Flevoland in 1988.

Litzbarski (1982) used mortality figures of Paludan (1973): an annual mortality rate of 41% of goslings and 32% of older birds. Nilsson & Persson (1991) calculated a mortality rate of 37% for goslings and 10% for older geese breeding in Sweden. In this study both estimates are used to calculate the number of banded geese alive per age class. The results of this calculation are given in Appendix 1.

Results

Goose counts

Figure 2 shows the number of Greylag Geese counted in Flevoland in 1988. All geese present spend at least the night in the Oostvaardersplassen. There are three periods of high numbers in the area. In spring and autumn, geese mainly feed on agricultural land. In May, they arrive in the area to moult. Prior to losing their flight feathers, they stay for a short period on grazed areas outside the marsh. When moult starts, geese disappear into the reeds and the numbers counted by car decline. In the middle of the moult, a total of 32,000 geese was counted from an airplane. After regaining flight, geese stay on grassland once more for a short period before they leave the area.

Greylags were already suspected of moulting in the area in 1968. Since 1973, estimates have been made on their numbers (Dubbeldam 1978) and showed a steady increase from about 1100 in 1973 to about 35,000 in 1989 (Fig. 3) so that the Oostvaardersplassen is now by far the largest known moulting site for Greylag Geese in Europe. The estimated number of breeding pairs has increased over the same period, but is very low in comparison with the numbers of moulting geese. In 1989, 350 nests were counted from an airplane, and we conclude that the majority of those moulting in the Oostvaardersplassen are non-breeders.

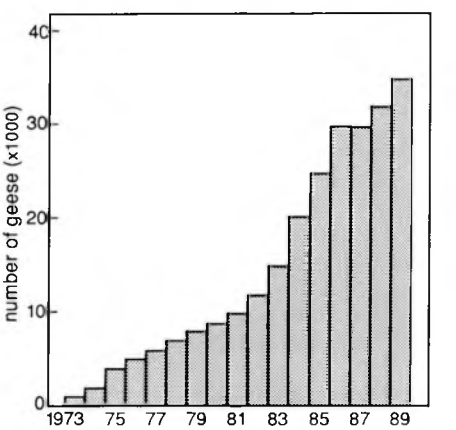

Fig. 3. Estimated number of moulting Greylag Geese in the Oostvaardersplassen 1973-1989. The numbers in 1973 and 1974 are minimum estimates.

Origin of moulting geese

There is a striking difference in the origin of

Table 2. Number of neck-collared Greylag Geese from different banding sites visiting the Oostvaardersplassen at different times of the year. Data are from 1988.

	Norway %	Sweden %	Denmark %	GDR %	Spain %	Total %
Spring	25 (46)	10 (18)	2 (4)	8 (15)	9(17)	54 (100)
Summer	2 (1)	43 (18)	7 (3)	175 (73)	13 (5)	240 (100)
Autumn	282 (66)	74 (17)	6 (2)	55 (13)	10 (2)	427 (100)

neck-banded Greylag Geese moulting in the Oostvaardersplassen compared to the neck-banded geese visiting at other times of the year. During moult, geese from the German Democratic Republic and Sweden form the majority of neck-banded individuals, while in spring and autumn it is mainly bands from Norway and Sweden that are observed. Table 2 gives an overview of the banding localities of geese seen during spring, summer and autumn in the Oostvaardersplassen and its surroundings. Note that not all banding occurs at the breeding site, so that the data are not suitable for interpretation about the breeding origin of all marked birds

Geese visiting the Oostvaardersplassen may originate from far more countries than are listed in Table 2, but because these are not neck-banded, nothing is known about their origin.

There is a clear distinction between the moulting population and the Greylags visiting the Netherlands at other times of the year. From all birds seen during the moulting period from 1 May to 1 August 1988 (n=240), only 5 % (n=12) is seen in spring and only 12.5 % (n=30) in autumn in Flevoland.

From the 30 birds seen both in the moulting period and in autumn, only 4 have been observed in our study sites in August or September. All others are not seen again until October.

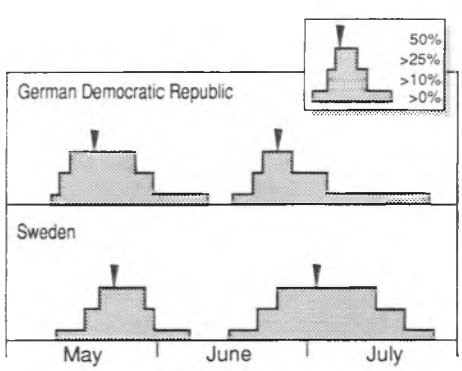

Fig. 4. Period of presence of Greylag Geese on agricultural land around the Oostvaardersplassen. Data from different populations are based on neck-collared individuals. For calculation: see text.

Litzbarski (1982) showed that 90% of non-breeding Greylags leave the breeding grounds during May but return again in July and August.

Arrival of moulters

There is a difference in the time of arrival of geese from the GDR and from Sweden. Geese from the GDR arrive about one week earlier than geese from Sweden. This is shown in Figure 4 where the lowest band represents the entire period during which marked geese were present. The next two bands represent a period in which 10% to 90% and 25% to 75% of the cumulative number of goosedays are spent for each group of marked individuals from one country. A small arrow indicates the day on which 50% of the cumulative number of goosedays of one category was passed. The calculation has been made for the two periods when geese are visiting fields outside the reeds, before and after their moult.

There is also a relation between the arrival time of individuals seen in two successive years. The first sightings of geese seen both in 1987 and 1988 before moult, are plotted in Figure 5.

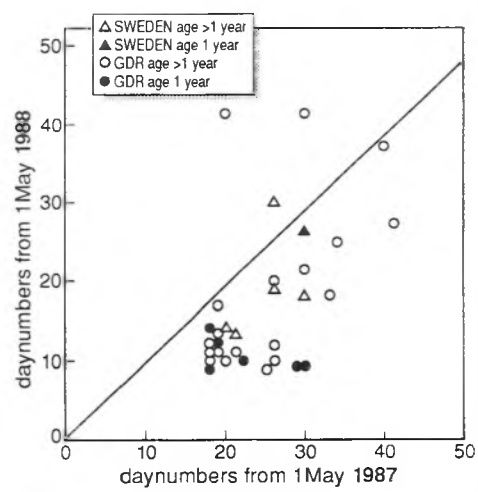

Fig. 5. Date of first sighting (daynumbers from 1 May) of neck- collared Greylag Geese, prior to moult in the Oostvaardersplassen in 1987 and 1988.

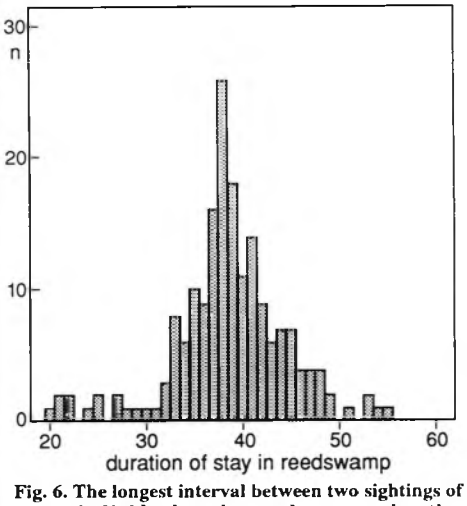

Fig. 6. The longest interval between two sightings of one individual observed around the Oostvaardersplassen. Only intervals of at least 20 days are shown, to establish the duration of the wing moult in the swamp.

Of these 35 geese, 29 individuals were banded in the GDR and six were banded in Sweden. There is a significant positive linear relationship ($r^2 = 0.28$, $P<0.01$, $n=35$). In 1988 birds arrived on average 8 days earlier than in 1987.

Duration of moult

There are no significant differences in the calculated moulting intervals between years, based on intervals of at least 20 days. Therefore the data of 1987, 1988 and 1989 are pooled and presented in Figure 6. Geese stay for a period of 38 days in the marsh. Based on a calculation of primary length and growth rate, a flightless period of 35 days was calculated by Lebret & Timmerman (1968), but they suggested that geese were actualy flightless for a shorter period based on their field observations.

Age structure of moulting geese

In the GDR, 818 Greylags of known age have been banded. Several of these have been seen moulting at ages ranging from 1 to 14 years (see Appendix 1). Figure 7A and B show the percentage of geese seen from each age class. Figure 7A is based on the mortality rates calculated by Paludan (1973). These figures suggest that 58% and 52% of first year birds visited the Oostvaardersplassen in 1988 and 1989 respectively, while 56% and 59% of older geese were seen in both years. Figure 7B is based on mortality rates calculated by Nilsson & Persson (1991) and show that 54% and 48% of first year geese would come to the Oostvaardersplassen and 21% and 22% of older birds in 1988 and 1989 respectively. The figures on which these graphs are based are given in Appendix 1. Values higher than 100% (Fig. 7A) are caused by an underestimate of the number of geese alive. The trends are completely different with the different mortality rates and will be discussed.

Discussion

Population trends

Figure 8 shows the development of the north-

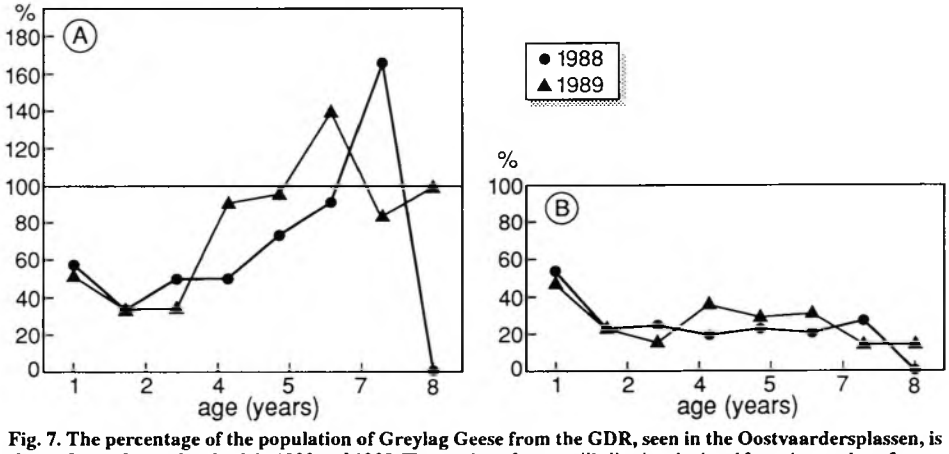

Fig. 7. The percentage of the population of Greylag Geese from the GDR, seen in the Oostvaardersplassen, is shown for each age class both in 1988 and 1989. The number of geese still alive is calculated from the number of geese banded and the mortality rate. Mortality rates are used from Paludan (1973) for Figure 7A and from Nilsson & Persson (1991) for Figure 7B. See also Appendix 1.

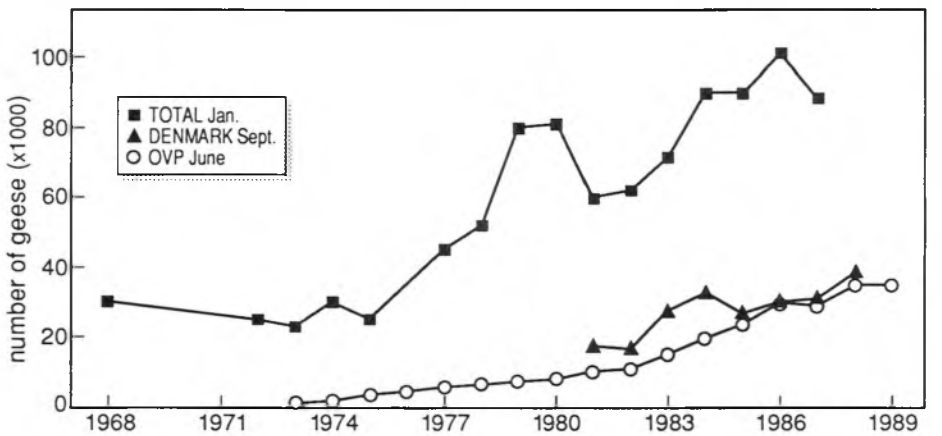

Fig. 8. Population trend in the northwest European population of Greylag Goose. Total number is based on mid-winter counts (IWRB Goose Research Group, unpubl.). The number of Greylag Geese in Denmark is based on counts in September (Danish Goose Working Group, unpubl.), while the number of moulting geese in the Oostvaardersplassen refers to this study.

west European population of Greylag Geese. The numbers of the whole population are based on mid-winter counts (IWRB Goose Research Working Group, Madsen 1987 and unpubl.). The September counts of Greylags in Denmark (Danish Goose Working Group unpubl.) are also given. There is a steady increase in numbers since 1973. The increase in numbers in the Oostvaardersplassen corresponds with the increase of the population.

Ouweneel (1978) and Madsen (1987) showed that Greylags have switched their preferred moulting areas regularly during past decades. The numbers of moulting geese at Vejlerne in Denmark declined sharply after 1959 (Paludan 1965). At the same time, the area in Friesland on the shore of Lake IJsselmeer in the Netherlands as well as the moulting grounds at Gotland, Sweden, became more important. The numbers of moulting Greylag Geese in Gotland have declined since 1979 (Von Essen & Beinert 1982). From 1970 onwards, numbers declined again in Friesland and the Haringvliet while the Oostvaardersplassen became more and more important (Ouweneel 1978).

What causes the preference for the Oostvaardersplassen?

Safety seems to be an important factor. The reedbeds are huge and inaccessible. Some predation by red foxes is observed (N. Beemster pers. comm.), but this is probably a local problem. Tall reeds limit the view, and the water within the stand makes silent approach almost impossible. The decline of Greylags at several other moulting grounds has been related to an increase in disturbance (Lebret & Timmerman 1968, Follestad 1988).

Besides safety, the foodsupply is important (Owen 1980, Rutschke 1987). In the Oostvaardersplassen, geese feed on *Phragmites australis*, whose growth is probably not limited by local nutrients and which recovers rapidly from grazing (Van Eerden & Loonen in prep.). Loonen *et al.* (1991) showed that the moulting period of the Greylags is related to the phenology of the foodplant, being relatively early in the Oostvaardersplassen compared to other moulting sites. Further research will focus on possible positive effects of an early moult.

The correlation between arrival time in different years indicates an individually fixed travelling scheme and corresponding timing of wing moult. The earlier arrival in the Oostvaardersplassen in 1988 compared to 1987 seems to be related to the timing of breeding. In south Sweden median date of hatching was 18 May in 1987 and 6 May in 1988 (L. Nilsson pers. comm.). In 1987 Greylags arrived on average 8 days later than in 1988. Also the difference in arrival time at the Oostvaardersplassen between geese from the GDR and Sweden may reflect the synchrony with the local breeding population.

The absence of Norwegian birds during the moult might be explained with their timing of breeding. Data on the date at which the first goslings were observed in the Oostvaardersplassen range from 28 March to 25 April between 1979 and 1989, with a median date of 9 April. Goslings hatch about 1½ to 2

months later in mid and northern Norway (A. Follestad pers. comm.). It seems unlikely to skip ahead the moment of moult from a breeding year to a non-breeding year with 2 months.

Data of two Greylag Geese, held in captivity in Haren, the Netherlands, support this idea. One female is caught during moult in the Oostvaardersplassen and belongs probably to the Baltic population. The other female is caught in The Lauwersmeer area in August, when there are only banded geese from Norway observed in this area. After being held in captivity for more than two years, the onset of moult for the goose from Norway is 23 days later than for the goose from the Baltic.

Age-structure and survival rates

There is no recent estimate for the survival rate of Greylag Geese banded in the GDR (E. Rutschke pers. comm.). Litzbarski (1982) used the data of Paludan (1973) to calculate the age structure of the population of Greylag Geese in the GDR and found a good correlation with the actual numbers counted. But the results of our study suggest, that these data are not valid any more. An increase in moult migration towards the Oostvaardersplassen from age 3 onwards is not supported by any other data in literature. The concentrations of moulting non-breeding geese are generally considered to consist mainly of immature birds, with smaller numbers of adult birds, who failed breeding (Salomonsen 1968, Rooth 1971, Rutschke 1987).

Haack and Ringleben (1972) pointed out that the role of adult birds in the moulting flock should not be underestimated because they make it possible to use previous experience in finding a moulting area. But they wonder wether the group of birds banded as adults and seen in the moulting flocks are sub-adult geese. This study shows, that geese from all ages are present in the moulting flock.

Only an analysis of recovery data or last sightings of neckbanded individuals will reveal the actual mortality rate. Our results point out that such an analysis is urgently needed at the moment, especially in relation to the increasing numbers of Greylag Geese in Western Europe. Changes in mortality could be the prime factor (see also Madsen 1987) causing this upward population trend.

We thank J. Beekman and B. Voslamber for their help in organizing and computerizing the data, M. van Geene for his help with collecting data in 1989, and J. Madsen for the population counts. A. Follestad and J. Madsen made valuable comments on this manuscript. This project was not possible without the tremendous amount of work by various people to catch and band Greylag Geese all over Europe.

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Appendix 1 Number of Greylag Geese banded of known age in the GDR, the number of geese alive, based on mortality figures and the number of geese from each age class seen in the Oostvaardersplassen during moult. Two sets of mortality figures are used.

A: first year 0.41, older 0.32 (Paludan 1973)
B: first year 0.37, older 0.10 (Nilsson & Persson 1991)

	Geese banded in the GDR								
	Banded with age			Number of geese alive 1988		1989		Seen in OVP during moult	
	0	1	2	A	B	A	B	1988	1989
1988	59	5	0			35	37		18
1987	109	0	0	64	69	47	66	37	16
1986	75	0	0	30	43	20	38	10	7
1985	107	5	0	29	55	20	49	15	18
1984	57	0	0	12	29	8	27	6	8
1983	75	1	0	9	31	6	28	7	9
1982	100	7	0	9	38	6	34	8	5
1981	64	11	0	4	25	3	23	7	3
1980	0	1	0	1	5	1	5	0	0
1979	2	9	0	0	1	0	1	0	0
1978	35	9	3	1	12	1	11	0	0
1977	50	6	0	1	14	1	13	1	0
1976	7	19	1	0	4	0	4	0	0
1975	0	1	0	0	5	0	5	0	1