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Development and management of wintering geese in the Lower Rhine area of North Rhine-Westphalia/Germany

By Johan H. Mooij

Abstract: Mooij, J. H. (1993): Development and management of wintering geese in the Lower Rhine area of North Rhine-Westphalia/Germany. – Vogelwarte 37: 55–77.

The Lower Rhein area, the biggest Ramsar site of North Rhine-Westphalia, is a traditional goose wintering site. The peak winter numbers at the Lower Rhine goose wintering site are nowadays at a level that is more than 180 times higher than it was about 30 years ago. The highest increase is shown by the White-fronted Geese (*Anser albifrons*) where the wintering population has risen from 10 000 to about 140 000, whereas Bean Geese (*Anser fabalis*) increased from 1000 to 20 000–30 000 birds. The development of the Bean and White-fronted Goose populations of the Lower Rhine area is not isolated. In the same period the populations of both species increased in Belgium, the Netherlands and the German part of the Dollart region. Data from other wintering sites and from a part of the breeding area seem to indicate, that there is no general increase of the numbers of these species in Eurasia, but a shift of wintering geese to western Europe.

All wintering geese of the Lower Rhine area prefer to feed on grasslands of relatively undisturbed feeding sites with buffer zones of at least 250 meters that are periodically flooded and more or less richly structured by hedges and relief. Bean Geese show a definitly stronger preference for drier feeding sites and for areas structured by hedges than Whitefronted. A management strategy for the long term protection of wintering geese at the Lower Rhine has to take into account these preferences by creating a network of protected areas, where geese can roost and feed with a minimum of disturbance and maintain good condition throughout the winter. Because the Lower Rhine area is a Ramsar site such a strategy has to be a part of an integrated strategy for the management of breeding, wandering and wintering waders and waterfowl within the scope of a „Western Palearctic Waterfowl Agreement" under the Bonn Convention.

Key words: Arctic geese, goose numbers, reliability of goose counts, behaviour and feeding ecology, management.

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1. Introduction

The Lower Rhine area, the biggest Ramsar site of North Rhine-Westphalia (Fig. 1), ist a traditional goose wintering site. Besides old names of farms, such as „Gansward" and „Gänseward", or fields, like „Gänsekuhl" and „Gänsespeck", there are several references in older literature which indicate that the Lower Rhine area has been a wintering site for geese since the 19th century at least. Hartert (1887) reported a small number of geese were recorded in the neighbourhood of the town of Wesel: „*Anser segetum*" (synonym for *Anser fabalis rossicus*) and „*Anser cinereus*" (synonym for *Anser anser*). Le Roi (1906) and Le Roi & Geyr von Schweppenburg (1912) stated that „*Anser fabalis* (Lath.) – Die Saatgans" (synonym for *Anser fabalis rossicus*) regularly migrates through and winters at the Lower Rhine whereas „*Anser arvensis* Brehm – Die Ackergans" (synonym for *Anser fabalis fabalis*) is only seldom seen. They also reported that *Anser anser* migrated regularly through the area and that individuals of several other goose species were seen now and then. Neubaur (1957) stated that the wintering population of the Lower Rhine area, with about 1000 Bean Geese during the winter in the 1950s, was smaller than it had been in former times. White-fronted Geese *Anser albifrons albifrons* and some other goose species were only occasionally seen in very small numbers.

As from the end of the 1950s the number of geese was counted regularly at the most important feeding sites of the Lower Rhine of that time. On basis of these data Eberhardt (1966) estimated the wintering population at the beginning of the 1960s to be about 1000–1500 geese, mainly Bean Geese belonging to the subspecies *Anser fabalis rossicus*.

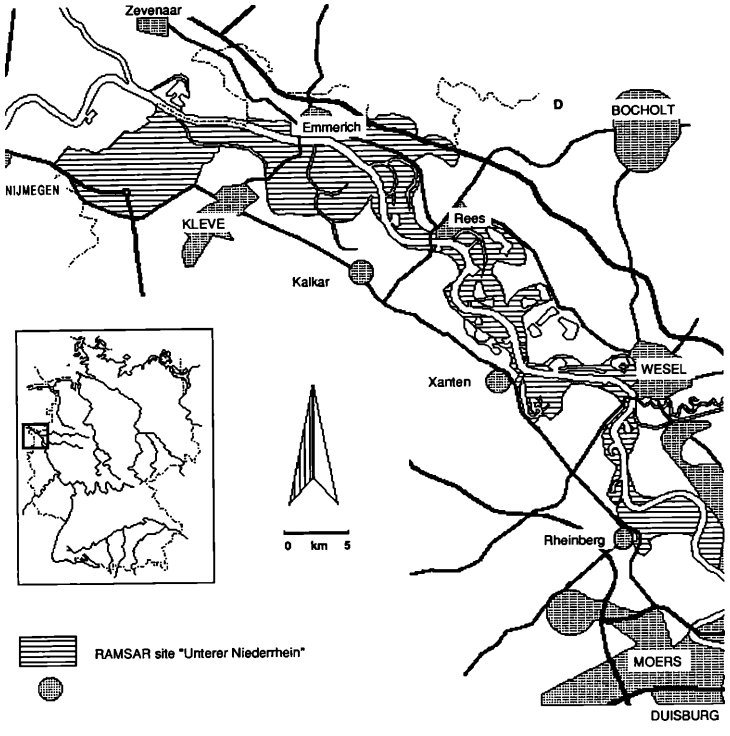

Fig. 1: Ramsar site „Unterer Niederrhein" (Lower Rhine) in North Rhine-Westphalia (D). – Abb. 1: Ramsar-Gebiet „Unterer Niederrhein" im Land Nordhrein-Westfalen.

It seems that the number of geese in this area increased as from the 1950s. In winter 1965/66 the same author already counted a winter peak of about 3000 Bean and about 250 White-fronted Geese and at the end of the 1960s the winter peak ascended to about 8000 Bean and 1500 White-fronted Geese on the feeding sites that were regularly visited (EBERHARDT 1971a).

In winter 1976/77 I started goose counts in the entire Lower Rhine area between Nijmegen (NL) and Duisburg (D) in order to obtain exact data about the number and phenology of wild geese in this goose wintering site and the way they use it.

2. Study Area

The goose wintering site at the Lower Rhine lies between the coordinates 51.50 N 5.52 E (Nijmegen, NL) and 51.30 N 6.45 E (Duisburg, D) in the natural flood plaines of the river Rhine between Rhinekilometer 793 and 883. About 85% of the area belongs to Germany (Federal state of North Rhine-Westphalia), 15% to the Netherlands (Province of Gelderland). Only relatively few geese winter outside this compact wintering site. South of this area every year up to 2000 geese winter between Duisburg and Cologne and several hundred stay east and west of the described site. Most of the geese however winter in the Ramsar site „Unterer Niederrhein" between Duisburg and the Dutch-German border (Fig. 1) and the neighbouring part of the Netherlands from the border to Nijmegen, on a 10 km wide strip of agricultural land on both banks of the river Rhine. About 70% of the area is put to agricultural use and is one of the most productive agricultural areas of North Rhine-Westphalia. As a result of modern farming pastures are replaced by arable land and the traditional high proportion of grasslands decreases every

year. With about 295 residents per square kilometer (Kreis Kleve 209 and Kreis Wesel 397 residents/km²) the area is not densely populated by comparison with the mean values for North Rhine-Westphalia and the neighbouring Netherlands of about 500 residents per square kilometer (Regierungspräsident Düsseldorf 1986).

3. Methods

The following methods were used:

Since winter 1976/77 the number of geese in the Lower Rhine area has been counted at least two times per ten-day period and the feeding sites have been drawn on a map (Scale 1 10 000). On this map there was a screen of 50 × 50 meter squares. For every square there was a filing card with the same coordinates. Every goose observation was filed on the index cards. These cards also contained information about the way the square was used (water, grassland, arable land etc.), the character of the landscape (relief, heges, trees etc.) and the distance of the square to the nearest source of disturbance (town, village, farm, road etc.). All counts were made with the help of binoculars (9 × 63) and a telescope (20–60 × 70). Small groups (1– ca. 100 geese) were individually counted, greater groups in units of 5 (ca. 100–ca. 1000 geese), 10 (ca. 1000–10 000 geese) or 50 birds (more than 10 000 geese). Every group was counted three times and the mean value of these three counts was recorded as the factual number of geese. The species composition of all groups was recorded as well as the percentage of juvenile birds in the wintering population of White-fronted and Bean Geese.

To make a reliability test on the counted goose numbers from 154 goose groups the counted numbers of all three counts were recorded and the groups were photographed with a Canon A-1-camera with 200 mm (Tokina) and 400 mm (Novoflex) objectives. The film material used was Kodak Ektachrom 100, 200 and 400 Asa, Fujichrome 100 Asa and 3 M 1000 Asa. The number of geese counted on the projected diaslides was compared with the data of the field counts. – It happened several times at one feeding site that the geese were counted on the same day independently of each other by Mr. Leo van den bergh and me. The results of these counts were compared.

To reconstruct the number of geese wintering in this area before winter 1976/77 data from older literature (van den Bergh 1977a & b & 1978, van den Bergh & Reijnen 1972, Eberhardt 1966 & 1971a & b, Engländer & Mildenberger 1973, Hummel 1976, 1977, 1980, 1981, 1982, 1983, 1984 & 1988, Kuhn 1973, Möller 1972, Müller 1977 & 1978, Stichmann & Timmerman 1965, Timmerman 1976, Timmerman et al. 1976, Wille 1971, 1972, 1973 & 1974), from several local ornithologists (among others: D. Eberhardt, K.-H. Gassling, W. Hingmann, G. Huyskens, H. Mildenberger, D. Möller and U. and V. Wille) and from the data bank of the „Gesellschaft Rheinischer Ornithologen e. V " (the regional ornithologists society) were evaluated. The goose counts in the area between Duisburg and Düsseldorf were mainly made by a group of local ornithologists (W. Mayer, M. Mietke, R. Müller, J. Schulte and M. Volpers) who gave me their date (see also Volpers & Müller 1986).

In order to obtain information about behaviour of the geese during flight within the wintering site (flying speed and height, flight formation, distances between flight neighbours, favoured flight routes, flight distance etc.) almost 2 million geese in more than 800 flights were followed, observed and partly photographed during flight (morning flights, drink flights and evening flights). For the favourite feeding sites of the wintering geese the main flyways and the distance between feeding site and roost were recorded.

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4. Results

4.1. Reliability of goose counts

The reliability test of the goose counts was made by counting the number of geese on 89 of the 154 photographs taken. 42 photographs – almost without exception taken on 3M 1000 Asa – could not be used because of their coarse grain, another 18 were not usable because the geese were not always separable as a result of the bad position of the photographer, the bad light conditions or the large number of geese. From 5 photographis it was not clear to which goose count they belonged.

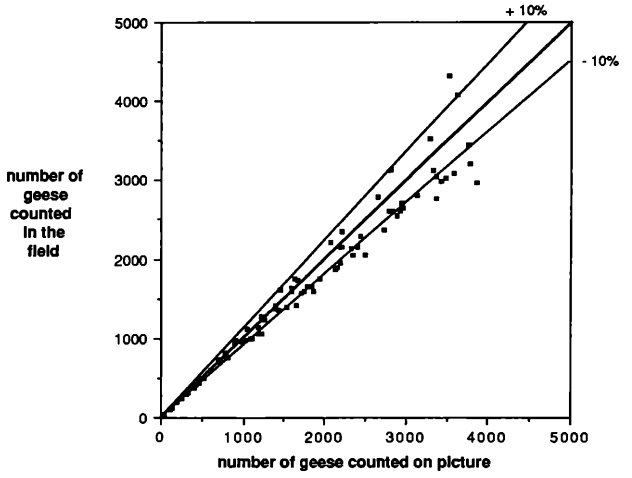

Fig. 2: Reliability-test of the goose counts at the goose wintering site of the Lower Rhine area. Comparison between the counted goose numbers in the field and on the picture. – Abb. 2: Überprüfung der Zuverlässigkeit der Gänsezählungen im Wintergebiet am Unteren Niederrhein durch einen Vergleich der ermittelten Zahl einer Gänsegruppe im Freiland (senkrecht) und auf einem Foto (waagerecht).

The 89 photographs that were used to make a reliability test of the goose counts showed goose groups with about 4000 geese at the most (Fig. 2).

The reliability test indicates that 70.8% of all controlled goose counts were in a range of 10% of the number of the control counts. Of this nunber 69.9% of the field counts showed a lower, 1.6% the same and 28.5% a higher number than was counted on the photographs.

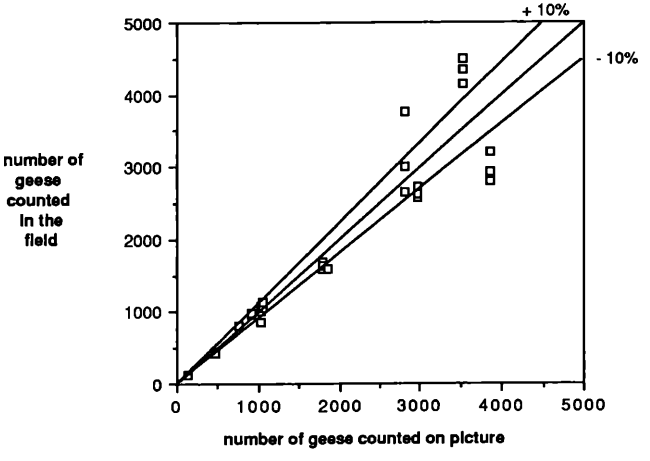

Fig. 3: Reliability-test of the goose counts at the goose wintering site of the Lower Rhine area. Comparison of the goose numbers of the three counts per group in the field and the number counted on the picture. – Abb. 3: Überprüfung der Zuverlässigkeit der Gänsezählungen im Wintergebiet am Unteren Niederrhein durch einen Vergleich der bei drei Zählungen ermittelten Zahlen einer Gänsegruppe im Freiland (senkrecht) und auf einem Foto (waagerecht).

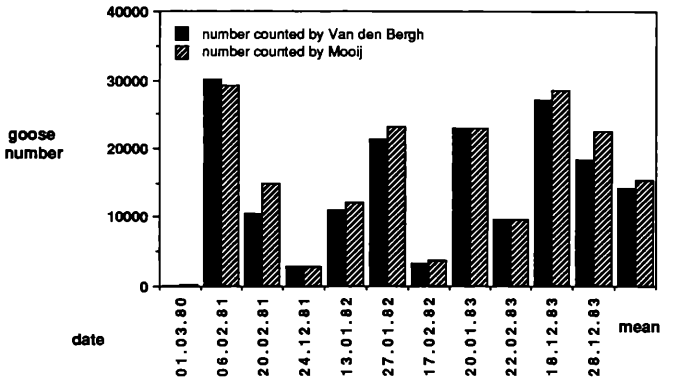

Fig. 4: Comparison between counted goose numbers in the area „Die Düffel/Salmorth" on the same day by VAN DEN BERGH and MOOIJ. – Abb. 4: Vergleich der im Gebiet „Die Düffel/Salmorth" am gleichen Tag durch VAN DEN BERGH und MOOIJ ermittelten Gänsezahlen.

In 12 cases from a photographed group not only the meanvalue but also the result of the three basic field counts were recorded. A comparison of the field data with the result of the counting of the same group on the photographs (Fig. 3) showed that 64% of the field counts and 75% of the calculated mean goose numbers lay within a 10% range compared with the actual goose number counted on the pictures.

A comparison of the number of geese counted in the same area by the author and VAN DEN BERGH on the same day (Fig. 4) showed a mean difference of about 10%.

4.2. Goose numbers

The evaluation of data from older literature, from local ornithologists and from the card-index of the „Gesellschaft Rheinischer Ornithologen e. V " brought fairly reliable goose peak numbers for the period 1959/60 until 1976/77, whereas the goose numbers since winter 1976/77 are the result of the author's own goose counts. The goose number of 1976/77 is the result of a combination of both, because of the fact that the author started to work in the area in this winter and partly used this winter to become aquainted with the site.

The results of the goose counts are shown in Table 1. The peak numbers at the Lower Rhine goose wintering site are nowadays at a level that is more than 180 times higher than it was about 30 years ago. The highest increase is shown by the White-fronted Geese where the wintering population risen from 10 000 birds to about 140 000, whereas Bean Geese numbers increased from 1000 to 20 000–30 000 birds. Until 1982 the most important wintering goose species at the Lower Rhine was the Bean Goose. The peak number of this species has stabilised since winter 1980/81 at a level between 20 000 and 60 000 birds. The number of White-fronted Geese continued to increase until at the end of the 1980's this development seemed to slow down at a level of 130 000–180 000 birds.

4.3. Goose species

Besides Bean and White-fronted Geese each year a variable number of other goose species is recorded:

- Greyleg Goose (*Anser anser*). Several thousand birds, mostly introduced birds that breed and winter in the area.
- Pink-footed Goose (*Anser brachyrhyncus*). Up to 50 birds in mixed Bean and White-fronted goose groups.

Table 1: Peak numbers of wintering geese at the Lower Rhine goose wintering site between winter 1959/60 and 1989/90. – Tab. 1: Wintermaxima der Wildgänse am Unteren Niederrhein von Winter 1959/60 bis 1989/90.

Winter	*Anser fabalis*	*Anser albifrons*	total number
1959/60	1000	10	1010
1960/61	1500	50	1550
1961/62	1500	150	1650
1962/63	2000	100	2100
1963/64	2350	200	2550
1964/65	2750	200	2950
1965/66	3400	250	3650
1966/67	4100	600	4700
1967/68	6600	1000	7600
1968/69	8100	1500	9600
1969/70	10800	1600	12400
1970/71	12450	2350	13800
1971/72	12500	2200	14700
1972/73	11500	1900	13400
1973/74	15200	3000	18200
1974/75	13300	3300	16600
1975/76	20500	2500	23000
1976/77	23500	2800	26300
1977/78	16900	3200	20100
1978/79	20600	5500	26100
1979/80	47200	9000	56200
1980/81	55000	15000	70000
1981/82	65000	19000	84000
1982/83	37000	55000	92000
1983/84	62000	55000	117000
1984/85	53000	48000	101000
1985/86	56000	90000	146000
1986/87	50000	80000	130000
1987/88	45000	135000	180000
1988/89	22000	163000	185000
1989/90	13000	127000	140000

- Lesser White-fronted Goose (*Anser erythropus*). Irregular guest in small numbers.
- Snow Goose (*Anser caerulescens*). Irregular guest in small numbers.
- Bar-headed Goose (*Anser indicus*). Irregular guest in small numbers. Free living, escaped birds.
- Canada Goose (*Branta canadensis*). Up to several hundred birds, mostly wintering apart from other goose species.
- Barnacle Goose (*Branta leucopsis*). Up to several hundred birds.
- Brent Goose (*Branta bernicla*). Up to 50 birds.
- Red-breasted Goose (*Branta ruficollis*). Regular guest, up to 4 birds.
- Egyptian Goose (*Alopochen aegyptiacus*). Up to 50 birds. Free living, escaped birds.

4.4. Winter ecology

The phenology of Bean and White-fronted Goose in the Lower Rhine area (Fig. 5) shows that the winter peak of these two species shifted from February at the end of the 1970s to January in the second half of the 1980s.

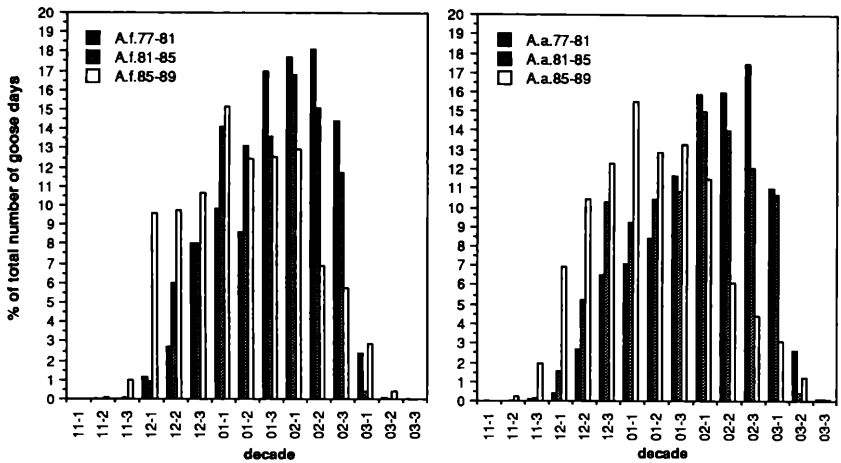

Fig. 5: Phenology of Bean (*A. f.*) and White-fronted Goose (*A. a.*) in the Lower Rhine area from winter 1977/78–1980/81, 1981/82–1984/85 and 1985/86–1988/89. – Abb. 5: Phänologie der Saat- (*A. f.*) und Bläßgans (*A. a.*) am Unteren Niederrhein in der Periode 1977/78–1980/81, 1981/82–1984/85 und 1985/86–1988/89.

The percentage of juvenile birds in the wintering populations of White-fronted and Bean Geese show a strong variation from winter to winter (Table 2). The average reproduction rate during the period 1977–1990 – deducted from the mean proportion of first-winter birds counted at the wintering sites of the Lower Rhine area – is 27.8% for White-fronted and 24.6% for Bean Geese.

For flights between feeding sites and roosts as well as between the different feeding sites the geese used favoured flight lanes. The results of the observation of flying geese at the wintering site of the Lower Rhine area are shown in Fig. 6.

Table 2: Proportion of first-winter birds at the lower Rhine goose wintering site from winter 1977/78 until 1989/90. – Tab. 2: Jungvogelanteil bei den am Unteren Niederrhein überwinternden Saat- und Bläßgänsen von Winter 1977/78 bis 1989/90.

Winter	*Anser albifrons*		*Anser fabalis*	
	% juvenile	n	% juvenile	n
1977/78	29.4	8082	31.2	634
1978/79	11.3	10921	12.8	873
1979/80	26.8	7314	21.8	432
1980/81	24.3	4535	25.2	516
1981/82	37.2	8286	29.8	985
1982/83	26.9	7511	18.2	1032
1983/84	29.7	16458	29.9	2865
1984/85	25.6	3246	25.2	1232
1985/86	47.7	7543	28.9	875
1986/87	17.7	9397	14.3	1123
1987/88	30.3	6874	29.2	1246
1988/89	45.3	27276	39.7	1586
1989/90	8.8	10273	14.1	465
1977–1990	27.8	127716	24.6	13864

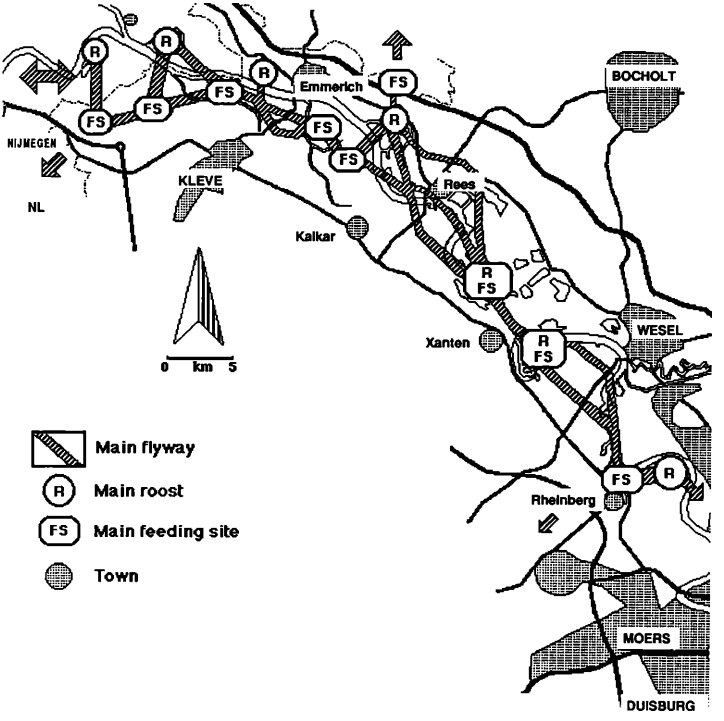

Fig. 6: Main flyways of wintering geese over the wintering site of the Lower Rhine. – Abb. 6: Wichtigste Flugschneisen der am Unteren Niederrhein überwinternden Wildgänse über ihrem Wintergebiet.

The geese of the Lower Rhine wintering site have seven main roosts. In the morning most of the birds leave their roost to visit neighbouring feeding sites. In the evening most of the geese of these feeding sites flew back to the neighbouring roost. Such a unit of roost and feeding sites I called „Complex" An exchange of geese between different complexes mostly happened during drinking-flights or flights between feeding sites.

At the Lower Rhine goose wintering site there are 6 complexes (Fig. 7):

- Bijland-Complex (BC), between Nijmegen (NL) and Emmerich (D), enclosing the feeding grounds of the „Emmericher Eyland" and the „Netterdense en Azewijnse Broek"
- Grietherbusch-Complex (GBC), between Emmerich and Rees.
- Hübsch-Complex (HC), between Rees and Xanten.
- Bislicher Insel-Complex (BIC), between Xanten and Wesel.
- Orsoyer Rheinbogen-Complex (ORC), between Wesel and Duisburg.
- Angermund-Complex (AC), between Duisburg and Düsseldorf.

The distribution of goose feeding over the complexes of the Lower Rhine between 1963/64 and 1989/90 (Fig. 8) showed that the increase of goose numbers resulted in an increase of the total number of goose days mainly in the Bijland-Complex until winter 1980/81. Since that winter there has also been an increase in the other complexes. At the same time the number of goose days fed in the Bijland-Complex stabilsed and the proportion of all goose days for this complex has decreased.

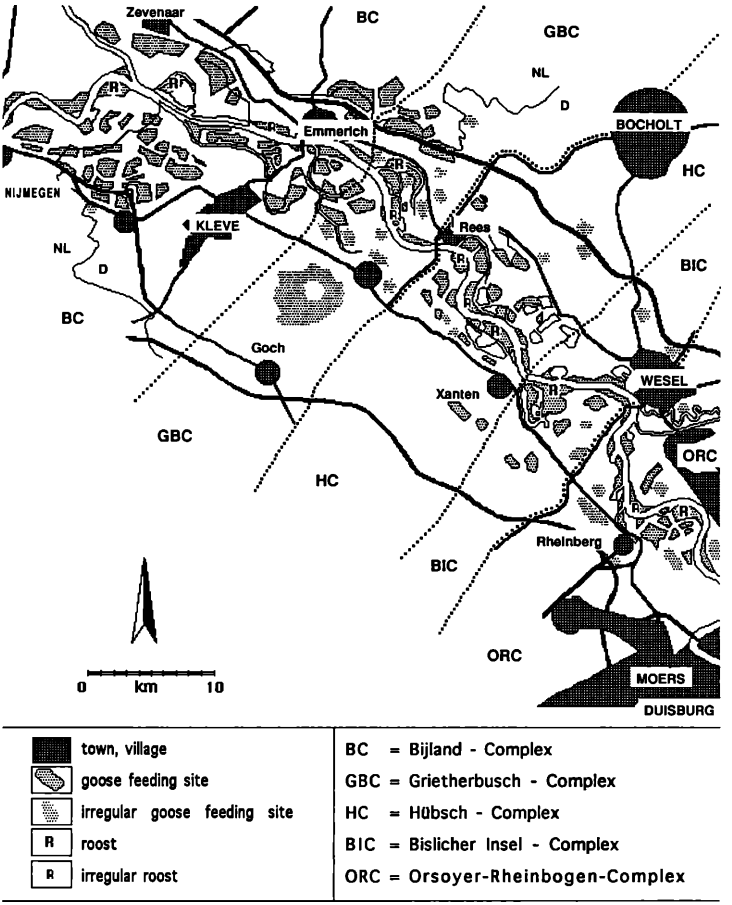

Fig. 7: Map of the goose complexes at the goose wintering site of the Lower Rhine. – Abb. 7: Karte der Wildgans-Komplexe am Unteren Niederrhein.

The main feeding sites are grasslands (Fig. 9); they compose about 60% of all potential feeding sites. The proportion of goosedays fed on grasslands (ca. 85%) is much bigger. This shows a clear preference of the wintering geese to feed on grass vegetation, that is stronger in White-fronted (95.7%) than in Bean Geese (82.2%). About 40% of the potential goose feeding sites of the Lower Rhine area are arable land. Only about 15% of the goosedays is fed on these fields.

The grasslands frequently used by the wintering geese of the Lower Rhine as a feeding site are without exception more or less regularly fertilized pastures and meadows with an intensive agricultural use. Although after a high water of the Rhine, after a longer period of precipitation and after snow thaw greater parts of these grassland areas can be flooded for some days, most of the time the only open sheets of water that can be used by geese for drinking and bathing are the river Rhine, its old river arms, gravel pits and some ditches. Grassland areas that are temporarily flooded are prefered by the geese (Fig. 10) and 41.5% of the feeding sites of the goose wintering site of the Lower Rhine area has open water within a radius of 500 m, 53.7% within a radius of 1000 m and 78.3% within a radius of 2500 m (Fig. 11). This does not mean that the nearest potential drinking site is actually used by the feeding geese.

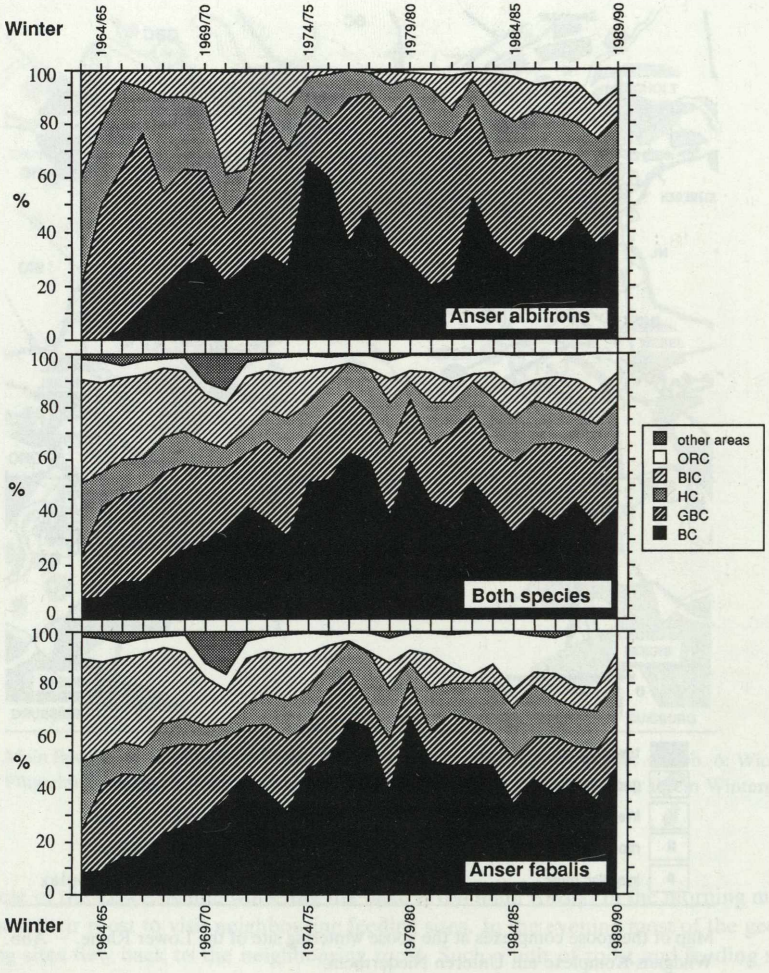

Fig. 8: Distribution of goose feeding over the complexes of the Lower Rhine goose feeding site between 1963/64 and 1989/90 (data from the period 1963/64–1976/77 reconstructed). – Abb. 8: Verteilung der Gänse während der Nahrungsaufnahme über die Komplexe des Unteren Niederrheins in der Periode von 1963/64 bis 1989/90 (die Daten der Winter 1963/64–1976/77 rekonstruiert).

About 10% of the goose feeding sites of the Lower Rhine area is still richly structured by an extensive network of field hedges and rows of willows, ashtrees and oaks (distance between two hedges 100–300 meters), on 11% there is only a wide-meshed network (distance between two hedges more than 300 meters) and on the other feeding sites there are only a few trees and bushes (Fig. 12). About 21% of the feeding sites shows a small-scaled relief of the ground whereas the majority shows only large-scaled differences in ground level. Frequently (12.9%) a small scaled relief is connected with a rich structure of wood. On 29.5% of all feeding sites there is a small-scaled relief or a rich structure of wood or we find both elements. On these feeding sites about 80% of all goose days is fed by the wintering geese; 65.0% of the goose days of White-fronted Geese and 80.2% of Bean Geese. Altogether 21% of the goose feeding sites of the Lower Rhine area is more or less structured by hedges and trees. In this part of the feeding sites almost 30% of

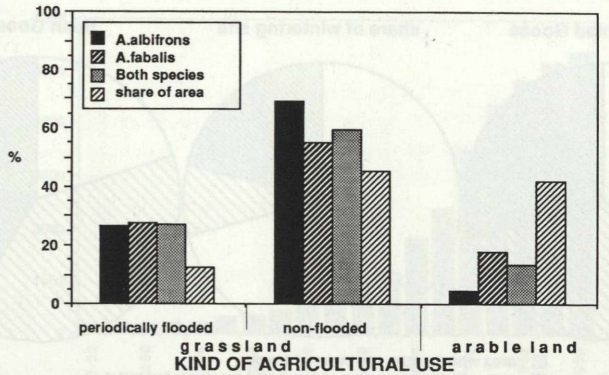

Fig. 9: Usage of the feeding sites of the Lower Rhine area by wintering geese. – Abb. 9: Nutzung der Nahrungsplätze des Unteren Niederrheins durch Wildgänse) Kategorien: periodisch überschwemmtes Grünland, nicht überschwemmtes Grünland und Ackerflächen).

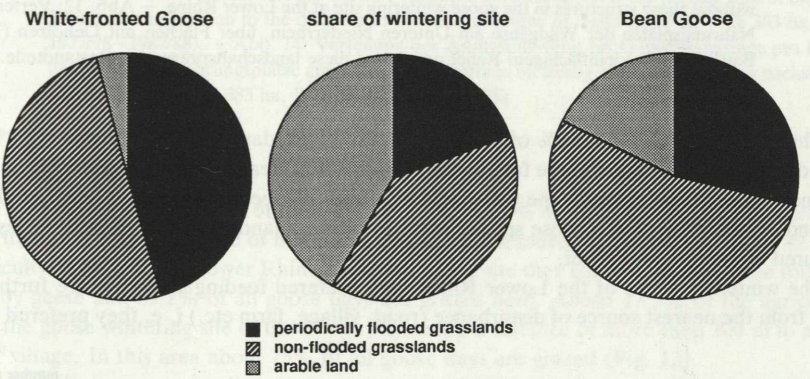

Fig. 10: Distribution of goose feeding over periodically flooded grasslands, non-flooded grasslands and arable land in the goose wintering site at the Lower Rhine. – Abb. 10: Verteilung der Nahrungsflächen von Wildgänsen über periodisch überschwemmtes Grünland, nicht überschwemmtes Grünland und Ackerflächen im Überwinterungsgebiet am Unteren Niederrhein.

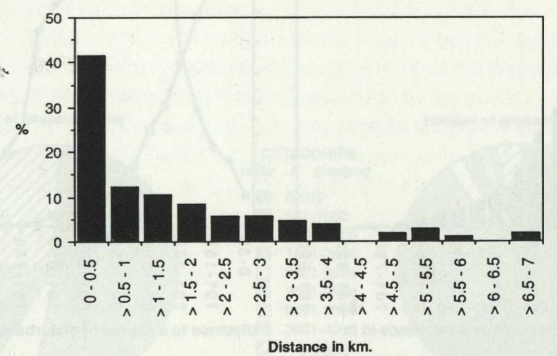

Fig. 11: Distance of the main feeding sites of the Lower Rhine goose wintering site to a more or less significant sheet of water (the river Rhine, an old Rhine arm, a gravel pit) (n = 106). – Abb. 11: Entfernung der Hauptnahrungsplätze der Wildgänse am Unteren Niederrhein zu mehr oder weniger bedeutsamen Gewässern (Rhein, Altrheinarm, Baggersee) (n = 106).

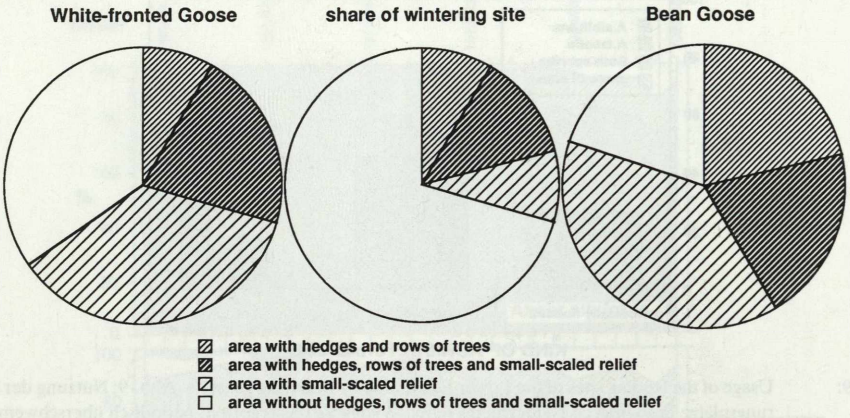

Fig. 12: Distribution of goose feeding over areas with hedges and rows of trees, with small-scaled relief or without these structures in the goose wintering site at the Lower Rhine. – Abb. 12: Verteilung der Nahrungsplätze der Wildgänse am Unteren Niederrhein, über Flächen mit Gehölzen (Hecken, Baumreihen), kleinflächigem Relief oder ohne diese landschaftsprägenden Bestandteile.

the White-fronted and about 60% of the Bean Geese goose days respectively almost 54% of all goose days is fed. Because of these facts it can be stated that Bean Geese have a strong preference for a more closed type of landscape whereas White-fronted Geese show a much weaker liking for this kind of landscape. Both goose species seem to prefer a landscape that is more or less richly structured by hedges and relief.

The wintering geese of the Lower Rhine area prefered feeding sites that are further than 250 m from the nearest source of disturbance (road, village, farm etc.) i. e. they prefered feeding

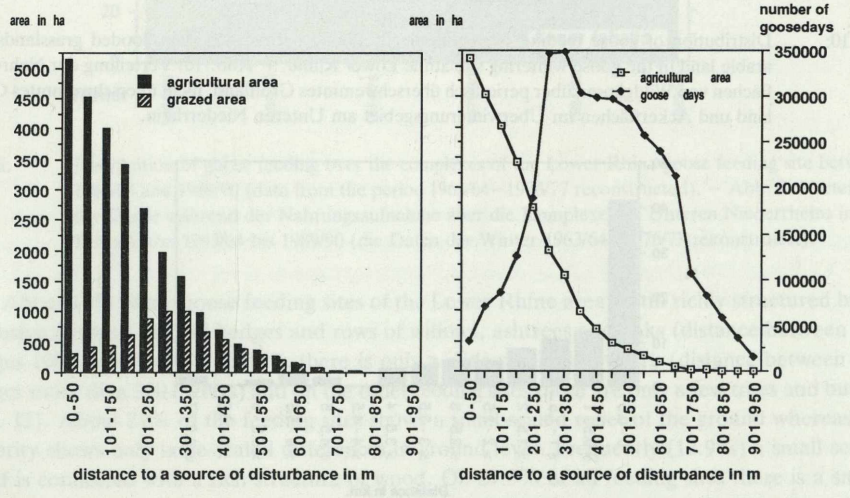

Fig. 13: Distribution of goose feeding over the agricultural area of the Lower Rhine goose wintering site in consideration of the distance to a source of disturbance. – Abb. 13: Verteilung der Nahrungsaufnahme der Wildgänse am Unteren Niederrhein im Bezug zur Entfernung zur nächsten Störungsquelle (Siedlung, Hofanlage, Straße usw.).

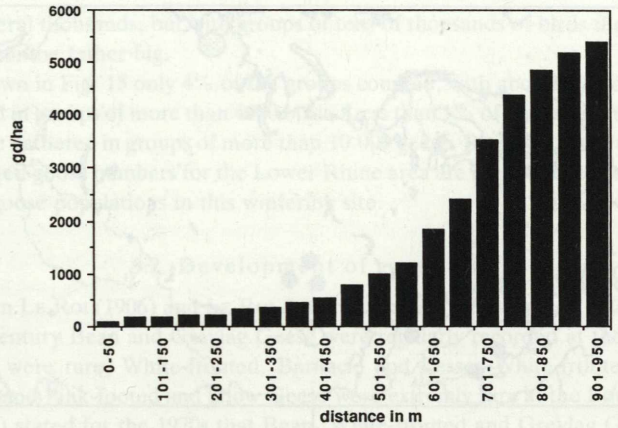

Fig. 14: Distribution of the goose feeding intensity (in goose days/hectar) over the feeding sites of the Lower Rhine area in relation to the distance to the nearest source of disturbance (n = 26 383 ha, winter 1977/78–1987/88). – Abb. 14: Verteilung der Äsungsintensität (in Gänseäsungstage pro Hektar) über die Gänsenahrungsplätze am Unteren Niederrhein im Bezug zur Entfernung zur nächsten Störungsquelle (n = 26 383 ha, Winter 1977/78–1987/88).

on 49.2% of the agricultural area of their wintering site. 66.5% of this area is grazed by geese. Although the areas with a distance of more than 250 m from a source of disturbance form 49.2% of the agricultural area of the Lower Rhine goose wintering site they contain 62.3% of the total area grazed by geese and 85.2% of all goose days are grazed here. About 17.5% of the agricultural area of the goose wintering site of the Lower Rhine has a distance of more than 300 m to a road, farm or village. In this area about 75% of all goose days are grazed (Fig. 13).

Feeding sites at a greater distance from a source of disturbance are more intensively used by geese than areas that are nearer. With the growing distance from a source of disturbance there is an increase in feeding intensity (Fig. 14).

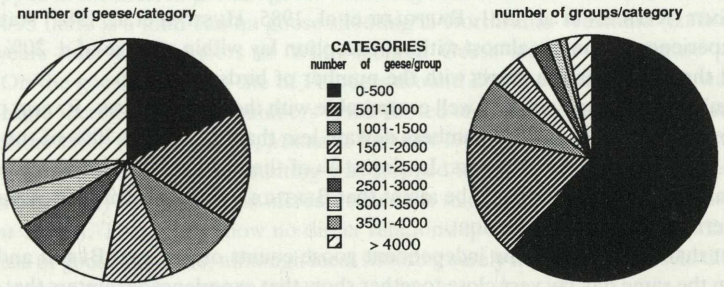

Fig. 15: Distribution of counted geese amoung groups of different size. – Abb. 15: Verteilung der gezählten Gänse über Gruppen unterschiedlicher Größe.

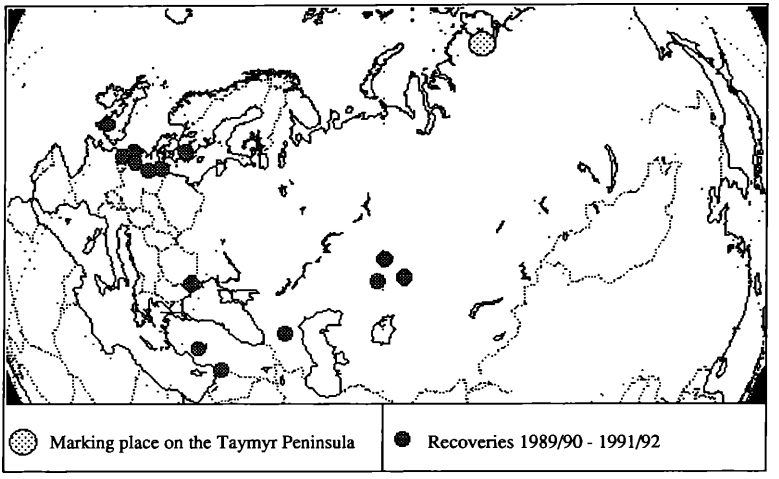

Fig. 16: Recoveries in winter 1989/90, 1990/91 and 1991/92 of White-fronted Geese marked at their moulting site on the Taymyr Peninsula since summer 1989. – Abb. 16: Rückmeldungen aus den Wintern 1989/90, 1990/91 und 1991/92 von auf den Mauserplätzen der Halbinsel Taimyr seit Sommer 1989 markierten Bläßgänsen.

5. Discussion

5.1. Reliability of goose counts

The results of the reliability tests of the goose counts shows that the method used of counting each group three times and recording the average provides reliable figures within a range of 10%. It also showed that the author generally tended to underestimate the actual goose number.

There are a great number of publications about the reliability of birdcounts. ATKINSON WILLES (1963) states that the differences between experienced counters is predictable and seldom will exceed 10%. SCHUSTER (1975) and HULSCHER (1975) are sure that it is impossible to make reliable counts of bigger concentrations of birds; according to these authors differences between two experienced counters of more than 100% are very well possible. BERTHOLD (1976) stated that every counter has his own personal deviation of the real number and advises every counter to write down his personal count deviation in all publications about bird counts. STOUTHAMER (1980) found that even experienced counters can show deviations above 10% from the real number and that this deviation grows when the counted number of birds in a group increases. KERSTEN, RAPPOLDT and SMIT (KERSTEN et al. 1981, RAPPOLDT et al. 1985, HUSTING et al. 1985) stated that the results of experienced counters almost without exception lay within a range of ± 20% of the real number and that the deviation grows with the number of birds per group.

The results of this study are very well comparable with those of KERSTEN, RAPPOLDT and SMIT and with STOUTHAMER. All counted numbers deviate less than ± 20%, in 70% of the cases even less than ± 10% from the real numbers. In almost 3/4 of these counts the author underestimated the real number of birds, which could be a hint that BERTHOLD was right with his assumption that every counter has a personal deviation.

The fact that the results of the independent goose counts of VAN DEN BERGH and me in the same area on the same day lay very close together show that experienced counters that know their counting area very well can make quite reliable counts of the number of wintering geese. Small groups of several hundred geese can be counted almost exactly, a reliable estimate can be made of

groups of several thousands, but with groups of tens of thousands of birds the deviation from the real number can be rather big.

As is shown in Fig. 15 only 4% of the groups counted, with about 25% of all counted geese, were gathered in groups of more than 4000 birds. Less than 1% of the groups and less than 10% of the birds were gathered in groups of more than 10 000 geese. Based on these facts it can be stated that the counted goose numbers for the Lower Rhine area are a reliable reflection of the development of the goose populations in this wintering site.

5.2. Development of goose numbers

We learn from Le Roi (1906) and Le Roi & Geyr von Schweppenburg (1912) that at the beginning of this century Bean and Greylag Geese were regularly recorded at the Lower Rhine, that Brent Geese were rare, White-fronted, Barnacle and Lesser White-fronted Geese were very seldom seen, and Pink-footed and Snow Geese were extremly rare at the Lower Rhine. Mildenberger (1982) stated for the 1970s that Bean, White-fronted and Greylag Geese were regularly recorded in a considerable number and Pink-footed, Barnacle and (since 1959) Canada Geese were recorded in small numbers at the Lower Rhine. Brent and Lesser White-fronted Geese were irregularly recorded in small numbers, whereas Snow and Red-breasted Geese were very seldom and irregularly seen in this area (Eberhardt 1971b, Mildenberger 1982). The recent data show much higher numbers of all these species, which is not only the result of an actual increase of numbers but surely also of the more intensive and complete goose counts of the last decenia. The regular sightings of Red-breasted Geese in the last few years could also incidate a shift of wintering geese from eastern European to western European wintering sites.

The way the goose numbers in the Lower Rhine area have increased in the last decades (Table 1, Fig. 8, Mooij 1982a, 1991a), shows clearly that these birds „discovered" the Lower Rhine area coming from the Netherlands following the course of the Rhine. This assumption is corroborated by the change in phenology of the two important species Bean and White-fronted Geese (Fig. 5). Until the 1980s both species showed a peak number in February, one month later than in the Netherlands, which means that the geese visited this area on their way back to the breeding area. Since the middle of the 1980s the peak number has been reached in January, just as in the Netherlands, which means that the Lower Rhine area is nowadays an integrated part of the western European wintering site (Flanders, Netherlands, Dollart Region and Lower Rhine area).

The hypothesis of Ebbinge (1991) that the increase of goose numbers in Flanders and at the Lower Rhine is a direct result of the ceasing of all goose hunting in both areas is not supported by the development of goose numbers of the Lower Rhine area. Here the number of Bean Geese increased from the middle of the 1960s although it was not until the winter 1969/70 that goose hunting was stopped at the most important goose wintering sites of the area (Eberhardt 1971a). Since winter 1974/75 there is a total ban on goose shooting in Northrhine-Westfalia (Eberhardt 1979) and four years later the numbers of White-fronted Geese started to increase very rapidly (Table 1). On the goose wintering site of Flanders around Damme goose hunting was banned in 1960 but a rapid increase of goose numbers (Pink-footed and White-fronted geese) started at the beginning of the 1980s (Kuyken 1975, Meire & Kuyken 1991) and in the German part of the Dollart-Region (Lower Saxony) goose hunting was stopped in 1977 and goose numbers (Bean and White-fronted Geese) started a rapid increase since the middle of the 1980s (Gerdes et al. 1978, 1983, Mooij 1991a). These data show no direct relationship between a goose hunting ban and a rapid increase of goose numbers, although local shooting surely influences the local distribution of wintering geese within their wintering site.

The development of the Bean and White-fronted Goose populations of the Lower Rhine area is not an isolated event. In the same period the populations of both species increased in Belgium,

the Netherlands and the Dollart region at the Dutch-German border (VAN DEN BERGH 1983, 1985, EBBINGE et al. 1987, GANZENWERKSGROEP 1976, 1977, 1978, 1979, 1980, 1981, 1983, 1984a & b, 1986, 1987a & b, 1989, 1990 and 1991, GERDES ET AL. 1978, 1983, KUYKEN 1975, LEBRET et al. 1976, MEIRE & KUYKEN 1991, MOOIJ 1991a, PHILIPPONA 1972, TIMMERMAN 1976). All over the western European wintering sites, with exception of the British sites, the numbers of both species has increased in the last decade. This increase started in the Netherlands and radiated to the Lower Rhine area almost 10 years later. The Lower Rhine area became the most important *Anser* goose wintering site in Germany and is the second in importance only to the Netherlands within a western European perspective (MOOIJ 1991a). Inspite of the enormous increase in goose numbers in western Europe it can not be stated that the Eurasian populations of Bean and White-fronted Geese increased in the same way. Literature about the number of wintering geese in Asia (PERENNOU et al. 1990, SCOTT & ROSE 1989, VAN DER VEN 1987, 1988, YOKOTA et al. 1982) show that the goose counts in this area are still incomplete and that the populations in some well known areas still decrease from year to year or stabilised on a low level in the last few years. In eastern Europe the numbers of Bean and White-fronted Geese seems to decrease (BOYD & PIROT 1989, CRAMP & SIMMONS 1977, DICK 1990, MADSEN 1987, 1991, STERBETZ 1968, 1971, 1982a, b & pers.com.) and the Greenland race of the White-fronted Goose, wintering on the British Isles, just survived a period of decrease and seems to increase again from a very low level (BOYD & PIROT 1989, FOX & STROUD 1981, GREENLAND WHITE-FRONTED GOOSE STUDY 1990, MADSEN 1987, 1991).

During several expeditions to the Taymyr Peninsula since summer 1989 523 White-fronted Geese were marked with legrings and neck-collars at their moulting sites. Of these birds 53 were resighted during winter 1989/90, 1990/91 and 1991/92 in Belgium, Germany, Great Britain, Kasachstan, the Netherlands, Rumania, the Russian Federation, Sweden and Turkey (Fig. 16, MOOIJ & KOSTIN and MOOIJ et al. in prep.). These results of goose-ringing on the Taymyr Peninsula show that there is a considerable number of White-fronted Geese breeding and moulting on the Taymyr Peninsula and wintering in western Europe. This number is considerably higher as was thought till now. This means that RUTSCHKE's hypothesis (1987) that the migration route from the breeding to the wintering grounds for all breeding populations is comparatively long and the thesis that the White-fronted Geese of Taymyr winter south of the Caspian Sea is wrong. That at least a part of these geese winter in western Europe was already contended by CRAMP et al. (1977). Several White-fronted Geese of the „Baltic-North Sea group" (see BAUER & GLUTZ VON BLOTZHEIM 1968, CRAMP & SIMMONS 1977, PHILIPPONA 1972, RUTSCHKE 1987, TIMMERMAN 1976, TIMMERMAN et al. 1976), ringed in the Netherlands and England, were recovered in south-eastern Europe in later winters, on the wintering sites of the „Pannonic" and „Pontic group" and from breeding areas between Archangelsk and the Taymyr Peninsula (BAUER & GLUTZ VON BLOTZHEIM 1968, CRAMP & SIMMONS 1977). Ringed birds from the Taymyr Peninsula were recovered at the wintering sites of western and eastern Europe, on the sites of the „Baltic-North Sea" and the „Pontic group" as well as on wintering sites of south-west Asia, on the sites of the „Anatolian" and „Caspian group" Therefore it is not unrealistic to assume that maybe the breeding birds of one area are distributed over several wintering sites in winter. There are several indications that new pair bonds are made in the wintering areas (VAN IMPE 1978, JOHNSGARD 1978, RUTSCHKE 1987). The mixture of several breeding populations and the formation of new pairs on the wintering grounds would be of great genetic importance; it would enlarge the possibility of genetic exchange between breeding populations and decrease the chances of developing new subspecies. The fact that the Eurasian race, *Anser albifrons albifrons* (SCOPOLI, 1769), has a core breeding area on the tundra between the Kanin Peninsula and Kolyma river (over a distance of about 4500 km) without showing much geographical variation, could indicate that there must have been

a permanent intensive interchange between local breeding populations on all winter sites and supports this hypothesis.

The results of the ringing programme of Greenland White-fronted Geese *Anser albifrons flavirostris* also seem to support this hypothesis. Although these birds were caught and ringed in a very limited area in west Greenland (400 km²) they were recovered dispersed over the wintering sites of Ireland and Scotland, i.e. they were distributed over almost the whole wintering area of the subspecies (WILSON et al. 1991).

Such a high rate of interchange between different breeding and wintering populations not only would ensure genetic exchange but also would enable these populations to react rather quickly on a change in wintering conditions by shifting from one site to another, even over large distances.

During the Taymyr-expedition of 1989 Soviet biologists showed us the results of their counts of breeding White-fronted and Bean Goose pairs in several parts of Taymyr Peninsula between 1968 and 1984. In this part of the breeding area the yearly breeding density of White-fronted Geese fluctuates between 0.25 and 4.0 and of Bean Geese between 0.1 and 6.0 nests per square kilometer. In the valley of the Pura river (West-Taymyr) KOKOREW (1985) found breeding densities between 0.2 and 0.9 for White-fronted and between 0.03 and 0.32 nests per square kilometre of Bean Geese for the period 1978–1982. Between 1986 and 1988 SYROECHKOVSKIY et al. 1991 found for Vaygach Island between 1.0 and 3.0 nests per square kilometre for Bean and 1.5 nests (1 year) per square kilometre for White-fronted Goose. Allthough these results maybe are not representative for the whole breeding area the densities found seem to be comparable and there seems to be no increasing tendency in breeding densities of White-fronted and Bean Geese on the Taymyr Peninsula between 1968 and 1984. All these data could indicate that there is no general increase of Whitefront numbers in Eurasia but a shift of wintering birds to western Europe.

5.3. Effects of goose shooting

White-fronted and Bean Geese are hunted in the breeding areas as well as on their migration routes and on most of the wintering sites, without regard of either their yearly reproductive and natural mortality rates or the total number shot on the previous part of their flyway. In most countries goose hunters can shoot as many birds as they want, although nobody knows if this years shooting will impair the future development of the populations or not. Because of the strong yearly variation of the reproductive rate (Table 2), this kind of goose shooting can easily become a serious threat to these populations (MOOIJ 1991b, c, MOOIJ & KOSTIN in prep.). Therefore for all species each year exact data have to be collected at least about the total number of individuals, the size of the breeding population, the breeding densities, the reproductive and mortality rate as well as the total number of geese shot „to ensure that any consumptive ‚use' of the populations is wisely undertaken on the basis of sustainability" (STROUD 1992). Such a „wise-use" hunting strategy has to be developed in the scope of the „Western Palearctic Waterfowl Agreement" under the Bonn Convention (BOERE 1990).

5.4. Winter ecology

From the map of Fig. 6 it becomes clear that the geese follow flight lanes during their flights over their wintering site. It seems that the river Rhine is their main guiding line. Large obstacles such as bridges crossing the Rhine and high-tension long-distance lines, industrial plants, recreation centres and places with high human activity such as towns are avoided by most of the geese. How effective this kind of human made barries can be is shown at the southern border of this wintering site, where a chain of agglomarated towns (Wesel-Voerde-Dinslaken-Duisburg-Moers) is overflown by only 1% of the geese.

Similar behaviour was also found with geese wintering at other sites (GERDES et al. 1978, MARKGREN 1963, PHILIPPONA 1972) and with other bird species (JELLMANN 1988, TINBERGEN 1967).

Strong links between a roost and several feeding sites, as they were found within the complexes at the goose wintering site of the Lower Rhine, were also found with other waterfowl by FREDERICK et al. (1987), OWEN & BLACK (1990), RUTSCHKE (1990) and TAMISIER (1985). FREDERICK et al. called it „core-arena-system" and TAMISIER „Functional Unit System" The main reasons for the distribution of goose feeding over smaller units within a wintering site are:

- energy budget. Flying is the activity with the highest energy expenditure per time unit. Short flights between roost and feeding site save energy (see MOOIJ 1992a).
- distance. The feeding sites of a complex are seldom at more than 10 kilometers distance from the main roost. Flights longer than 10 km are very rare at the Lower Rhine.
- geographical barriers, like bridges, high-tension long-distance lines, industrial plants, towns, villages and other centres of human activity.
- tradition. Some of the roosts and feeding sites of the Lower Rhine area have been used by geese for more than a century.

The geese of the Lower Rhine wintering site show a clear preference for feeding on pastures. This preference is more marked in White-fronted than it is in Bean Geese (Fig. 9). Similar results were found in the goose wintering sites of southern Sweden (MARKGREN 1963, NILSSON & PERSSON 1991), the Netherlands (VAN DEN BERGH 1985, LEBRET et al. 1976, PHILIPPONA 1972) and northwest Germany (GERDES et al. 1978). In the Belgium goose wintering site of Damme – with a clear majority of White-fronted Geese – the geese only use pastures as a feeding site (KUYKEN 1975), whereas the majority of migrating Bean and White-fronted Geese (beginning of October–end of December) in the former GDR feeds on arable land, mainly on remnants of the harvest (RUTSCHKE 1987, SCHRÖDER 1975). For the Lower Rhine goose wintering site it can be stated that the progressive development in agriculture to change grassland into arable land not only reduces the area of potential feeding sites and causes an undesirable concentration of wintering geese, but also enlarges the risk of goose damage (MOOIJ 1992b).

Besides the agricultural use of an area it seems to be important to the geese that the feeding site is periodically flooded (Fig. 10), that there is water nearby (Fig. 11) and that the landscape is structured by woods (hedges and rows of trees) and relief of the ground surface (Fig. 12). Both Bean and White-fronted Goose seem to prefer a landscape that is periodically flooded and more or less richly structured by hedges and relief, but Bean Geese show a definitely stronger preference for more dry feeding sites and for areas structured by hedges and rows of trees than White-fronted. This difference in preference could be related to the breeding habitat preference of these species (CRAMP & SIMMONS 1977).

All roosts of the geese of the Lower Rhine area are on the edge of water with shallow banks, show a grassy vegetation and are situated in areas seldom disturbed by human activities. Human disturbance can force the geese to leave the roost and the surrounding area for several weeks (MOOIJ 1991b).

5.5. Management aspects

All geese need relatively undisturbed feeding sites and buffer zones of at least 250 meters around them (Fig. 13 & 14). Similar results were found by GERDES et al. (1978), KUYKEN (1975), MOOIJ (1982b) and OWEN (1973). As a result of these facts it can be stated that a high disturbance rate or enlarging the share of arable land lessens the potential feeding area of the geese at the wintering site of the Lower Rhine.

At the moment at the Lower Rhine goose wintering site we would need an area big enough to offer food for about 10–12 000 000 goose days and about 25 000 ha of agricultural land are visited

by geese each winter. Because of the fact that the Lower Rhine is divided by a close-meshed network of roads and the wintering geese keep an average distance of about 300 m to the nearest source of disturbance (Mooij 1982b) and have a strong preference for feeding on grassland (Ernst & Mooij 1988, Mooij 1984, 1991b, 1992b) big parts of this area cannot be fully used by geese. About 17.6% of the agricultural area of the goose wintering site of the Lower Rhine is further than 300 m from a road, farm or village. In this area about 75% of all goose days are grazed (Mooij in prep.). More than 80% of the feeding sites are not optimal for use by wild geese. On the feeding sites most favoured by the geese feeding intensities frequently exceed a level of 2500 gd/ha – which seems to be a goose damage threshold in this area (Mooij in prep.) – and an increasing number of complaints about goose damage is the result. Assuming that the feeding intensity has to be under 2500 gd/ha we would need an undisturbed area of 5000–6000 ha. Each undisturbed feeding site (central zone) has to be surrounded by a buffer zone of at least 300 m. Small undisturbed feeding areas need relatively big buffer zones, large undisturbed feeding sites need relatively small buffer zones. Fields in the central zones enlarge the area needed, fields in the buffer zones do not.

To keep the grazing intensity in the feeding areas below the damage threshold about 6000 ha of undisturbed grassland are needed at the Lower Rhine area at present. By a mean size of 100 ha per central zone exclusively used as grassland this would mean that a total area of 15 000 ha is needed for central and buffer zones. In fact at present the mean size of the undisturbed goose feeding sites of the Lower Rhine area is substantially smaller and most of them are a mixture of grassland and fields and have a hight disturbance rate. Therefore one of the most important parts of a management strategy for wintering geese is a good farming strategy. Fields and grasslands in the direct neighbourhood of villages, farms and other buildings, roads and forest or surrounded by hight trees are seldom visited by geese. These areas could be used for the cultivation of crops that are vulnerable to goose feeding. In the central zones fields should primarily be transformed in grasslands. The cultivation of vulnerable crops should be avoided. In cases where because of the structure of the affected farms it is impossible to change fields into grasslands, these favourite feeding sites can be made more attractive to geese by later ploughing up of harvest remnants or the cultivation of interim crops on fallow fields and measures to guarantee undisturbed feeding. In this way not only goose damage can be reduced, but at the same time the food basis of the geese can be increased and the number of disturbances can be reduced. In addition to this feeding conditions can be improved by the temparary closure of roads to enlarge central zones and by temporary damming up of ditches during autumn and winter to create flooded areas or by the creation of permanent shallow waters on the feeding sites where the geese can drink, preen and roost.

6. Management implements

A management strategy for the long term protection of wintering geese at the Lower Rhine has to consider the following conservation and development aspects:

- On the goose wintering site a network of protected areas has to be created with undisturbed central zones, surrounded by bufferzones of at least 300 m, where geese can roost and feed with a minimum of disturbance and maintain good condition during the winter.
- Highest protection status is needed for the roosts. Without suitable roosts no geese can stay in the area. Any kind of human disturbance on a roost can chase the geese away for weeks. Because there are very few sites suitable for roosting geese, disturbing a goose roost means that a whole area will be deserted by geese. Several „Complexes" have only one roost. Every kind of human activity must be forestalled.

- Further obstruction of the main flyways has to be prevented. The creation of further barriers within the wintering site can cut off parts of it, but will at least extend the flyways, which costs additional energy.
- The main feeding grounds of the geese have to be protected. In the central zones the number of human disturbance must be reduced. In the buffer zones only necessary agricultural activities can be allowed. Because of the clear preference of the geese for grasslands, the grassland share on these feeding sites must be kept. In the central parts of goose feeding sites an effort must be made to transform arable land in grassland, arable land can shift into the buffer zones.
- To reduce the disturbance rate on the main feeding grounds of the geese it is necessary to reduce the accessibility of these areas by the temporary barring of roads. To rule and direct the increasing interest of the people in observing geese it is inevitable to create some vantage points and hides at less critical places (Mooij 1988a).
- In cases of goose damage the government has to pay compensation to ensure that the farmers do not disturb the feeding geese (see Mooij 1992b).
- It is necessary to develop a farming strategy to enable the farmers to make a living out of farming in spite of restricted use of land because of nature protection schemes and to improve the conditions for wintering geese. With the help of an agricultural consolidation programme and financial compensation for the farmers the share of grasslands has to be increased again in the central areas of the goose feeding grounds. In the buffer zones fields can be made more attractive to geese by leaving fields unploughed or by the cultivation of interim crops. With the help of a good farming strategy goose feeding can be better spread over an area, the carrying capacity can be increased and the risk of goose damage can be reduced (Mooij 1992b).
- It would be very important to improve landscape structures for wintering geese. This means that on the feeding sites not only the share of grassland has to be increased but also the extent of hedges and rows of trees. At the same time it would be very helpful to raise the ground water level in the central zones by damming up ditches during autumn and winter to create flooded areas where geese can drink, preen, loaf and roost without being disturbed.
- It is important to develop an integrated concept for the management of breeding, migrating and wintering waders and waterfowl species for the Ramsar-site at the Lower Rhine as a part of a „Western Palearctic Waterfowl Agreement" under the Bonn Convention (Boere 1990). Because of the fact that the goose wintering site of the Lower Rhine is a Ramsar-site that is also important as a wintering, migration and breeding site for a great number of waterfowl and waders (Mooij 1988b) it is important not only to improve the area for geese but also for waders and waterfowl.
- It is necessary to create one administrative organisation for the whole area (Mooij 1988b). In an initial phase this could be an administrative unit for the German part that can be extended also for the Dutch part after 1992. The goose wintering site at the Lower Rhine is a natural unit distributed over two countries. Even the German part is distributed over several administrative districts. This means a great number of administrative borders within the site with different laws or different enforcement of laws.

7. Zusammenfassung

Der Untere Niederrhein, das größte Ramsar-Gebiet Nordrhein-Westfalens, ist ein traditionelles Überwinterungsgebiet für Wildgänse. Das Wintermaximum liegt hier heutzutage mehr als 180mal höher als noch vor 30 Jahren. Die größte Zunahme zeigen die Bläßgänse, deren Winterpopulation von 10 000 auf ca. 140 000 Individuen zunahm, während die Zahl der Saatgänse von 1000 auf 20 000–30 000 Individuen anwuchs. Diese Entwicklung bei den Saat- und Bläßganspopulationen des Unteren Niederrheins steht in Westeuropa nicht isoliert da, denn in derselben Periode nahmen die Bestände beider Arten auch in Belgien, den Niederlanden und im Dollart-Gebiet

auf ähnliche Weise zu. Die bis heute vorliegenden Daten aus den Brutgebieten geben jedoch keine Hinweise auf eine generelle Bestandszunahme. Die abnehmende Tendenz der Bestände in osteuropäischen Wintergebieten legt die Vermutung nahe, daß zur Zeit eine Verlagerung überwinternder Gänse von Ost- nach Westeuropa stattfindet.

Die am Unteren Niederrhein überwinternden Gänse bevorzugen für die Nahrungsaufnahme Grünlandflächen in relativ ungestörten Bereichen mit Pufferzonen von zumindest 250 m Breite, die periodisch überflutet werden und mehr oder weniger kleinflächig durch Hecken, Gehölze und Relief strukturiert sind. Saatgänse zeigen eine deutlich stärkere Präferenz für trocknere Nahrungsflächen und eine durch Gehölze strukturierte Landschaft als Bläßgänse.

Eine Management-Strategie für den langfristigen Schutz der am Unteren Niederrhein überwinternden Wildgänse sollte diese ökologischen Präferenzen berücksichtigen und ein Netzwerk geschützter Gebiete einrichten, wo die Gänse rasten und Nahrung suchen können, mit einem Minimum an Störungen, damit sie während des gesamten Winters in einer optimalen Kondition bleiben können. Da der Untere Niederrhein ein Feuchtgebiet von internationaler Bedeutung gemäß RAMSAR-Konvention ist, sollte eine solche Strategie Teil eines integrierten Schutzkonzeptes für den Gesamtlebensraum (Brutgebiete, Wanderwege, Wintergebiete) wandernder Wasser- und Watvögel im Rahmen des „Western Palearctic Waterfowl Agreement" im Rahmen der Bonner Konvention sein.

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