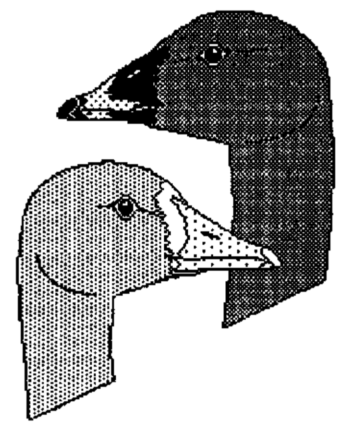
Ecology of geese wintering at the Lower Rhine area (Germany).



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Ecology of geese wintering at the Lower Rhine area (Germany).

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Stellingen

I

De hypothese (o.a. Philippona 1972, Rutschke 1987), dat de westpalearctische populatie van de Kolgans in verscheidene, relatief scherp gescheiden winterpopulaties te verdelen is en deze verdeling in het broedgebied gehandhaafd blijft, waardoor de trekweg tussen broed- en wintergebied voor alle subpopulaties ongeveer even lang is, wordt door de resultaten van recent ringonderzoek niet bevestigd.

Philippona, J. - 1972 - Die Bleßgans. - Ziemsen, Wittenberg Lutherstadt.
Rutschke, E. - 1987 - Die Wildgänse Europas. - Aula, Wiesbaden.

II

De in veel westeuropese literatuur verdedigde opvatting, dat de toename van de in Westeuropa overwinterende aantallen Kolganzen met een toename van het broedbestand in de westelijke Palearctis te verklaren is (b.v. Ebbinge 1991, Rutschke 1987), staat linea recta tegenover de opvatting in russische literatuur, dat de Kolgansbestanden in het broedgebied sinds de jaren dertig sterk teruggelopen zijn en zich sinds de jaren zestig op een laag niveau schijnen te stabiliseren (b.v. Flint & Krivenko 1990, Krivenko 1994, Rogacheva 1992).

Ebbinge, B.S. - 1991 - The impact of hunting on mortality rates and spatial distribution of geese, wintering in the western Palearctic. - Ardea 79: 197-209.
Flint, V.Ye. & V.G.Krivenko - 1990 - The present status and trends of waterfowl in the USSR. - in Matthews, G.V.T. (Ed.) - 1990 - Managing Waterfowl Populations. - IWRB Spec.Publ. 12: 23-26.
Krivenko, V.G. - 1994 - Current numbers of water birds in Russia and adjecent countries. - Manuscript van een rapport voor de internationale watervogel-conferentie "Anatidae 2000", December 1994 in Staatsburg.
Rogacheva, H. - 1992 - The Birds of Central Siberia. - Husum Verlag, Husum.
Rutschke, E. - 1987 - Die Wildgänse Europas. - Aula, Wiesbaden.

III

De recente toename van de in Westeuropa overwinterende aantallen Riet- en Kolganzen is voornamelijk het gevolg van het verschuiven van overwinteringszwaartepunten binnen het westpalearctische overwinteringsareaal en is niet door een verminderde jachtdruk of een algemene toename van de westpalearctische populaties van beide soorten te verklaren.

IV

Zolang er geen integraal managementconcept voor de westpalearctische ganzensoorten is en een centrale coördinatie van de jaarlijkse telgegevens en tableaus, reproductie en mortaliteit en het jaarlijks en regionaal vastleggen van variabele jachttijden en "bag-limits" niet mogelijk is, is de jacht op deze soorten volgens het "wise use" principe niet mogelijk.

V

Storing van voedselzoekende ganzen door belangstellenden of jacht verhoogt de schuwheid en de energiebehoefte van de vogels, waardoor het risico van ganzenschade in storingsarme gebieden toeneemt.

VI

Ellenberg (1989) gaat ervan uit, dat de toename van een aantal watervogelsoorten in West-Europa op het verbeterde voedselaanbod, als gevolg van de sterk gestegen bemesting in de landbouw, terug te voeren is.
Als deze hypothese juist is, moeten de aantallen van deze soorten bij een veranderd nationaal landbouwbeleid, dat tot een geringere bemesting voert (Klep 1989), in Nederland teruglopen.

Ellenberg, H. - 1989 - Fülle-Schwund-Schutz: Was will der Naturschutz eigentlich? Über Grenzen des Naturschutzes in Mitteleuropa unter den derzeitigen Rahmenbedingungen.-Verhandl.Gesellsch.f.Ökologie,Bd.XVI: 449-459.
Klep, L. - 1989 - Van landbouw en veeteelt wordt een nieuw wonder verwacht. - in: Groen, M. (red.) - 1989 - Milieu: kiezen of verliezen. - SDU, 's Gravenhage.

VII

De Ramsar-Conventie verplicht de lidstaten enerzijds de ecologische kwaliteit van "wetlands" te verbeteren en anderzijds door geschikte maatregelen de daar voorkomende watervogelpopulaties te vergroten.
Deze verplichtingen voeren in sterk anthropogeen beinvloede gebieden, waar de watervogelconcentraties op een ecologisch ongewenste concentratie van voedingstoffen als gevolg van menselijke activiteiten terug te voeren zijn, tot conflicten bij de formulering van management-doelstellingen (ZWFD 1994)

ZWFD - 1994 - Feuchtgebietsschutz in der Bundesrepublik Deutschland durch Monitoring der Wasservogelarten sowie durch Gebietsmonitoring speziell der Feuchtgebiete Internationaler Bedeutung gemäß RAMSAR-Konvention. - Rapport in opdracht van het Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit en de deelstaten Noordrijn-Westfalen en Brandenburg.

VIII

In botanische literatuur wordt de opvatting verdedigd, dat de gematigde klimaatzone in Europa van nature met een gesloten bos bedekt is, dat op droge gronden in het "climax-stadium" uit hoogopgaand beukenbos bestaat (b.v. Aichele & Schwegler 1994, Ellenberg 1963).
In de laatste jaren werd steeds vaker de opvatting geuit, dat zich in Europa eerst na de laatste ijstijd min of meer homogene, gesloten bosformaties konden ontwikkelen als gevolg van het wegvallen van de invloed van door de mens uitgeroeide grote herbivoren (b.v. Beutler 1992, Geiser 1992, May 1993 & Schüle 1991).
Als deze hypothese juist is, moeten we ervan uitgaan, dat gesloten bosformaties een "onnatuurlijke" verschijning en een van de eerste vormen van een "kultuurlandschap" zijn.

Aichele, D. & H.-W.Schwegler - 1994 - Die Blütenpflanzen Mitteleuropas. - Franckh-Kosmos, Stuttgart.
Beutler, A. - 1992 - Die Großtierfauna Mitteleuropas und ihr Einfluß auf die Landschaft. - Landschaftsökologie Weihenstephan 6: 49-69.
Ellenberg, H. - 1963 - Vegetation Mitteleuropas mit den Alspen in ökologischer Sicht. - Ulmer, Stuttgart.
Geiser, R. - 1992 - Auch ohne Homo sapiens wäre Mitteleuropa von Natur aus eine offene Weidelandschaft. - Laufener Seminarbeitr. 2/92: 22-34.
May, T. - 1993 - Beeinflußten Großsäuger die Waldvegetation der pleistozänen Warmzeiten Mitteleuropas?- Natur und Museum 123(6): 157-170.
Schüle, W. - 1991 - Landscapes and Climate in Prehistory: Interactions of Wildlife, Man, and Fire. - Ecological Studies 84: 273-318.

IX

De projekten voor de ontwikkeling van natuurlijke ooibossen in de uiterwaarden van de grote rivieren Rijn, Waal en IJssel hebben te lijden onder het feit, dat slechts een gedeelte van de vroeger hier werkzame natuurlijke factoren te reconstrueren is.

X

De inhoud van het nederlandse kinderboek "Pietje Bell is weer aan de gang" van Chr.v.Abkoude (verschenen tussen 1920 en 1930) en het duitse kinderboek "Kai aus der Kiste" van Wolf Durian (verschenen in 1924) vertonen een zo sterke overeenkomst, dat men ervan uit moet gaan, dat beide boeken een gemeenschappelijke basis moeten hebben.

XI

Het feit, dat in de duitse Bondsrepubliek op het ogenblik meer auto´s rijden dan in Zuid-Amerika en Afrika bij elkaar en de opvatting dat de autoindustrie de belangrijkste gangmaker van de duitse economie is, biedt duistere perspectieven voor de toekomst van het milieu in Duitsland en toont hoe moeilijk het is economische en ecologische interessen met elkaar te verzoenen.

XII

Door de in het algemeen lage opkomst bij verkiezingen in westeuropese landen zonder kiesplicht, worden deze landen door een gequalificeerde minderheid geregeerd.

XIII

Het door Darwin geformuleerde evolutie-principe, dat de soorten in een stabiel of zich langzaam veranderend milieu moeten "doorvechten" en alleen de best aangepaste soorten en individuen kunnen overleven, is zowel in de theorie van het kapitalisme, het communisme als in het nationaal-socialisme terug te vinden (Hsu 1990).

Hsu, K.J. - 1990 - Die letzten Jahren der Dinosaurier (The Great Dying). - Birkhäuser, Basel/Boston/Berlin.

XIV

De hypothese, dat de dinosauriers aan het einde van de Krijt-periode door een katastrofe uitgeroeid werden, is een late ondersteuning van de katastrofen-theorie van Cuvier.

Stellingen behorend bij het proefschrift

Ecology of geese wintering at the Lower Rhine area (Germany)

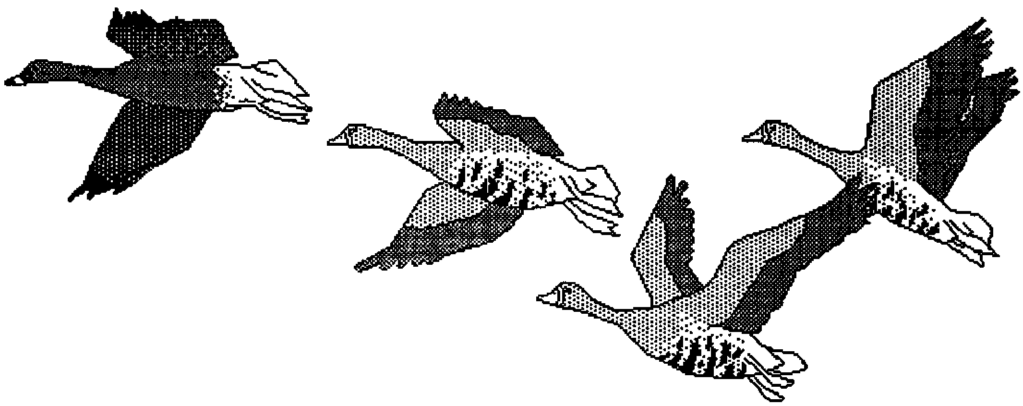
Johan H. Mooij

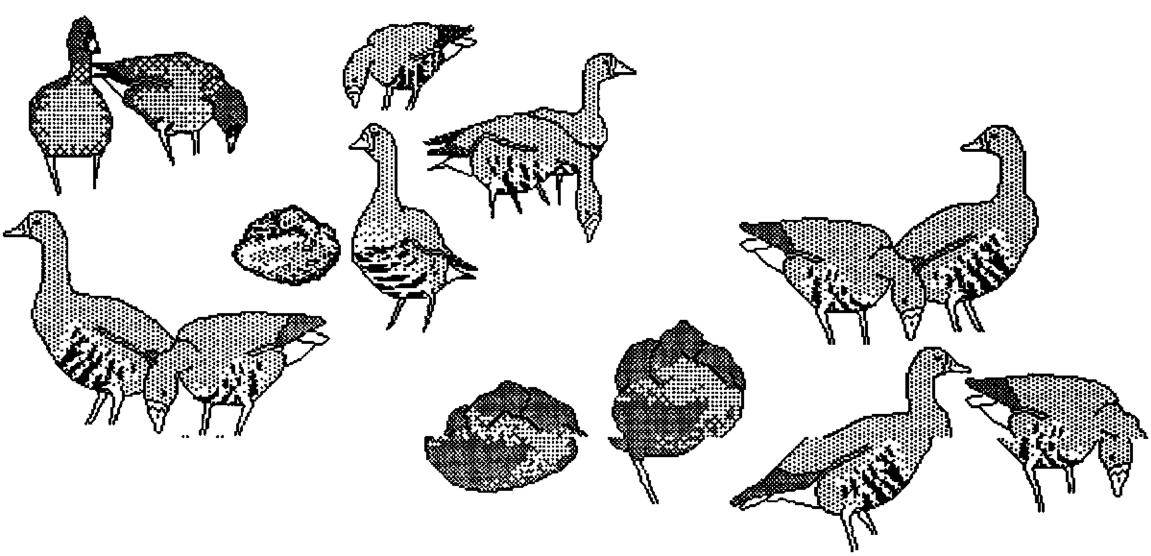
Wageningen, 18 oktober 1996

Contents / Inhalt

Chapter 1

Ecology of geese wintering in the Lower Rhine area (Germany).
Einführung / Introduction





Ecology of geese wintering in the Lower Rhine area (Germany).
Einführung / Introduction

Aus alten Beschreibungen von in West-Europa überwinternden arktischen Wildgänsen (z.B. Brouwer 1943 & 1953, Gesner 1669) wissen wir, daß sie in der Vergangenheit mehrheitlich in natürlichen und naturnahen Gebieten, wie Meeresküsten, naturnahe Überschwemmungsbereiche, Flußdelten und Mooren, überwinterten. Witherby et al. (1939) beschreiben das Biotop der in Großbritannien überwinternden *Anser*-Arten (*A.anser, A.albifrons, A.fabalis*) als "Salz- und Süßwassermarsche, Feuchtwiesen, Moore, usw., mehrheitlich in der Nähe von Flußmündungen und flachen Meeresküsten, aber ebenso in der Nähe von Seen, Lagunen, Flüssen und Überschwemmungsgebieten an der Küste sowie im Inland, ebenso für einen Teil auf Getreide, Stoppel, Bohnen und sonstigen Kulturpflanzen (im Ausland Reis). Im allgemeinen ziehen sich die Gänse nachts in Flachwasserbereiche oder auf Sandbänke vor der Küste oder im Fluß bzw. auf Seen zurück." Nach Aussage von Witherby et al. findet man Bläßgänse weniger auf Kulturland als Graugänse und bevorzugen Bläßgänse Sümpfe sowie feuchtes und überschwemmtes Grünland, Moore, Salzwiesen usw., während Saatgänse auf den Britischen Inseln selten bis nie auf Stoppelfeldern anzutreffen sind. Frieling (1936) stuft die *Anser*-Gänse in Deutschland als Vögel der Feuchtwiesen, moorigen Grasländer, Moore und Sümpfe ein. Relikte dieser traditionellen Habitatwahl zeigen zur Zeit noch die Grönländische Bläßgans (*Anser albifrons flavirostris*) und die Taiga Saatgans (*Anser fabalis fabalis*) (z.B. Van den Bergh 1985, Stroud 1992).

Aufgrund der günstigen klimatischen Bedingungen wurden die meisten traditionellen Gänsehabitate West-Europas in den letzten Jahrhunderten nach und nach in Kultur gebracht.

From old descriptions of arctic geese wintering in Western Europe (e.g. Brouwer 1943 & 1953, Gesner 1669) we know that in the past most of them wintered in more or less natural habitats, like coastal areas, semi-natural flood plains, river deltas and boglands.

Witherby et al. (1939) described the British habitat of the *Anser*-species wintering in Great Britain (*A.anser, A.albifrons, A.fabalis*) as "salt and fresh marshes and marshy grasslands, bogs, peat-mosses, etc., largely near estuaries and low-lying coasts, but also near lakes, lagoons, rivers, and inundated country from coast to long distances inland; also partial to fields of young grain, stubble, beans and other cultivation (rice-fields abroad), usually retiring at night to shoals and sandbanks on coasts or in rivers or to secluded lakes and pools." According to Witherby et al. White-fronted Geese resort less to cultivated fields than Greylags, "preferring marshes and wet or flooded grasslands, bogs, saltings and the like", whereas Bean Geese appear "seldom, if ever, to feed on stubble in British Is., though it does so regularly on parts of Continent". Frieling (1936) ranked *Anser*-geese in Germany with the birds of wet meadows, marshy grasslands, bogs and swamps. Remains of this traditional habitat choice are still shown by Greenland White-fronted (*Anser albifrons flavirostris*) and Taiga Bean Goose (*Anser fabalis fabalis*) (e.g. Van den Bergh 1985, Stroud 1992).

Because of the favourable climatic conditions most of the traditional goose habitats in Western Europe were turned over to agricultural land during the last centuries.

Unter Einfluß der industriellen Revolution des 19. Jahrhunderts hat sich diese Entwicklung in den letzten 150 Jahren wesentlich beschleunigt und als Folge davon waren die Gänse gezwungen, zunehmend von natürlichen und naturnahen Gebieten auf Agrarflächen auszuweichen.

Am Anfang haben sich die Gänse sicherlich zunehmend in den verbliebenen natürlichen und naturnahen Bereichen konzentriert, wurden jedoch zunehmend gezwungen wenigstens einen Teil ihrer Zeit, insbesondere zur Nahrungsaufnahme, auf landwirtschaftlichen Nutzflächen zu verbringen. Traditionelle Namen, wie "Ackergans", "Anser campestre", "Bean Goose", "Oca graniola", "Oie des moissons", "Saatgans", "Saedgås", "Sädgås" und "Zaadgans" sowie "*Anser segetum*" und "*Anser arvensis*" (=Ernte- oder Ackergans) für *Anser fabalis* (= Bohnengans) und historische Beschreibungen von Gänseschäden (z.B. Alferaki 1904, Bos 1889, Gattiker & Gattiker 1989, Gesner 1669, Lorenzen 1749 in Prokosch 1984, Schlegel 1877) zeigen, daß einige Gänsearten schon recht früh, wenigstens teilweise, auf landwirtschaftliche Nutzflächen ausgewichen sind.
Bauer & Glutz von Blotzheim (1968), Flint & Krivenko (1990) und Schlegel (1877) stellen fest, daß die Gänsezahlen dramatisch zurückgegangen sind seit Mitte des 19. Jahrhunderts. Grimpe (1933) nennt den zunehmenden Flächenanspruch der Landwirtschaft als Grund des Rückgangs.
Hieraus kann man ableiten, daß die Umstellung von natürlichen und naturnahen Habitaten auf landwirtschaftliche Nutzflächen für die Gänse nicht ohne Probleme abgelaufen ist.

Seit den 1950er Jahren setzte eine Zunahme der Gänsezahlen auf den landwirtschaftlichen Nutzflächen West-Europas ein, die darauf hinweisen könnte, daß es den Gänse gelungen war, sich an die veränderten Überwinterungsbedingungen anzupassen. Während zwei *Branta*-Arten (*B.bernicla* und *B.leucopsis*) auch heutzutage noch einen Großteil

As a consequence of the industrial revolution in the 19th century, this development has accelerated during the last 150 years. As a result the geese had to shift from natural habitats to agricultural land.

In the beginning the geese surely concentrated more and more in the remnants of their traditional natural and semi-natural habitats, but gradually they were forced to spend at least a part of their (feeding) time on agricultural land. Traditional names like "Ackergans", "Anser campestre", "Bean Goose", "Oca graniola", "Oie des moissons", "Saatgans", "Saedgås", "Sädgås" and "Zaadgans" as well as "*Anser segetum*" and "*Anser arvensis*" (= Harvest- or Farmland goose) for *Anser fabalis* (= Beangoose) and historical records of goose damage (e.g. Alferaki 1904, Bos 1889, Gattiker & Gattiker 1989, Gesner 1669, Lorenzen 1749 in Prokosch 1984, Schlegel 1877) indicate that some species started to move to agricultural land - at least periodically - quite early.
Bauer & Glutz von Blotzheim (1968), Flint & Krivenko (1990) and Schlegel (1877) stated that goose numbers have dropped dramatically since the first half of the 19th century. Grimpe (1933) wrote that goose numbers dropped as a result of the increasing use of land for agriculture.
These data could indicate that the shift from natural and semi-natural habitats to agricultural land was not without problems for the geese.

Since the 1950s the numbers of most goose species started to increase again in the agricultural areas of Western Europe, which could indicate that they manage to cope with the new wintering conditions. Whereas the two *Branta*-species (*B.bernicla* and *B.leucopsis*) nowadays still spend much of their time in the wintering area on natural habitat most of the *Anser*-geese ihres Aufenthaltes im Wintergebiet in weitgehend natürlichen Habitaten verbringen, sind die meisten *Anser*-Arten für die Nahrungsaufnahme mittlerweile fast ausschließlich auf Kulturland angewiesen.

Diese Umstellung auf Kulturland und die wachsenden Gänsezahlen haben in den meisten westeuropäischen Ländern zunehmend zu Problemen zwischen Landwirten und Gänsen geführt (Roomen & Madsen 1992). Als Folge klagt eine wachsende Zahl von Bauern über Gänseschäden und forderten eine finanzielle Kompensation.

Auch im traditionellen Gänsewintergebiet am deutschen Unteren Niederrhein (Nordrhein-Westfalen) nahmen die Zahlen der Bläß- (*Anser albifrons*) und Saatgans (*Anser fabalis*) in der zweiten Hälfte des 20. Jahrhunderts zu. Auch hier haben seit den 1970er Jahren die Probleme zwischen Gänsen und Landwirtschaft in den letzten Jahren erheblich an Schärfe zugenommen. Trat hier in der ersten Hälfte der 70er Jahre noch ein von allen Seiten getragenes Gänsejagdverbot in Kraft, so wurde zu Beginn der 80er Jahre zunehmend gefordert, nicht nur die vermuteten Gänseschäden zu entschädigen, sondern auch wieder die Jagd auf die stark angestiegenen Gänsezahlen zuzulassen. Seit Winter 1985/86 zahlt die nordrhein-westfälische Landesregierung offiziell Kompensation für gemeldete Gänseschäden und der jährlich gezahlte Betrag ist seitdem ständig angestiegen: von ca. DM 640.000 im ersten Jahr auf über DM 1,5 Mio wenige Jahre später und seit 1991 auf ca. DM 2 Mio jährlich, obwohl die Gänsezahlen seit einigen Jahren nicht mehr zunehmen (Mooij 1994a).

Aufgrund der steigenden Tendenz bei den gemeldeten Gänseschäden und den zunehmenden Gänsezahlen wurde es notwendig, ein Forschungsprogramm zur Populationsentwicklung und Winterökologie der Saat- und Bläßgans sowie zu den Gänseschäden sowohl im hiesigen Wintergebiet wie auch in einer gesamteuropäischen Perspektive zu starten.

shifted in Western Europe to cultural land and are almost totally dependent on agricultural land for feeding.

The shift to farmland and the increasing goose numbers resulted in increasing problems between farmers and geese in several European countries in the last decades (Roomen & Madsen 1992). As a result a growing number of farmers complain about goose damage and claim for financial compensation.

Also in the goose wintering site at the Lower Rhine area, in the Dutch-German border region, the numbers of White-fronted (*Anser albifrons*) and Bean Goose (*Anser fabalis*) has increased in the second half of the 20th century. Since the 1970s a growing number of farmers have complained about goose damage and claimed for compensation. Part of them have also demanded the reintroduction of goose hunting that has been prohibited in the area since the beginning of the 1970s. Since winter 1985/86 the federal government of Nordrhein-Westfalen started to pay compensation for reported goose damage in the Lower Rhine area, the annual amount of compensation paid has steadily increased: in the first year about DM 640 000, in the next year more than 1.5 million DM and since 1991 about 2 million DM yearly, although goose numbers have remained stable in the past few winters (Mooij 1994a).

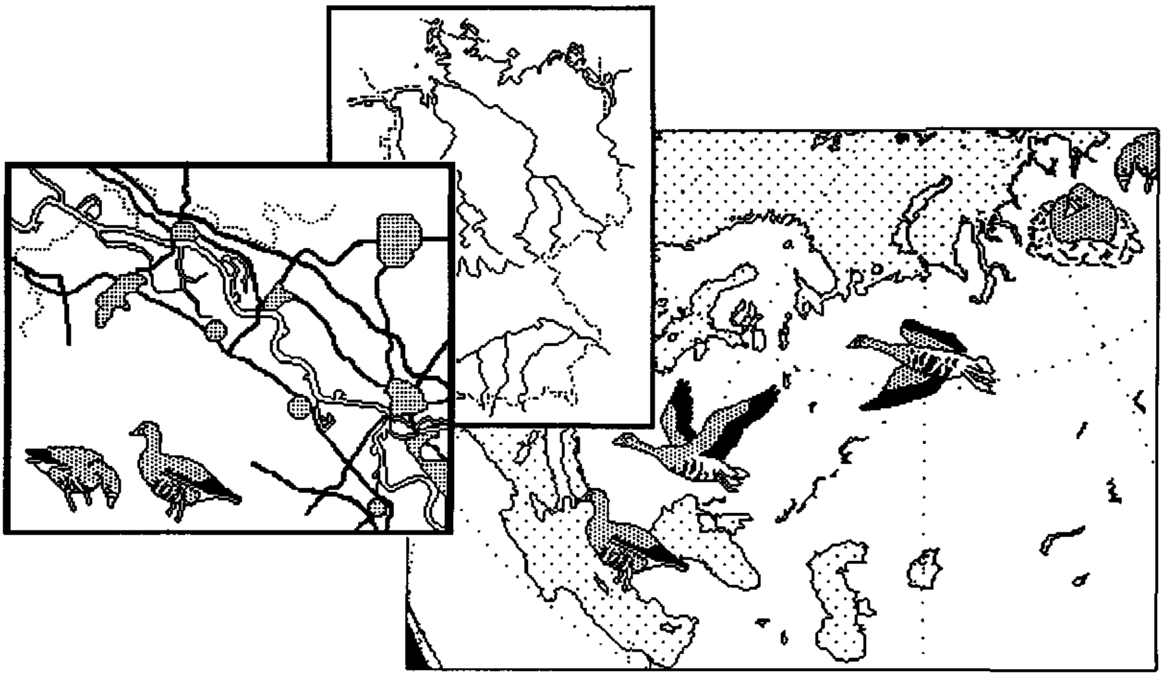
In the face of the increase both in the number of geese and in the number of claims for compensation for goose damage, it was felt necessary to set up a research programme. The aim of this programme is to investigate the population development and the winter ecology of White-fronted and Bean Geese as well as the problem of goose damage both within a local and in a wider European perspective.

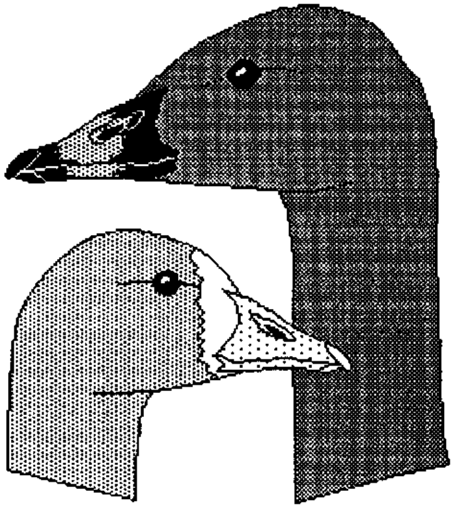
Mit dem Ziel, Daten für ein zukünftiges Gänsemanagement in Nordrhein-Westfalen zu sammeln, startete der Autor 1976 ein Gänseforschungsprogramm, das im Laufe der 80er Jahre auch auf andere Gänserastplätze in Deutschland und Ende der 80er/Anfang der 90er Jahre auf die sibirischen Brutgebiete ausgedehnt wurde.

In 1976 the author began his research in the Lower Rhine area with the aim of gathering data to guide the management the area as a goose wintering site. In the 1980s the research programme was extended to cover other goose wintering sites in Germany, and was extended further still at the end of the 1980s to cover the breeding sites in Siberia.

Chapter 2

Ecology of geese wintering in the Lower Rhine area (Germany). Übersicht / Overview





Ecology of geese wintering in the Lower Rhine area (Germany). Übersicht / Overview

1. Entwicklung der Gänsezahlen am Niederrhein im westeuropäischen Rahmen.

Das erste Ziel der Untersuchungen war, die Entwicklung der am Unteren Niederrhein überwinternden Gänsepopulationen zu erfassen und zu dokumentieren (Kapitel 3 & 4).
Hierbei entstanden folgende Fragestellungen:
- Welche Gänsearten überwintern am Unteren Niederrhein (Kapitel 3 & 4)?
- Nehmen die Gänsezahlen am Niederrhein zu und wenn, warum (Kapitel 3, 4 & 8)?
- Ist diese Entwicklung einmalig oder Teil einer großräumigen Entwicklung (Kapitel 3, 4, 5 & 8)?

Der Untere Niederrhein ist ein traditioneller Gänsewinterrastplatz. Neben alten Hofnamen ("Gansward" und "Gänseward") oder Flurnamen, ("Gänsekuhl" und "Gänsespeck") liegen mehrere Literaturhinweise auf die früheren Gänsevorkommen vor.
Hartert (1887) berichtet, daß zur Mitte des 19. Jahrhunderts jährlich eine kleine Zahl von "*Anser segetum*" (= Synonym für die Tundrasaatgans *Anser fabalis rossicus*) und "*Anser cinereus*" (= Synonym für die Graugans *Anser anser*) in der Nähe von Wesel beobachtet wurde.
In der gleichen Periode wurden beide Arten auch als regelmäßige und häufige Wintergäste für die angrenzenden Niederlande festgestellt, wo sie gemeinsam mit einer wesentlich geringeren Zahl von Bläßgänsen, *Anser albifrons*, beobachtet wurden (Bos 1889, Schlegel 1877). Es scheint, daß die Bläßgans im 19. Jahrhundert am Unteren Niederrhein nicht oder nur äußerst selten aufgetreten ist. Le Roy (1906) und

1. Development of goose numbers at the Lower Rhine in a western European context.

The first aim of the research programme was to study the development of the goose numbers at the Lower Rhine goose wintering site (Chapters 3 & 4).
Focus points of this part of the study were:
- Which goose species winter at the Lower Rhine (Chapters 3 & 4)?
- Do the goose numbers increase and if so, why (Chapters 3, 4 & 8)?
- Is this development unique or part of an overall population development (Chapters 3, 4, 5 & 8)?

The Lower Rhine area is a traditional goose wintering site. Besides old names of farms, such as "Gansward" and "Gänseward" (= non flooded area with geese), or areas, like "Gänsekuhl" (= wet hollow for geese) and "Gänsespeck" (= excelent goose feeding site), there are several references in older literature which indicate that the Lower Rhine area has been a wintering site for geese at least since the 19th century.
Hartert (1887) reported that a small number of "*Anser segetum*" (synonym for the tundra race of the Bean Goose *Anser fabalis rossicus*) and "*Anser cinereus*" (synonym for the Greylag Goose *Anser anser*) were recorded in the neighbourhood of Wesel every year.
In the same period both species were also recorded as common wintering geese of the Netherlands together with a much smaller number of White-fronted Geese *Anser albifrons* (Bos 1889, Schlegel 1877). In the 19th century the latter species does not seem to have been present in the Lower Rhine area. Le Roy (1906) and Le Roi &

Le Roi & Geyr von Schweppenburg (1912) stellen fest, daß "*Anser fabalis (Lath.)* - Die Saatgans" (= Synonym für die Tundrasaatgans *Anser fabalis rossicus*) am Unteren Niederrhein regelmäßig durchzieht und überwintert, während "*Anser arvensis Brehm* - Die Ackergans" (= Synonym für die Taigasaatgans *Anser fabalis fabalis*) nur selten beobachtet wird. Sie berichten auch, daß die Graugans am Unteren Niederrhein ebenfalls regelmäßig durchzieht und andere Gänsearten hin und wieder in geringer Zahl beobachtet werden.

Neubaur (1957) schrieb, daß die Zahl der am Unteren Niederrhein überwinternden Gänse, mit einem mittleren Niveau von ca. 1 000 Saatgänsen in den 1950er Jahren, wesentlich geringer ist als früher. Er stellte weiterhin fest, daß die Bläßgans, ebenso wie einige andere Gänsearten, nur unregelmäßig und ausschließlich in kleiner Zahl beobachtet wurden.

Seit dem Ende der 1950er Jahre wurden die Gänsezahlen auf den bedeutsamsten Rastplätzen des Unteren Niederrheins regelmäßig gezählt. Zu dieser Zeit schätzte Eberhardt (1966) die niederrheinische Winterpopulation auf 1 000 - 1 500 Gänse, vornehmlich Saatgänse. Möller (1972) stellte fest, daß die Bläßgans seit Anfang der 1960er Jahre regelmäßig in kleiner Zahl am Unteren Niederrhein überwintert. Von da an setzte ein ständiger Anstieg der Gänsezahlen im hiesigen Raum ein.

Im Winter 1965/66 zählte Eberhardt schon ein Wintermaximum von ca. 3 000 Saat- und 250 Bläßgänsen und am Ende der 1960er Jahre stieg das Wintermaximum auf den regelmäßig gezählten Nahrungsplätzen auf ca. 8 000 Saat- und ca. 1 500 Bläßgänse (Eberhardt 1971).

Eine Auswertung vorliegender Daten aus der Literatur sowie von örtlichen Ornithologen und die Beobachtungsdatei der Gesellschaft Rheinischer Ornithologen (GRO) ergab ein recht zuverlässiges Bild der Bestandsentwicklung bei Saat- und Bläß-

Geyr von Schweppenburg (1912) stated that "*Anser fabalis (Lath.)* - Die Saatgans" (synonym for the Tundra Bean Geese *Anser fabalis rossicus*) regularly migrates through and winters at the Lower Rhine, whereas "*Anser arvensis Brehm* - Die Ackergans" (synonym for the taiga race of the Bean Goose *Anser fabalis fabalis*) is only seldom seen. They also reported that Greylag Geese migrated regularly through the area and that individuals of several goose species were seen now and then in small numbers.

Neubaur (1957) wrote that the wintering goose population of the Lower Rhine area, with about 1 000 Bean Geese during winter in the 1950s, was smaller than it used to be in former times. According to this author White-fronted Geese 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. Eberhardt (1966) estimated the wintering population at the beginning of the 1960s to be about 1 000 - 1 500 geese, mainly Bean Geese. Möller (1972) stated that White-fronted Geese have wintered regularly at the Lower Rhine in very small number since the beginning of the 1960s. It seems that the number of geese in this area has increased steadily since that time.

In winter 1965/66 Eberhardt already counted a winter peak of about 3 000 Bean and 250 White-fronted Geese, and at the end of the 1960s the winter peak rose to about 8 000 Bean Geese and about 1 500 Whitefronts on the feeding sites where the geese were regularly counted (Eberhardt 1971).

The evaluation of data from older literature and local ornithologists brought fairly reliable goose peak numbers for the period from 1959/60 until 1976/77, whereas the goose numbers since then are the result of the author´s own counts gans am Unteren Niederrhein für die Periode 1959/60 - 1976/77, während für die Periode 1977/78 - 1990/91 eigene Daten und danach auf die Daten der AG Wildgänse der GRO sowie Zahlen der Zentrale für Wasservogelforschung und Feuchtgebietsschutz in Deutschland (ZWFD) zurückgegriffen wurde (Tab. 1.; Kapitel 3, 4 & 9, Arbeitsgemeinschaft Wildgänse 1989, 1991, 1992, 1993; Mooij 1979, 1982a & 1995a).

(1977/78-1989/90) and of the Arbeitsgemeinschaft Wildgänse (1990/91-1992/93) as well as the Central Institute for Goose Research and Wetlands Protection in Germany (Zentrale für Wasservogelforschung und Feuchtgebietsschutz in Deutschland - ZWFD) (1990/91-1992/93) (Tab. 1.; Chapter 3, 4 & 9, Arbeitsgemeinschaft Wildgänse 1989, 1991, 1992, 1993; Mooij 1979, 1982a & 1995a).

Winter	*Anser fabalis*	*Anser albifrons*	TOTAL
1959/60	1.000	10	1.010
1960/61	1.500	50	1.550
1961/62	1.500	150	1.650
1962/63	2.000	100	2.100
1963/64	2.350	200	2.550
1964/65	2.750	200	2.950
1965/66	3.400	250	3.650
1966/67	4.100	600	4.700
1967/68	6.600	1.000	7.600
1968/69	8.100	1.500	9.600
1969/70	10.800	1.600	12.400
1970/71	12.450	2.350	14.800
1971/72	12.500	2.200	14.700
1972/73	11.500	1.900	13.400
1973/74	15.200	3.000	18.200
1974/75	13.300	3.300	16.600
1975/76	20.500	2.500	23.000
1976/77	23.500	2.800	26.300
1977/78	16.900	3.200	20.100
1978/79	20.600	5.500	26.100
1979/80	47.200	9.000	56.200
1980/81	55.000	15.000	70.000
1981/82	65.000	19.000	84.000
1982/83	37.000	55.000	92.000
1983/84	62.000	55.000	117.000
1984/85	53.000	48.000	101.000
1985/86	56.000	90.000	146.000
1986/87	50.000	80.000	130.000
1987/88	45.000	135.000	180.000
1988/89	22.000	163.000	185.000
1989/90	13.000	127.000	140.000
1990/91	12.500	117.000	129.500
1991/92	10.000	160.000	170.000
1992/93	6.300	138.700	145.000
1993/94	7.700	181.700	189.400

Tab. 1. Entwicklung des Wintermaximums der Saat- und Bläßgänse am Unteren Niederrhein zwischen Winter 1959/60 and 1993/94 (nicht immer der Januar-Wert).
Development of the peak numbers of Bean and White-fronted Geese at the Lower Rhine wintering site between 1959/60 and 1993/94 (peak numbers are not always identical with the January numbers).

Diese Daten zeigen, daß das Wintermaximum der Saatgans bis Anfang der 1980er Jahre zunahm, dann für mehrere Jahre stabil war und seitdem stetig abnahm. In der erste Hälfte der 1990er Jahre hat das Wintermaximum der Saatgänse wieder das Niveau der zweiten Hälfte der 1960er Jahre erreicht. Die Zunahme der Bläßganszahlen scheint am Unteren Niederrhein, ca. 10 Jahre später als bei der Saatgans, ebenfalls beendet und sich rund 1990 auf einem Niveau von 150 000 - 180 000 Vögeln zu stabilisieren (Tab.1, Kapitel 3 & 4).

Neben Saat- und Bläßgans werden jeden Winter einige weitere Gänsearten in wechselnder Zahl am Unteren Niederrhein wahrgenommen. Während der Untersuchungsperiode wurden jährlich mehrere Tausend Graugänse (*Anser anser*), mehrheitlich Nachkommen der seit 1960 hier ausgesetzten Population, die im Gebiet brüten und überwintern, bis zu einigen Hundert Weißwangengänse (*Branta leucopsis*), bis zu hundert Kanadagänse (*Branta canadensis*), bis zu 50 Kurzschnabelgänse (*Anser brachyrhynchus*), (mehrheitlich unerkannt vergesellschaftet mit Saatgänsen), Ringelgänse (*Branta bernicla*) und Nilgänse (*Alopochen aegyptiacus*) sowie eine jährlich wechselnde kleine Zahl von Rothalsgänsen (*Branta ruficollis*), Zwerggänsen (*Anser erythropus*), Schneegänsen (Anser caerulescens) und Streifengänsen (*Anser indicus*) beobachtet (Kapitel 4).

Die festgestellte zahlenmäßige Zunahme der Gänsezahlen am Unteren Niederrhein zeigte sich als Teil einer gesamt-westeuropäischen Entwicklung. Parallel zur Zunahme der Gänsezahlen in West-Europa nahmen auch die Gänsezahlen in Deutschland zu, insbesondere in den Bundesländern Brandenburg und Mecklenburg-Vorpommern im Osten und im Dollart-Gebiet (Niedersachsen) und am Unteren Niederrhein (Nordrhein-Westfalen) im Westen Deutschlands.

These data show that the peak number of wintering Bean Geese increased until the beginning of the 1980s, was stable for about half a decade and has decreased since then. At the beginning of the 1990s the peak numbers of the Bean Goose reached again the level of the end of the 1960s. The development of Whitefront numbers is different. Here we see a strong increase of the winter peak until the end of the 1980s. Since then their numbers seem to remain stable (Tab.1, Chapters 3 & 4).

Besides Bean and White-fronted Geese each year a variable number of other goose species is recorded at the Lower Rhine. During the study period several thousand Greylag Geese (*Anser anser*), mostly offspring of introduced birds breeding and wintering in the area, up to several hundred Barnacle Geese (*Branta leucopsis*), up to a hundred Canada Geese (*Branta canadensis*), up to 50 Pink-footed (*Anser brachyrhynchus*) (most of them unrecognized associated with Bean Geese), Brent (*Branta bernicla*) and Egyptian Geese (*Alopochen aegyptiacus*) and a variable small number of Red-breasted (*Branta ruficollis*), Lesser White-fronted (*Anser erythropus*), Snow (*Anser caerulescens*) and Bar-headed Geese (*Anser indicus*) were reported every year (Chapter 4).

The development of goose numbers at the Lower Rhine area was part of an overall development in western Europe.

Parallel to the increase of goose numbers in western Europe the numbers of wintering geese in Germany increased, especially in the federal states of Brandenburg and Mecklenburg-Vorpommern in the eastern as well as in the Dollart region (Niedersachsen) and the Lower Rhine area (Nordrhein-Westfalen) in the western part of Germany.

Mit über 150 000 Bläß- und in manchen Wintern 50 000 Saatgänsen wurde der Untere Niederrhein in der zweiten Hälfte der 80er Jahre eins der bedeutendsten Gänsewintergebiete West-Europas (Kapitel 3, 4 & 8, Mooij 1994a & 1995a).

Es gibt mehrere Faktoren, die die Entwicklung des Unteren Niederrheins zu einem bedeutsamen Gänsewintergebiet positiv beeinflußt haben können. Die Bestandszunahme der Wildgänse im Westen Europas verlief in etwa parallel mit einer zunehmenden Intensivierung der landwirtschaftlichen Nutzung.

Ein Vergleich der Entwicklung der mittleren jährlichen Stickstoffgabe der Landwirte in der Europäischen Union - als Indikator für die Intensivierung der landwirtschaftlichen Nutzung - zwischen 1950 und 1995 mit der Entwicklung der Gänsezahlen am Niederrhein und in den Niederlanden, ergibt eine Korrelation (Fig. 1).

With more than 150 000 Whitefronts and in some winters 50 000 Bean Geese the Lower Rhine area became one of the most important wintering sites for *Anser* geese during the second half of the 1980s (Chapters 3, 4 & 8, Mooij 1994a & 1995a).

There are several factors that could have influenced this development of the Lower Rhine area to an important goose wintering site.

The increase in the numbers of wintering geese in western Europe was recorded during a period of an explosive growth of agricultural production as a result of a strong increase in intensive farming.

The comparison of the increase of N-application by the farmers of the European Union between 1950 and 1995 - as an indicator of the development of the intensity level of farming - with the development of goose numbers in the Lower Rhine area and the Netherlands shows a correlation between both parameters (Fig. 1).

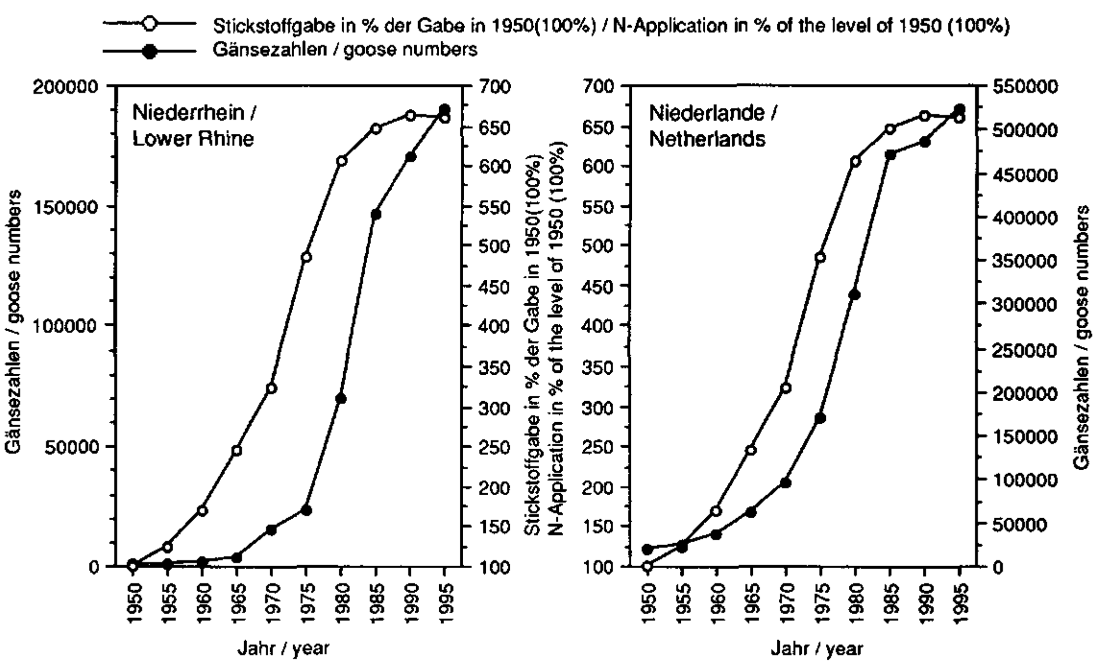


Fig. 1. Entwicklung der Gänsezahlen (Saat- und Bläßgans) am Unteren Niederrhein und in den Niederlanden und Stickstoffgabe auf landwirtschaftlichen Nutzflächen in der Europäischen Union (Quelle: EU 1995, Umweltbundesamt 1986, MURL pers.Mitt.) zwischen 1950 und 1995.

Development of goose numbers (Bean and White-fronted Goose) at the Lower Rhine area and in the Netherlands and the N-application on the farmland in the European Union (source: EU 1995, Umweltbundesamt 1986, MURL pers.comm.) between 1950 and 1995.

Ein solcher Zusammenhang wurde für Deutschland u.a. von Ellenberg (1987 & 1990) und Harengerd et al. (1990) schon früher für andere Wasservogelarten angenommen.
Da die landwirtschaftliche Entwicklung im nordwest europäischen Flachland (Norddeutschland, die Niederlande, West-Belgien), beeinflußt durch die gemeinsame EU-Agrarpolitik, einen vergleichbaren Verlauf gehabt haben dürfte (Fig. 1), ist anzunehmen, daß die Intensivierung der Landwirtschaft mit ihrem verbesserten Nahrungsangebot für überwinternde Wildgänse eine wichtige Rolle bei der Zunahme der Gänsezahlen in West-Europa spielte.

Die Bestandsentwicklung am Unteren Niederrhein läßt sich aus der gesamt-westeuropäischen Bestandsentwicklung erklären (Fig. 2). Die westdeutschen Winterrastplätze am Unteren Niederrhein und am Dollart haben, ebenso wie der Winterrastplatz des belgischen Flandern, zwischen 1960 und 1990 von der Bestandsentwicklung in den Niederlanden profitiert und den "overflow" der wachsenden Winterbestände des Nachbarlandes aufgenommen (Kapitel 3).

Die Entwicklung der Gänserastbestände in den Niederlanden, in der Dollart Region und am Unteren Niederrhein zeigen eine auffällige Parallelität. In allen diesen Gebieten zeigte das Bläßgansvorkommen eine starke Zunahme. Dieses Bestandswachstum fing an in den Niederlanden und Flandern, strahlte ca. 10 Jahre später auf den Unteren Niederrhein aus und erreichte ca. 15 Jahre später ebenfalls die Dollart Region (Gerdes 1994, Gerdes et al. 1978 & 1983, Kuijken 1975, Meire & Kuijken 1991).

Die Art und Weise wie die Gänsezahlen am Unteren Niederrhein zugenommen haben und die Zunahme sich über das Gebiet ausdehnte (Kapitel 4), unterstützt die Hypothese, daß die Vögel den Niederrhein von den Niederlanden aus entlang des Rheines "entdeckten" und "kolonisierten".

Such a connection was already assumed earlier for some other waterfowl species in Germany, e.g. by Ellenberg (1987 & 1990) and Harengerd et al. (1990).
Because the development of agriculture at the most important western European wintering sites is much the same all over northwestern Europe (lowland areas of Germany, the Netherlands and Belgium) as a result of the EU agricultural policy (Fig. 1), it seems reasonable to assume that the development to more intensive farming methods played an important role in the increase in goose numbers in northwestern Europe.

The development of goose numbers at the Lower Rhine area could be explained by the overall increase in goose numbers in northwestern Europe (Fig. 2). The western German goose wintering sites at the Lower Rhine and the Dollart as well as the goose wintering site in Flanders (western Belgium) profited between 1960 and 1990 from the increase in goose numbers at the wintering sites of the Netherlands and took up the overflow from there (Chapter 3).

The development of goose numbers in the Netherlands, the Dollart region and the Lower Rhine area shows great similarity. In all these wintering sites the peak numbers of Whitefronts especially have shown a striking increase. This population growth started in the Netherlands and Flanders, radiated to the Lower Rhine area about 10 years later and had, about 15 years later, also reached the Dollart region (Gerdes 1994, Gerdes et al. 1978 & 1983, Kuijken 1975, Meire & Kuijken 1991).

The way the goose numbers have increased in the Lower Rhine area and spread over the area (Chapter 4) shows clearly that these birds "discovered" the Lower Rhine area as they came from the Netherlands following the course of the Rhine.

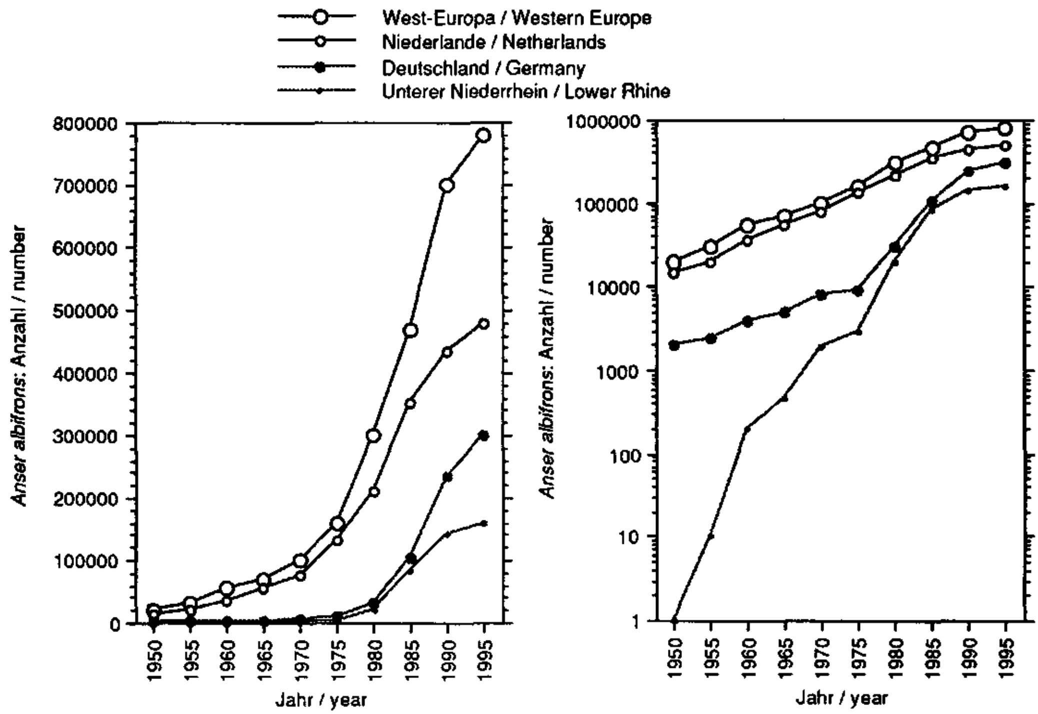


Fig. 2. Lineare und logarithmische Darstellung der Entwicklung der Bläßganszahlen in West-Europa, den Niederlanden, Deutschland und am Unteren Niederrhein 1950 - 1995 (Januar-Zählungen).

Linear and logarithmic graph of the development of White-fronted Goose numbers in Western Europe, the Netherlands, Germany and at the Lower Rhine 1950 - 1995 (January counts).

Diese Hypothese wird unterstützt durch die Entwicklung der Bläßganszahlen in West-Europa und den Niederlanden seit Mitte der 1950er Jahre, die von einer vergleichbaren Entwicklung (auf einem niedrigeren Niveau) in Gesamtdeutschland (Territorien der ehem. BRD und DDR) und am Niederrhein begleitet wurde. Die Zunahme in Deutschland war jedoch vornehmlich auf eine explosive Entwicklung des Unteren Niederrheins als Bläßgansrastplatz zurückzuführen (Fig. 2).

Seit Anfang der 1990er Jahre scheint die Zunahme in Gesamt-Westeuropa und damit auch am Niederrhein weitgehend beendet. Aufgrund der Zunahme der Bläßganszahlen im Osten Deutschlands (Mooij 1995a) gibt es im gesamtdeutschen Raum noch eine vergleichsweise langsame Zunahme (Fig. 2).

This hypothesis is supported by the development of the White-fronted Goose numbers in Western Europe and the Netherlands since the 1950s, that was accompanied by a comparable development in Germany (the territory of both the former FRG and the former GDR) and at the Lower Rhine, although at a lower level. The increase of Whitefront numbers was mainly the result of the explosive development of the Lower Rhine area as a wintering site for White-fronted Geese (Fig. 2).

Since the beginning of the 1990s the numbers in Western Europe and therefore also at the Lower Rhine seem to have remained stable. Based on the increase of Whitefront numbers in eastern Germany (Mooij 1995a) the numbers in Germany still show an increase, but at a lower rate than before (Fig. 2).

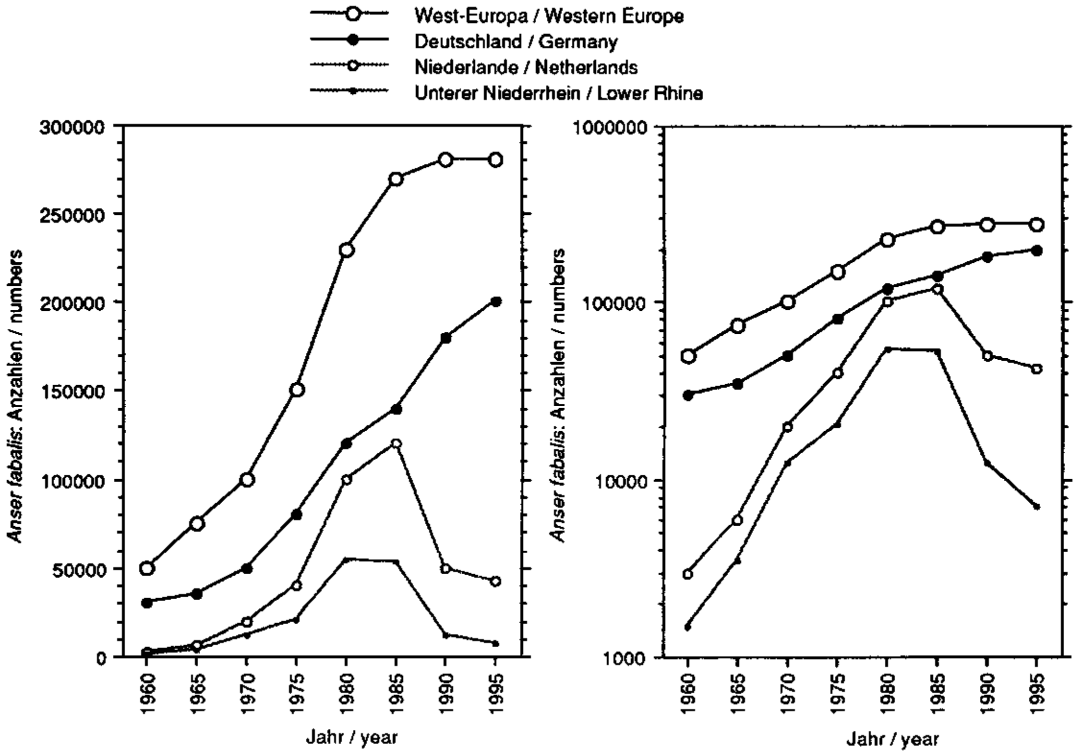


Fig. 3. Lineare und logarithmische Darstellung der Entwicklung der Saatganszahlen in West-Europa, den Niederlanden, Deutschland und am Unteren Niederrhein 1960 - 1995 (Januar-Zählungen).

Linear and logarithmic graph of the development of Bean Goose numbers in Western Europe, the Netherlands, Germany and at the Lower Rhine 1960 - 1995 (January counts).

Auch die Entwicklung der Saatganszahlen am Unteren Niederrhein zeigt sich als Teil einer gesamt-westeuropäischen Entwicklung (Fig. 3). Die Gesamtentwicklung der Saatganszahlen des Unteren Niederrheins und der Niederlanden zeigen eindeutig Parallelen. Nach einer Zunahme bis in die erste Hälfte der 1980er Jahre sind in beiden Gebieten die Saatganszahlen rückläufig, während die Gesamtzahlen in West-Europa stabilisieren und die Zahlen in Gesamtdeutschland, aufgrund der Zunahme der Saatganszahlen im Osten Deutschlands, weiter ansteigen (Mooij 1995a). Gleichzeitig sind die Saatgansbestände Spaniens fast erloschen (Persson & Urdialis 1995) und nahmen die Saatgänse in der Tschechischen Republik zu (Hudac 1994 & 1995).

Also the development of the Bean Goose numbers at the Lower Rhine area reflects the development of the species in the western European part of the wintering area (Fig. 3). The development of the Bean Goose numbers at the Lower Rhine and in the Netherlands run clearly parallel. After a period of steady increase until the first half of the 1980s, the Bean Goose numbers in both areas have decreased dramatically, whereas the numbers in Western Europe have stabilised and the numbers in Germany still show an increase because of the growing Bean goose numbers wintering in eastern Germany (Mooij 1995a). At the same time the Bean Goose almost disappeared in Spain (Persson & Urdialis 1995) and the Bean Geese numbers in the Czech Republic increased (Hudac 1994 & 1995).

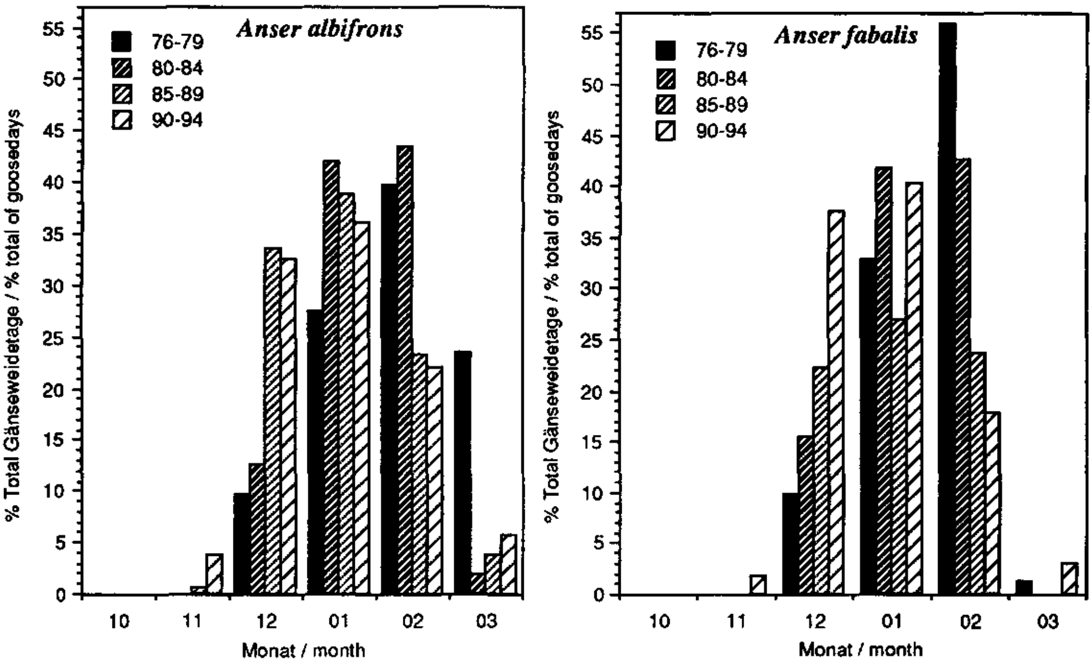


Fig. 4. Phänologie der am Unteren Niederrhein überwinternden Bläß- (*Anser albifrons*) und Saatgänse (*Anser fabalis*) zwischen 1976 und 1994.

Phenology of the White-fronted (*Anser albifrons*) and Bean Geese (*Anser fabalis*) at the Lower Rhine wintering site between 1976 and 1994.

Die Hypothese wird auch unterstützt durch eine Änderung der Phänologie bei Saat- und Bläßgans (Fig. 4). Bis Ende der 1970er Jahre erreichten beide Arten ihr Wintermaximum im Februar, einen Monat später als in den Niederlanden, d.h. sie besuchten den Unteren Niederrhein auf ihrem Rückzug in die Brutgebiete. Seitdem verschob sich das Wintermaximum auf den Januar, wie in den Niederlanden, d.h. daß der Winterrastplatz am Unteren Niederrhein gegenwärtig ein integraler Teil des westeuropäischen Wintergebietes - bestehend aus großen Teilen der Niederlande, Flandern, Dollart-Region und dem Unteren Niederrhein - ist (Kapitel 3). In den letzten Jahren scheint sich das Wintermaximum noch weiter nach vorne zu verschieben, während gleichzeitig die Januar- und Februar-Zählungen im Osten Deutschlands steigende Gänsezahlen zeigen (Kapitel 8, Mooij 1995a).

The hypothesis is also corroberated by the change in phenology of the two important species Bean and White-fronted Geese (Fig. 4). Until the 1980s both species showed a winter peak in February, one month later than in the Netherlands, which means that the geese visited the Lower Rhine on their way back to the breeding area. Since the middle of the 1980s the peak number at the Lower Rhine is reached in January, just as in the Netherlands, which means that the goose wintering site at the Lower Rhine nowadays is an integrated part of the western European wintering site (Flanders, the Netherlands, Lower Rhine area, Dollart region) (Chapter 3). In the first half of the 1990s the winter peak at the Lower Rhine seems to shifted to the end of December, whereas over the same period increasing goose numbers are reported from the midwinter counts in eastern Germany (Chapter 8, Mooij 1995a).

Diese Entwicklung könnte darauf hinweisen, daß die Rastplätze im Osten Deutschlands, die bisher vornehmlich während des Herbst- und Frühjahrszuges von Bedeutung waren, zunehmend als Winterrastplatz an Bedeutung gewinnen.

Spätestens seit Anfang der 1960er Jahre stiegen die Gänsenzahlen am Niederrhein stetig an. Diese Entwicklung führte dazu, daß auf den wichtigsten Rastplätzen seit Winter 1969/70 die Gänsejagd auf freiwilliger Basis eingestellt wurde (Eberhardt 1971). Seit Winter 1975/76 wurde die Gänsejagd auf dem gesamten Territorium Nordrhein-Westfalens verboten, gefolgt von einem starken Anstieg der Gänsezahlen.
Auch in den Gänserastgebieten im belgischen Flandern (1960) und am niedersächsischen Dollart (1977) wurde die Gänsejagd verboten und es erfolgte eine starke Zunahme der dort überwinternden Gänsezahlen (Kapitel 3, Gerdes 1994, Gerdes et al. 1978 & 1983, Kuijken 1975, Meire & Kuijken 1991, Mooij 1982a).

Es gibt jedoch keinen belegbaren Zusammenhang zwischen dem Anstieg der Gänsezahlen in Flandern, dem Dollart und am Unteren Niederrhein einerseits, und der Einstellung der Gänsejagd andererseits.
Am Unteren Niederrhein wurde die Gänsejagd ab Winter 1969/70 auf den wichtigsten Gänserastplätzen eingestellt und im Winter 1975/76 auf dem gesamten Territorium des Landes Nordrhein-Westfalen verboten, der Anstieg der Gänsezahlen aber fing an in den 1950er Jahren und beschleunigte sich ab Winter 1979/80, also 4 Jahre nach dem Jagdverbot (Tab. 1).
Hinzu kommt, daß die logarithmische Darstellung der Entwicklung der Bläß- und Saatganszahlen in Fig. 2 & 3 eine nahezu gleichbleibende Anstiegsrate zwischen 1950 und 1980 zeigt (Fig. 2 & 3, Kapitel 3 & 4, Eberhardt 1971, Mooij 1982a).

This development could indicate that the goose sites of eastern Germany, formerly mainly important as stopover sites during autumn and spring migration, have become more and more important as wintering sites.

Since the beginning of the 1960s the number of geese wintering at the Lower Rhine have increased steadily. This development led to a voluntary hunting ban at the most important wintering sites in the area as from winter 1969/70 (Eberhardt 1971). Since winter 1975/76 the goose hunting has been prohibited throughout Nordrhein-Westfalen. Since then there has been a rapid increase in goose numbers.
Goose hunting was also forbidden at the goose wintering sites of Flanders (1960) as well as in the German part of the Dollart region (1977) and goose numbers started to increase rapidly (Chapter 3, Gerdes 1994, Gerdes et al. 1978 & 1983, Kuijken 1975, Meire & Kuijken 1991, Mooij 1982a).

Although in all these areas goose numbers increased rapidly after a ban on goose shooting there seems to be no verifiable relation between the two parameters.
Whereas goose hunting stopped at the most important goose wintering sites at the Lower Rhine in winter 1969/70 and since winter 1975/76 there has been a total ban on goose shooting in Nordrhein-Westfalen, the increase of goose numbers started in the 1950s and accelerated since winter 1979/80, i.e. 4 years after the shooting ban (Tab. 1).
Besides the logarithmic graph of the development of White-fronted and Bean Goose numbers at the Lower Rhine, figures 2 & 3 show an almost constant rate of increase between 1950 and 1980 (Fig. 2 & 3, Chapters 3 & 4, Eberhardt 1971, Mooij 1982a).

In Flandern wurde die Jagd 1960 verboten und die starke Zunahme der Gänsezahlen begann Anfang der 1970er Jahre, etwa 10 Jahre später (Kuijken 1975, Meire & Kuiken 1991), während im deutschen Dollart-Gebiet die Gänsejagd in 1977 eingestellt wurde und die Gänsezahlen ca. 8 Jahre später, Mitte der 1980er Jahre stark anstiegen (Gerdes et al. 1978 & 1983, Kapitel 3).

Obwohl also, im Gegensatz zu der Hypothese von Ebbinge (1991), keine direkte Relation zwischen der Einstellung der Gänsejagd und der Bestandsentwicklung in den genannten Gebieten vorzuweisen ist, kann aufgrund der Untersuchungen nach störenden Auswirkungen der Jagd (u.a. Bell & Owen 1990, Madsen 1994, Mooij 1991b, Wille 1995) angenommen werden, daß die Einstellung der Jagd am deutschen Niederrhein für die Dauer der niederländischen Gänsejagd eine Änderung der Verteilung der Gänse im Grenzraum bewirkt hat.

2. Winterökologie, Energiebedarf, Tragfähigkeit und Gänseschäden.

Der deutlich erkennbare Anstieg der Gänsezahlen am Unteren Niederrhein von ca. 1.000 in den 1950er auf ca. 170.000 in den 1990er Jahren, die dadurch in der örtlichen Landwirtschaft entstehende Unruhe und die Bedeutung des hiesigen Überwinterungsgebietes im westeuropäischen Rahmen, führte zu einer Erweiterung des Fragenkatalogs um die folgenden Fragen:

- Wie nutzen die Gänse ihr Wintergebiet und ihre Nahrung (Kapitel 4 & 6)?
- Gibt es Faktoren, die die Kapazität des Gebietes für Gänse begrenzen (Kapitel 4, 6 & 7)?
- Führt die Nutzung landwirtschaftlicher Nutzflächen durch Gänse zu Schäden (Kapitel 6 & 7)?

Als typische Pflanzenfresser halten sich die Gänse in unserer Kulturlandschaft vornehmlich auf den ausgedehnten landwirtschaftlichen Nutzflächen auf.

On the goose wintering site of Flanders goose hunting was banned in 1960 but an increase in goose numbers (Pink-footed and White-fronted Geese) started at the beginning of the 1970s, i.e. almost 10 years later (Kuijken 1975, Meire & Kuijken 1991). Similary in the German part of the Dollart-Region (Lower Saxony) goose hunting was closed in 1977 and goose numbers (Bean and White-fronted Geese) have shown a rapid increase since the middle of the 1980s, i.e. about 8 years later (Gerdes et al. 1978 & 1983, Chapter 3).

Contrary to the hypothesis of Ebbinge (1991) there is no clear correlation between the ban on goose hunting and the development of goose numbers in the areas mentioned, but based on the results of studies of hunting disturbance (e.g. Bell & Owen 1990, Madsen 1994, Mooij 1991b, Wille 1995) it can be stated that the goose hunting ban in Nordrhein-Westfalen surely changed the distribution of the geese in the border area during the goose hunting season in the Netherlands.

2. Winterecology, energy budget, carrying capacity and goose damage.

The obvious increase in goose numbers at the Lower Rhine from about 1 000 in the 1950s to about 170 000 in the 1990s, the anxiety amongst the farmers triggered off by this development and the importance of the wintering site in a western-European context, resulted in a expansion of this study to cover the following questions:

- How do geese use their wintering sites and food resources (Chapters 4 & 6)?
- Are there factors that limit the use of an area by geese (Chapters 4, 6 & 7)?
- Does the use of agricultural land by geese cause goose damage (Chapters 6 & 7)?

As typical herbivores in our cultivated landscape geese are mainly to be found on agricultural land.

Im Laufe des Tages wechseln sie mehrmals ihren Aufenthaltsort; nachts befinden sie sich auf einem Schlafplatz und während der hellen Stunden auf den Nahrungsplätzen. Zwischendurch fliegen sie mehrmals einen Trink-/Badeplatz an.
Während ihrer Flüge über das niederrheinische Wintergebiet folgen die Gänse bestimmten Flugschneisen. Große Objekte, wie Rheinbrücken, Hochspannungsleitungen, Kraftwerke, Industrieanlagen, Erholungsschwerpunkte, Städte und sonstige menschliche Aktivitätsschwerpunkte werden durch die Gänse gemieden. Die wichtigste Flugschneise verläuft entlang des Rheins und verbindet die sieben wichtigsten Schlafplätze. Alle hiesigen Gänseschlafplätze liegen am Ufer des Rheins, eines Altrheins oder einer Rheinvorlandabgrabung, haben eine geringe Störungshäufigkeit, flache Ufer und eine Grasvegetation.
Die wichtigste Aktivität auf den Schlafplätzen (Aufenthaltsdauer durchschnittlich 13 1/2 Stunden) ist Schlafen (durchschnittlich 6 Stunden), direkt gefolgt von der Nahrungsaufnahme (durchschnittlich 5 1/4 Stunden). Die Gänse verteilen die Nahrungsaufnahme über den ganzen Tag: 60% während der hellen und 40% während der dunklen Tagesstunden.

In den frühen Morgenstunden, etwa eine Stunde vor Sonnenaufgang, fliegen kleine Gänsegruppen zu den Nahrungsplätzen. In den letzten 45 Minuten vor Sonnenaufgang folgen nahezu 80% der Gänse (Fig. 5) in großen Gruppen und landen dort wo die "Späher", die den Schlafplatz früher verließen, ungestörtes Nahrungsverhalten zeigen.

Die Vögel fliegen zu den Nahrungsplätzen, für einen Aufenthalt von durchschnittlich 10 1/2 Stunden. Hier ist die Nahrungsaufnahme (durchschnittlich 8 Stunden) zweifellos die wichtigste Aktivität, gefolgt vom Schlafen (durchschnittlich 1 1/4 Stunden).

During the day they shift several times between different parts of the wintering area; during the night they stay at a roost and during the more or less bright hours of the day they frequent the feeding sites. In between they visit drinking/bathing sites several times.
During flights through the Lower Rhine wintering site the geese follow more or less fixed flight lanes. Large obstacles such as bridges crossing the Rhine and high-tension long-distance overhead wires, industrial plants, recreation centres and places with high human activity such as towns are avoided by most of the geese. The most important flight lane follows the course of the river Rhine and connects the seven important roosts. All roosts of this wintering site are situated on the banks of the river Rhine, of one of the old river arms or of one of the gravel pits in the flood plains of the river Rhine, and offer both a low disturbance rate and a shallow bank with a grassy vegetation.
The most important activity at the roosts of the Lower Rhine (average time of stay 13 1/2 hours) is sleeping (average time spent 6 hours), followed by feeding (average time spend 5 1/4 hours). The geese distribute feeding over the whole day: 60% during the bright and 40% during the dark hours of the day.

About one hour before sunrise small groups of geese start to leave the roosts for the feeding sites and in a period of 45 minutes before sunrise they are followed by about 80% of the geese (Fig. 5). The latter birds fly off in larger flocks and land where the "scouts" - those that left the roost early - show undisturbed feeding behaviour.

The geese fly to the feeding sites to stay there for an average period of 10 1/2 hours. At the feeding sites feeding is the most time consuming activity (ca. 8 hours), followed by sleeping (ca. 1 1/4 hours).

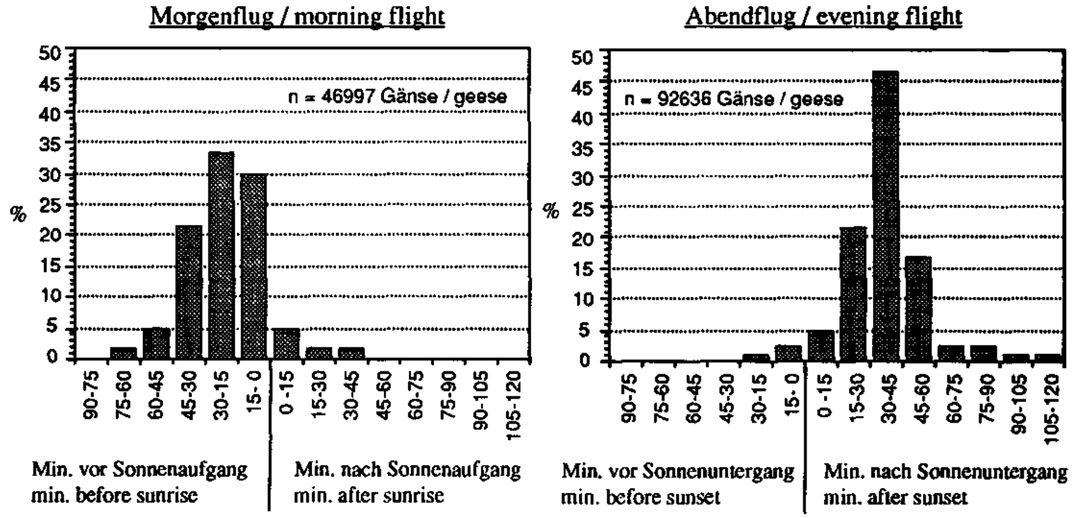


Fig. 5. Zeitpunkt, zu dem die Gänse am Unteren Niederrhein den Schlafplatz am Morgen (Morgenflug) und den Nahrungsplatz am Abend (Abendflug) verlassen in Relation zum Zeitpunkt des Sonnenaufgangs und -untergangs.

Time geese leave the roost (morning flight) and the feeding sites (evening flight) in relation to the time of resp. sunrise and sunset at the wintering site at the Lower Rhine.

Vom Schlafplatz fliegt die Mehrheit der niederrheinischen Gänse am Morgen zu den nahegelegenen Nahrungsplätzen und am Abend vom jeweiligen Nahrungsplatz, zwischen 15 und 60 Minuten nach Sonnenuntergang (Fig. 5), zum nächstgelegenen Schlafplatz (Kapitel 4 & 6).

Über ein Viertel dieser Flüge zwischen Schlaf- und Nahrungsplatz sind kürzer als 2 km, etwa 50% kürzer als 5 km und weniger als 5% länger als 10 km (m = 5,1 km; n = 514 Gänsegruppen mit 204 188 Gänse; Fig. 6). Die Entfernung zwischen den sieben Hauptschlafplätzen liegt zwischen 6 und 14 km (m = 9,9 km).

Auf diese Weise entstehen Einheiten, die aus einem Schlafplatz und mehreren Nahrungsplätzen in einem Umkreis von bis zu 10 km bestehen. Solche Einheiten wurden vom Autor "Komplexe" genannt. Ein Austausch von Gänsen zwischen den einzelnen Komplexen findet mehrheitlich während Trinkflügen sowie während Flügen zwischen Nahrungsplätzen statt (Kapitel 4 & 6).

Rund 60% aller potentiellen Nahrungsflächen für Gänse am Unteren Niederrhein sind Grünland. Die hier überwinternden Gänse sind vornehmlich auf

In the morning the majority of the geese of the Lower Rhine goose wintering site fly from the roost to the neighbouring feeding sites and in the evening from the feeding site between 15 and 60 minutes after sunset (Fig. 5) to the nearest roost (Chapters 4 & 6).

More than 25% of these flights between roost and feeding sites is shorter than 2 km, about 50% shorter than 5 km and less than 5% longer than 10 km (m = 5.1 km; n = 514 goose groups with 204 188 geese; Fig. 6). The distance between the seven main roosts is between 6 and 14 km (m = 9.9 km).

In this way the geese form units within the wintering site, composed of a roost and several feeding sites in a vicinity of less than 10 km. Such units were called a "complex" by the author. An exchange of geese between different complexes mostly happens during drinking-flights or flights between feeding sites (Chapters 4 & 6).

About 60% of all potential goose feeding sites at the Lower Rhine are grasslands. The majority of wintering geese prefers feeding on grasslands and only about 15% of all goose days is spent

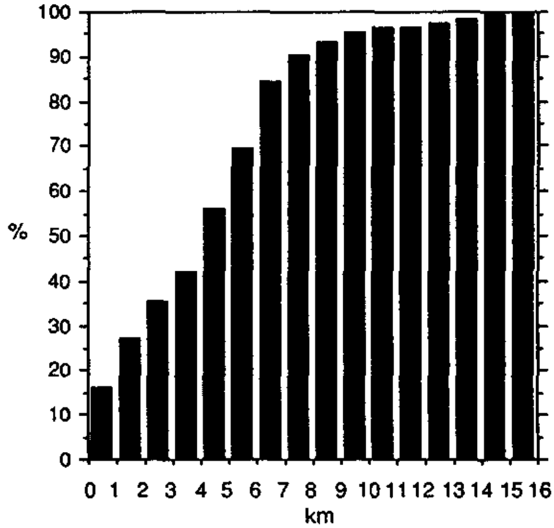


Fig. 6. Kumulative Darstellung der Flugentfernungen zwischen Schlaf- und Nahrungsplatz am Unteren Niederrhein.
Cumulative presentation of flight distances between roost and feeding sites at the Lower Rhine.

Grünland anzutreffen und nur höchstens 15% der Gänseweidetage werden auf Ackerflächen verbracht. Diese Präferenz für Grünland ist mit über 95% der Gänseweidetage bei Bläßgänsen deutlich größer als bei Saatgänsen, die ca. 80% der Gänseweidetage auf Grasland verbringen (Kapitel 4).

Die Nahrungsaufnahme ist die wichtigste Aktivität der am Unteren Niederrhein überwinternden Gänse, die durchschnittlich ca. 55% eines 24-Stunden Tages (13 1/4 Stunden) brauchen, um die täglich benötigte Grasmenge von durchschnittlich 1 500 g Frischgewicht (= 300 g Trockengewicht) für die Bläßgans und durchschnittlich 1 950 g Frischgewicht (= 390 g Trockengewicht) für die Saatgans aufzunehmen. Infolge des relativ ineffektiven Verdauungssystems verläßt - abhängig vom Rohfasergehalt der aufgenommenen Gräser - 70% (oder mehr) der aufgenommenen Nahrung, nach einer Darmpassage von 3/4 - 1 1/2 Stunden, als Kot wieder den Körper.
Aus dem verwertbaren Teil der Nahrung gewinnen die Vögel pro Tag ca. 2 100 kJ an Energie (Bläßgans: 1 780 kJ/Tag; Saatgans: 2 360 kJ/Tag), um ihren täglichen Energiebedarf zu decken (Daily energy expenditure = DEE).

on arable land. This preference of the wintering geese to feed on grass vegetation is considerably stronger in White-fronted than in Bean Geese (more than 95% to about 80%) (Chapter 4).

Feeding is the most time consuming activity of the wintering geese of the Lower Rhine area and it takes an average of 55% of a 24-hours day (13 1/4 hours) to pick up the needed daily intake of about 1 500 g fresh weight (= 300 g dry weight) of grass for a White-fronted and of about 1 950 g fresh weight (= 390 g dry weight) for a Bean Goose. As a result of the relatively ineffectiv digestive system of the geese about 70% (or more) of the food intake - depending on the crude fibre contents - is excreted after a intestinal passage of about 3/4 - 1 1/2 hours.
From the valuable part of the food the geese gain an amount of energy of about 2 100 kJ per day (White-fronted Goose: 1 780 kJ/day; Bean Goose: 2 360 kJ/day) to cover their daily energy expenditure (DEE).

Wegen der schnellen Darmpassage ist der Verdauungstrakt der Gänse bei Grasnahrung spätestens nach 2 Stunden ohne Nahrungsaufnahme leer und müßten die Vögel auf die Fettreserven zurückgreifen. Da es physiologisch weniger sinnvoll wäre, jede Nacht von den im Winter so dringend benötigten Fettreserven zu zehren, während am Ufer reichlich Nahrung steht, verbringen die niederrheinischen Gänse einen Großteil der Nachtstunden an Land und verteilen die Nahrungsaufnahme über den ganzen Tag (Kapitel 4 & 6, Mooij 1991a).

Gänse scheinen über natürliche Mechanismen zu verfügen, um eine Überweidung der Vegetation ihrer Nahrungsplätze zu vermeiden und sich optimal über ihre Nahrungsflächen zu verteilen. Auf natürlichen und naturnahen Nahrungsflächen begrenzt die Zahl und örtliche Verteilung der Nahrungspflanzen die Verteilung der Gänse über die Fläche. Das meist flächendeckende Vorhandensein geeigneter Nahrungspflanzen guter Qualität auf landwirtschaftlichen Nutzflächen könnte daher ohne das Vorhandensein solcher Mechanismen, leicht zu einer örtlichen zufälligen Konzentration der Gänse und damit zu einer örtlichen Überweidung der Vegation führen.

Because of the rapid intestinal passage of food in geese feeding on grassy vegetation the intestinal tract of the geese at the Lower Rhine would be empty after two hours without feeding. Without feeding after two hours the geese would have to live on their body reserves. Because it would be a poor survival strategy physiologically to roost on cold water for the entire night without feeding and thereby wasting body fat, while being surrounded on the banks of the river, lake or gravel pit by an abundance of food, the geese of the Lower Rhine wintering site stay on land during most of the night and distribute feeding over the entire 24 hour day (Chapters 4 & 6, Mooij 1991a).

The geese seem to have natural mechanisms which prevent an excessive use of the vegetation and make them spread over their feeding sites. At natural and semi-natural feeding sites the number and local distribution of the feeding plants limits the concentration of the birds and causes a distribution of the geese over the feeding sites. The presence of good quality food plants throughout the entire feeding area therefore could, if the geese did not posses such natural mechanisms, induce accidental local concentrations of feeding geese that excessively use the vegetation.

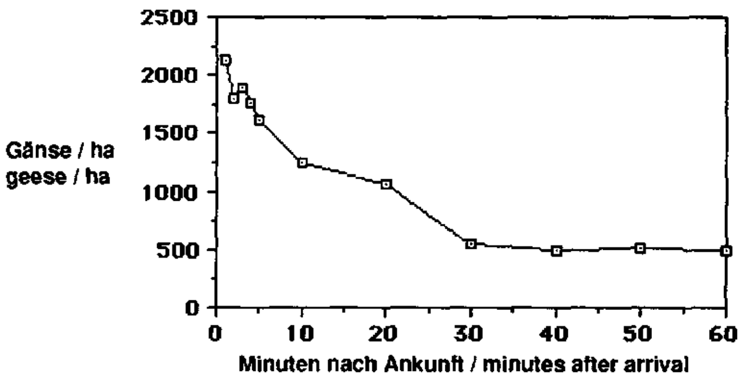


Fig. 7. Relation zwischen der Beweidungsdichte (in g/ha) und der Aufenthaltsdauer auf der Nahrungsfläche (in Minuten nach Ankunft) im Wintergebiet am Unteren Niederrhein (n = 52 Gruppen, 65 104 Gänse).

Relation between feeding density (in g/ha) and the time of stay at the feeding sites (in minutes after arrival) at the goose wintering site (n= 52 flocks, 65 104 individuals).

Wie Beobachtungen zeigten (Fig. 7), ist die Beweidungsdichte der Gänse bei der Nahrungssuche auf landwirtschaftlichen Nutzflächen jedoch während des Tages unterschiedlich hoch. Normalerweise landen die Gänse in dichtgedrängten Gruppen auf einer Nahrungsfläche und beginnen mit der Nahrungsaufnahme. Aufgrund des individuellen Nahrungsbedarfs und der intraspezifischen Aggression zwischen Individuen und Familien verbreiten die Vögel sich während der Nahrungsaufnahme zunehmend über die Fläche. Nach ca. einer halben Stunde scheint eine optimale Beweidungsdichte erreicht. Wenn keine Störungen auftreten, verbreiten sich die Gänse nicht weiter über die Fläche. Höhere Beweidungsdichten als ca. 500 Gänse pro Hektar wurden nur kurz nach Ankunft bzw. kurz nach Störungen festgestellt.

Am Niederrhein werden Grünlandflächen von Gänsen vielfach nicht mehr frequentiert, wenn die Vegetation bis zu einer durchschnittlichen Höhe von 2-4 cm abgeweidet worden ist. Dies ist im allgemeinen nach einer Beweidung mit einer Beweidungsintensität von ca. 2 000 Gänseäsungstage/ha (GT/ha) der Fall. Wahrscheinlich ist von diesem Moment an die für die Nahrungsaufnahme benötigte Energiemenge annähernd gleichgroß, wie die bei der Nahrungsaufnahme aufgenommene Energiemenge.
Bei einer Beweidungsintensität dieser Größenordnung entfernen die Gänse bis zu 1 000 kg Trockenmasse/ha (TM/ha), bezogen auf den Herbstaufwuchs und Winterzuwachs. Diese Menge kann laut Remmert (1973) im Winter ohne schädliche Auswirkungen auf den Frühjahrsertrag abgefressen werden. Auch Mott (1969) und Mott & Müller (1971) stellten fest, daß ohne Berücksichtigung der zum Teil noch erheblichen Futterreste, die nach dem Aufstallen auf den Weiden zurückbleiben (häufig über 500 kg TM/ha), noch bis zu 500 kg TM/ha an Gräsern während des Winters abgeweidet werden kann, ohne daß es zu Ertragsminderungen im Frühjahr kommt.

As observations showed (Fig. 7) the density of geese feeding on agricultural land varies during the day. Normally the geese land on the feeding site close together and start feeding. Based on the individual need for food and the intraspecific aggression between individuals and families, the feeding birds spread more and more over the feeding site during grazing. After about half an hour an optimal feeding density seems to be reached; without being disturbed the geese do not spread further, but keep grazing with a density of about 500 geese/ha. Goose concentrations at a higher level only were recorded shortly after arrival and after disturbance.

At the Lower Rhine the individual grasslands were not generally visited by geese after the average vegetation height fell under a level of 2-4 cm. In most cases this situation was reached after goose feeding with a feeding intensity of about 2 000 goose days/ha (gd/ha).
Probably at this vegetation level the energy expenditure necessary to take in food approximately reaches the amount of energy that can be gained from the food intake.
At a feeding intensity at this level the geese remove up to 1 000 kg dry weight/ha (kg dw/ha), the sum of the remainder of last year's growth until autumn and growth during winter. According to Remmert (1973) this amount of vegetation can be removed during winter without negative effects either on spring growth or on the yield in spring. Mott (1969) and Mott & Müller (1971) stated that, without consideration of the amount of vegetation left over after cattle left the grasslands in autumn for the stable (most of the time more than 500 kg dw/ha), up to 500 kg dw/ha of grass can be grazed from grasslands, without negative effects on the yield in spring.

Aufgrund dieser Fakten könnte man annehmen, daß am Unteren Niederrhein keine Gefahr einer Überweidung der landwirtschaftlichen Nutzflächen durch Gänse besteht, d.h. keine Aufwuchsbeeinträchtigungen der Nutzpflanzen als Folge der Gänsebeweidung auftreten.

According to these data there seems to be no danger of an excessive use of agricultural land by geese in the Lower Rhine area, i.e. no impairment of agricultural crops caused by goose feeding are to be expected.

Unter Berücksichtigung der Tatsachen, daß der Gänselebensraum am Unteren Niederrhein in Komplexe verteilt ist, und ca. 90% der Gänse weniger als 8 km zwischen Schlaf- und Nahrungsplatz zurücklegen (Fig. 6), stehen den Gänsen am Unteren Niederrhein theoretisch ca. 97 000 ha zur Verfügung, von denen ca. 58 000 ha landwirtschaftlich genutzt werden: ca. 35 000 ha als Grünland und ca. 23 000 ha als Acker.

Considering the fact that the goose wintering site at the Lower Rhine area is divided into complexes and about 90% of the goose flights between roost and feeding sites is shorter than 8 km (Fig. 6), theoretically the geese could use an area of about 97 000 ha, of which about 58 000 are used for agriculture: about 35 000 ha as grassland and about 23 000 ha as arable land.

In den letzten Jahren wurden von den niederrheinischen Gänsen jährlich 20 000 - 25 500 ha (m = ca. 23 000 ha) beweidet (Tab. 2), worunter 2 000 - 4 000 ha Ackerflächen waren.

In the last years the wintering geese of the Lower Rhine used 20 000 - 25 000 ha (m = about 23 000 ha) for feeding every year (Tab. 2), of which 2 000 - 4 000 ha are arable land.

Winter	Wintermax.	Gänseweidetage (Gt)	Nahrungs-fläche (ha)	Ø Beweidungsintensität (Gt/ha)	Gänseschadens-zahlung / goose damage (in DM)	Aufenthalt in Tagen
	peak number	goose days (gd)	feeding area (ha)	feeding intensity (gd/ha)	damage (in DM)	stay in days
1977/78	20.100	700.000	1.720	406,7	0	126
1978/79	26.100	670.000	1.430	469,9	0	128
1979/80	56.200	1.760.000	3.440	511,6	0	128
1980/81	70.000	3.650.000	7.520	485,3	0	126
1981/82	84.000	3.610.000	7.690	469,4	6.000	124
1982/83	92.000	4.210.000	7.920	531,9	10.000	128
1983/84	117.000	7.130.000	15.080	472,8	16.000	140
1984/85	101.000	4.770.000	10.090	472,8	30.000	140
1985/86	146.000	8.790.000	18.390	478,1	640.000	127
1986/87	130.000	7.060.000	14.780	477,6	1.530.000	143
1987/88	180.000	8.590.000	17.140	501,3	360.000	138
1988/89	185.000	11.800.000	24.060	490,5	1.010.000	148
1989/90	140.000	10.950.000	21.500	509,4	1.067.000	147
1990/91	125.000	9.890.000	19.780	500,1	1.880.000	181
1991/92	170.000	11.600.000	23.530	492,8	1.849.000	175
1992/93	146.500	13.500.000	25.500	529,4	1.979.000	182

Tab. 2. Gänsezahlen, Gänseweidetagen, Nahrungsfläche, mittlere Beweidungsintensität, gezahlte Gänseschäden und Aufenthaltsdauer der Gänse am Unteren Niederrhein zwischen 1977/78 und 1992/93.

Goose numbers, goosedays, feeding area, average feeding intensity, compensated goose damage and stay of the geese in days at the Lower Rhine area between 1977/78 and 1992/93.

Vergleicht man die tatsächlich von den Gänsen genutzten Flächen mit dem theoretisch verfügbaren, unter Berücksichtigung der seit 1977/78 in etwa gleichbleibenden Beweidungsintensität (Tab. 2), entsteht der Eindruck, daß im hiesigen Überwinterungsraum nur nahezu die Hälfte der zur Verfügung stehenden Flächen von den Gänsen auch tatsächlich genutzt wird.

Der Niederrhein verfügt jedoch über ein dichtes Wegenetz und die Störungshäufigkeit ist relativ hoch. Regelmäßig werden die nahrungssuchenden Gänse durch menschliche Aktivitäten gestört und es gibt kaum Vögel, die nicht wenigstens einmal pro Tag wesentlich gestört werden. Jede Störung aber, bei der die Gänse auffliegen, führt zu einer Konzentration der Vögel in einigen störungsärmeren Bereichen, in denen es dann zu einer wesentlich höheren Beweidungsintensität, einer Überweidung der Vegetation und zu Gänseschäden kommen kann (Kapitel 7).

Es zeigt sich, daß ca. 50% der Gänseweidetage in einer Entfernung von mehr als 450 m und ca. 80% der Gänseweidetage in einer Entfernung von mehr als 250 m von einer Störungsquelle (Siedlung, Haus, Hof oder Straße) verbracht werden (Fig. 8). Zu gleicher Zeit muß festgestellt werden, daß ca. 75% der potentiellen Gänsenahrungsflächen am Unteren Niederrhein bis zu 250 m von einer Störungsquelle enfernt sind. Dies bedeutet, daß nur ca. 25% der potentiellen Nahrungsflächen, d.h. ca. 14 500 ha, als mehr oder weniger optimale Nahrungsfläche für Gänse einzustufen ist.

In den letzten fünf Jahren wurde pro Winter ein Beweidungsdruck von ca. 11,5 Mio Gänseweidetagen pro Winter erreicht. Da ca. 80% der Gänseweidetage auf Flächen mit einer Entfernung von mehr als 250 m von einer Störungsquelle verbracht werden, ist davon auszugehen, daß diese relativ störungsarmen Flächen spätestens seit Winter 1987/88 von den Gänsen nahezu restlos genutzt wurden.

A comparison of the area actually used by the geese for feeding with the theorethically available area, considering the stable feeding intensity since winter 1977/78 (Tab. 2), gives the impression that the geese of the Lower Rhine actually only use about half of the available feeding area.

However the Lower Rhine area is covered by a dense network of bigger and smaller roads and the disturbance rate of the feeding geese is relatively high. The feeding geese are periodically disturbed during the day and hardly a goose can feed one day without at least one considerable disturbance. However each disturbance, especially if the geese are forced to fly off, induces a concentration of the birds in a few relatively disturbance free areas. At these feeding sites considerably higher feeding intensities than the level described above can be reached, which can result in an excessive use of the vegetation, which in turn can lead to goose damage (Chapter 7).

Figure 8 shows that about 50% of the goose days are spent in areas with a distance of more than 450 m and about 80% of the goose days at a dis-tance of more than 250 m from a source of dis-turbance (settlement, house, farm or road). At the same time it can be stated that about 75% of the potential goose feeding sites at the Lower Rhine are less than 250 m away from a source of disturbance. This means that only about 25% of the potential goose feeding sites, i.e. about 14 500 ha, can be considered as more or less optimal goose feeding sites.

In the last five winters a total feeding pressure of about 11.5 million goose days per winter was reached. Because about 80% of these goose days were spent in areas more than 250 m away from a source of disturbance, it can be stated that at the latest since winter 1987/88 all more or less undisturbed feeding sites have been used by geese.

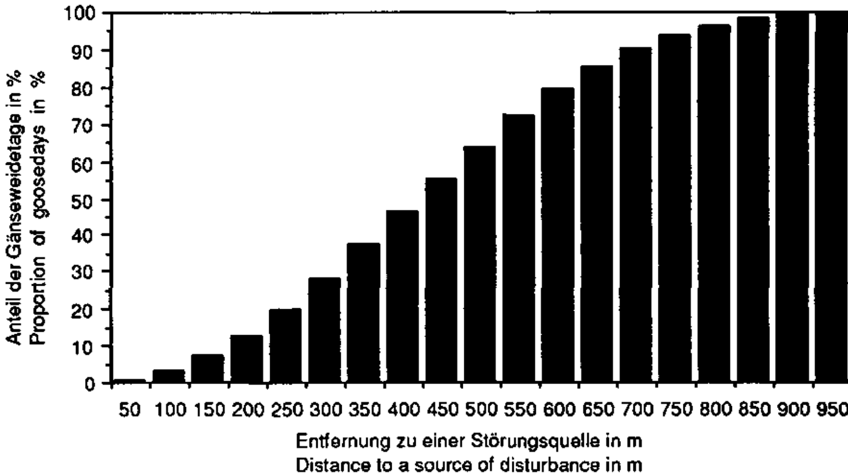


Fig. 8. Verteilung der Gänseweidetage über den Nahrungsflächen am Unteren Niederrhein in Relation zu der Entfernung zu einer *Störungsquelle* zwischen Winter 1977/78 und 1988/89.

Distribution of goose feeding over the feeding sites of the Lower Rhine area in relation to the distance of a source of disturbance between winter 1977/78 and 1988/89.

Dies bedeutet, daß nahezu 35% der zur Zeit genutzten Nahrungsflächen als suboptimal anzusehen sind, weil die Gänse hier regelmäßig bei der Nahrungssuche gestört werden. Die höhere Störungshäufigkeit auf diesen suboptimalen Nahrungsflächen wird zweifellos zu einer höheren Beweidungsintensität auf Teilen der mehr oder weniger optimalen Nahrungsflächen geführt haben, was zu einer Zunahme von Gänseschäden geführt haben könnte.

Aufgrund dieser Tatsachen scheint die Tragfähigkeit des hiesigen Gänsewintergebietes unter den jetzigen Voraussetzungen erreicht zu sein.
Diese Annahme scheint sich durch die allmähliche Stabilisierung der jährlichen Wintermaxima seit Mitte der 1980er Jahre zu bestätigen (Fig. 1, Tab. 1 & 2). Die zahlenmäßige Stabilisierung der niederrheinischen Winterbestände kann jedoch auch die Folge einer gesamtwesteuropäischen Entwicklung sein, da sich die Saat- und Bläßgansbestände in den letzten Jahren nicht nur am Unteren Niederrhein, sondern auch in Gesamtdeutschland und in den Niederlanden zu stabilisieren scheinen (Fig. 3, Kapitel 4 & 8, Mooij 1995a).

This means that almost 35% of the present goose feeding sites have to be considered to be suboptimal, because the geese using them are disturbed regularly. The high disturbance rate of these suboptimal feeding sites without doubt caused higher feeding intensities at the more or less optimal feeding sites and could have caused an increase in claims for goose damage.

Based on these data and reflections it seems that under the present conditions the carrying capacity of the goose wintering site at the Lower Rhine area is reached.
This assumption seems to be confirmed by the gradual stabilization of the annual peak numbers since the middle of the 1980s (Fig. 1, Tab. 1 & 2). On the other hand this development can also be explained as a reflection of the general development of Bean and White-fronted Goose numbers in western Europe, which show a stabilization in the numbers of both species not only at the Lower Rhine area but also in Germany and in the Netherlands (Fig. 3, Chapters 4 & 8, Mooij 1995a).

Die durchschnittliche Beweidungsintensität am Unteren Niederrhein liegt zwischen 400 und 550 Gt/ha (Tab. 2), kann jedoch störungsbedingt örtlich Werte über 6 000 Gt/ha erreichen. Störung weidender Gänse verursacht bei den Vögeln also nicht nur den Verlust von Äsungszeit und Energie durch Fliegen, sondern verringert auch das zur Verfügung stehende Nahrungsareal, weil Flächen mit einer hohen Störungshäufigkeit gemieden werden. Störungen vergrößern so das Risiko von Gänseschäden infolge eines gestiegenen Nahrungsbedarfs und einer starken Konzentration gestörter Gänse (Mooij 1982b, 1992a, 1993).

In mehrjährigen Beweidungsversuchen mit Saat- und Bläßgänsen in Käfigen, die am Unteren Niederrhein durchgeführt wurden, zeigte sich, daß auf Grünland bei Beweidungsintensitäten über 3 000 Gt/ha beim ersten Ernteschnitt Anfang-Mai Ernteverluste von 10% und im Gesamtjahresertrag Verluste von ca. 3% möglich sind. Bei Beweidungsintesitäten über 6 000 Gt/ha betrug der Ertragsverlust im ersten Schnitt sogar fast 20% und beim Gesamtjahresertrag ca. 6% (Kapitel 7, Ernst 1991, Mooij 1984, Mooij & Ernst 1987, Mott 1985).

Die Ergebnisse der Beweidungsexperimente auf Wintergetreide zeigten, daß Gänseschäden erwartet werden können, wenn die Beweidungsintensität höher als 1 500 Gt/ha und nahezu 2/3 der Blattmasse von den Gänsen gefressen worden ist. Bei Beweidungsintensitäten über 1 500 Gt/ha zeigten sich Ertragsverluste von 5-10%, bei Beweidungsintensitäten über 3 000 Gt/ha von 10-15% und bei extrem hohen Beweidungsintensitäten sogar von 30% und mehr (Mooij 1984 & Kapitel 7).

Die Ergebnisse der niederrheinischen Gänseschadensforschung wurden durch die Untersuchungen in Belgien (Kuijken 1969 &1975), den Niederlanden (Groot Bruinderink 1987 & 1989, Teunissen 1992) und Großbritanien (Patterson et al. 1989, Summers 1990) bestätigt.

The average feeding intensity at the Lower Rhine goose wintering site is between 400 and 550 gd/ha (Tab. 2). However in some relatively disturbance free areas the feeding intensity can reach a level of 6 000 gd/ha or more as a result of disturbance elsewhere. Disturbance not only reduces the available feeding time and consumes energy as a result of flying activities, but it also reduces the potential feeding area, because geese avoid feeding sites with a high disturbance rate. In this way disturbance of geese enlarges the risk of goose damage as a result of an increased need of food and a concentration of disturbed geese (Mooij 1982b, 1992a, 1993).

Long-term grazing experiments with semi-tame White-fronted and Bean Geese in cages carried out at the Lower Rhine showed that goose feeding intensities of more than 3 000 gd/ha on grasslands could cause yield reductions of about 10% in the first cut in the first week of May and an overall yield loss of about 3% per year. With feeding intensities higher than 6 000 gd/ha the yield loss was almost 20% in the first cut and about 6% for the year (Chapter 7, Ernst 1991, Mooij 1984, Mooij & Ernst 1987, Mott 1985).

The results of the grazing experiments with semi-tame geese in cages on cereals showed that on these crops goose damage can be expected at feeding intensities higher than 1 500 gd/ha and when about 2/3 of the leaves have been grazed by geese. After goose grazing at this level yield losses of 5-10% were found, after feeding intensities of more than 3 000 gd/ha yield losses of 10-15% were recorded and after extremely high feeding intensities there were yield losses of more than 30% (Mooij 1984 & Chapter 7).

The results of the goose damage research at the Lower Rhine were confirmed by the results of studies in Belgium (Kuijken 1969 &1975), the Netherlands (Groot Bruinderink 1987 & 1989, Teunissen 1992) and Great Britain (Patterson et al. 1989, Summers 1990).

Im Rahmen des Gänseschutzes zahlt die nordrhein-westfälische Landesregierung seit Winter 1981/82 Entschädigungen an Landwirte, die Gänseschäden bei der Landwirtschaftskammer melden. Während in den letzten sechs Jahren kein erwähnenswerter Anstieg der Gänsemaxima zu verzeichnen ist und auch die mittlere Beweidungsintensität stabil geblieben ist, haben sich die von den Landwirten gemeldeten und von der Landesregierung entschädigten "Gänseschäden" vervielfacht und nähern sich mittlerweile der 2 Millionen-Grenze. Es hat in dieser Periode eine deutliche Verlängerung des Gänseaufenthaltes, jedoch ohne eine gleichzeitige Erhöhung der insgesamt im Wintergebiet gefressenen Gänseweidetage gegeben (Tab. 2).

Es gibt offensichtlich keine Korrelation zwischen den Gänsemaxima, der Aufenthaltsdauer und der Zahl der Gänseweidetage einerseits und der Höhe der entschädigten Gänseschäden andererseits. Da Gänseschäden dort auftreten, wo eine Beweidungsintensität von 2 000 Gt/ha überschritten wird, sind Gänseschäden am Unteren Niederrhein auf allen Flächen mit einer Beweidungsintensität über diesem Niveau, also auf ca. 4% der Nahrungsflächen, zu erwarten, wo ca. 24% aller Gänseweidetage festgestellt wurden (Tab.3).

Aufgrund der in den letzten sechs Jahren festgestellten Größe der Nahrungsflächen von jährlich 20 000 - 25 000 ha (Tab. 2), wären damit Schadflächen in einer Ausdehnung von maximal ca. 1 000 ha/Jahr zu erwarten.

Within the scope of a goose protection scheme the government of the German federal state of Nordrhein-Westfalen has paid compensation since winter 1981/82 to the farmers who report goose damage to the regional Chamber of Agriculture. Although during the past six years there has been no actual increase in peak numbers, number of goose days or feeding density, the total amount of goose damage claimed by the farmers has increased from about 1 million DM in winter 1988/89 to about 2 million in winter 1992/93. During this period the stay of the geese was prolongued, but this did not result in an increase in the total number of goose days (Tab. 2).

There is no obvious correlation between the peak numbers of geese, their period of stay and the total number of goose days in an area on the one hand and the extent of goose damage claimed on the other. Because goose damage can be expected at all feeding sites where feeding pressure surmounts the threshold of 2 000 gd/ha, goose damage can be expected at about 4% of all feeding sites of the area where about 24% of all goose days were recorded (Tab. 3).

Based on the size of the total annual feeding area of the last six years of 20 000 - 25 000 ha (Tab. 2), in these years goose damage could be expected in an area of a maximum size of about 1 000 ha/anno.

Beweidungsintensität	Nahrungsfläche		Ø Beweidungsintensität	Anzahl Gänseweidetage	
Feeding intensity	Feeding area		Ø feeding intensity	Number of goose days	
Gt/ha / gd/ha	in ha	in %	Gt/ha / gd/ha	Gt / gd	%
0 - 999	90 367	85.9	284.1	25 673 760	50.4
1 000 - 1 999	10 625	10.1	1 213.0	12 887 820	25.3
2 000 - 2 999	2 946	2.8	2 714.7	7 997 580	15.7
≥ 3 000	1 262	1.2	3 471.3	4 380 840	8.7
Ø	105 200		484.2	50 940 000	

Tab. 3. Nahrungsfläche und die Anzahl der Gänseweidetage in Relation zu der Beweidungsintensität am Unteren Niederrhein zwischen 1977/78 und 1987/88.

Feeding area and number of goose days in relation to the feeding intensity at the goose wintering site at the Lower Rhine between 1977/78 and 1987/88.

Tatsächlich wurden jedoch Entschädigungen für Flächen mit einer Größe von 4 000 - 9 500 ha/Jahr bezahlt (Tab. 2). Diese Tatsache legt die Vermutung nahe, daß es sich bei einem Teil der gemeldeten Gänseschäden nicht um durch Gänse verursachte Schäden handeln muß.

Beim Entstehen der als Gänseschäden gemeldeten Aufwuchsbeeinträchtigungen spielen vielfach noch andere Faktoren als Gänsefraß eine Rolle.
Zuerst muß festgestellt werden, daß bei weitem nicht alle gemeldeten Gänseschäden auch tatsächlich von Gänsen verursachte Schäden sind. Häufig handelt es sich um durch abiotische und anthropomorphe Faktoren (z.B. Witterungseinflüsse, Bodenqualität, Staunässe, Bearbeitungsunterschiede innerhalb der Fläche) verursachte Aufwuchsbeeinträchtigungen, die als Folge einer psychologischen Sensibilisierung für mögliche Schäden, aufgrund der beeindruckenden Massierung überwinternder Wildgänse und der Nichterfassung des Vegetationszustandes vor der Beäsung, den Wildgänsen zugeschrieben werden. Die Schadensursache ist im nachhinein schwer feststellbar.
Hinzu kommt, daß die tatsächliche Ertragsminderung für den Landwirt wesentlich geringer ist, als die von den Nahrung suchenden Gänse gefressene Vegetationsmenge. In vielen Fällen fressen Gänse Vegetationsteile, die witterungsbedingt dem Landwirt im Laufe des Winters sowieso entgehen und zum Teil wird der im Frühjahr fehlende Aufwuchs durch ein verstärktes Wachstum während der Vegetationsperiode weitgehend ausgeglichen (Ernst 1991, Mooij 1984 & 1994a).

Die bisherigen Untersuchungen haben gezeigt, daß es außerordentlich schwierig ist, das tatsächliche Ausmaß der eindeutig auf Gänsefraß zurückzuführenden Ertragsminderungen abzuschätzen (u.a. Ernst 1991, Groot Bruinderink

The actual size of the area where goose damage was claimed and compensated had a size of 4 000 - 9 500 ha/anno (Tab. 2). This fact indicates that at least a part of the goose damage claimed must be damage of crops caused by factors other than goose feeding.

There are a number of factors other than goose feeding that could be responsible for impaired growth of agricultural crops which has been claimed to be goose damage.
First it must be stated that part of vegetation damage reported as goose damage is actually impaired growth caused by abiotic and anthropogenous factors (e.g. influence of disadvantageous weather conditions, quality of the soil, water logging, differences in farming activity, fertilizer application etc. within the plot). These factors cause locally different growth conditions for the crop and thereby different yield levels within the plot that, as a result of a psychological sensibility of the farmers for possible goose damage caused by the impressive massing of wintering geese on their lands and to the lack of an actual inventory prior to goose feeding, are put down to the feeding geese. In the retrospective it is almost impossible to decide on the actual cause of the damage.
It must be added that in a number of cases the actual yield loss for the farmer is much less than the amount of the vegetation grazed by the geese. In most cases the geese feed parts of the vegetation that are of no use to the farmers because without goose feeding they would fade away during the winter under the weather influences. Part of the yield reduction in spring is compensated by increased growth during the rest of the vegetation period (Ernst 1991, Mooij 1984 & 1994a).

The present goose damage studies have shown that it is extremely difficult to estimate the actual extent of damage definitely caused by goose feeding (e.g.. Ernst 1991, Groot Bruinderink 1987 &

1987 & 1989, Kuijken 1969 & 1975, Mooij 1984, Mooij & Ernst 1988, Patterson 1991, Rutschke 1983, Schröder 1975, Summers 1990, Teunissen 1992).

Die Schlußfolgerung aus dem Vorhergegangenen kann nur lauten, daß Kompensationszahlungen für gemeldete Gänseschäden zwar ein naturschutzpolitisches Mittel zur Entschärfung der Konflikte zwischen Landwirten und Gänseschutz sein können, diese jedoch weder das Problem der tatsächlichen Gänseschäden lösen, noch zuverlässige Informationen über das Niveau tatsächlicher Gänseschäden geben.
Eine Lösung des Problems tatsächlicher Gänseschäden kann nur in der Vermeidung dichter Gänsekonzentrationen und damit der Verhinderung von Beweidungsintensitäten über 2 000 Gänseweidetage pro Hektar liegen. Hierzu müssen Managementstrategien entwickelt werden, die zu einer Verteilung der Gänseweide über größere Flächen abzielen. Da die häufigen Störungen am Unteren Niederrhein zu einer starken Konzentration der Gänse führen, kommt der Verringerung von Störungen im hiesigen Überwinterungsraum eine hohe Bedeutung zu.

3. Brutökologie, Wanderung und Bestandsentwicklung.

Am Unteren Niederrhein überwintern vornehmlich Bläß- und (in weit geringerer Zahl) Saatgänse.
Aufgrund des grenzüberschreitenden Lebensraumes dieser Arten kann ein regionales Gänsemanagement nur sinnvoll sein, wenn dieses Teil einer überregionalen Konzeption ist.
Ein solches Konzept kann jedoch nur aufgestellt werden, wenn ausreichende Kenntnisse über Brutökologie und Wanderwege vorliegen.

1989, Kuijken 1969 & 1975, Mooij 1984, Mooij & Ernst 1988, Patterson 1991, Rutschke 1983, Schröder 1975, Summers 1990, Teunissen 1992).

The only conclusion possible from the previous reflections is that compensation schemes for alleged goose damage could be an instrument to reduce the conflicts between farmers and goose protection aims within a nature conservation policy. But compensation payments for alleged goose damage are not able to solve actual goose damage problems or to give information about the actual level of genuine crop damage caused by geese.
The solution of the problem of crop damage actually caused by geese can only be solved by management measures to encourage the dispersion of the wintering geese and thereby avoid feeding intensities higher than 2 000 goose days per hectare. Therefore it is necessary to develop management strategies to disperse goose feeding over greater areas. Because the high disturbance frequency is one of the most important reasons for large goose concentrations at the Lower Rhine wintering site the reduction of disturbance should have high priority.

3. Breeding ecology, migration and population development.

The Lower Rhine is an important wintering area mainly for White-fronted Geese and (in a much smaller number) for Bean Geese.
Because the living range of these species crosses national borders, regional goose management can only be effective if part of an international management plan.
International goose management must be based on sufficient knowledge of breeding ecology and migration.

Deshalb wurde das Untersuchungsprogramm auf diese beiden Themenbereiche ausgedehnt, was zu den folgenden Fragen führte:

- Wo liegt das Brutgebiet der in West-Europa überwinternden Saat- und Bläßgänse, und wie sind ihre Wanderwege (Kapitel 4 & 8)?
- Wie ist die Bestandsentwicklung dieser Arten im Brutgebiet sowie im Gesamtlebensraum (Kapitel 8)?
- Wie ist die Schutzsituation dieser Arten im Gesamtlebensraum (Kapitel 8)?

Die Bläßgans brütet in einem geschlossenen Brutareal auf den Tundren Eurasiens und Nordamerikas. Ein Großteil der eurasischen Bläßgänse gehört zu der Subspecies *Anser albifrons albifrons*(Scopoli 1769), die in der russischen Tundra zwischen der Halbinsel Kanin im Westen und dem Kolyma-Fluß im Osten brütet.

Aufgrund ihrer Zugwege läßt sich diese Population in zwei Gruppen aufteilen. Bläßgänse, die östlich des Chatanga-Flußes beheimatet sind, ziehen in südöstlicher Richtung und überwintern in Südost- und Ostasien (Ostpaläarktische Population).

Die in Westeuropa durchziehenden und überwinternden Bläßgänse gehören zu der westpaläarktischen Population, die zwischen der Halbinsel Kanin im Westen und dem Chatanga-Fluß im Osten brütet (Cramp & Simmons 1977, Rogacheva 1992, Rutschke 1987).

Die gesamte westpaläarktische Population wurde in den letzten Jahren auf 0.8 - 1.3 Mio Vögel geschätzt (Rose & Scott 1994 Rose 1995), wovon 400 000-600 000 regelmäßig in Westeuropa überwintern (Kapitel 5, Mooij 1995a & b, 1996, Rose & Scott 1994, Rose 1995).

Die Saatgans brütet in der gesamten Tundra- und Taigazone Eurasiens.

Die in Westeuropa durchziehenden und überwinternden Saatgänse gehören zwei Subspecies an: *Anser fabalis rossicus* und *Anser fabalis fabalis*.

For that reason this study was extended to cover both fields, which brought the following questions:

- Where are the breeding areas situated of the Bean and White-fronted geese that winter in western Europe (Chapters 4 & 8)?
- How is the population development of both species in the breeding areas and the whole of the living range (Chapter 8)?
- How is the protection situation of both species in their living range (Chapter 8)?

The White-fronted Goose breeds in a closed breeding range in the tundra zone of Eurasia and Northern America. The majority of the Eurasian Whitefronts belongs to the subspecies *Anser albifrons albifrons* (Scopoli 1769) that breeds in the Russian tundra between the Kanin Peninsula in the west and the Kolyma river in the east.

Based on its migratory routes the population can be divided in two groups. Whitefronts breeding east of Chatanga river migrate in southeastern direction and winter in southeastern and eastern Asia (eastern palearctic population).

The White-fronted Geese wintering in western Europe belong to the western palearctic population, breeding in the Eurasian tundra between the Kanin Peninsula in the west and the Chatanga river in the east (Cramp & Simmons 1977, Rogacheva 1992, Rutschke 1987).

The whole western palearctic population was estimated during the last decade to be about 0.8-1.3 million individuals (Rose & Scott 1994, Rose 1995), of which between 400 000 and 600 000 birds regularly winter in western Europe (Chapter 5, Mooij 1995a & b, 1996, Rose & Scott 1994, Rose 1995).

The Bean Goose breeds in the Eurasian tundra and taiga zone.

The Bean Geese migrating through and wintering in western Europe belong to two subspecies: *Anser fabalis rossicus* and *Anser fabalis fabalis*.

Die Taiga- oder Wald-Saatgans (*Anser f. fabalis* (Latham 1787)) brütet wahrscheinlich in der Taigazone Nordeuropas von Skandinavien bis zum Yenessei-Fluß, und die Tundra-Saatgans (*Anser f. rossicus* Buturlin 1933) in der russischen Tundra von der Kanin-Halbinsel bis im westlichen Teil der Taimyr Halbinsel (Burgers et al. 1991, Cramp & Simmons 1977, Rogacheva 1992, Rutschke 1987).
Die genaue Abgrenzung der einzelnen Subspezies, die Zahl der Subspezies sowie ihre jeweiligen Bestandsgrößen und Wanderwege sind zur Zeit noch weitgehend ungeklärt (Burgers et al. 1991, Van den Bergh 1984, Huyskens 1986, Rooselaar 1977, Voous 1960).
Die gesamte westpaläarktische Population (Taiga- und Tundrasaatgans zusammen) wurde in den letzten Jahrzehnten auf ca. 400 000 (Rose & Scott 1994, Rose 1995) bis 600 000 Vögel (Huijskens 1986) geschätzt, wovon 250 000 - 330 000 regelmäßig in Westeuropa überwintern (Mooij 1995a & b).

Die in der eurasischen Arktis brütenden Gänse müssen ihr Brutgebiet, aufgrund des einsetzenden Winters, spätestens in der zweiten Septemberhäfte verlassen und ziehen vor der Frostgrenze in Richtung ihrer Wintergebiete (Kapitel 5, Mooij et al. 1995).
Um in guter Kondition zu bleiben, verteilen die durch das Binnenland ziehenden *Anser*-Gänse ihren Zugweg auf mehrere Abschnitte und verbleiben nach jedem Flug ein bis zwei Wochen auf einem traditionellen Zwischenrastplatz, um durch intensive Nahrungsaufnahme das während des Fluges entstandene Energiedefizit wieder auszugleichen. Auf diese Weise dauert der Zugweg vom Brut- zum Wintergebiet ebenso wie der Weg zurück von den Winter- zu den Brutgebieten zwei bis drei Monate (Kapitel 5 & 7, Mooij et al. 1995).

In älterer Literatur geht man aufgrund der geographischen Verteilung im Wintergebiet davon aus, daß es weitgehend getrennte Brutpoplationen gibt, und jede Brutpopulation einem eigenen traditionellen Zugweg zu ihren traditionellen Winterrastplätzen folgt.

The Taiga Bean Goose (*Anser f. fabalis* (Latham 1787)) probably breeds in the taiga zone of northern Europe from Fennoscania east to the Yenessei river and the Tundra Bean Goose (*Anser f. rossicus* Buturlin 1933) in the Russian tundra between the Kanin Peninsula and the western part of the Taimyr Peninsula (Burgers et al. 1991, Cramp & Simmons 1977, Rogacheva 1992, Rutschke 1987).
The number of subspecies, the geographical distribution of each subspecies, their population size and migratory routes are not yet clear (Burgers et al. 1991, Van den Bergh 1984, Huyskens 1986, Rooselaar 1977, Voous 1960).
The whole western palearctic population (Taiga and Tundra Bean Goose together) during the last decade was estimated to be about 400 000 (Rose & Scott 1994, Rose 1995) to 600 000 individuals (Huijskens 1986), of which between 250 000 and 330 000 regularly winter in western Europe (Mooij 1995a & b).

Because of the on-set of winter the geese breeding in the Eurasian arctic have to leave their breeding range during the second half of September at the latest. They migrate to the wintering sites ahead of the frost border (Chapter 5, Mooij et al. 1995).
To stay in good condition the *Anser* geese that migrate across inland divide their total flight into several stages. After a flight they stay at a traditional stopover site for one or two weeks to compensate for body reserve loss by intensive feeding. In this way the migration between breeding and wintering site takes between two and three months (Chapters 5 & 7, Mooij et al. 1995).

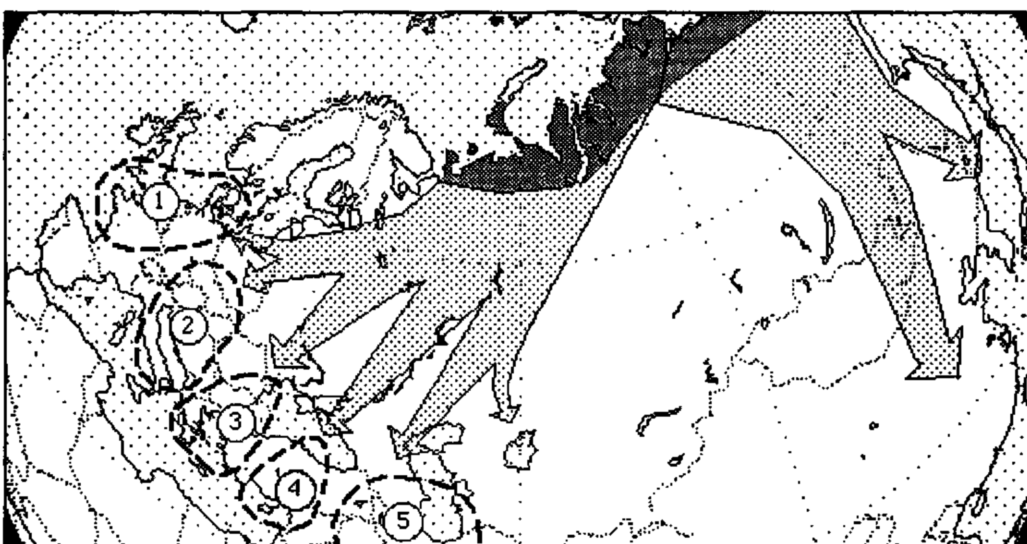
Based on the geographical distribution in winter in older literature it is assumed that most goose species can be divided into more or less separate breeding populations.

Das Ergebnis dieses Modells sind mehr oder weniger stark getrennte "Winterpopulationen". Da die Anwendung des Populationsbegriffes auf eine Wander- und Rastgemeinschaft von Vögeln problematisch ist, wenn nicht gesichert ist, daß es sich hierbei tatsächlich um eine mehr oder weniger geschlossene Fortpflanzungsgemeinschaft handelt, wird hier der Begriff "Gruppe" statt "Population" verwendet.

According to this model each breeding population follows its own traditional migratory routes to the wintering sites. As a result the species were divided in several "wintering populations". Because it is doubtful if these are real "populations" in a biological sense as long as it is not clear if they actually are more or less closed reproductive units, this study uses the term "group" instead of the word "population".

Bei der Bläßgans hat man deshalb mehrere solcher "Wintergruppen" unterschieden, die als "Nordsee-Ostsee-Gruppe", "Pannonische Gruppe", "Pontische Gruppe", "Anatolische Gruppe" und "Kaspische Gruppe" bezeichnet wurden (Bauer & Glutz von Blotzheim 1968, Cramp & Simmons 1977, Lebret et al. 1976, Philippona 1972, Rutschke 1987, Timmerman 1976 und Timmerman et al. 1976) (Kapitel 5, Fig. 9.).

According to their geographical distribution during winter the western palearctic White-fronted Goose population was divided into 5 subdivisions, that were named "Baltic-North sea group", "Pannonic group", "Pontic group", "Anatolian group" and "Caspian group" (Bauer & Glutz von Blotzheim 1968, Cramp & Simmons 1977, Lebret et al. 1976, Philippona 1972, Rutschke 1987, Timmerman 1976 and Timmerman et al. 1976) (Chapter 5, Fig. 9.).



Brutgebiet / breeding site	Winterpopulationen:	1. Nordsee-Ostsee-Gruppe/Baltic-Northsea group 2. Pannonische Gruppe/ Pannonic group
Zugroute / flyway	wintering groups:	3. Pontische Gruppe/Pontic group 4. Anatolische Gruppe/Anatolian group 5. Kaspische Gruppe/Caspian group

Fig. 9. Brutgebiet, Zugrouten und Wintergruppen bei der westpaläarktischen Population der Bläßgans (*Anser albifrons albifrons*) nach Cramp & Simmons (1977), Lebret et al. (1976), Philippona (1972), Rutschke (1987) , Timmerman (1976) und Timmerman et al. (1976).

Breeding area, flyways and wintering groups of the western palearctic population of the White-fronted Goose (*Anser albifrons albifrons*) after Cramp & Simmons (1977), Lebret et al. (1976), Philippona (1972), Rutschke (1987) , Timmerman (1976) and Timmerman et al. (1976).

Unter Berücksichtigung neuerer Forschungsergebnisse, wobei die Rückmeldungen beringter und markierter Bläßgänse analysiert wurden (Kapitel 4 & 5, Mooij 1995b, Mooij et al. 1995), scheinen diese bisher gängigen Ansichten über die Wintergruppen und Wanderungen der Bläßgans jedoch nicht länger haltbar.

Eine Analyse der Rückmeldungen beringter und markierter Bläßgänse führt zu dem Schluß, daß die Kontakte zwischen den verschiedenen Wintergruppen der West-Paläarktis wesentlich intensiver sind als bisher angenommen (z.B. durch Bauer & Glutz von Blotzheim 1968, Cramp & Simmons 1977, Lebret et al. 1976, Philippona 1972, Rutschke 1987 & 1990, Timmerman 1976 und Timmerman et al. 1976, Fig. 9), und daß Vögel aus einem Brutgebiet im Winter über weit entfernte Wintergebiete verteilt sind (Fig. 10.).

Hierdurch wäre nicht nur ein regelmäßiger genetischer Austausch zwischen den Brutpopulationen gewährleistet, sondern entstehe auch die Möglichkeit,

In the light of resent results of an analysis of the recoveries of ringed and the resightings of marked Whitefronts (Chapters 4 & 5, Mooij 1995b, Mooij et al. 1995) it seems that the hypothesis of more or less separate breeding and wintering groups is not tenable.

The analysis of the recoveries of ringed and the resightings of marked Whitefronts lead to the conclusion that there is much more interchange between the western palearctic wintering groups than has been assumed up till now (e.g. by Bauer & Glutz von Blotzheim 1968, Cramp & Simmons 1977, Lebret et al. 1976, Philippona 1972, Rutschke 1987 & 1990, Timmerman 1976 and Timmerman et al. 1976, Fig. 9) and that the breeding birds of one area are distributed over several wintering sites in winter (Fig. 10).

In this way not only a regular genetic exchange between the birds of different breeding sites is secured, but also the possibility to react

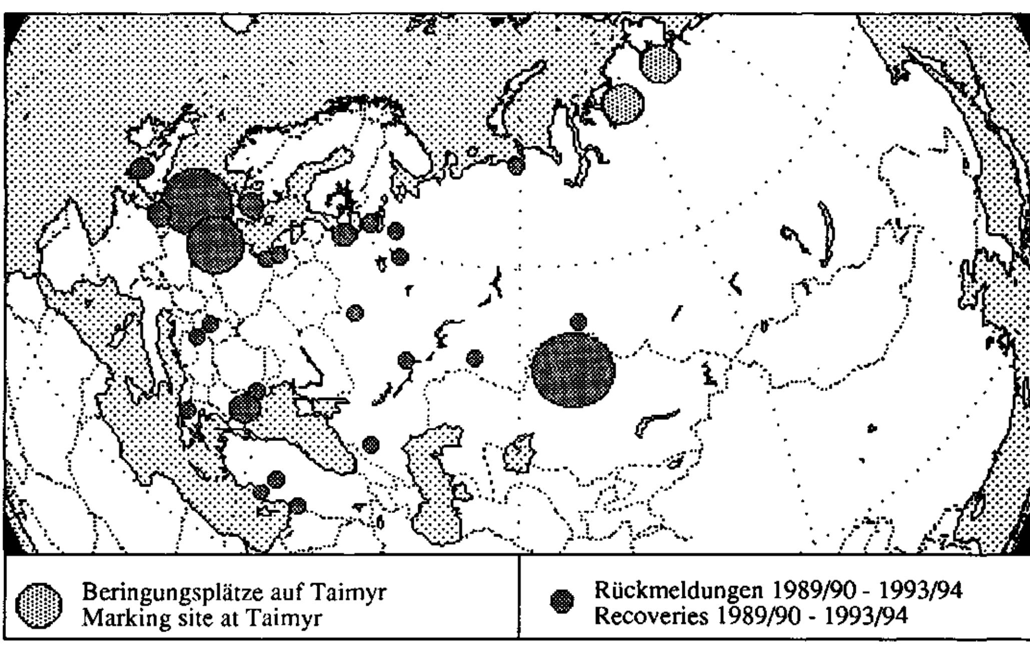


Fig. 10. Rückmeldungen vom Winter 1989/90 bis Ende 1994 von zwischen Sommer 1989 und 1992 auf der Halbinsel Taimyr markierter Bläßgänse.

Recoveries between Winter 1989/90 and the end of 1994 of White-fronted Geese marked at the Taimyr Peninsula between summer 1989 and 1992.

daß die überwinternden Vögel eines Gebietes relativ schnell auf ökologische Änderungen reagieren und in andere, ggf. sogar weit entfernte, Wintergebiete abwandern könnten. Dies würde bedeuten, daß die Brutvögel aus einem Brutareal im Winter möglicherweise über sämtliche Winterrastplätze der westlichen Paläarktis verteilt sind (Kapitel 4 & 5, Mooij et al. 1995).

Wenn dies zutrifft, würden wir auf sämtlichen Winterrastplätzen eine Mischung aus Brutvögeln verschiedenster Brutgebiete der westlichen Paläarktis finden. Da es eine Reihe von Hinweisen gibt, daß neue Paarbindungen vornehmlich auf den Winterrastplätzen gebildet werden (Van Impe 1978, Johnsgard 1978, Owen & Black 1990, Rutschke 1987), käme diese Vermischung von Brutvögeln einzelner Brutgebiete eine hohe genetische Bedeutung zu. Sie würde den genetischen Austausch zwischen den regionalen Gruppen der Brutpopulation erhöhen und die Möglichkeiten der Subspezies-Bildung wesentlich einschränken.

Die Tatsache, daß die eurasische Subspezies, *Anser albifrons albifrons*, ein ausgedehntes Brutgebiet auf der russischen Tundra zwischen der Halbinsel Kanin und dem Kolyma-Fluß (über eine Entfernung von ca. 4 500 km) besiedelt, ohne wesentliche zoogeographische Variabilität zu zeigen, unterstützt die Hypothese eines regelmäßigen Genaustausches zwischen den einzelnen Brutpopulationen der Subspezies.

Auch die Ergebnisse des Beringungsprogramms bei der Grönländischen Bläßgans, *Anser albifrons flavirostris*, scheinen diese Hypothese zu unterstützen. Obwohl die Vögel in einem relativ kleinen Areal in West-Grönland (400 km²) gefangen und markiert worden waren, wurden sie von allen Winterrastplätzen der Subspezies in Irland und Schottland zurückgemeldet, d.h. sie waren über nahezu das gesamte Winterareal der Subspezies verteilt (Wilson et al. 1991).

rather quickly to ecological changes and to shift from the traditional to other wintering sites, even over larger distances. The results of the analyses indicate that the breeding birds of one breeding site are distributed over most western palearctic wintering sites (Chapters 4 & 5, Mooij et al. 1995).

If this view is correct this would mean that on each of the wintering sites we find a mixture of breeding birds of most of the regional breeding sites of the western palearctic.

There are several indications that new pair bonds are formed in the wintering areas (Van Impe 1978, Johnsgard 1978, Rutschke 1987). The mixture of breeding birds of several regional breeding sites at one wintering site 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 regional groups of breeding birds and decrease the chances of the development of new subspecies.

The fact that the Eurasian race, *Anser albifrons albifrons*, has a vast breeding area on the tundra between the Kanin Peninsula and Kolyma river (over a distance of about 4 500 km) without appreciable geographical variation, supports the hypothesis of a regular genetic interchange between local breeding groups.

The results of the ringing programme of Greenland White-fronted Geese *Anser albifrons flavirostris* also seem to support this hypothesis. Allthough all birds were caught and ringed in a very limited area in western 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).

Auch bei der Tundrasaatgans (*Anser fabalis rossicus*) wurde mehrfach ein Austausch von Individuen zwischen den verschiedenen Winterrastplätzen Westeuropas und denen der Donauebene in Südost-Europa festgestellt. Mehrere Saatgänse, die im Osten Deutschlands oder in den Niederlanden markiert wurden, wurden in späteren Jahren aus Südost-Europa zurückgemeldet.

Eine Saatgans wurde im gleichen Winter sogar in den Niederlanden, am Unteren Niederrhein und anschließend in Ungarn beobachtet (Bauer & Glutz von Blotzheim 1968, Van den Bergh 1984, Burgers et al. 1991, Cramp & Simmons 1977).

Wegen der unklaren Subspezies-Situation und fehlenden Daten sind Aussagen über die Wanderwege der Saatgans zur Zeit schwierig.

Aufgrund der Ergebnisse russischer Untersuchungen aus den Brutgebieten der arktischen Gänse verfügen wir über Hinweise auf die Bestandsentwicklung bei Saat- und Bläßgänsen in diesem wichtigen Teil des Lebensraumes. Auf der Taimyr Halbinsel, wo ca. 430 000 Bläßgänse, also über 50% der in den westpaläarktischen Wintergebieten gezählten Bläßgänse brüten, wurden seit 1960 abnehmende Brutdichten für Bläß- und Saatgans gefunden (Tab. 4).

Also in Tundra Bean Geese (*Anser fabalis rossicus*) the exchange of a number of individual birds between the wintering sites of western Europe and the Danube valley in southeastern Europe was recorded. Several Bean Geese ringed in the Netherlands or marked in eastern Germany were recorded on southeastern European wintering sites in later years.

One Bean Goose even was recorded in the same winter in the Netherlands, at the Lower Rhine wintering site in Germany and subsequently in Hungary (Bauer & Glutz von Blotzheim 1968, Van den Bergh 1984, Burgers et al. 1991, Cramp & Simmons 1977).

Because of the unclear subspecies-situation and the lack of data at present, it is not possible to give reliable information about the migratory routes of the Bean Goose.

From the results of Russian studies from the arctic breeding areas of these goose species we have an indication of the status of Bean and White-fronted Goose in this important part of their range. On the Taimyr Peninsula, where about 430 000 Whitefronts breed, i.e. more than 50% of the White-fronted Goose numbers counted at the wintering sites of the western Palearctic, a decrease in breeding densities of White-fronted and Bean Geese was found since the 1960s (Tab. 4).

	West-Taimyr / western Taimyr			**Ost-Taimyr / eastern Taimyr**		
Period(e)	**Brutdichte / breeding density (n/km²)**		**n**	**Brutdichte / breeding density (n/km²)**		**n**
	Anser albifrons	**Anser fabalis**	**Jahr/year**	**Anser albifrons**	**Anser fabalis**	**Jahr/year**
1950-59	5	5	-	5	5	-
1960-69	1.2 (0.3-1.7)	2.1 (1.7-2.5)	3	2.5 (1.5-4.0)	3.7 (1.5-6.0)	3
1970-79	0.2 (0.1-0.2)	0.2 (0.0-0.3)	3	1.3 (1.0-1.5)	1.8 (1.4-2.1)	2
1980-89	0.5 (0.2-0.9)	0.1 (0.0-0.2)	3	0.4 (0.1-0.9)	0.2 (0.1-0.6)	6
1990-95	0.3 (0.1-1.0)	0.1 (0.0-0.2)	3	0.3 (0.1-1.0)	0.1 (0.1-0.2)	3

Tab. 4. Brutdichte in Nester/km² von Bläß- und Saatgans seit den 1950er Jahren auf der Halbinsel Taimyr nach Schätzungen von Uspenski 1965 für die 1950er sowie nach Daten mehrerer Russischer Biologen (u.a. Chupin, Kokorev, Zirianov Pers.Mitt.) und eigener Daten (Untersuchtes Gebiet zwischen 10 und mehrere 100 km²).

Breeding densities in nests/km² of White-fronted and Bean Geese since the 1950s at the Taimyr Peninsula according to estimates of Uspenski 1965 for the 1950s and according to data of several Russian biologists (e.g. Chupin, Kokorev, Zirianov pers.comm.) as well as own data (areas investigated between 10 and several 100 km²).

Krivenko (1994) schätzte aufgrund großflächiger Untersuchungen aus den ersten Jahren der 1990er Jahre die Gänsedichte der gesamten Gänsepopulation auf der Halbinsel Taimyr (*Anser albifrons, Anser fabalis, Anser erythropus, Branta bernicla, Branta ruficollis*) auf 1-2 Individuen/km².

Obwohl die Schätzungen von Uspenski für die 1950er Jahre (Tab. 4) sicherlich zu hoch waren und diese Daten möglicherweise nicht repräsentativ für das gesamte Brutgebiet sind, sind die gefundenen Werte gut vergleichbar und zeigen eine fallende Tendenz. Seit den 1970er Jahren scheinen die Brutdichten beider Arten auf einem wesentlich niedrigeren Niveau als früher stabil zu sein.

Flint & Krivenko (1990) stellen fest, daß die eurasischen Populationen der Bläß- und Taigasaatgans (*Anser fabalis fabalis*) in Rußland stabil zu sein scheinen, während der Bestand der Tundrasaatgans (*Anser fabalis rossicus*) stark rückläufig ist.

Rogacheva (1992) stellt fest, daß die Taimyr Population der Bläßgans (geschätzte Populationsgröße ca. 430 000 Vögel, das sind über 50% des für die westpaläarktischen Wintergebiete geschätzten Gestamtbestandes der Bläßgans) seit den 40er Jahren stark abgenommen hat und sich gegenwärtig wahrscheinlich auf einem wesentlich niedrigeren Niveau als früher stabilisiert hat.
Für Saatgänse fand Rogacheva (1992) einen dramatischen Bestandsrückgang.

Neuerdings gibt es einige Teile des Brutgebietes, vornehmlich im Westen, wo eine zunehmende Tendenz örtlicher Brut-/Mauserpopulationen der Bläßgans gefunden wurde (Mineyev 1995, Ryabitsev 1995, Tomkovich et al. 1994). Der Trend bei der Saatgans zeigt dort jedoch auch weiterhin eine Abwärtstendenz (Chernichko et al. 1994, Ryabitsev 1995, Tomkovich et al. 1994).

Based on large scale studies Krivenko (1994) estimated the goose density (*Anser albifrons, Anser fabalis, Anser erythropus, Branta bernicla, Branta ruficollis*) for the Taimyr Peninsula to be 1-2 individuals/km².

Although the estimated breeding densities of Uspenski for the 1950s (Tab. 4) were surely too high and these data might be not representive for the whole breeding area, the values found seem to be very well comparable and show a decreasing tendency. Since the 1970s the numbers of both species seem to have stabilized at a much lower level than before.

Flint & Krivenko (1990) stated that the Eurasian populations of the White-fronted and Taiga Bean Goose (*Anser fabalis fabalis*) in Russia seem to be stable, whereas the numbers of the Tundra Bean Goose (*Anser fabalis rossicus*) are falling sharply.

Rogacheva (1992) stated that the White-fronted Goose population of the Taimyr Peninsula (estimated population size about 430 000 birds, i.e. more than 50% of the total Whitefront numbers estimated at the western palearctic wintering sites) has shown a sharp decrease since the 1940s but at present seems to stabilize at a considerably lower level.
For Bean Geese Rogacheva (1992) found a dramatic decrease.

Recently in some parts of the breeding areas, especially in the western part, increasing numbers of local breeding/moulting Whitefront populations were found (Mineyev 1995, Ryabitsev 1995, Tomkovich et al. 1994), but the overall trend for the Bean Goose in these areas continues to show a decrease (Chernichko et al. 1994, Ryabitsev 1995, Tomkovich et al. 1994).

Aufgrund 20-jähriger Untersuchungen betrachtet Kalyakin (1995) den Gesamtstatus der westsibirischen Bläßgans als unklar und stellt fest, daß die westliche Population der Saatgans (westlich der Yamal Halbinsel) zunimmt, während die Saatgansbestände der Gydan und Yamal Halbinsel rückläufig sind.

Der Bläßgansbestand für den europäischen Teil der Russischen Tundra wurde von Mineyev (1995) auf 100 000 - 180 000 Vögel geschätzt. Für die Taimyr-Halbinsel schätze Rogacheva (1992) den Bestand auf 400 000 - 450 000 Bläßgänse. Aufgrund dieser Bestandsschätzungen, der Größe des Brutgebietes und einer geschätzten Größe der Brutpopulation von 30% des Gesamtbestandes, wurde eine durchschnittliche Brutdichte von 0,17 Nester/km² und ein Gesamtbestand von 250 000 - 300 000 Bläßgänse für die Halbinsel Yamal und Gudan errechnet. Damit ergibt sich für die gesamte westpaläarktische Bläßganspopulation eine Bestandsgröße von ca. 840 000 Vögeln (Tab. 5, Mooij 1996).

Nach Bestandsschätzungen findet man in den westpaläarktischen Brutgebieten auf der nordrussischen Tundra 250 000 - 400 000 Saatgänse, auf den Halbinseln Yamal und Gydan 250 000 - 400 000 Saatgänse sowie eine unbekannte kleine Zahl von Saatgänsen westlich des Piassina Flusses auf der

Based on the results of 20 years of research Kalyakin (1995) considers the status of the western siberian White-fronted Goose to be unclear and reports that the Bean Goose numbers on the breeding grounds west of the Yamal Peninsula have increased, whereas the numbers on the Gydan and Yamal Peninsulas have decreased.

For the European part of the Russian Tundra Mineyev (1995) estimated the number of Whitefronts between 100 000 and 180 000 and Rogacheva (1992) estimated the Whitefront population of the Taimyr Peninsula between 400 000 and 450 000 birds. Based on these population estimates, the size of the breeding area and an assumed recrutement rate of 30% the mean breeding density is 0.17 nests/km² and the population of Yamal and Gydan Peninsulas can be calculated at 250 000 - 300 000 Whitefronts. According to these data the whole western palearctic population of the White-fronted Goose has to be estimated at about 840 000 birds (Tab. 5, Mooij 1996).

According to population estimates of the western palearctic breeding grounds there are 250 000 - 400 000 Bean Geese on the northern Russian tundra, 250 000 - 400 000 Bean Geese on the Yamal and Gydan Peninsulas as well as an unknown small number of Bean Geese west of

Brutgebiet	gesch. Brutgebiets-größe in qkm	Größe der Bläßganspopulation			Ø Brutdichte in Nester/qkm
		gesch. Bestand	Ø	Autor	
Breeding area	estimated size of breeding area in skm	Size of White-fronted Goose population			Ø breeding densit in nests/skm
		estimated number	Ø	author	
Kanin-Vaygach I.	120 000	100 000 - 180 000	140 000	Mineyev 1995	0.18
Yamal-Gydan	250 000	250 000 - 300 000	275 000	Mooij 1996	0.17
Taimyr	400 000	400 000 - 450 000	425 000	Rogacheva 1992	0.16
Westl. Paläarktis / Western Palearctic	770 000	750 000 - 930 000	840 000		0.17

Tab. 5. Geschätzte Bestandsgröße und -verteilung der westpaläarktischen Bläßganspopulation im Brutgebiet nach Mineyev 1995, Mooij 1996 und Rogacheva 1992.

Estimated population size and distribution of western palearctic White-fronted Goose in the breeding area according to Mineyev 1995, Mooij 1996 and Rogacheva 1992.

Halbinsel Taimyr (Krivenko 1994, Mineyev 1990 & 1995, Rogacheva 1992, Ryabitsev 1995).

Für die ostpaläarktischen Saat- und Bläßgansbestände wurde einhellig eine rückläufige Tendenz festgestellt (Degtyarev 1995, Flint & Krivenko 1990, Syroechkovski Sr. 1995, Syroechkovski Jr. 1995).

Für die 1980er Jahre schätzten Flint & Krivenko (1990 & pers.Mitt.) den gesamtrussischen Bestand der Bläßgans auf ca. 1,3 Mio und den der Saatgans auf über 1-1,5 Mio Vögel. Anfang der 1990er Jahre schätzte Krivenko (1994) die Gesamtbestandsgröße der eurasischen Bläßgans auf ca. 1 Mio und die der Saatgans auf 1,1 Mio Vögel.

Zusammenfassend kann man also feststellen, daß es aufgrund der Daten aus den paläarktischen Brutgebieten, trotz deutlicher Zunahme der Saat- und Bläßganszahlen in den Wintergebieten West-Europas, keinen Grund gibt, von einer Zunahme der eurasischen Bläß- und Saatgansbestände auszugehen.

Es scheint, daß die westpaläarktischen Populationen der beiden Arten zur Zeit insgesamt stabil sind, während die Bestände beider Arten in der gesamten Ost-Paläarktis eine rückläufige Tendenz zeigen, was die von Flint & Krivenko (1990) und Krivenko (1994) gefundene rückläufige Tendenz der Gesamtbestände erklären würde.

Aufgrund der im westeuropäischen Winterareal durchgeführten Zählungen, entstand seit den 60er Jahren die Meinung, daß die Bestände von Saat- und Bläßgans in der gesamten westlichen Paläarktis stark zugenommen haben müssen.

Seit Beginn regelmäßiger internationaler Gänsezählungen in den 1950er Jahren stellte man fest, daß die Bestände der Bläß- und Saatgans auf den meisten westeuropäischen Winterrastplätzen stark zunahmen (Kapitel 5 & 8).

the Piassina River on the Taimyr Peninsula (Krivenko 1994, Mineyev 1990 & 1995, Rogacheva 1992, Ryabitsev 1995).

All studies show a decrease in the eastern palearctic populations of Bean and White-fronted Goose (Degtyarev 1995, Flint & Krivenko 1990, Syroechkovski Sr. 1995, Syroechkovski Jr. 1995).

For the 1980s Flint & Krivenko (1990 & pers. comm.) estimated the all-Russian population of the White-fronted Goose at about 1.3 million and that of the Bean Goose at about 1-1.5 million individuals. At the beginning of the 1990s Krivenko (1994) estimated the all-Russian population of the White-fronted Goose at about one million and that of the Bean Goose at about 1.1 million individuals.

To summarize it can be stated that, based on data gathered in the palearctic breeding areas, there are no indications that there had been an increase in the numbers of White-fronted and Bean Geese in the Eurasian breeding areas in spite of the clear increase in the numbers of both species at the wintering sites of western Europe.

At present the western palearctic populations of both species seem to be stable, whereas the eastern palearctic populations of both species seem to be decreasing, which could explain the decreasing tendencies for the total Eurasian populations found by Flint & Krivenko (1990) and Krivenko (1994).

The goose counts at the western European wintering sites have given rise to the opinion since the 1960s that the western Palearctic White-fronted and Bean Goose populations must have increased considerably.

Since the start of regular international goose counts in the 1950s, it has been ascertained that the wintering populations of White-fronted and Bean Goose at most of the western European wintering sites have increased rapidly (Chapters 5 & 8).

Die Ausdehnung der regelmäßigen Bestandserfassungen auf den übrigen Gänserastplätzen Europas zeigte jedoch bald, daß trotz der enormen Zunahme der Gänsezahlen in West-Europa nicht von einer generellen Bestandszunahme der westpaläarktischen Bläß- und Saatganspopulationen gesprochen werden kann. In Südost-Europa stellte man starke Bestandsrückgänge bei Bläß- und Saatgans fest, während die grönländische Subspezies der Bläßgans (*Anser albifrons flavirostris*), die auf den britischen Inseln überwintert, gerade ein Bestandstief überwunden hat und sich langsam erholte (Tab. 6; Kapitel 8).

After including the other European goose wintering sites in the regular goose counts it was shown that in spite of the explosive development of goose numbers in western Europe, it is not clear at all if there is a general increase in the western palearctic White-fronted and Bean Goose populations. In southeastern Europe a sharp decline in the numbers of both species was found and the population of the Greenland Whitefront (*Anser albifrons flavirostris*), wintering at the British Isles, is recovering slowly from a very low population level (Tab. 6; Chapter 8).

BLÄßGANS / WHITE-FRONTED GOOSE (*Anser albifrons*)					
Periode	Nordsee-Ostsee-Gruppe	Pannonische Gruppe	Pontische-Anatolische Gruppe	Populationsgröße	Autor
Period	Baltic-North sea group	Pannonic group	Pontic-Anatolian group	Population size	Author
1950-60	10 000 - 50 000	400 000 - 500 000	?	-)*)**	BG 68, U 65
1960-70	50 000 - 100 000	100 000 - 150 000	500 000 - 600 000	ca. 775 000)**	BG 68, CS 77, Tea 76, P 72
1970-80	200 000 - 300 000	100 000 - 175 000	250 000 - 300 000	ca. 675 000)**	L 90, PF 90, S 80, Ru 87
1980-90	400 000	100 000	250 000	ca. 750 000)**	M 91 & 92
1990-93	400 000 - 600 000	10 000 - 40 000	350 000 - 700 000	ca. 1 050 000	RT 93, RS 94, R 95

SAATGANS / BEAN GOOSE (*Anser fabalis*)				
Periode	West-Europa	Südost-Europa	Populationsgröße	Autor
Period	Western Europe	Southeastern Europe	Population size	Author
1960-70	ca. 50 000)*	ca. 100 000)*	ca. 150.000)*)**	BG 68, Tea 76
1970-80	150 000 - 250 000	50 000 - 100 000	200 000 - 350 000)**	BG 68, B 85, CS 77, F 82, Ru 87
1980-90	200 000 - 250 000	100 000 - 150 000	300 000 - 400 000)**	Fea 91, M 91 & 92
1990-93	250 000 - 320 000	30 000 - 60 000	280 000 - 380 000	RT 93, RS 94, R 95

Tab. 6. Geschätzte Populationsgröße der westpaläarctischen Bläß- und Saatgänse seit 1950 bzw. 1960 nach Schätzungen von Bauer & Glutz von Blotzheim 1968 (BG 68), Bezzel 1985 (B 85), Cramp & Simmons 1977 (CS 77), Faragó et al. 1991, Fog 1982 (F 82), Lysenko 1990 (L 90), Madsen 1991 & 1992 (M 91 & 92), Philippona 1972 (P 72), Pirot & Fox 1990 (PF 90), Rose 1995 (R 95), Rose & Taylor 1993 (RT 93), Rose & Scott 1994 (RS 94), Rutschke 1987 (Ru 87), Scott 1980 (S 80), Timmerman et al. 1976 (Tea 76) und Uspenski 1965 (U 65).
( )* = unvollständige Zählung,)** = keine Zählungen aus der Ukraine und nur unregelmäßige Zählungen aus einigen weiteren Staaten, die seit den 1990er Jahren große Gänsezahlen zum Total beitragen).

Estimated population size of western palearctic White-fronted and Bean Goose since the 1950s resp. 1960s according to estimates of Bauer & Glutz von Blotzheim 1968 (BG 68), Bezzel 1985 (B 85), Cramp & Simmons 1977 (CS 77), Faragó et al. 1991, Fog 1982 (F 82), Lysenko 1990 (L 90), Madsen 1991 & 1992 (M 91 & 92), Philippona 1972 (P 72), Pirot & Fox 1990 (PF 90), Rose 1995 (R 95), Rose & Taylor 1993 (RT 93), Rose & Scott 1994 (RS 94), Rutschke 1987 (Ru 87), Scott 1980 (S 80), Timmerman et al. 1976 (Tea 76) and Uspenski 1965 (U 65).
( )* = incomplete count,)** = no counts from Ukraine and only irregular counts from some other states, which contribute considerable numbers to the totals since the 1990s).

Zählt man die seit Mitte dieses Jahrhunderts aufgrund der Gänsezählungen in den einzelnen Teilen Europas geschätzten Bestände der Bläß- und Saatgans zusammen, dann zeigt sich keine große Bestandszunahme, sondern eine relativ konstante Bestandsgröße von 700 000 - 1 Mio. Bläß- und ca. 400 000 Saatgänsen (Tab. 6).
Obwohl die Gänsezahlen aus Südost-Europa sicherlich noch lückenhaft und weniger zuverlässig sind, gab es keine wesentlichen Änderungen im Deckungsgrad zwischen den Zählungen der 1960er, 1970er und 1980er Jahre, so daß vorsichtige Vergleiche der einzelnen Perioden möglich sind.

Aufgrund dieser Daten scheint es, daß es statt einer starken Zunahme der westpaläarktischen Gesamtpopulationen beider Arten in den letzten 40 Jahren vielmehr größere innereuropäische Verlagerungen von Überwinterungsschwerpunkten der Bläß- und Saatgänse von Südost- nach West-Europa gegeben hat (Tab. 6, Kapitel 5 & 8).
Die Hypothese einer bedeutenden innereuropäischen Verschiebung von Überwinterungsschwerpunkten von Südost- zu West-Europa wird durch einer Reihe von Hinweisen unterstützt.

Aufgrund der in den westeuropäischen Gänsewintergebieten gezählten Saat- und Bläßgansbestände (Tab. 6) und die für die verschiedenen Teile des westpaläarktischen Brutgebietes geschätzten Bestandsgrößen beider Arten (Tab. 5), kann zumindest für die Bläßgans festgestellt werden, daß spätestens während der 1980er Jahre wenigstens ein Teil der Vögel der östlichsten Teile des westpaleärktischen Brutgebietes den Winter in West-Europa verbracht haben muß, da die dortigen Winterbestände die geschätzte Bestandsgröße der Art im westlichen Teil des Brutareals überschritten.

Based on a summation of the estimated population size of White-fronted and Bean Goose wintering in different parts of the western palearctic wintering area since the 1950s there is no indication of an increase of both populations. On the contrary these counts indicate more or less stable levels for both species of 700 000 - 1 million White-fronted and about 400 000 Bean geese (Tab. 6).
Although the goose numbers from eastern Europe surely must be regarded as far from complete and rather unreliable, there was no major change in the reliability of data during the 1960s, 1970s and 1980s, which means that a careful comparison of the estimates of these periods seems possible.

Based on these data it seems that, instead of a sharp increase in the population size of both species in the western Palearctic in the last four decades, there has been a major shift of White-fronted and Bean Goose numbers from southeastern to northwestern Europe (Tab. 6, Chapters 5 & 8).
This hypothesis of a major shift of wintering goose numbers from the wintering sites of southeastern to the sites of western Europe is supported by a number of indications.

Based on the numbers of Bean and White-fronted Geese counted at the wintering sites of western Europe (Tab. 6) and on the numbers of both species estimated for the different parts of the breeding grounds of the western Palearctic (Fig. 5), it can be stated in case of the White-fronted Goose that at least since the 1980s part of the birds of the easternmost western palearctic breeding grounds of the species must have been wintering in western Europe, because the estimated number at these wintering sites surmounted the numbers estimated for the western parts of the western palearctic breeding range.

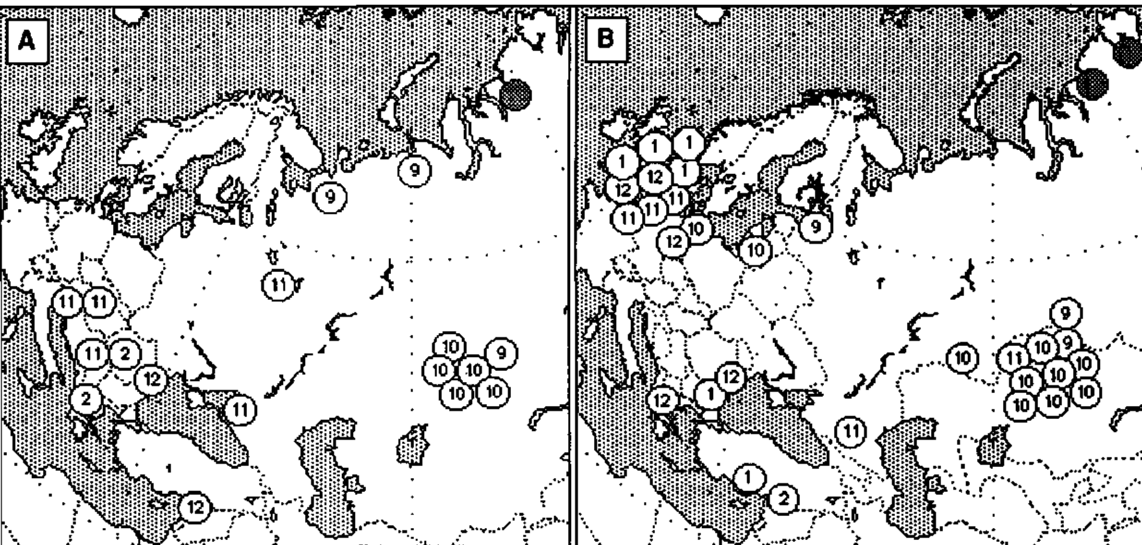


Fig. 11. Herbst- und Winterrückmeldungen geschossener Bläßgänse die auf der Taimyr Halbinsel zwischen 1966 und 1970 mit Metalringen durch Borzhonov 1975 (A) und zwischen 1989 und 1992 durch Mooij et al. (Kapitel 5) mit farbigen Beinringen und Halsbändern beringt wurden (B) (Die Nummer geben den Rückmeldungsmonat an).

Autumn and winter recoveries of shot White-fronted geese ringed at Taimyr Peninsula with metal rings between 1966 and 1970 in the scope of soviet ringing programmes after Borzhonov 1975 (A) and marked with coloured legrings and neck-collars between 1989 and 1992 (B) by Mooij et al. (Chapter 5) (The numbers refer to the month of recovery).

Auch könnten die Unterschiede in der Verteilung der Rückmeldungen geschossener Bläßgänse, welche auf der Taimyr Halbinsel Ende der 1960er Jahre von Borzhonov (1975) und seit 1989 vom gemeinsamen Deutsch-Niederländisch-Russischen Beringungsprogramm beringt worden sind, auf eine Änderung von Wanderwegen und eine Verschiebung von überwinternden Gänsen von den östlichen zu den westlichen Teilen des Winterareals hinweisen (Fig. 11; Kapitel 5).

Verlagerungen von Wintergebieten scheinen bei Gänsen häufiger vorzukommen.
Die Rothalsgans (*Branta ruficollis*) hat seit den 1950er Jahren das Wintergebiet von der Südküste des Kaspischen Meeres zur Westküste des Schwarzen Meeres verlegt (Alferaki 1904, Kostin & Mooij 1995, Rutschke 1987, Vinokurov 1982 & 1990). Alferaki (1904) beschreibt, daß die Zugwege der Bläßgans häufiger wechseln und daß die wichtigsten Wintergebiete in Großbritannien, Belgien, den Niederlanden und im gesamten mediteranen Becken, insbesondere in Ägypten liegen.

Further the differences in distribution of the recoveries of shot White-fronted Geese marked at the Taimyr Peninsula by Borzhonov (1975) at the end of the 1960s and by the joint German-Netherlands-Russian marking programme since 1989 could indicate a change of migratory routes and a shift of wintering birds from the eastern to the western part of the wintering range (Fig. 11; Chapter 5).

Changes of wintering sites seem to happen more frequently in goose species.
The Red-breasted Goose (*Branta ruficollis*) have shifted from the traditional wintering sites south of the Caspian Sea to the western coast of the Black Sea since the 1950s (Alferaki 1904, Kostin & Mooij 1995, Rutschke 1987, Vinokurov 1982 & 1990). Alferaki (1904) described that the migratory routes of White-fronted Geese changed more frequently and that their most important wintering sites in the last century were in Great Britain, Belgium, Holland and the whole Mediterranean basin, especially Egypt.

Die Wintergebiete im südlichen mediteranen Becken wurden spätestens während der ersten Hälfte dieses Jahrhunderts verlassen (Philippona 1972, Timmerman 1976, Timmerman et al. 1976.)

Vorhandene Literatur über die Zahl überwinternder Gänse in Asien (Perennou et al. 1990, Rogacheva 1992, Scott & Rose 1989, Rose & Scott 1994, Van der Ven 1987 & 1988, Yokota et al. 1982) zeigt, daß die Zählungen in diesem Raum zwar noch sehr unvollständig sind, aber ebenso, daß insgesamt ein deutlicher Abwärtstrend besteht.

Aus diesen Daten läßt sich ableiten, daß man auf die paläarktischen Bestände der Saat- und Bläßgans bezogen, nicht von einer Zunahme sprechen kann. Die westpaläarktischen Bestände beider Arten scheinen stabil und die ostpaläarktischen Bestände wahrscheinlich rückläufig. Dieses Bild deckt sich gut mit den Ergebnissen der vorhin aufgeführten Bestandsschätzungen aus den Brutgebieten.

Insgesamt wird klar, daß eine regionale Betrachtung der Bestandsentwicklung wandernder Tierarten außerordentlich gefährlich sein kann und leicht zu Fehlschlüssen führt. Die geschilderte Entwicklung, wobei nach einer längeren Periode der Abnahme, nicht nur eine starke Zunahme beider Arten im relativ gut bezählten westeuropäischen Wintergebiet, sondern auch ein starker Rückgang in den weniger gut bezählten Wintergebieten Südost-Europas sowie in der gesamten Ost-Paläarktis festgestellt wurde, steht nicht vereinzelt dar.

Eine Analyse der Wasservogelbestände auf dem Territorium der ehemaligen UdSSR, von Mitte des 19. Jahrhunderts bis heute, zeigt, daß die gesamte Wasservogelpopulation von ca. 350 Mio. Vögeln zur Mitte des 19. Jahrhunderts bis auf ein mehr oder weniger stabiles Niveau von 85 Mio. Vögeln in den 1980er und 1990er Jahren zurückging (Flint & Krivenko 1990, Krivenko 1994, Tab. 7).

The haunts in the southern part of the Mediterranian basin were abandonned at the latest during the first half of this century (Philippona 1972, Timmerman 1976, Timmerman et al. 1976).

Literature on the numbers of geese wintering in Asia (Perennou et al. 1990, Rogacheva 1992, Scott & Rose 1989, Rose & Scott 1994, Van der Ven 1987 & 1988, Yokota et al. 1982) shows that the counts are still incomplete in this area and that the numbers of wintering geese in the region are in sharp decline.

From these data it becomes clear that it is not tenable to state that there is an increase of the palearctic populations of White-fronted and Bean Goose. The western palearctic population of these species seem to be stable and the eastern palearctic populations decreasing. This picture of the status of the Eurasian populations of both species reflects quite accurately the previously described results of the studies on goose status in the breeding areas.

It becomes clear that a regional view of the population development of migratory species is beset with difficulties and easily leads to false conclusions. The described development whereby an increase in the numbers of both species in the relatively well monitored northwestern European part of the living range and a decrease in the still unsatisfactorily monitored southeastern part of the western palearctic living range, whereas in the eastern palearctic a sharp decline in numbers was found, is not unique.

An analysis of the waterfowl populations on the territory of the former USSR from the middle of the 19th century to the present showed that the total populations declined from 350 million at the middle of the 19th century to a more or less stable level of about 85 million birds during the 1980s and 1990s (Flint & Krivenko 1990, Krivenko 1994, Tab. 7).

Periode / Period	ca. 1850	1945-1950	ca. 1965	1980-1985	1990-1994
Vegetationszonen / Natural zone					
Aride & semi-aride Zone / arid & semi-arid zone	50	35	12	10	30
Taiga Zone / taiga zone	250	150	70	60	39
Waldtundra & Tundra / forest-tundra & tundra	50	35	18	15	18
Total	**350**	**220**	**100**	**85**	**87**

Tab. 7. Veränderungen in den Anzahlen von Anseriformes (in Mio.) auf dem Territorium der ehemaligen UdSSR von der Mitte des 19. Jahrhunderts bis zum Anfang der 1990er Jahre nach Flint & Krivenko (1990) und Krivenko (1994).

Changes in the Anseriformes numbers (in millions) on the territory of the former USSR from the middle of the 19th century until the beginning of the 1990s according to Flint & Krivenko (1990) and Krivenko (1994).

Die Wasservogelbestände im östlichen Siberien wurden von Krivenko (1994) Anfang der 1990er Jahre auf etwa die Hälfte des von Flint & Krivenko (1990) für die 1980er Jahre angenommenen Niveaus geschätzt.

Die Schätzungen der Populationsgröße mehrerer Entenarten (z.B. *Anas platyrhynchos, Anas penelope*) zeigen eine mit der Populationsentwicklung der beschriebenen Gänsearten vergleichbaren Populationsentwicklung mit Zunahmen in Nordwest- und Rückgängen in Südost-Europa und Südwest-Asien (Rose & Scott 1994).

Für die in West-Europa überwinternden Saat- und Bläßgänse wurde von Bauer & Glutz (1968), Grimpe (1933) und Schlegel (1877) ein starker Rückgang in der zweiten Hälfte des 19. Jahrhunderts und von Alferaki (1904) für die gleiche Periode eine auffällige Veränderung von Wanderwegen für beide Arten beschrieben.

Diese Fakten unterstützen die für Bläß- und Saatgans beschriebene Populationsentwicklung und könnten darauf hinweisen, daß die für beide Arten beschriebene Entwicklung Teil eines allgemeinen Prozesses ist.

Während ihrer Wanderung durch Rußland, Weißrußland, die baltischen Staaten, Kasachstan, die Ukraine, Polen, Deutschland und Ungarn sowie in den Wintergebieten der Niederlande, der Balkanstaaten und der Türkei werden Gänse intensiv bejagt.

The waterfowl populations of eastern Sibiria at the beginning of the 1990s were estimated by Krivenko (1994) at a level that was about half of the level they were estimated for the 1980s by Flint & Krivenko (1990).

The population estimates of several duck species (e.g. *Anas platyrhynchos, Anas penelope*) show a similar population development as the described goose species with increasing populations in northwestern and decreasing populations in southeastern Europe and southwestern Asia (Rose & Scott 1994).

For the Bean and White-fronted geese wintering in western Europe Bauer & Glutz (1968), Grimpe (1933) and Schlegel (1877) described a dramatic decrease in numbers during the second half of the 19th century and Alferaki (1904) reported considerable changes of migratory routes of both species during the same period.

These data support the described population development of White-fronted and Bean Goose and could indicate that this development is part of a more general proccess.

Both during migration through Russia, Belarus, the Baltic states, Kazakhstan, Ukraine, Poland, Germany and Hungary as well as on the wintering grounds in the Netherlands, the Balkan states and Turkey, geese are heavily hunted.

Land / Country	Geschätzte Gänsestrecke/Jahr Estimated annual goose bag	Autor / Author
Ehem. UdSSR (west) / Former USSR (west)	200 000	Priklonski & Sapetina 1990
Polen / Poland	12 000	Landry 1990, Wieloch 1992
Dänemark / Denmark	12 000 - 13 000	Jepsen & Madsen 1992
Schweden / Sweden	7 500	Hedlund 1992
Deutschland / Germany	10 000	Mooij 1991b & 1992a, Wiese 1991
Niederlande / The Netherlands	35 000 - 50.000	Oosterbrugge et al. 1992, Wiese 1991
Ungarn / Hungary	7 000 - 7 500	Faragó 1992 & Landry 1990
ehem. Tschechoslowakei / Former Czechoslowakia	ca.1 500	Urbanek 1992
Österreich / Austria	ca. 2 000	Dick 1992
Rumänien / Romania	ca. 5 000	Munteanu 1992
ehem. Jugoslavien / Former Yugoslavia	unbekannt / unknown	-
Bulgarien / Bulgaria	unbekannt / unknown	-
Türkei / Turkey	unbekannt / unknown	-
TOTAL	292 000 - 308 500	

Tab. 8. Geschätzte jährliche Gänsestrecke in der westlichen Paläarktis zwischen 1980 und 1990.

Estimated annual goose bag in the western Palearctic between 1980 and 1990.

Eine vorsichtige Schätzung der jährlichen Gänsestrecke in der Westpaläarktis, basierend auf vorliegenden unvollständigen Streckenangaben der 1980er Jahre (Tab. 8), ergibt eine jährliche Jagdstrecke von mindestens ca. 300 000 (vornehmlich *Anser*-) Gänsen.

Aufgrund dieser Schätzungen ist davon auszugehen, daß während der 1980er Jahre jährlich wahrscheinlich ca. 150 000 - 200 000 Bläß- und ca. 70 000 - 95 000 Saatgänse (ca. 20 % der westpaläarctischen Populationen beider Arten) geschossen wurden.

Hinzu kamen noch ca. 5% der Populationen, die aufgrund der indirekten Nebenwirkungen der Jagd, z.B. Krankschießen, Bleivergiftung, sterben (Ebbinge 1991, Kalchreuter 1994, Mooij 1990 & 1991b, Morehouse 1992), so daß während der 1980er Jahre durch die Jagd jährlich ca. 25 % den Beständen beider Populationen entzogen wurden. Über die gleiche Periode wurde die gesamte jährliche Mortalität bei der Bläßgans auf 27-37% und die jährliche Reproduktionsrate auf 30-38% geschätzt (Kapitel 8, Mooij 1994a & 1996, Mooij et al. 1995).

Der Jagddruck im Westen Europas hat in den letzten Jahrzehnten ständig zugenommen.

According to conservative estimates in the 1980s at least about 300 000 geese (Tab. 8) were killed annually by hunters on the migratory routes of the Western Palearctic (mainly *Anser* geese).

Based on these estimates it can be assumed that during the 1980s likely about 150 000 - 200 000 White-fronted and about 70 000 - 95 000 Bean Geese (i.e. about 20 % of the western palearctic populations of both species) were bagged by hunters every year.

Added to this each year a further 5% of these populations was killed by indirect effects of shooting, e.g. crippling loss, lead poisoning (Ebbinge 1991, Kalchreuter 1994, Mooij 1990 & 1991b, Morehouse 1992). According to these estimates the overall annual mortality of White-fronted and Bean Geese caused by hunting during the 1980s has to be estimated at about 25 %. Over the same period the overall annual mortality rate in White-fronted geese was estimated at 27-37% and the annual reproduction rate at 30-38% (Chapter 8, Mooij 1994a & 1996, Mooij et al. 1995).

During the past decades there has been a steady increase in the hunting pressure on geese wintering in western Europe.

In Deutschland nahm die jährliche Gänsestrecke von 7 000 - 8 000 zu Anfang der 1980er, über ca. 10 000 in der zweiten Hälfte der 1980er auf 25 000 - 31 000 Gänse Anfang der 1990er Jahre zu. Auch in den Niederlanden stieg die Gänsejagdstrecke seit den 1970er Jahren von weniger als 10 000 auf 35 000 - 50 000 Mitte der 1980er und 60 000 - 70 000 (vornehmlich Bläß-) Gänse Anfang der 1990er Jahre an. Die Situation im Osten Europas und im Westen Asiens ist zur Zeit unklar.
Da diese regionale Zunahme der jagdlichen Nutzung sich nur an der regionalen Entwicklung der Gänsebestände orientiert und es bisher keine lebensraumübergreifende Koordination bei der Jagdausübung auf diese wandernden Arten gibt (z.B. Begrenzung von Jagdstrecken und Jagdzeiten), kann die gegenwärtige Bejagung leicht zu einer Existenzbedrohung der westpaläarktischen Gänsearten werden (Kapitel 8).

Auch bei dem Schutz der Gänserastgebiete ist die Situation noch nicht optimal. Obwohl einige Winter- und Durchzugsrastplätze (vornehmlich im Nordwesten Europas) sowie Teile des Brutgebietes der Bläß- und Saatgänse mehr oder weniger geschützt sind, sind beide Arten sowie ihre Rastplätze in einem Großteil des Lebensraumes ungeschützt (Roomen 1989).

Damit ist die Schutzsituation der Saat- und Bläßgänse im größten Teil des Gesamtlebensraumes als unbefriedigend einzustufen.

4. Management von Gänsepopulationen.

Anhand der Ergebnisse und Schlußfolgerungen der Kapitel 3-8 werden im Folgenden einige Vorschläge für ein effektives Management der überwinternden Gänse am Unteren Niederrhein im Rahmen eines gesamtlebensraumübergreifenden Konzeptes unterbreitet.

In Germany the annual goose bag increased from 7 000 - 8 000 at the beginning of the 1980s, to about 10 000 in the second half of the 1980s and to 25 000 - 31 000 geese at the beginning of the 1990s. In the Netherlands the goose bag increased from less than 10 000 in the 1970s, to 35 000 - 50 000 at the middle of the 1980s and to 60 000 - 70 000 (mainly White-fronted) geese at the beginning of the 1990s. The present situation in eastern Europe and western Asia is unclear.
Because this regional increase in hunting pressure is based on the regional development of goose populations only, without any coordination of the hunting pressure througout the living range (e.g. regulations of hunting seasons and bag limits) the present form of hunting of these migratory species easily could become a threat for the long-term survival of western palearctic geese (Chapter 8).

The situation is far from optimal with respect to the protection of goose sites. Some of the wintering and stopover sites (most of them in northwestern Europe) and parts of the breeding areas of the White-fronted and Bean Goose are more or less protected, but both species as well as their sites are unprotected in most of the range (Roomen 1989).

Because of these facts it has to be stated that the overall protection situation of the White-fronted and Bean Goose is unsatisfactory in most of the range.

4. Management of goose populations.

Based on the results and conclusions of chapters 3-8 proposals for effective management of the wintering geese of the Lower Rhine area in the scope of a management concept for the whole range will be made.

Für ein effektives Gänsemanagement ist es notwendig, auf drei Ebenen zu arbeiten: international, national und regional.
Die wichtigsten Aufgaben sind:

- Schutz von Brutgebieten und Rastplätzen,
- Koordination der Jagdausübung,
- Koordination von Forschung und Monitoring.

4.1. Internationales Gänsemanagement.

Mit der Bonner und Ramsar Konvention wurde ein internationaler Rahmen für den Schutz wandernder Wasservogelarten und ihrer Habitate geschaffen, der durch weitere Detaillierungen auf internationaler und nationaler Ebene praktisch umsetzbar gemacht werden muß.
Das internationale Wasservogelabkommen unter der Bonner Konvention (Agreement on the Conservation of African-Eurasian Migratory Waterbirds) ist ein weiterer Schritt zur Konkretisierung des technischen Rahmens für den Wasservogelschutz im Gebiet des Abkommens, ist jedoch zur Zeit noch nicht in Kraft. Das Abkommen soll mittels Aktionsplänen und Schutzrichtlinien bis auf das Niveau von Arten präzisiert und praktisch umsetzbar gemacht werden.

Das im Rahmen der Ramsar Konvention angestrebte weltweite Biotopverbundsystem von Feuchtgebieten zeigt sich in Europa als noch recht lückenhaft, insbesondere im Osten Europas (Fig. 12). Es erfüllt deshalb noch nicht die Anforderungen eines Biotopverbundes von Wasservogelhabitaten gemäß Ramsar und Bonner Konvention und ist im Rahmen des Gänseschutzes nur begrenzt nutzbar (Mooij 1994b).

Als wichtige wissenschaftliche Basis für die Umsetzung der genannten Abkommen gilt das Monitoring.

To reach effective goose management it is necessary to work at three different levels: international, national and regional.
The most important aspects are:

- Protection of breeding and stopover sites,
- Coordination of hunting,
- Coordination of research and monitoring.

4.1. International goose management.

With the Bonn and Ramsar Convention an international framework was developed to protect migratory Waterfowl and their habitats, that need to be specified at the international as well as at a national level in order to become implemented.
The international waterfowl agreement under the Bonn Convention (Agreement on the Conservation of African-Eurasian Migratory Waterbirds) is a further step to specify the technical framework for the protection of waterfowl in the agreement area, but is not yet in force. The agreement will be specified for implementation by action plans and conservation guidelines down to the species level.

In the scope of the Ramsar Convention it is planned to create a worldwide net of wetlands. In Europe this network still show enormous gaps, especially in eastern Europe (Fig. 12).
The present network of Ramsar sites cannot fulfill the demands of a network of waterfowl habitats in the scope of the Ramsar and Bonn Convention and still is an inadequate network in the scope of a goose management strategy (Mooij 1994b).

Monitoring is an important scientific basis for the implementation of the above mentioned conventions and agreement.

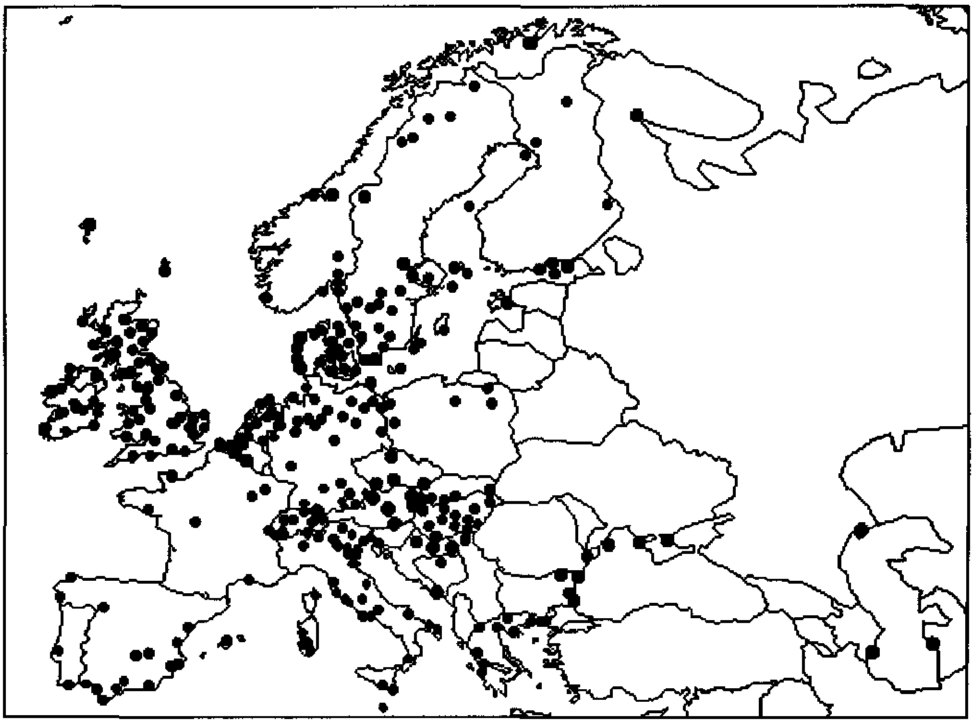


Fig. 12. Angemeldete Ramsar-Gebiete in Europa (Stand: Ende 1994).

Designated Ramsar sites in Europe (status: end of 1994).

Das internationale Wasservogelmonitoring hat in den letzten Jahrzehnten enorme Fortschritte gemacht, kann jedoch bis heute die von der Politik gestellten Anforderungen noch nicht erfüllen; die Bestandsschätzungen vieler Arten sind noch zu ungenau, um verantwortungsvolle Management-Entscheidungen zu begründen.

Grund für diese Mängel ist der noch immer mangelhafte Deckungsgrad der internationalen Wasservogelzählungen, insbesondere in Süd- und Ost-Europa, sowie Koordinationsschwierigkeiten zwischen Nachbarstaaten (Mooij 1992b & 1996, Rose 1995).

Für die Wasservogelforschung wurden in den letzten Jahren eine Reihe von internationalen Strukturen entwickelt, die den Austausch von Forschungsergebnissen erleichtern sollen. Insgesamt muß jedoch festgestellt werden, daß eine gezielte internationale Forschungskoordination und Forschungsfinanzierung ebenso fehlt wie eine internationale Koordination der Jagdausübung.

International waterfowl monitoring has made enormous progress during the last decades, but has still not reached a level suitable to serve the political demands; the population estimates of a number of species still are too uncertain to form a solid basis for responsible management decisions.

The shortcomings of the monitoring are based on gaps in the network of the international goose counts, especially in southern and eastern Europe as well as problems coordinating counts between neighbouring countries (Mooij 1992b & 1996, Rose 1995).

In the last few years a number of international structures were developed to improve the exchange of results of different waterfowl research programmes, but there is no specific international coordination or funding of research. Likewise there is no international regulation or coordination of hunting activities.

4.2. Nationales Gänsemanagement.

Es gibt in Deutschland weder eine einheitliche Feuchtgebietsschutzkonzeption noch eine einheitliche Gänsemanagement- und Gänseschutzkonzeption. Naturschutz und damit auch Feuchtgebiets- und Gänseschutz ist Länderaufgabe.
In den einzelnen Bundesländern herrschen damit sehr unterschiedliche Bedingungen für den Gänseschutz.

In der Bundesrepublik Deutschland liegt der Schwerpunkt der für Gänse wichtigen Gebiete eindeutig im Norden der Republik, in den Bundesländern Brandenburg, Mecklenburg-Vorpommern, Niedersachsen, Nordrhein-Westfalen, Sachsen, Sachsen-Anhalt, Schleswig-Holstein und Thüringen (Kapitel 2 & 8, Mooij 1992a, 1994a & 1995a, Fig. 13).

4.2. National goose management.

In Germany there is no uniform wetland policy, no uniform goose management strategy and no uniform concept for goose protection. Nature conservation and thereby also wetlands and goose protection is organised at the level of the federal states.
The conditions for goose protection and goose management vary greatly between the federal states.

The main goose sites in Germany are situated in the northern part of the country in the federal states Brandenburg, Mecklenburg-Vorpommern, Niedersachsen, Nordrhein-Westfalen, Sachsen, Sachsen-Anhalt, Schleswig-Holstein and Thüringen (Chapters 2 & 8, Mooij 1992a, 1994a & 1995a, Fig. 13).

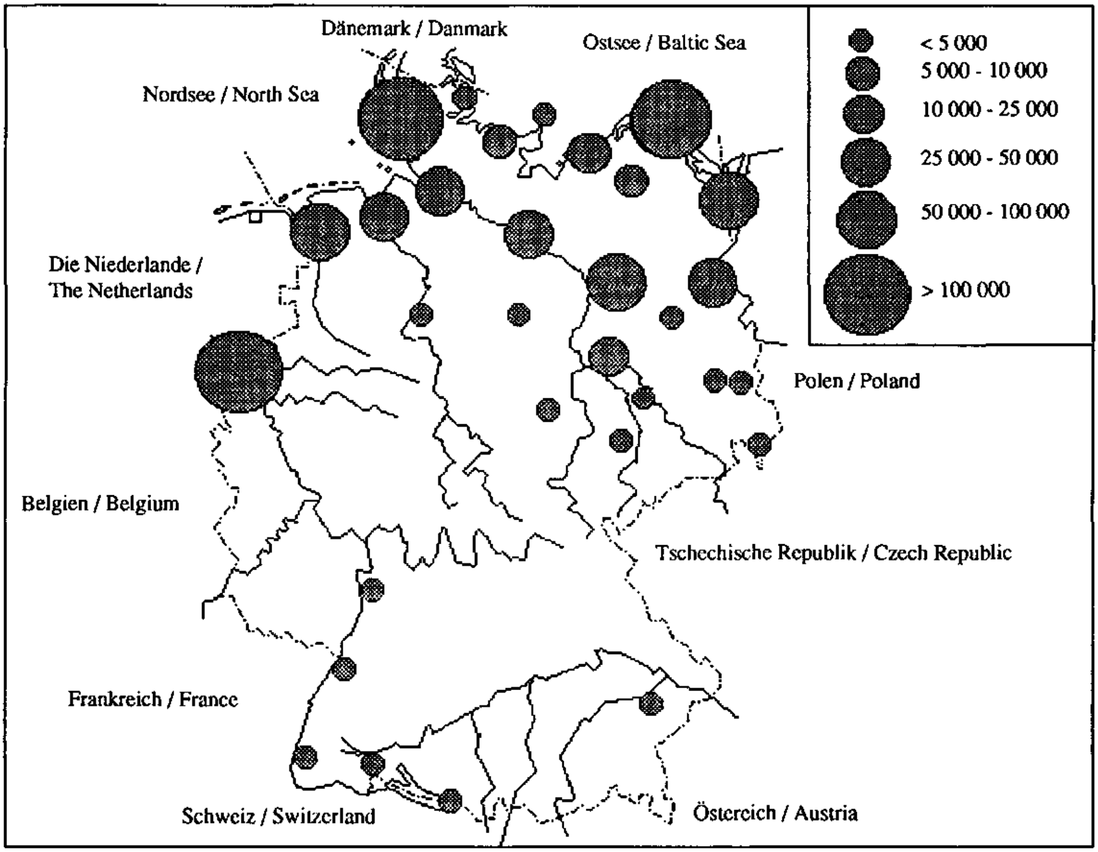


Fig. 13. Die wichtigsten Gänserastplätze in Deutschland 1988-1995 (Quelle ZWFD).
Main goose wintering sites of Germany 1988-1995 (source ZWFD).

Ein Teil der Gänserastplätze ist geschützt als Ramsar-Gebiet, Nationalpark, Naturschutzgebiet oder Landschaftsschutzgebiet. Dieser Schutzstatus bedeutet jedoch nicht, daß die Gänse ebenfalls geschützt sind, da die Gänsejagd in den meisten Fällen auch weiterhin erlaubt ist.
Als wichtige offizielle Begründung für die Gänsejagd werden meist Gänseschäden angeführt. Zur Verringerung von Schäden ist ein Verscheuchen weidender Gänse von landwirtschaftlichen Nutzflächen vielfach weiterhin erlaubt.

In Deutschland haben Ringel-, Kanada-, Saat- und Bläßgans (1. November - 15. Januar) sowie Graugans (August sowie 1. November - 15. Januar) eine Jagdzeit, die von den einzelnen Bundesländern in unterschiedlichem Maße ausgenutzt wird. So dürfen zur Zeit in Baden-Württemberg, Hessen, Rheinland-Pfalz und Thüringen Gänse nicht bejagt werden, während in Niedersachsen und Nordrhein-Westfalen die Jagd auf Bläß-, Saat-, Ringel- und Kanadagänse geschlossen ist.

Part of the German goose sites are protected as a Ramsar site, a national park, a nature protection area or a landscape protection area. This protection status does not mean that geese staying in the area also are protected, because in most cases goose shooting is still possible.
An important official reason for goose hunting is goose damage. To reduce goose damage in most sites it is even permitted to scare the geese from agricultural crops.

In Germany Brent, Canada, Bean and White-fronted Goose can be hunted between November 1 and January 15, Greylag Goose in August as well as between November 1 and January 15. These hunting seasons can be shortened or closed by the governments of the federal states. At present there is no hunting season for geese in the federal states of Baden-Württemberg, Hessen, Rheinland-Pfalz and Thüringen, no hunting season for Brent, Canada, Bean and White-fronted Goose in Niedersachsen and Nordrhein-Westfalen.

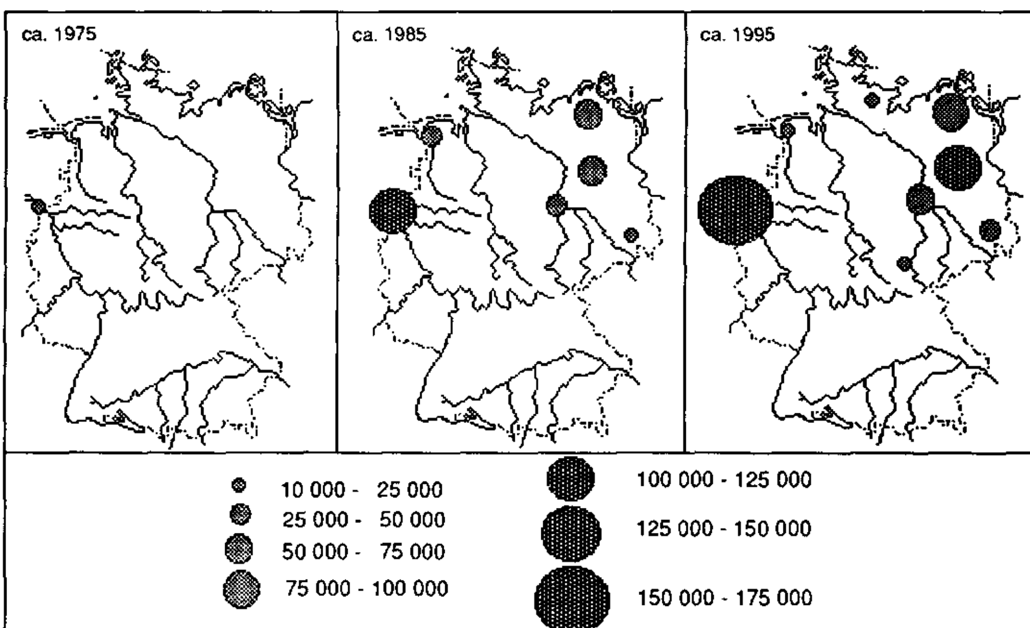


Fig. 14. Wichtigste Überwinterungsgebiete der Saat- und Bläßgänse in Deutschland während der internationalen Gänsezählungen in Januar für die 1970er, 1980er und die erste Hälfte der 1990er Jahren (Quelle ZWFD).

Main wintering sites of Bean and White-fronted Geese in Germany during the international January goose counts during the 1970s, the 1980s and in the first half of the 1990s (source ZWFD).

In Mecklenburg-Vorpommern wird nur die Ringelgans von der Jagd verschont und in Sachsen ist die Graugansjagd im August untersagt. In den übrigen Bundesländern gelten zur Zeit die maximalen Jagdzeiten der Bundesgesetzgebung (Kapitel 8, Wiese 1995).

Diese zwischen den Bundesländern unterschiedlichen jagdlichen Regelungen führen zu einem intensiven Jagdtourismus zwischen den Bundesländern. Bei der Festsetzung der länderbezogenen Jagdzeiten spielen vornehmlich regionale Aspekte eine Rolle.

Eine wichtige Begründung für den gestiegenen Jagddruck sind die in den letzten Jahrzehnten stark angestiegenen Gänsezahlen in Deutschland, insbesondere in den östlichen Bundesländern (Fig. 14), und die damit vielerorts verbundenen Gänseschadensforderungen aus der Landwirtschaft.

Großzügige Kompensationsregelungen für gemeldete Gänseschäden gibt es in Brandenburg und Nordrhein-Westfalen, während in einigen anderen Bundesländern (z.B. Mecklenburg-Vorpommern, Niedersachsen und Schleswig-Holstein) regional Zahlungen für Naturschutzleistungen in wichtigen Gänsegebieten geleistet werden. In Niedersachsen und Brandenburg laufen zur Zeit Forschungsprogramme zur Entwicklung länderbezogener Gänsemanagement-Konzepte.

Insgesamt zeigt sich, daß in Deutschland Gänsemanagement zur Zeit auf einer regionalen Ebene weitgehend ohne Berücksichtigung der Situation im Gesamtlebensraum stattfindet. Eine bessere Koordination aller Aktivitäten auf einer nationalen Ebene ist dringend notwendig.

Das Wasservogelmonitoring als Basis für ein verantwortungsvolles Gänsemanagement ist in der Bundesrepublik Deutschland vornehmlich ehrenamtlich organisiert. Durch die in den letzten Jahren stark angestiegene Datenfülle sowie die angehobenen internationalen Anforderungen an Datenqualität und Koordination des nationalen Wasservogelmonitorings,

In Mecklenburg-Vorpommern only the hunting season for the Brent Goose is closed and in Sachsen it is not allowed to shoot Greylag Geese in August. In all other federal states the maximum hunting season of the federal hunting law is valid (Chapter 8, Wiese 1995).

These different hunting regulations within Germany stimulate intensive goose hunting tourism between the federal states. Most of these hunting regulations are the result of the consideration of local and regional aspects.

The reason for the increase in hunting pressure in most cases is the increase in goose numbers in Germany during the last decades, especially in eastern Germany (Fig. 14), and the increasing number of claims for goose damage from local farmers that acompannied the rise in numbers.

Generous compensation regulations in case of goose damage are practiced in Brandenburg and Nordrhein-Westfalen, whereas in some other states (e.g. Mecklenburg-Vorpommern, Niedersachsen and Schleswig-Holstein) in some important goose sites the farmers are paid for nature conservation efforts. Niedersachsen and Brandenburg are at present funding research projects in order to develop a regional goose management concept.

At present goose management is a regional affair in Germany. In this local or regional approach international aspects hardly play a role. Better coordination of all activities at a national level is urgently needed.

Waterfowl monitoring as a basis for goose management in the Federal Republic of Germany is organised at a voluntary non-governmental level. Because of the rapid growth of the amount of data and the higher international demands placed on the quality of the data and the coordination of the national waterfowl ist es nicht mehr möglich, die Koordination auf ehrenamtlicher Basis weiterzuführen. Das gestiegene öffentliche Interesse am Wasservogelmonitoring, als staatliche Pflichtaufgabe im Rahmen der Ramsar und Bonner Konvention sowie als Basis für nationale und regionale Management-Entscheidungen, muß durch eine erhöhte Unterstützung des Monitorings durch die nationale Regierung Rechnung getragen werden. Das auch weiterhin auf ehrenamtliche Zähler basierende Monitoringnetz muß durch eine hauptamtliche Koordination optimiert werden. Diese Koordinationsstelle muß mit staatlichen Mitteln so unterstützt werden, daß eine flächendeckende Bestandsüberwachung, eine optimale Betreuung der Zähler und eine durch moderne Technik unterstützte Datenanalyse gewährleistet ist (Harengerd 1992, Mooij 1992b, ZWFD 1994).

census, the national coordination of the waterfowl monitoring cannot in future be organized on a leisure time basis. The enhanced official status of waterfowl monitoring as obligation of the contracting parties of the Ramsar and Bonn Convention must be documented by increased support by the national government. The work of the basis of the monitoring network, which will remain voluntary in future, must be optimized by the creation of a national coordination on a full time basis. This full time national coordination bureau must be funded in a way that it is able to guarantee reliable counts from all sites, an optimal counselling of the local counters and computerized data analysis (Harengerd 1992, Mooij 1992b, ZWFD 1994).

4.3. Regionales Gänsemanagement.

Es gibt in Nordrhein-Westfalen kein spezifisches Gänsemanagement-Konzept, aber eine Reihe von Einzelprogrammen, die zusammen die Grundlage eines zukünftigen regionalen Gänsemanagement-Konzeptes bilden könnten.

So ist der wichtigste Gänserastplatz Nordrhein-Westfalens, der Untere Niederrhein, als Ramsar-Gebiet ausgewiesen und ca. 3/4 der Flächen sind als Naturschutzgebiet oder Landschaftsschutzgebiet geschützt (ZWFD 1993). Daneben leistet die Landesregierung Kompensationszahlungen für Gänseschäden und hat trotz der im Lande zugenommenen Gänsebestände, aufgrund der durch das internationale Gänsemonitoring festgestellten Bestandsgröße und Bestandsentwicklung der für das Land wichtigen Gänsearten, die Jagd auf arktische Gänse verboten.

Anfang der 1990er Jahre wurde vom Land ein Gutachten zur Entwicklung der Gänsebestände und Gänseschäden in Nordrhein-Westfalen als Basis für ein künftiges regionales Gänsemanagement in Auftrag gegeben (Mooij 1994a) und wird die Koordination des landesweiten Wasservogel-(Gänse-)Monitoring seit 1990 vom Land finanziell unterstützt.

4.3. Regional goose management.

In Nordrhein-Westfalen there is no specific goose management concept, but there are a number of separate programmes that could be the basis for a future regional goose management concept.

The most important goose wintering site of Nordrhein-Westfalen, the Lower Rhine area, is designated as Ramsar site and about 3/4 of the area is protected as nature or landscape conservation site (ZWFD 1993). Further the government pays compensation in cases of goose damage and has closed hunting on arctic geese, based on the population estimates and development for the western Palearctic, although the goose numbers in Nordrhein-Westfalen have increased considerably.

At the beginning of the 1990s the government ordered and funded a study of the development of goose numbers and goose damage in Nordrhein-Westfalen as a basis for the future regional goose management (Mooij 1994a). It has funded the coordination of the regional waterfowl (goose) monitoring since 1990.

Es gibt jedoch noch eindeutige Defizite:

- es fehlt ein durchgängiges Gänsemanagement-Konzept, um diese Ansätze zu verbinden,
- der Schutzstatus der ausgewiesenen Schutzgebiete ist vielfach nicht ausreichend, weil die Naturschutzziele zu schwach bzw. nur unzureichend umzusetzen sind,
- Pufferzonen fehlen,
- Jagd ist in allen Schutzgebieten möglich, jagdfreie Zonen fehlen,
- die Störungshäufigkeit rastender Gänse ist hoch,
- landwirtschaftliche Entwicklungen, die die Ziele des Natur-, Feuchtgebiets- und Gänseschutzes zuwiderlaufen, werden zu wenig gesteuert.

Im Jahre 1982 wurden große Teile des Gänsewintergebietes am Unteren Niederrhein in die Liste der international bedeutsamen Feuchtgebiete gemäß dem "Übereinkommen über Feuchtgebiete, insbesondere als Lebensraum für Wasser- und Watvögel, von internationaler Bedeutung" - kurz "Ramsar-Konvention" - eingetragen. Hiermit hat Nordrhein-Westfalen die Verpflichtung übernommen, ihre Feuchtgebiete und das von ihnen abhängige Pflanzen- und Tierinventar zu schützen und eine Nutzung nur auf der Basis eines "wise use" stattfinden zu lassen (Art. 3.1. der Ramsar-Konvention, RES. 5.1. & 5.6., REC. 3.3. & 4.10.).

"Wise use" von Feuchtgebieten ist die mit der Erhaltung der natürlichen Ressourcen eines Ökosystems (= physikalische, biologische und chemische Bestandteile des Ökosystems wie Erde, Wasser, Luft, Pflanzen, Tiere und Nährstoffe sowie deren Interaktionen) zu vereinbarende nachhaltige Nutzung zum Vorteil der Menschheit.

Wegen ihrer weltweiten Gefährdung müssen in Feuchtgebieten Schutz vor Nutzung und Schutzziele vor Nutzungszielen Vorrang haben. Eine Nutzung ist daher nur möglich, wenn diese den Schutzzielen dient bzw. diesen auf jeden Fall nicht widerspricht oder ihre Realisierung nicht behindert.

But there are still some clear deficits:

- there is no overall goose management concept to coordinate these separate programmes,
- the protection status of the protected areas is not sufficient in most cases, because it is only possible to realize a part of the nature conservation objectives,
- there are no buffer zones,
- hunting is possible in all protected areas, there are no hunting free zones,
- there is a high disturbance rate for feeding geese,
- agricultural development that contradicts the objectives of nature, wetlands and goose protection, cannot be controlled.

In 1982 the greatest part of the goose wintering site of the Lower Rhine area was designated for the List of wetlands of international importance under the "Convention on Wetlands of International Importance especially as Waterfowl Habitat", in short "Ramsar Convention". In joining the Ramsar Convention Nordrhein-Westfalen is bound to protect its wetlands as well as the plant and animal species living there and to formulate and implement their planning in such a way that the wise use of wetlands is promoted (Art. 3.1. of the Ramsar Convention, RES. 5.1. & 5.6., REC. 3.3. & 4.10.).

The "wise use" of wetlands is their sustainable utilization for the benefit of humankind in a way compatible with the maintenance of the national properties of the ecosystem (those physical, biological or chemical components, such as soil, water, air, plants, animals and nutrients, and the interactions between them).

Because of the worldwide threat to wetlands in these areas the protection objectives must have priority over all other interests. Therefore the use of wetlands can only be acceptable if the utilization serves the realisation of the protection objectives or at least does not hinder their realisation.

In diesem Fall ist die zulässige Nutzung nur auf Basis einer "wise use"-Konzeption möglich.

Primäres Schutzziel gemäß Ramsar-Konvention ist Schutz der Feuchtgebiete und ihres Inventares, insbesondere Wasser- und Watvögel, d.h. daß die im Feuchtgebiet zulässigen Nutzungen Rücksicht auf die hier vorkommenden Wat- und Wasservögel nehmen müssen.

Diese Verpflichtung gilt auch für Industrie, Landwirtschaft und Bauvorhaben sowie für Jagd, Angelei und sonstige Erholungsaktivitäten. Es bedeutet jedoch gleichzeitig, daß in einem Ramsar-Gebiet, wie dem Unteren Niederrhein, das Gänsemanagement im Gesamtrahmen der Feuchtgebietsschutzkonzeption integriert sein muß.

Die Schutzziele und Nutzungseinschränkungen dienen damit zwar dem Schutz der Feuchtgebiete und der dort lebenden Pflanzen- und Tierarten, aber gleichzeitig auch den Gänsen, ohne speziell auf den Gänseschutz zugeschnitten zu sein.

Aufgrund von Untersuchungen im Wintergebiet können noch folgende spezielle Anforderungen an den Gänserastplatz formuliert werden (Kapitel 4 & 6, Gerdes et al. 1978, Kuijken 1969 & 1975, Mooij 1982b & 1991a, Owen 1973):

- Der Schutz von Gänserastplätzen darf sich nicht auf den Schutz einzelner Schlaf- und Nahrungsplätze beschränken, sondern muß sich vielmehr auf den Schutz von Komplexen richten, d.h. das Schutzgebiet muß zumindest einen geeigneten Gänseschlafplatz, umgeben von geeigneten Nahrungsflächen in ausreichender Größe in einem Umkreis von im allgemeinen weniger als 10 km enthalten.
- Ein geeigneter Schlafplatz ist ein absolut störungsarmer Bereich mit grasiger Vegetation und einem freien Zugang zum Wasser.
- Ein geeigneter Nahrungsplatz ist eine störungsarme Fläche mit grasiger Vegetation, bevorzugt Grünland, nicht zu weit entfernt vom Schlafplatz und von Wasser.

In general this means that only wise use is possible.

The main objective of the Ramsar Convention is the protection of wetlands and their stock, especially waterfowl, i.e. that all utilization of a wetland have to take the needs of waterfowl into consideration.

This obligation is valid for all forms of utilization, i.e. also for industrial und agricultural use, building activities as well as hunting, fishing and other recreational activities. At the same time it means that the goose management at a Ramsar site like the Lower Rhine area has to be part of an overall wetland management scheme.

Although the protection objectives and restrictions of utilization primarily serve the protection of wetlands and their stock, they also serve geese wintering at the site, without being specific goose protection measurements.

Based on studies in the wintering area the following demands should be made of an optimal goose site (Chapters 4 & 6, Gerdes et al. 1978, Kuijken 1969 & 1975, Mooij 1982b & 1991a, Owen 1973):

- The protection of goose sites can not be restricted to a roost or a feeding site, but has to protect complexes, i.e. the protected site has to consist of at least one suitable roost, surrounded by a number of feeding sites of suitable size at a distance of less than 10 km from the roost.
- A suitable roost is an area that has an extremely low disturbance rate, grassy vegetation and free admittance to water.
- A suitable feeding site is an area with a relatively low disturbance rate with grassy vegetation, especially agricultural graslands, not too far from the roost and water.

Bei der Sicherung von Gänserastplätzen im Winterareal sind diese Anforderungen zu berücksichtigen.

Für den Schutz von Nahrungsflächen "ausreichender Größe" ist es notwendig, den Begriff "ausreichender Größe" zu präzisieren. Die zur Verfügung gestellten, geschützten Nahrungsflächen (Kernbereiche) müssen eine solche Größe besitzen, daß Gänseschäden vermieden werden können. Die Flächen sollten daher so groß sein, daß die überwinternden Gänse dort ausreichend Nahrung für den gesamten Aufenthaltszeitraum finden können.

Für den Unteren Niederrhein wurde berechnet, daß in den letzten Jahren ein Nahrungsbedarf für überwinternde Gänse in einer Größenordnung von 10 - 14 Mio. Gänseweidetagen pro Winter besteht. Zur Vermeidung von Gänseschäden darf die Beweidungsintensität ca. 2 000 Gänseweidetage pro Hektar auf Grünland nicht übersteigen (Kapitel 7). Dies bedeutet, daß zumindest eine weitgehend ungestörte Fläche von mindestens 6 000 ha als Nahrungsfläche für die Gänse zur Verfügung stehen muß.

Das Gänsewintergebiet am Unteren Niederrhein ist jedoch sehr stark zersiedelt und von Straßen durchschnitten, weshalb die meisten Nahrungsflächen ständigen Störungen ausgesetzt sind. Da die Nahrungsflächen störungsarm sein müssen, bedeutet dies, daß sie von Pufferzonen mit einer Tiefe von zumindest 200-300 m umgeben werden müssen (Kuijken 1969 & 1975, Keller 1991, Mooij 1982b). Aufgrund der eindeutigen Präferenz der am Unteren Niederrhein überwinternden Gänse für Grünland, sollten Ackerflächen in den gesicherten Nahrungsbereichen in Grünland umgewandelt bzw. bei der Berechnung der Nahrungsflächen unberücksichtigt bleiben.

Zur Zeit sind gut 75 % der niederrheinischen Gänsenahrungsplätze suboptimal aufgrund der Störungshäufigkeit und des hohen Ackeranteils, wodurch die optimalen Nahrungsflächen häufiger angeflogen werden und dort der Beweidungsdruck von 2 000 Gt/ha häufig überschritten wird, was zu Schäden an der Vegetation führen kann.

These demands have to be taken into consideration in the process of site protection.

Before it is possible to protect feeding sites of a suitable size, it is necessary to define the term "suitable size". The protected feeding sites (core areas) should have such a size that goose damage can be avoided. Therefore the protected feeding sites should have such a size that the geese of that roost can find enough food within the limits of the protected area for the total period of their stay.

At the Lower Rhine goose wintering site it was calculated that the need for food of the wintering geese during the last winters was in an order of 10 - 14 million goosedays per winter. To avoid goose damage the feeding intensity should not exceed a threshold of 2 000 gd/ha (Chapter 7). This means that the geese have to have at the least a largely undisturbed protected feeding site of at least 6 000 ha at their disposal.

The Lower Rhine goose wintering area is covered with small settlements and single houses and is divided by a close-meshed network of roads, which causes a high disturbance rate. Because the feeding sites have to be largely undisturbed, this means that they have to be surrounded by buffer zones with a depth of at least 200-300 m (Kuijken 1969 & 1975, Keller 1991, Mooij 1982b). Based on the clear preference of the geese of the Lower Rhine wintering site for grasslands, arable land within the limits of the protected feeding sites should be transformed into grassland or not be included into the protected area.

At present about 75% of the Lower Rhine goose feeding sites are suboptimal because of the high disturbance rate and the high proportion of arable land, which causes an overuse of optimal feeding areas and could result in goose damage.

Durch die Ausweisung von Pufferzonen, rund um die vorhandenen Nahrungsflächen, könnte die Störungshäufigkeit erheblich gemindert werden. Da kleine ungestörte Nahrungsflächen relativ große Pufferzonen brauchen und große zusammengeschlossene Nahrungsflächen relativ geringe Pufferzonen, ist es notwendig, dort wo möglich, mittels der (zeitweiligen) Sperrung von befestigten Feldwegen und kleineren Straßen, örtlich einen Zusammenschluß mehrerer kleinerer Nahrungsflächen zu einer größeren anzustreben. Darüber hinaus sollten Ackerflächen innerhalb dieser Kernbereiche in Grünland umgewandelt werden. Als Ersatz für die verlorengegangenen Ackerflächen könnten straßen- und siedlungsnahe Flächen in eine Ackernutzung genommen werden. Die Schadenshäufigkeit auf diesen Flächen würde durch die größere Störungshäufigkeit verringert.

Im Falle einer Umsetzung eines solchen Konzeptes und einer angenommenen Durchschnittsgröße der ausschließlich als Grünland genutzten Kernzonen von jeweils ca. 100 ha, wäre am Unteren Niederrhein mit Gänseschutzgebieten (Kern- und Pufferzonen) von insgesamt ca 15 000 ha zu rechnen.
Innerhalb dieser Gänseschutzzonen sollte auf den Anbau von für Gänsefraß empfindlichen Kulturen (z.B. Grassaat, Raygras, spät eingesähter Winterweizen usw.) verzichtet werden. Auf Ackerflächen in den Pufferzonen bzw. für eine Übergangsperiode in den Kernzonen, sollten über Winter keine umgepflügten Ackerflächen liegen bleiben. Diese Flächen sollten für Gänse attraktiv gemacht werden durch Zwischenfruchtanbau bzw. das Zurücklassen von Ernteresten (z.B. Rübenreste für Saatgänse).
Auf den wichtigsten Gänsenahrungsplätzen sollte die Grünlandnutzung nicht soweit extensiviert werden, daß der Anteil trockener Altgräser im Herbst und Winter zu groß wird, da hierdurch die Eignung als Gänsenahrungsfläche erheblich gemindert wird. Eine Beweidung bzw. Schnittnutzung im Spätsommer oder Herbst könnte diese Gefahr verringern.

The disturbance rate could be reduced considerably by creating buffer zones around existing feeding sites. Because small undisturbed feeding sites need relatively big buffer zones and large undisturbed feeding sites relatively small ones, it is necessary - where-ever possible - to create a number of big core zones by help of (periodical) blocking of roads. As further measurements arable fields within the core zones should be turned over to grassland. To compensate for the transformed fields, grassland areas in the neighbourhood of roads and settlements could be turned over to arable land. Here the risks of goose damage would be much lower because of the higher disturbance rate.

In case of the implementation of the described concept and a assumed mean size of core zones with a grassy vegetation of about 100 ha, the total size of the protected goose site (core and buffer zones) at the Lower Rhine should have a size of about 15 000 ha.
Within the limits of this area no crops should been grown that are susceptible to goose feeding (e.g. grass-seed culture, fodder grass, winter cereals sown late etc.). On arable land in the buffer zones - or for a transition period in the core zone - harvested fields should not be ploughed until the geese leave for the breeding areas. Such fields are more attractive to geese as fallow fields, where geese can feed on harvest remnants (e.g. the remains of sugar beets for Bean Geese), or with special feeding crops.
On the main feeding sites the agricultural practice of grasslands should not be reduced too much, to avoid a high proportion of old grass and herbs not attractive to geese. Cattle grazing or a grasscut in late summer or autumn could solve this problem.

	GRÜNLAND / GRASSLAND			ACKER / ARABLE LAND			TOTAL
	geschädigtes Gebiet	Gezahlte Entschädigung		geschädigtes Gebiet	Gezahlte Entschädigung		Ø
	Damaged area	Compensation paid		Damaged area	Compensation paid		
	ha	DM	DM/ha	ha	DM	DM/ha	DM/ha
1986	596	156.268	262	711	483.594	680	**490**
1987	882	172.198	195	1.926	1.357.868	705	**545**
1988	1.704	236.209	139	213	121.047	568	**186**
1989	3.158	497.868	158	915	513.931	562	**248**
1990	4.016	525.022	131	1.008	542.161	538	**212**
1991	5.268	872.666	166	4.147	1.002.852	242	**199**
1992	6.985	978.556	140	1.822	870.909	478	**210**
1993	7.236	1.217.191	168	1.351	761.512	564	**230**
Ø	**3.731**	**581.997**	**170**	**1.512**	**706.734**	**542**	**290**

Tab. 9. Gezahlte Gänseschäden am Unteren Niederrhein zwischen 1986 und 1993 (Daten MURL NW).
Goose damage compensation paid at the Lower Rhine between 1986 and 1993 (Data MURL NW).

Aufgrund der hohen Qualität der niederrheinischen Gründlandflächen sind Maßnahmen zur weiteren Qualitätsverbesserung der Grasnarbe nicht notwendig. Darüber hinaus zeigten die Untersuchungen von Percival (1993), daß solche Maßnahmen zwar zu einer Konzentration der Gänse führen, jedoch nicht unbedingt Gänse von außerhalb des Gebietes anziehen. Aufgrund der Untersuchungen von Bell & Owen (1990), Jepsen (1991), Kuijken (1975), Keller (1991), Madsen (1994), Mooij 1982b, Spilling & Königstedt (1995) und Wille (1995) scheint es wesentlich wichtiger, Störungen (insbesondere durch die Jagd) zu verhindern, wodurch die Attraktivität des Gebietes für Wasservögel erhöht und die Körperkondition der Vögel wesentlich verbessert wird.

Im Rahmen der Gänseschadensregelung zahlt das Land Nordrhein-Westfalen zur Zeit jährlich nahezu 2 Mio. DM mit steigender Tendenz, d.h. umgerechnet auf die gemeldeten Schadensflächen 200-230 DM/ha (Tab. 9).
Diese Kompensationszahlungen für Gänseschäden könnten durch Zahlungen im Rahmen des Feuchtwiesenschutzprogramms, dessen Förderkulisse auf das Gänseschutzgebiet ausgedehnt werden sollte, ersetzt werden.

Because of the high quality grasslands in the region measures to further improve the quality of grasslands for goose feeding are not necessary. Besides the studies of Percival (1993) showed that such measures indeed increased the number of geese feeding on the experimental fields, but they did not attract geese from the surrounding areas to feed in the improved grassland areas. Based on the studies of Bell & Owen (1990), Jepsen (1991), Kuijken (1975), Keller (1991), Madsen (1994), Mooij (1982b), Spilling & Königstedt (1995) and Wille (1995) it seems much more important to avoid disturbance (especially by hunting), to improve the attractivity of feeding sites for geese as well as to improve the body condition of the wintering birds.

In the scope of the goose damage compensation programme at present Nordrhein-Westfalen pays about 2 million DM a year (with an increasing tendency), i.e. 200-230 DM/ha (Tab. 9).
These compensation payments for goose damage could be replaced by payments under the northrhine-westphalian wet-grasslands protection programme, that is to be extended to the goose wintering sites.

Im Rahmen des nordrhein-westfälischen Feuchtwiesenschutzprogramms kann den örtlichen Landwirten ein Grundbetrag von 240 DM/ha angeboten werden, wobei die beschriebenen Gänsemanagementsmaßnahmen Teil des Vertrages sein sollten. Für zusätzliche Naturschutzleistungen der Landwirte können freiwillige Verträge mit einem höheren Hektarsatz abgeschlossen werden.

Für ca. 2 Mio. DM, die in den letzten Jahren jährlich für die Kompensation gemeldeter Gänseschäden an die örtliche Landwirtschaft gezahlt wurden, könnte das Land Nordrhein-Westfalen ca. 8 300 ha Gänseschutzflächen, d.h. alle wichtigen Nahrungsflächen (Kernflächen), mit einer jährlichen Vergütung von 240 DM/ha unter Vertrag nehmen.

Zur Zeit sind schon ca. 6 000 ha des hiesigen Gänsewintergebietes in die Förderkulisse des Feuchtwiesenschutzprogrammes aufgenommen und weitere ca. 3 000 ha sind im Eigentum der Öffentlichen Hand und brauchen damit nicht zusätzlich gefördert werden, sodaß neben der Sicherung von ca. 15 000 ha Kern- und Pufferzonen, noch Finanzmittel für freiwillige Verträge mit einzelnen Landwirten für zusätzliche Naturschutzmaßnahmen zur Verfügung stehen.

Vorteile des beschriebenen Konzeptes:
- Die Schadensdiskussion verliert an Schärfe, aufwendige und zum Teil zweifelhafte Schadensschätzungen entfallen.
- Landwirtschaft und Naturschutz arbeiten zusammen in Sachen Feuchtgebiets-/Gänseschutz.
- Landwirte und Landeskasse können mit jährlich planbaren Finanzleistungen rechnen.
- Mit den eingesetzten Geldern werden keine Entschädigungsansprüche abgegolten, sondern wird aktiv Naturschutz betrieben.

Under the northrhine-westphalian wet-grassland protection programme the farmers receive a basic financial support of 240 DM/ha for nature conservation efforts, whereby the goose management measures described should be included. For further nature conservation efforts by the farmers it is possible to offer them voluntary contracts with higher hectare rates.

With the ca. 2 million DM that have been paid annually in the last few years to the farmers to compensate for claimed goose damage the government of Nordrhein-Westfalen could take about 8 300 ha, i.e. all important feeding sites (core zones), under contract as goose protection sites, with an annual payment of 240 DM/ha.

At present about 6 000 ha of the goose wintering site already are included in the wet-grassland protection programme, further ca. 3 000 ha are owned by the government or official bodies and therefore do not require additional funding. This means that besides the protection of about 15 000 ha core and buffer zones by a basic annual payment of 240 DM/ha there is still money left that could be used for voluntary contracts with the farmers for additional nature conservation efforts.

The concept described here has several advantages:
- The discussion about goose damage will become less emotional, the costly and dubious goose damage estimation process is avoided.
- Farmers and nature conservationists cooperate in the interest of wetland/goose protection.
- Farmers and government can calculate with a relatively predictable annual amount of money.
- The tax-payers' money is not spent on compensation payments for damage claims but on active nature conservation measurements.

- Die eingesetzten Gelder kommen nicht nur in Form einer Entschädigung den örtlichen Landwirten zugute, sondern ebenso den Gänsen und den sonstigen Arten (z.B. Wiesenvögel durch Grünlandschutz) des hiesigen Ramsar-Gebietes.

Eine Kosten-Nutzen-Analyse des beschriebenen Konzeptes zeigt, daß die Einrichtung von Gänseschutzgebieten in Kombination mit einer Strategie für eine umweltgerechtere Landwirtschaft, nicht nur den Gänsen nutzt, sondern ebenso der sonstigen Flora und Fauna des geschützten Gebietes. Darüber hinaus verbessert es die gesamte ökologische Situation des hiesigen Ramsar-Gebietes, bietet der örtlichen Landwirtschaft eine klare und kalkulierbare Perspektive für die Zukunft und macht die finanziellen Leistungen des Landes planbar.

Bei einzelnen wenigen Landwirten könnte die Umstellung von der Kompensationsregelung auf Zahlungen gemäß Feuchtwiesenschutzprogramm zu finanziellen Einbußen führen, die dort, wo berechtigt und gewünscht, mittels zusätzlichen freiwilligen Vereinbarungen für zusätzliche Naturschutzmaßnahmen ausgeglichen werden könnten. Damit hat das vorgeschlagene Konzept gegenüber der Kompensationsregelung entscheidende Vorteile sowohl für die Landwirtschaft, als auch für die Volkswirtschaft.

Die Schlußfolgerung von Vickery et al. (1994), daß die beste Lösung des Gänseschadensproblems für die Gesellschaft in der Einrichtung von Gänseschutzgebieten besteht, aber für die Landwirtschaft in einer Schadenskompensationsregelung, gilt nicht für die Situation am Unteren Niederrhein. Für die hiesige Situation mag Vickery's Schlußfolgerung für einige wenige Landwirte zutreffen, jedoch sicherlich nicht für die Landwirtschaft allgemein.

- The tax-payers' money is not only spent on compensation payments to the local farmers, but also on the protection of geese and other species (e.g. grassland species by means of grassland protection) that live on the local Ramsar site.

A cost-benefit-analysis of the described concept shows that the establishment of goose protection sites combined with a wise use farming strategy not only benefits geese, but also all flora and fauna of the protected area. Moreover, it is an important step to improve the overall ecological situation of the Lower Rhine Ramsar site, it gives the local farmers a clear and calculable perspective for the future and it enables the federal government to make long-term financial planning.

For a few local farmers the change from a compensation scheme to the wet-grassland protection programme could cause financial loss. In cases where there is an unjustified difference in the financial outcome of both schemes and full financial compensation is wished, this could be compensated by voluntary contracts with these farmers for additional nature conservation efforts.
In this way the proposed concept has decisive advantages over the present compensation scheme, as well as for the farmers as for the society.

The conclusion of Vickery et al. (1994) that the optimal financial solution of the goose damage problem for the society is the establishment of goose protection areas and for the farmers the payment of compensation, is not valid for the situation at the Lower Rhine. For the local situation Vickery's conclusion may be valid for a few individual farmers, but is surely not for most of them.

Zusammenfassend kann festgestellt werden, daß am Unteren Niederrhein die beste Methode, um Gänseschäden vorzubeugen bzw. zu verringern, die Schaffung von Gänseschutzgebieten ist. Diese müssen groß genug sein, um alle in dem Raum überwinternden Gänse zu ernähren, ohne daß eine stellenweise Überweidung der Flächen auftritt.

Außerhalb dieser Schutzgebiete können die Vögel dann von den für Gänsefraß empfindlichen Gewächsen vertrieben werden, jedoch ohne zu Hilfenahme der Jagd (Kapitel 8, Mooij 1991b & 1994a).

As a summary it can be stated that at the Lower Rhine goose wintering site the creation of goose protection sites is the best method to avoid or reduce goose damage. These sites have to be big enough to feed all geese wintering at the site without overgrazing.

Outside the protected sites the geese could be chased from crops susceptible to goose feeding, but without hunting (Chapter 8, Mooij 1991b & 1994a).

5. Literatur / References

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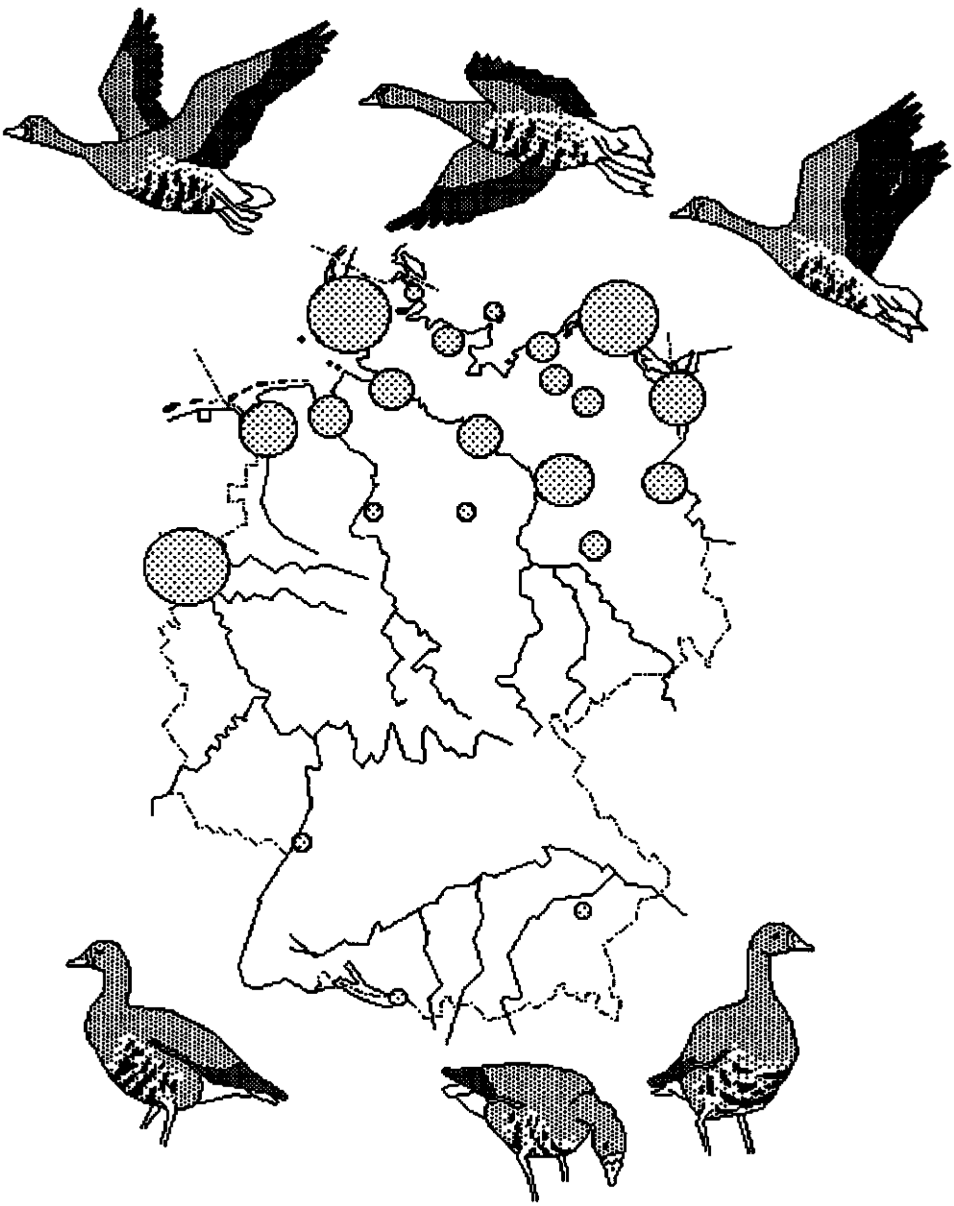
Chapter 3

Numbers and distribution of grey geese (genus *Anser*) in the Federal Republic of Germany, with special reference to populations in the Lower Rhine region.

Johan H. Mooij



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NUMBERS AND DISTRIBUTION OF GREY GEESE (genus *Anser*) IN THE FEDERAL REPUBLIC OF GERMANY, WITH SPECIAL REFERENCE TO THE LOWER RHINE REGION

JOHAN H. MOOIJ

ABSTRACT The most important *Anser* geese wintering in the Federal Republic of Germany (before reunion) are the White-fronted Goose *Anser albifrons* and the Bean Goose *Anser fabalis*. With peak numbers of almost 140 000 White-fronted and 45 000 Bean Geese in winter 1987/88, the Lower Rhine area was the most important *Anser* goose wintering area, and is second in importance only to The Netherlands within the western European perspective. The Dollart region is the second-best grey goose wintering site in Germany. Peak numbers of 58 000 White-fronted and 10 000 Bean Geese in the winter of 1987/88 brought the Dollart region to the second place, and to the fourth place in western Europe. Other wintering areas for *Anser* geese in the Federal Republic of Germany are in the coastal areas of Schleswig-Holstein and Niedersachsen, the plains of the Elbe, the Upper Rhine and the Upper Danube. These sites are less important as wintering sites because most of the northern sites only are used during migration and the numbers on the southern sites are small. Both of the main wintering sites are threatened by agricultural and economic developments.

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INTRODUCTION

Four goose species of the genus *Anser* pass through or winter in appreciable numbers in the Federal Republic of Germany every year: the Bean Goose *Anser fabalis*, the Pink-footed Goose *Anser brachyrhynchus*, the White-fronted Goose *Anser albifrons* and the Greylag Goose *Anser anser*. In the last 10 years there has been a remarkable change not only in the peak numbers but also in the distribution of the geese.

In the mid-1970s a maximum of about 80 000 grey geese of the genus *Anser* roosted here, almost 60 000 (about 75%) on the roosts in the federal states of Niedersachsen and Schleswig-Holstein. The centre of goose wintering areas was clearly situated in the northern parts of west-Germany (Fig. 1 & 2).

In the mid-1980s the situation has changed. Almost 240 000 grey geese stayed and/or wintered in west-Germany, about 150 000 of them (more than 60%) in the Lower Rhine area, Nordrhein-Westfalen (Fig. 1 & 2).

The Lower Rhine area, a wetland of international importance included on the List of the Ramsar-Convention (Ramsar-Gebiet "Unterer Niederrhein"), has become the most important goose wintering area for grey geese in west-Germany. The second-most important winter roost is the Dollart-region in northwestern Niedersachsen, followed by the plains of the River Elbe.

THE STATUS OF GREY GEESE

Bean Goose

The peak numbers of the Bean Goose have increased from about 31 000 in the mid-1970s to about 80 000 in the mid-1980s. These numbers refer, almost without exception, to *Anser fabalis rossicus*. The increase in goose numbers in the western part of the wintering area was considerably greater than in the eastern part. The centre of Bean Goose wintering areas is now situated along the Lower Rhine and in the Dollart Region.

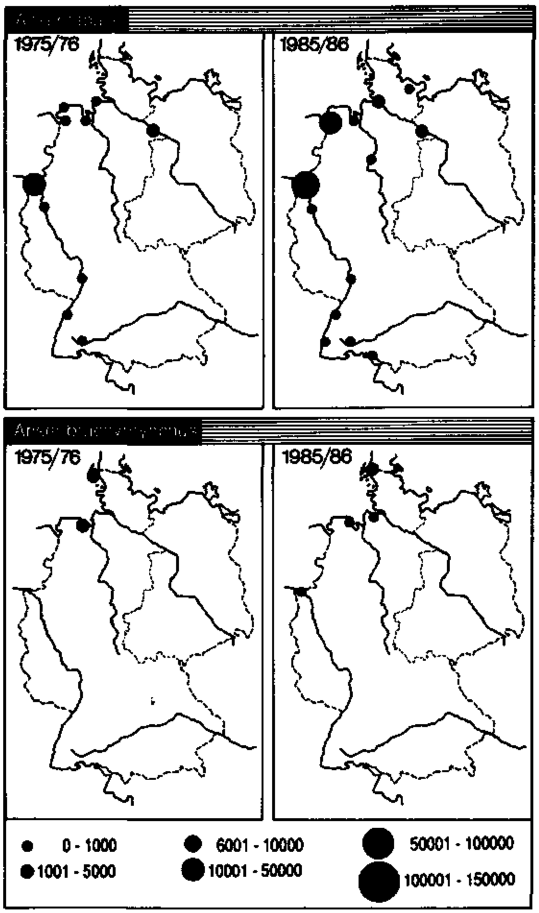

Fig. 1. Main roosts of Bean Goose (*Anser fabalis*) and Pink-footed Goose (*Anser brachyrhynchus*) in the Federal Republic of Germany (before reunion) during the goose wintering season 1975/76 and 1985/86.

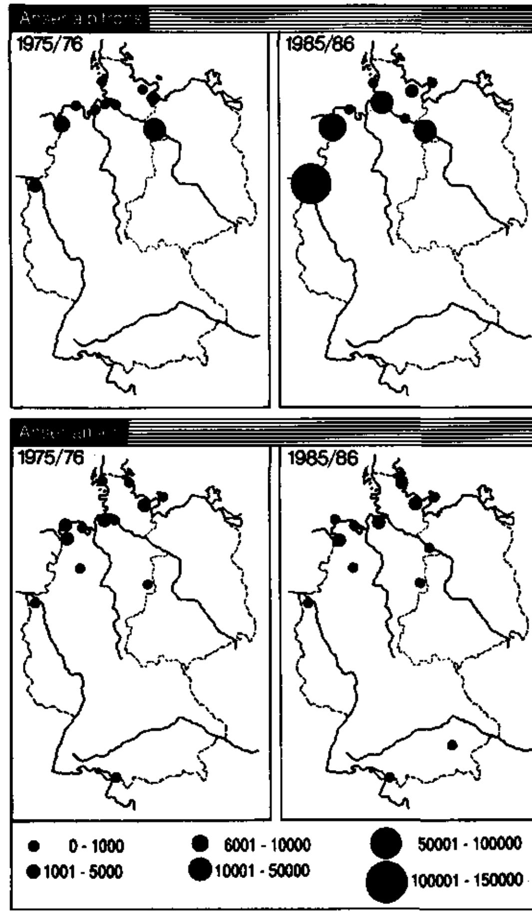

Fig. 2. Main roosts of White-fronted Goose (*Anser albifrons*) and Greylag Goose (*Anser anser*) in the Federal Republic of Germany (before reunion) during the goose wintering season 1975/76 and 1985/86.

Pink-footed Goose

Although there has been an increase in the number of Pink-footed geese in western Europe, there was no remarkable increase in the Federal Republic of Germany. Only from the Lower Rhine area there are more records, but this may be the result of the more intensive goose counts of the last few years.

Every year a peak number of 1 000 - 2 000 Pink-footed Geese are counted. Hummel (1983, 1984) suggested that in autumn, Pink-footed Geese may spend some time in Denmark and then migrate along the German coast or fly directly over the North Sea to The Netherlands. In spring they may follow the same flyway back to the north.

White-fronted Goose

The White-fronted Goose showed the greatest increase in numbers of all the geese found in the Federal Republic of Germany. In the mid-1970s about 27 000 geese of this species wintered here. The main wintering sites were the plains of the River Elbe and the Dollart Region. After the explosive increase in numbers on the Lower Rhine and a large increase in the Dollart Region, the centre of the wintering area is now situated on the Netherlands/German border. In the mid-1980s, about 75% of the more than 130 000 White-fronted geese wintering in west-Germany were counted in the Lower Rhine area.

Greylag Goose

It is difficult to make a statement about the status of the Greylag Goose in the Federal Republic of Germany. In several federal states, for instance Niedersachsen, Nordrhein-Westfalen, Baden-Württemberg und Bayern, Greylag Geese have been introduced. In several places they have established local populations of several hundreds to over thousand of individuals. At present these populations may total several thousands of individuals. Most of these geese do not migrate, spending both summer and winter in the same region. Observations of Greylag Geese partly refer to introduced birds.

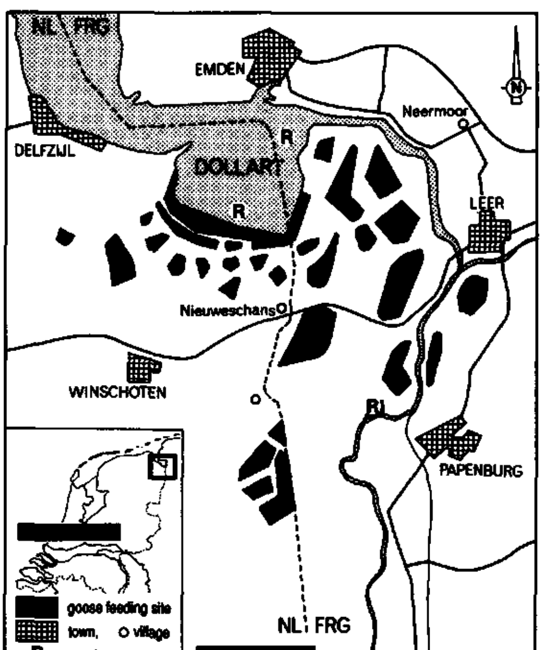

Fig. 3. Map of the goose wintering site in the Dollart region of northwestern Niedersachsen, after Van den Bergh (1985), Gerdes & Reepmeyer (1983) and Gerdes, Heß & Reepmeyer (1978).

Both in the mid-1970s and the mid-1980s, the peak numbers of Greylag Geese lay between 10 000 - 20 000 individuals.

STATUS OF THE MOST IMPORTANT WINTERING SITES

The greatest increase in peak numbers between 1975 and 1985 is found in the northwestern part of Niedersachsen and the Lower Rhine Area. In both regions the increase is mainly in the numbers of White-fronted Geese and to a lesser extent in Bean Geese. Both regions are continuous with the goose wintering sites in The Netherlands, where the peak numbers of these two species also increased strongly over this 10-year period (Ganzenwerkgroep 1976, 1977, 1978, 1979, 1980, 1981, 1983, 1984ab, 1986, 1987; Gerdes, Heß & Reepmeyer 1978; Hummel 1976, 1977, 1980, 1981, 1982, 1983, 1984; Mooij 1979, 1982, 1984).

The Dollart Region

In the Dollart Region (Fig. 3) the peak number of Bean Geese increased from 1 000 - 2 000 in the mid-1970s up to about 20 000 individuals in the mid-1980s (Fig. 4). After a small increase at the beginning of the 1980s, there followed a second in-

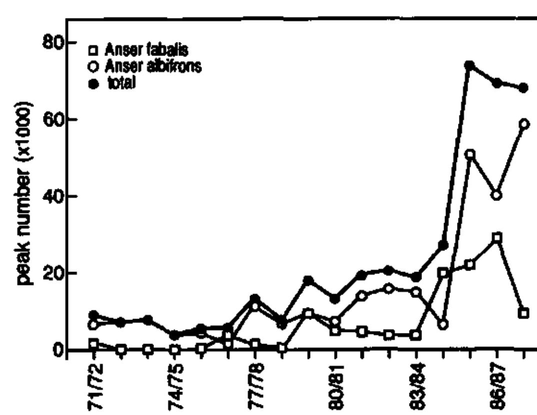

Fig. 4. Peak numbers of Bean and White-fronted Goose in the Dollart-region from winter 1971/72 to 1987/88, after data from Gerdes (own obs.), Gerdes, Heß & Reepmeyer (1978) and Hummel (1976, 1977, 1980, 1981, 1982, 1983, 1984).

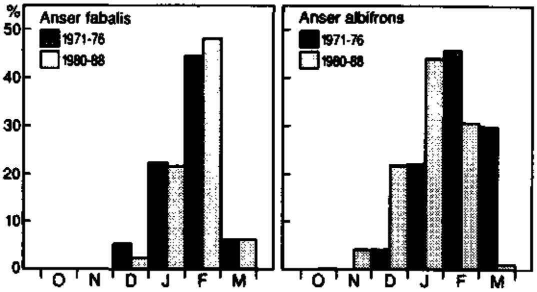

Fig. 5. Distribution of goose numbers of Bean and White-fronted Goose (% of total number) in the Dollart-region from winter 1971/72 to 1975/76 and 1980/81 to 1987/88, after data from Gerdes (own obs.) and Gerdes, Heß & Reepmeyer (1978).

crease in the winter of 1984/85. Since then, the numbers seem to be constant or declining. The time of this winter maximum did not change much over this period (Fig. 5).

The winter maximum of White-fronted Geese increased from about 5 000 individuals in the mid-1970s to 50 000 in the mid-1980s. Most of this increase happened since the winter of 1984/85 (Fig. 4). In the beginning of the 1970s the greatest number of geese was recorded in February. This winter maximum is now earlier: in the middle of the 1980s peak numbers were reached in January (Fig. 5).

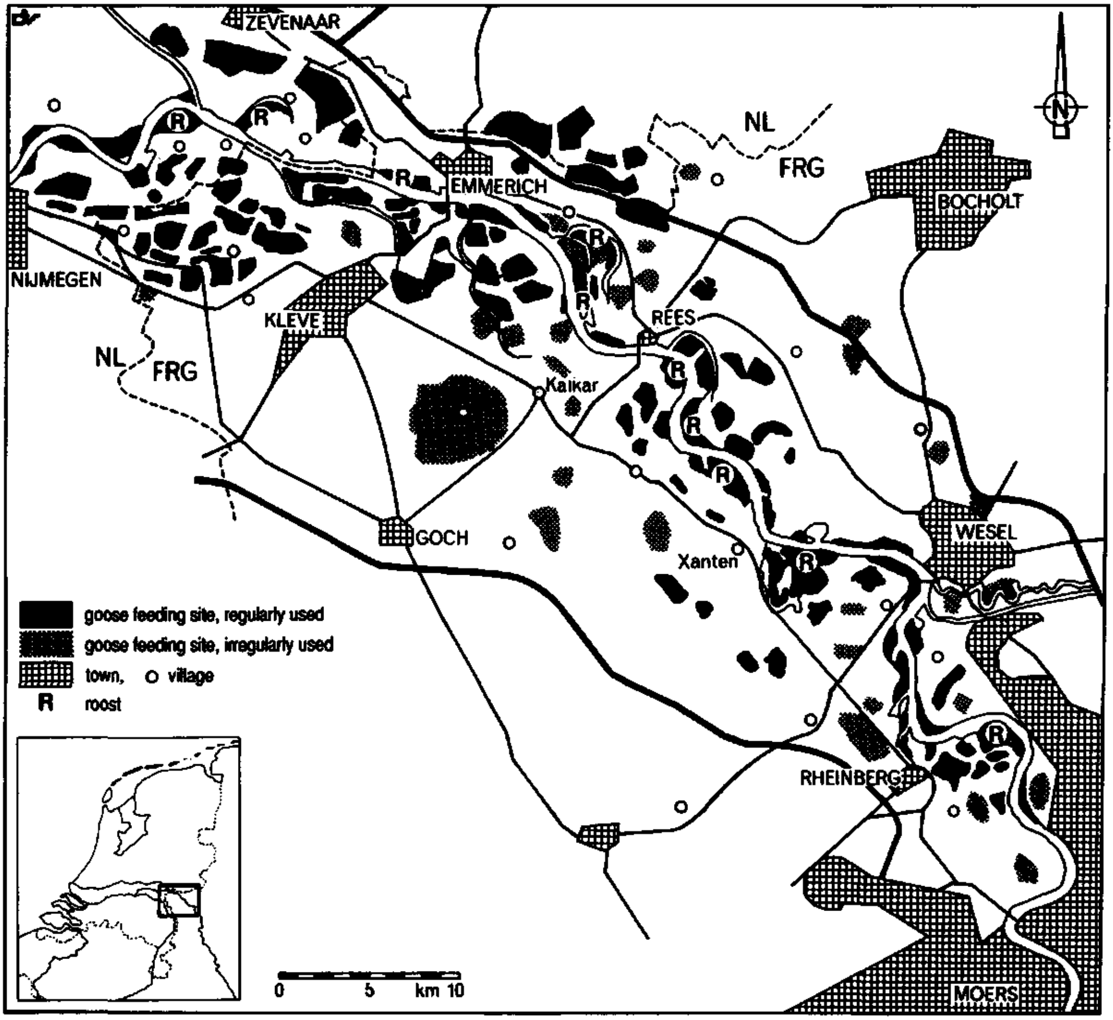

Fig. 6. Map of the goose wintering site in the Lower Rhine area in Nordrhein-Westfalen.

Although the goose wintering site around the Dollart is on both sides of the Netherlands/German border and the main roost is on Netherlands territory, it will be treated here as a German wintering site.

The Lower Rhine area

The Lower Rhine area (Fig. 6) is 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 (Hartert 1887, Le Roi 1906, Le Roi & Geyr von Schweppenburg 1912) which indicate, that the Lower Rhine area has been a wintering site for the tundra race of the Bean Goose since the 19th century. Neubaur (1957) stated that the wintering population of the Lower Rhine area, with about 1 000 Bean Geese during winter in the 1950s, was smaller than it had been in former times. White-fronted Geese were only irregularly seen and in very small numbers. At the beginning of the 1960s a gradual increase of Bean Goose numbers began, continuing to the winter of 1978/79 when a peak of about 20 000 individuals was reached. In the next two winters, the peak numbers rose to about 50 000 birds and has remained at this level since then (Fig. 7). The greatest number of Bean Geese was always recorded at the end of January or the beginning of February (Fig. 8).

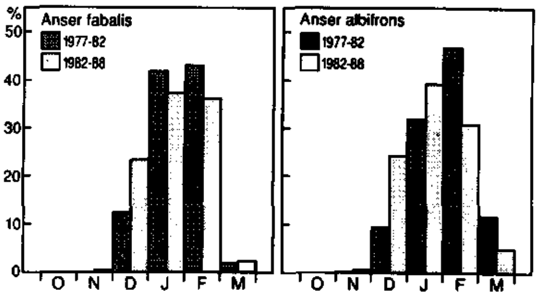

Fig. 8. Distribution of goose numbers of Bean and White-fronted Goose (% of total number) in the Lower Rhine Area from winter 1977/78 to 1981/82 and 1982/83 to 1987/88.

Since the beginning of the 1960s an appreciable number of White-fronted Geese winter at the Lower Rhine area. Their numbers rose slowly to about 3 000 individuals (winter 1973/74) and then stabilised for some years (winter 1973/74 to 1977/78). In the following four winters there was a rapid increase to about 20 000 wintering White-fronted Geese (winter 1978/79 to 1981/82), followed by a period of explosive growth to almost 140 000 individuals in winter 1987/88. To date (1988), there are no signs, that this increase will slow down (Fig. 7).

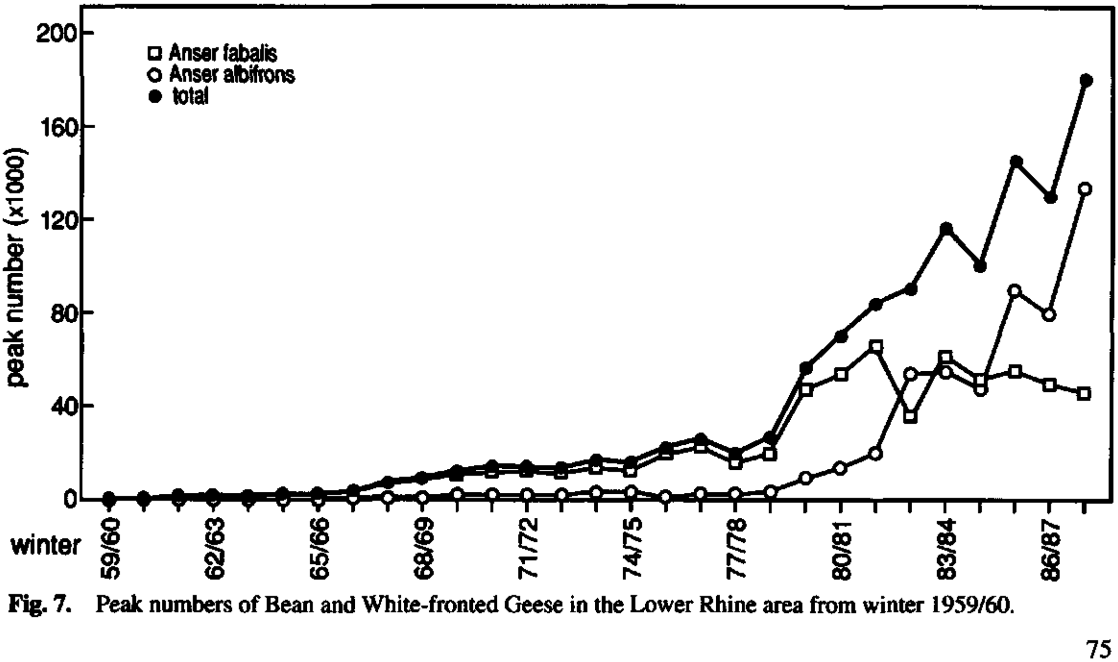

Fig. 7. Peak numbers of Bean and White-fronted Geese in the Lower Rhine area from winter 1959/60.

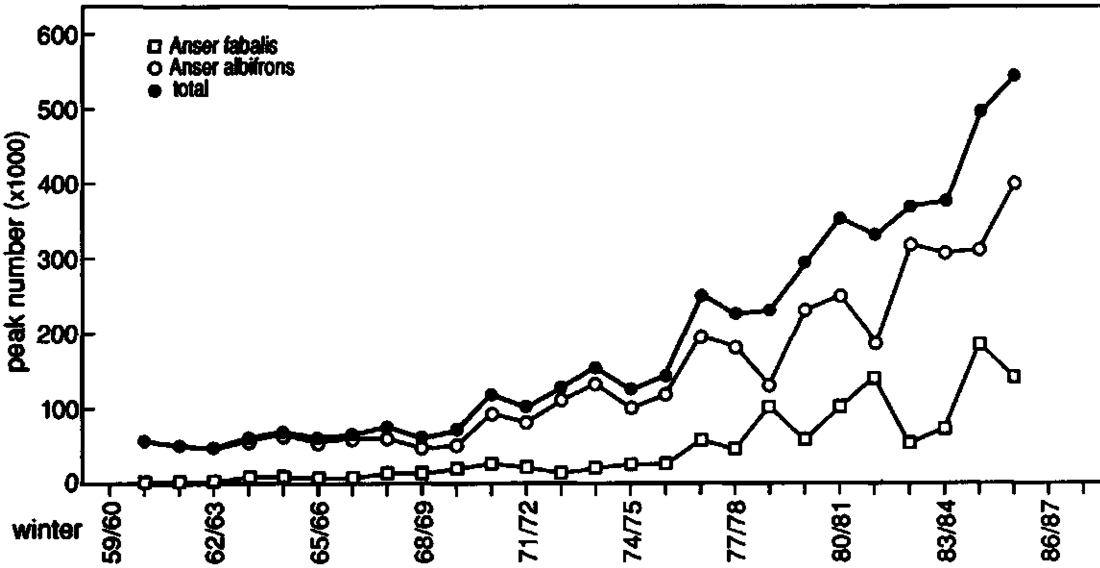

Fig. 9. Peak numbers of Bean and White-fronted Goose in The Netherlands from winter 1960/61 to 1985/86, after Van den Bergh (1983 & 1985), Ebbinge *et al.* (1987), Ganzenwerkgroep (1976, 1977, 1978, 1979, 1980, 1981, 1983, 1984a & b, 1986, 1987), Kuyken (1975), Lebret *et al.* (1976), Philippona (1972), Timmerman (1976).

In the period between winter 1977/78 and 1981/82, the peak was reached in February. In the period between winter 1982/83 and 1987/88 the winter maximum was recorded in January (Fig. 8).

Two important roosts and a small part of the feeding grounds of this goose wintering site are situated on Netherlands territory, more than 90% of the feeding sites and five main roosts are on German territory.

The Netherlands

The number of Bean Geese wintering in The Netherlands grew slowly from winter 1960/61 (about 4 000 individuals) to the winter of 1976/77

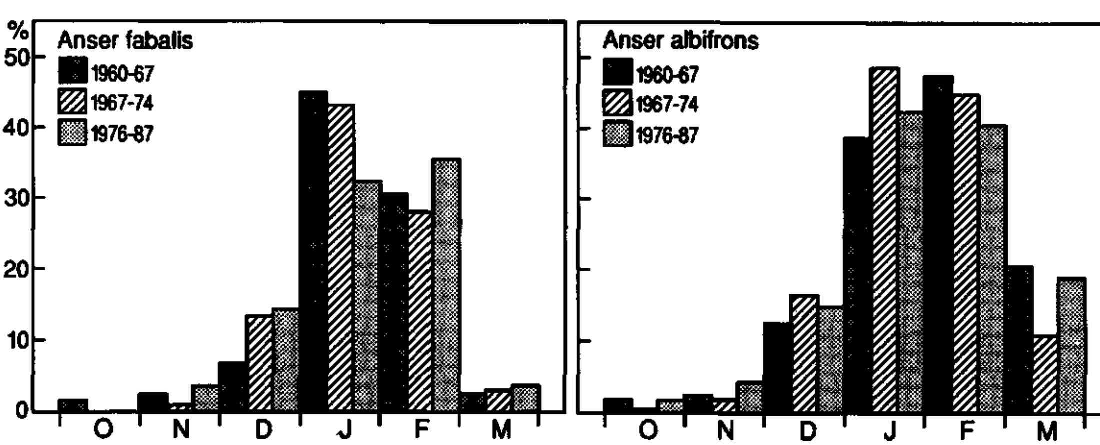

Fig. 10. Distribution of goose numbers of Bean and White-fronted Goose (% of total number) in The Netherlands, after Lebret *et al.* (1976) and Ebbinge *et al.* (1987).

(about 25 000 individuals). In the following period the Netherlands' population increased very rapidly to a number of 150 000-160 000 individuals (Fig. 9). The time at which peak numbers were recorded shifted from January to February (Fig. 10).

In winter 1960/61, 50 000 - 60 000 White-fronted Geese wintered in The Netherlands. Since winter 1970/71 this wintering population has increased to 400 000 in winter 1985/86 (Fig.9). The time at which this winter maximum was recorded shifted from February to January (Fig. 10).

DISCUSSION AND CONCLUSIONS

The development of the Bean and White-fronted Goose populations of The Netherlands, the Dollart region and the Lower Rhine area shows great similarity. In all three wintering sites the peak numbers of White-fronted Geese have increased considerably. This population growth started in The Netherlands, radiated to the Lower Rhine area almost 10 years later and had, almost 15 years later, also reached the Dollart region.

In the mid-1960s, the winter peak in The Netherlands was in February, which indicates that geese from other regions did assemble there at the beginning of the spring migration. In the beginning of the 1970s The Netherlands White-front winter maximum shifted from February to January, although the February numbers were only a little smaller than the peak numbers. A situation that has not changed today. It seems that the wintering sites in The Netherlands are today a final stopping point and wintering site for most of the White-fronted Geese and that the geese do not leave again until spring. The development in both the Dollart region and the Lower Rhine area is very similar to the situation in The Netherlands. In both wintering sites the period of the winter peak also changed from February to January.

Both the population growth and the shift of the winter peak may indicate that, for White-fronted Geese during the beginning of the 1980s, the Dollart and Lower Rhine region became an integrated part of the western European wintering site (northwestern Belgium, The Netherlands and the northwestern parts of the Federal Republic of Germany). In this region during winter 1985/86 about 480 000 White-fronted Geese were present at the time of the winter peak in January: ca. 285 000 individuals in The Netherlands (59.4%), ca. 90 000 on the Lower Rhine (18.8%), ca. 55 000 in Belgium (11.4%) and ca. 50 000 in the Dollart region (10.4%).

The Bean Goose situation seems to be more complicated. Between the beginning of the 1960s and the middle of the 1980s there was a marked increase in numbers, although these stabilized in the last few winters in all three wintering areas described. The period of peak numbers shifted in The Netherlands from January to February. In contrast, on the Lower Rhine peak numbers shifted to a slightly earlier date and in the Dollart region time of winter maximum did not change at all.

On the Lower Rhine a great number of geese, both Bean and White-fronted Geese, move from feeding sites near the border in the Federal Republic of Germany to feeding sites on the other side of the border in The Netherlands after 31 January, when the Netherlands' goose shooting season is closed (in North Rhine-Westphalia goose shooting is not allowed). But this fact alone does not explain this change in behaviour. It seems that some of the Bean Geese wintering in the Lower Rhine area fly to The Netherlands and maybe also to the Dollart region before the main spring migration starts. To answer this question more data are needed.

At time of winter maximum in February 1986 125 000 Bean Geese were recorded on the western European wintering site in The Netherlands, northwestern Belgium, the Lower Rhine area and the Dollart region: about 63 500 individuals in The Netherlands (50.8%), about 40 000 at the Lower Rhine (32.0%), about 20 000 in the Dollart region (16.0%) and less then 1500 in Belgium (1.2%). In January 1986 50 000 Bean Geese were counted on the Lower Rhine, i.e. about 40.0% of the west European Bean Goose population spends some time at this North Rhine-Westphalian wintering site.

THE FUTURE

The wintering sites on both the Lower Rhine and in the Dollart region are threatened by economic developments. In the Dollart region there are plans to build a new harbour near Emden (Niedersachsen) threatening one of the roosts, and a motorway (BAB 31) which will cut the feeding places in two. The wintering site on the Lower Rhine is threatened mainly by gravel quarrying, which destroys feeding places and roosts, and by several planned roads (Mooij 1988). In both areas there have been great changes in agricultural use. More and more traditional pastures are ploughed up and converted to arable land which is less favoured by geese as a feeding site. Furthermore, crops are more vulnerable to goose feeding than pastures which increases goose damage.

In the Lower Rhine area, the Government has made a beginning towards protecting the area against new industrial claims. Plans have also been made to restore disturbed and damaged parts of this Ramsar site. Several parts of the Lower Rhine area are designated as nature conservation areas and are protected, but the realization of urgently necessary management measures has not yet begun (Mooij 1988).

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SAMENVATTING

In de Bondsrepubliek Duitsland (lees: de BRD van voor de hereniging) overwinteren verscheidene soorten wilde ganzen. In de periode tussen rond 1975 en rond 1985 hebben zich daar enorme veranderingen voorgedaan (Fig. 1 en 2) in de aantallen (een verdrievoudiging), en in het belang van de verschillende overwinteringsplaatsen (een verschuiving van het noorden naar het Duitse Nederrijn gebied).

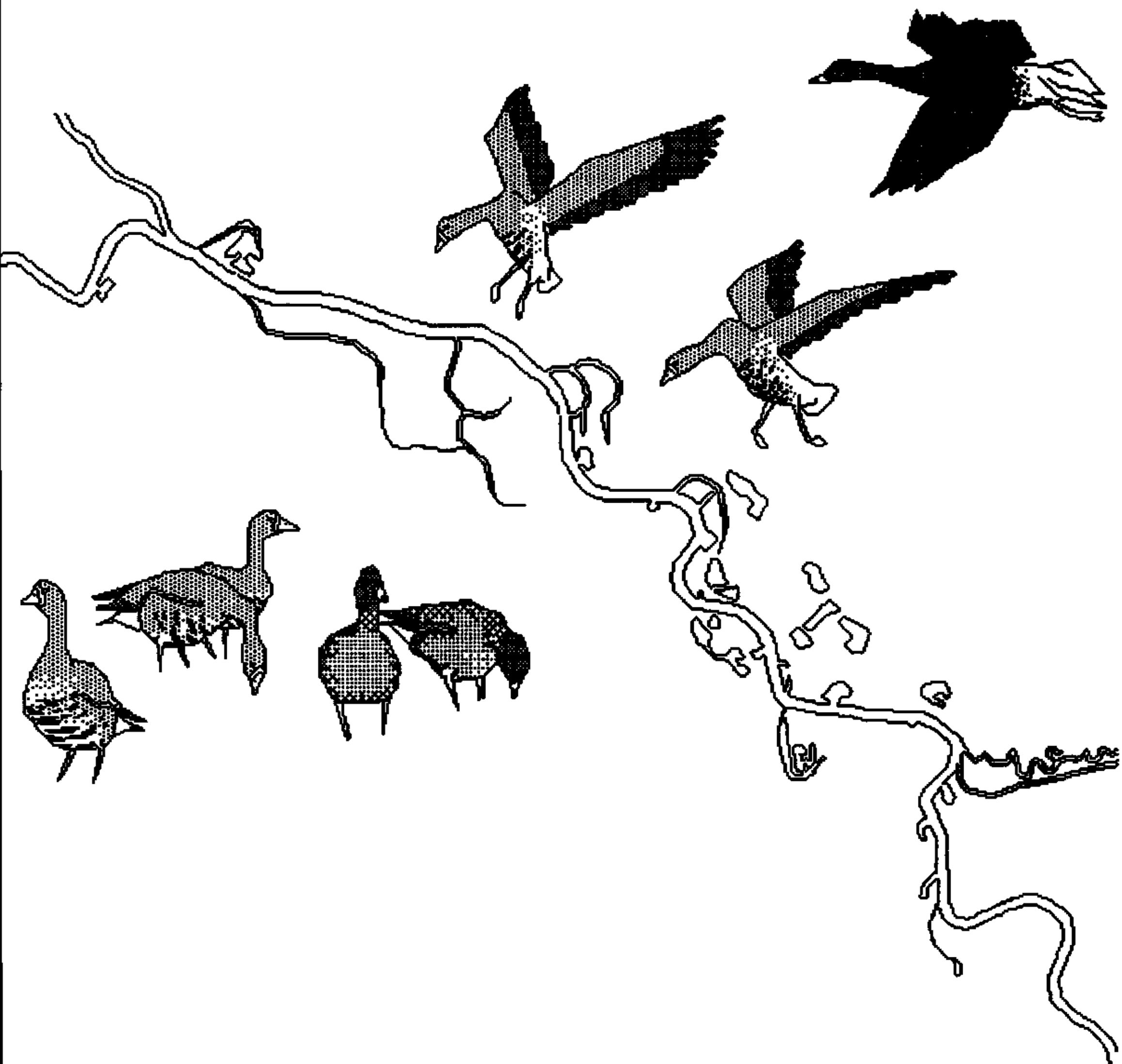
De belangrijkste soorten zijn Kolgans *Anser albifrons* en Rietgans *Anser fabalis*. Met maximum aantallen van 140 000 Kol- en 45 000 Rietganzen in de winter van 1987/88 is de Duitse Nederrijn het belangrijkste wintergebied in de BRD voor ganzen van het geslacht *Anser* (Fig. 6 en 7). De populatie in dit gebied is thans na die in Nederland (Fig. 9) de grootste in West Europa. Het tweede belangrijke wintergebied in de BRD is dat rond de Dollard, waar tijdens de winter van 1987/88 maximum aantallen van 58 000 Kol- en 10 000 Rietganzen werden waargenomen (Fig. 3 en 4). Ganzen van het geslacht *Anser* worden verder aangetroffen aan de kust van Sleeswijk-Holstein en Nedersaksen en in de uiterwaarden van de Elbe, de Boven-Rijn en de Boven-Donau. Deze gebieden zijn echter als overwinteringsgebied van geringe betekenis.

Verschuivingen in de perioden waarin de hoogste aantallen Kolganzen worden waargenomen lopen parallel in alle Westeuropese gebieden (Fig. 5, 8 en 10). Bij de Rietgans is dat niet het geval. Dit suggereert dat de uitwisseling van Rietganzen tussen de diverse gebieden volgens een bepaald tijdspatroon verloopt. De beide grootste wintergebieden in de BRD (de Nederrijn en de Dollard) worden ernstig bedreigd door de landbouwkundige en industriële ontwikkelingen.

Chapter 4

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

Johan H. Mooij



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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*.

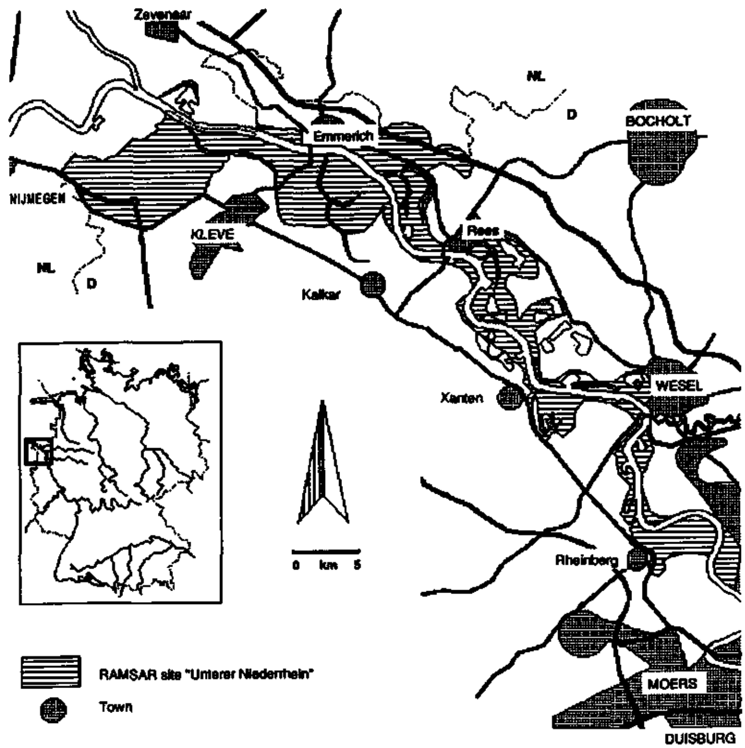

Fig. 1: Ramsar site „Unterer Niederrhein" (Lower Rhine) in North Rhine-Westphalia (D). – Abb. 1: Ramsar-Gebiet „Unterer Niederrhein" im Land Nordrhein-Westfalen.

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, Fuji-chrome 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.

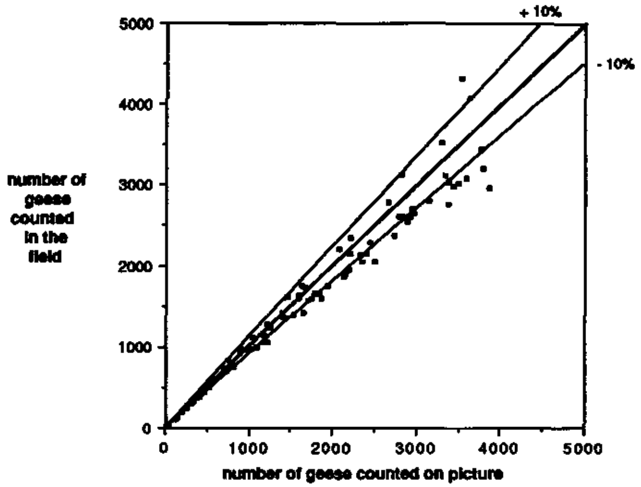

Fig. 2: Reliability-test of the goose counts at the goose wintering site of the Lower Rhine area. Comparison between the counted goose numbers in the field and on the picture. – Abb. 2: Überprüfung der Zuverlässigkeit der Gänsezählungen im Wintergebiet am Unteren Niederrhein durch einen Vergleich der 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.

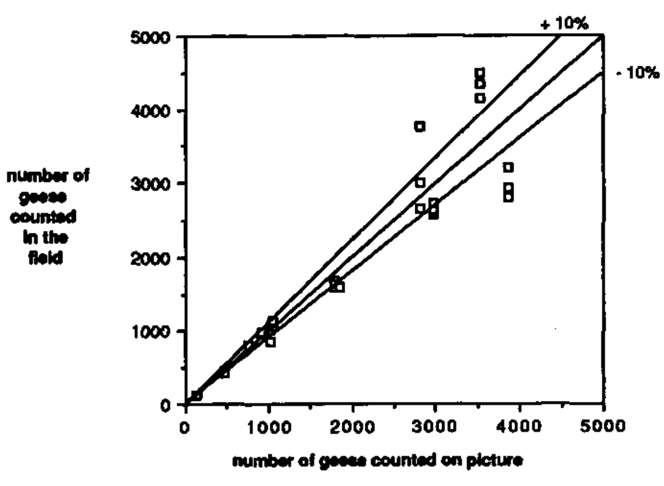

Fig. 3: Reliability-test of the goose counts at the goose wintering site of the Lower Rhine area. Comparison of the goose numbers of the three counts per group in the field and the number counted on the picture. – Abb. 3: Überprüfung der Zuverlässigkeit der Gänsezählungen im Wintergebiet am Unteren Niederrhein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

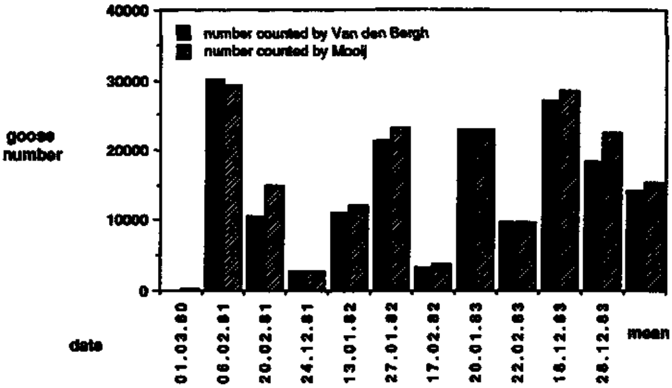

Fig. 4: Comparison between counted goose numbers in the area „Die Düffel/Salmorth" on the same day by VAN DEN BERGH and MOOIJ. – Abb. 4: Vergleich der im Gebiet „Die Düffel/Salmorth" am gleichen Tag durch VAN DEN BERGH und MOOIJ ermittelten Gänsezahlen.

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.

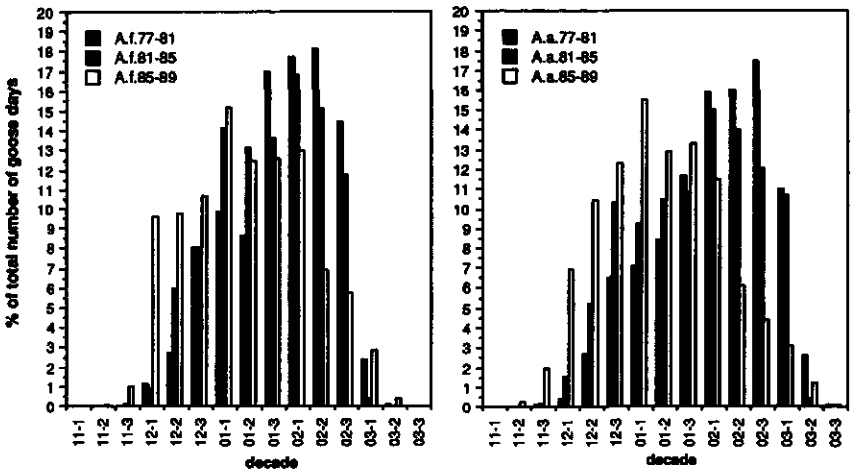

Fig. 5: Phenology of Bean (*A. f.*) and White-fronted Goose (*A. a.*) in the Lower Rhine area from winter 1977/78–1980/81, 1981/82–1984/85 and 1985/86–1988/89. – Abb. 5: Phänologie der Saat- (*A. f.*) und Bläßgans (*A. a.*) am Unteren Niederrhein in der Periode 1977/78–1980/81, 1981/82–1984/85 und 1985/86–1988/89.

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

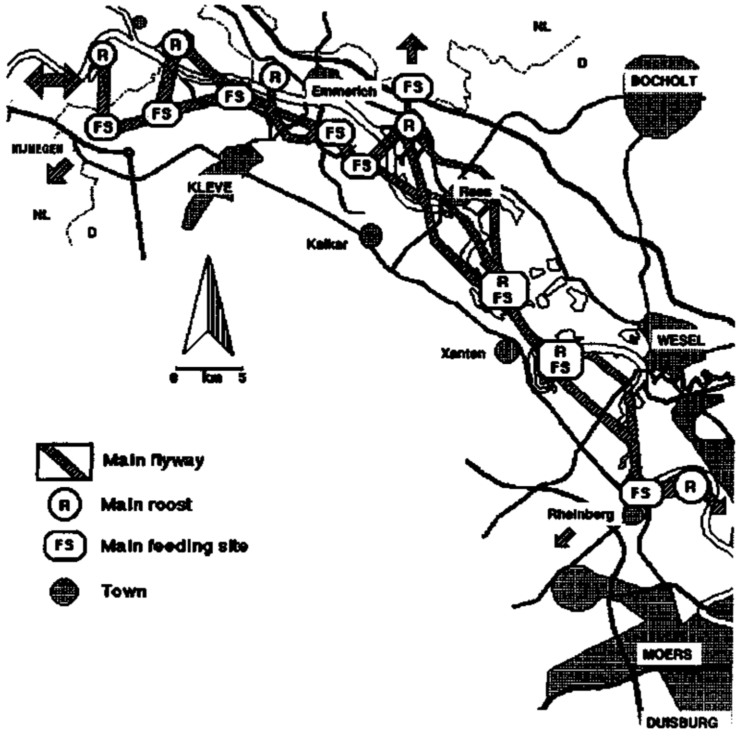

Fig. 6: Main flyways of wintering geese over the wintering site of the Lower Rhine. – Abb. 6: Wichtigste Flugschneisen der am Unteren Niederrhein überwinternden Wildgänse über ihrem Wintergebiet.

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.

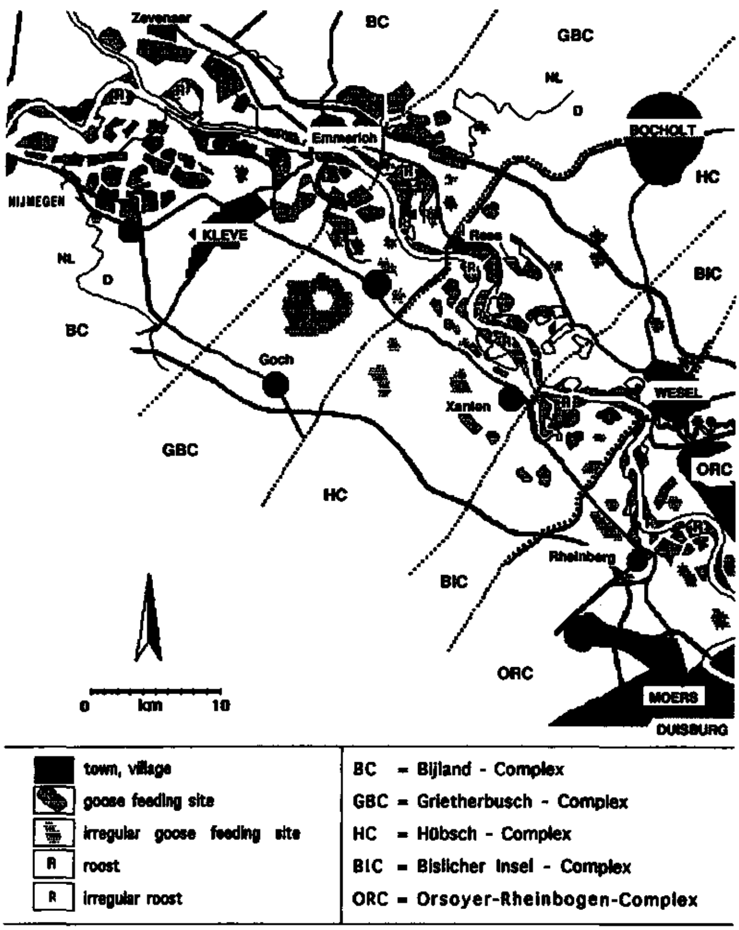

Fig. 7: Map of the goose complexes at the goose wintering site of the Lower Rhine. – Abb. 7: Karte der Wildgans-Komplexe am Unteren Niederrhein.

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.

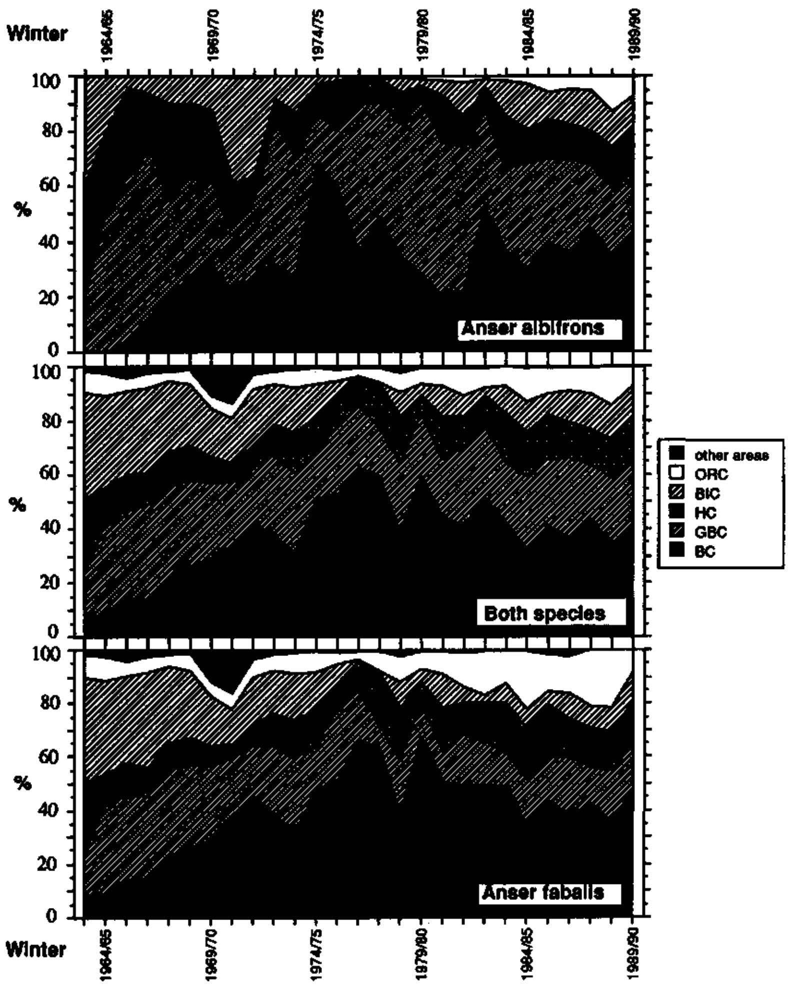

Fig. 8: Distribution of goose feeding over the complexes of the Lower Rhine goose feeding site between 1963/64 and 1989/90 (data from the period 1963/64–1976/77 reconstructed). – Abb. 8: Verteilung der Gänse während der Nahrungsaufnahme über die Komplexe des Unteren Niederrheins in der Periode von 1963/64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

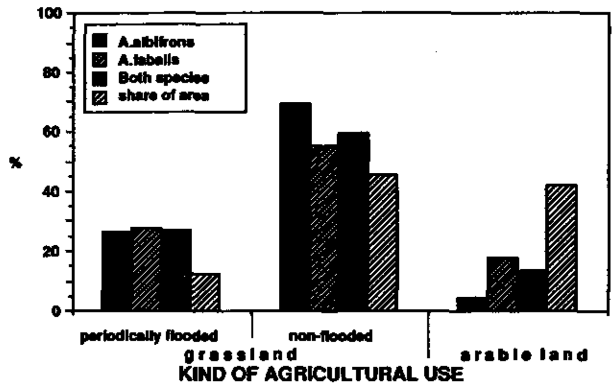

Fig. 9: Usage of the feeding sites of the Lower Rhine area by wintering geese. – Abb. 9: Nutzung der Nahrungsplätze des Unteren Niederrheins durch Wildgänse) Kategorien: periodisch überschwemmtes Grünland, nicht überschwemmtes Grünland und Ackerflächen).

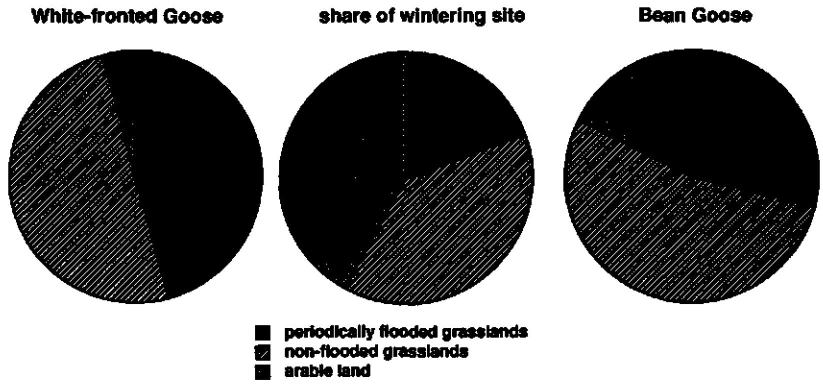

Fig. 10: Distribution of goose feeding over periodically flooded grasslands, non-flooded grasslands and arable land in the goose wintering site at the Lower Rhine. – Abb. 10: Verteilung der Nahrungsflächen von Wildgänsen über periodisch überschwemmtes Grünland, nicht überschwemmtes Grünland und Ackerflächen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

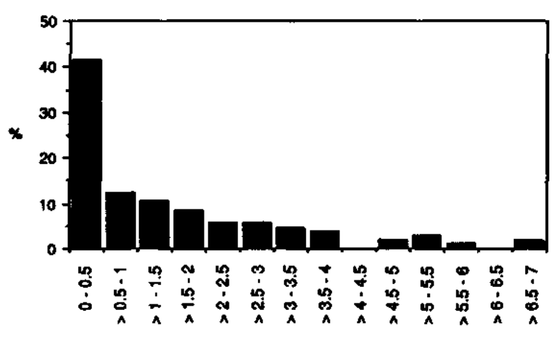

Fig. 11: Distance of the main feeding sites of the Lower Rhine goose wintering site to a more or less significant sheet of water (the river Rhine, an old Rhine arm, a gravel pit) (n = 106). – Abb. 11: Entfernung der Hauptnahrungsplätze der Wildgänse am Unteren Niederhein zu mehr oder weniger bedeutsamen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

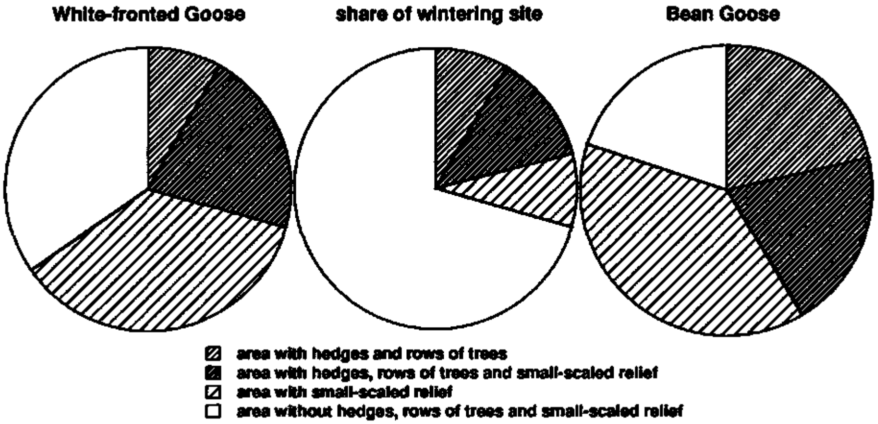

Fig. 12: Distribution of goose feeding over areas with hedges and rows of trees, with small-scaled relief or without these structures in the goose wintering site at the Lower Rhine. – Abb. 12: Verteilung der Nahrungsplätze der Wildgänse am Unteren Niederrhein, über Flächen mit Gehölzen (Hecken, Baumreihen),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

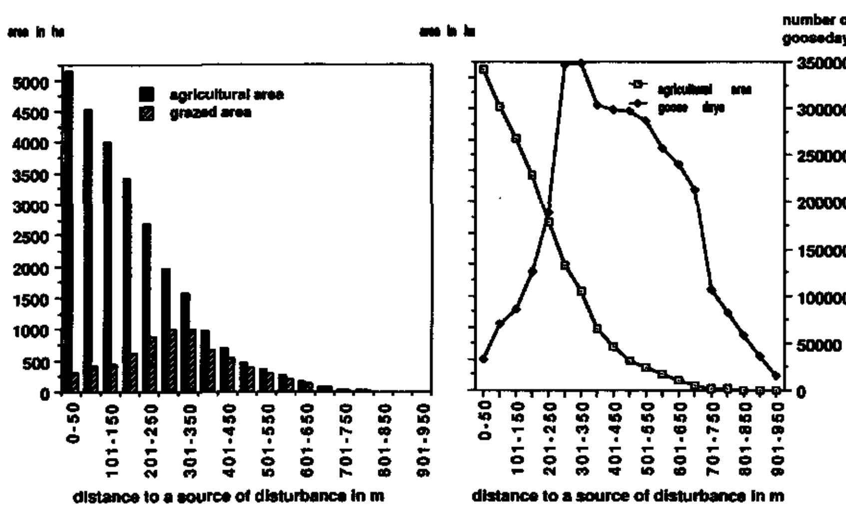

Fig. 13: Distribution of goose feeding over the agricultural area of the Lower Rhine goose wintering site in consideration of the distance to a source of disturbance. – Abb. 13: Verteilung der Nahrungsaufnahme der Wildgänse am Unteren Niederrhein im Bezug zur Entfernung zur nächsten Störungsquelle (Siedlung,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

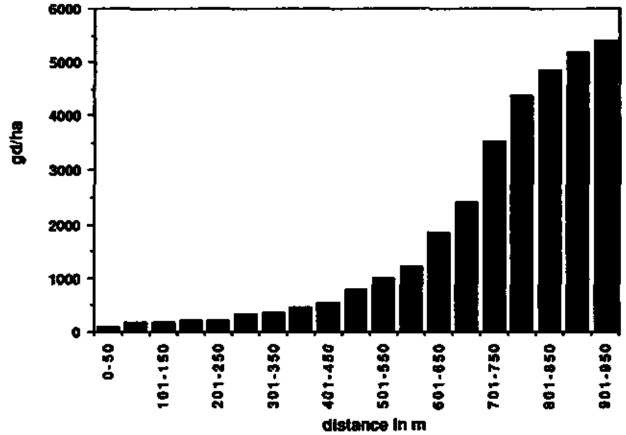

Fig. 14: Distribution of the goose feeding intensity (in goose days/hectar) over the feeding sites of the Lower Rhine area in relation to the distance to the nearest source of disturbance (n = 26 383 ha, winter 1977/78–1987/88). – Abb. 14: Verteilung der Äsungsintensität (in Gänseäsungstage pro Hektar) 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).

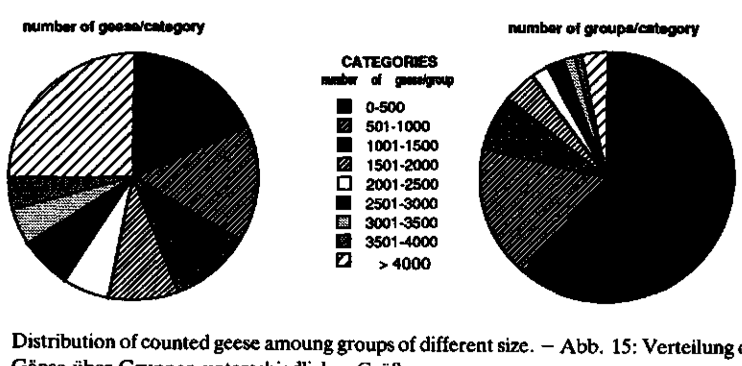

Fig. 15: Distribution of counted geese amoung groups of different size. – Abb. 15: Verteilung der gezählten Gänse über Gruppen unterschiedlicher Größe.

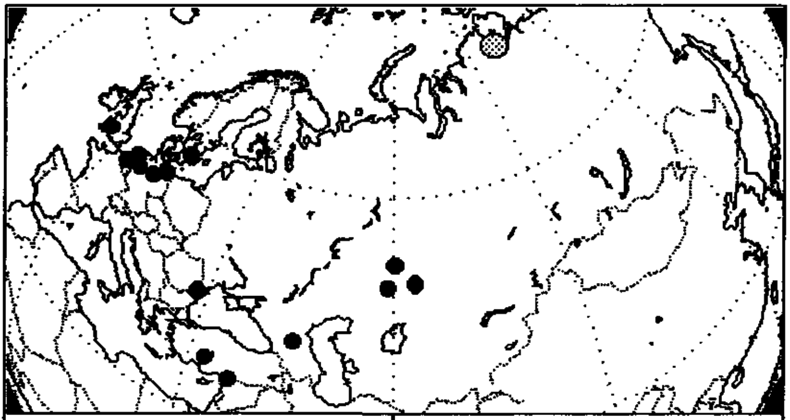

Fig. 16: Recoveries in winter 1989/90, 1990/91 and 1991/92 of White-fronted Geese marked at their moulting site on the Taymyr Peninsula since summer 1989. – Abb. 16: Rückmeldungen aus den Wintern 1989/90, 1990/91 und 1991/92 von auf den Mauserplätzen der Halbinsel Taimyr seit Sommer 1989 markierten Bläßgänsen.

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 km^2) 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.

8. References

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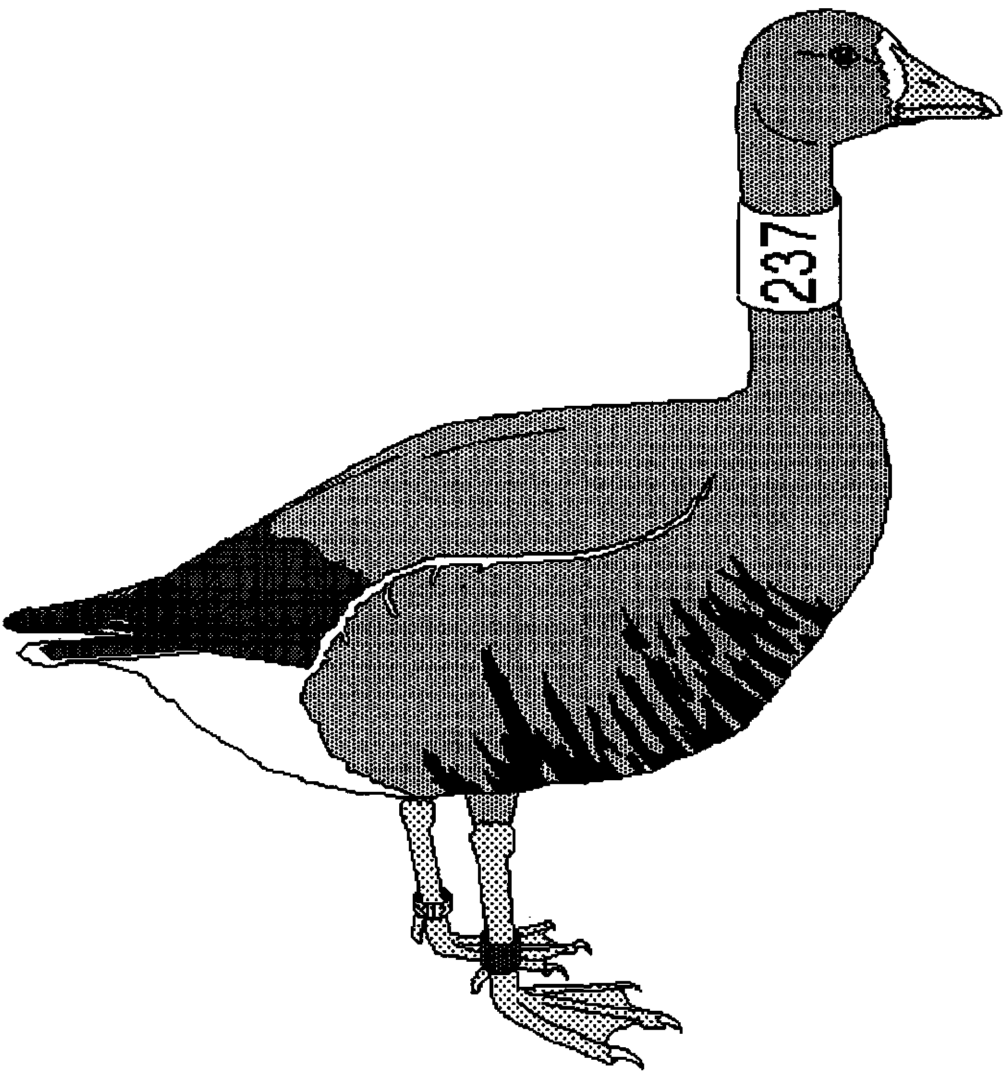
Chapter 5

Panmixia in White-fronted geese of the Western Palearctic

Johan H. Mooij, Barwolt S. Ebbinge, Igor O. Kostin, Jan Burgers, Bernard Spaans



Panmixia in White-fronted Geese (*Anser a. albifrons*) of the Western Palearctic

Johan H. Mooij, Barwolt S. Ebbinge, Igor O. Kostin, Jan Burgers, Bernard Spaans

ABSTRACT: Mooij, J.H., B.S. Ebbinge, I.O. Kostin, J. Burgers, B. Spaans - Panmixia in White-fronted Geese (*Anser a. albifrons*) of the Western Palearctic

Based on the results of an analysis of ring recoveries of White-fronted Geese *Anser albifrons* ringed in the Netherlands between 1953 and 1986 as well as at the Taimyr Peninsula 1966-1970 and 1989-1992 the following conclusions can be reached:

- The wintering populations of White-fronted Geese in the Western Palearctic are characterized by a high degree of interchange.
- There is a regular exchange between the breeding/moulting population of White-fronted Geese of the Taimyr Peninsula and the wintering sites of western Europe.
- The breeding birds of one area (Taimyr Peninsula) in winter are distributed over several wintering sites. This winter mixture of regional breeding populations and the formation of new pairs on the wintering grounds enhance the possibility of genetic exchange between breeding stocks and helps to explain why no subspecies have been formed in this part of the species range.
- Recoveries from birds ringed on the Taimyr Peninsula indicate that in the 1990s a higher proportion of the Taimyr population winters in western Europe than in the 1960s. This shift coincides with a marked increase in numbers wintering in western Europe since the 1970s.

Keywords: *Anser albifrons*, populations, migratory routes, ring recoveries.

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INTRODUCTION

According to literature the nominate race of the White-fronted Goose (*Anser a. albifrons*) breeds from the Kanin Peninsula (44° East) in northern Russia to the Kolyma delta (155° East) in northern Siberia. The winter quarters of the birds west of Chatanga river are situated in Europe and western Asia and their winter range stretches from Great Britain (3° West) in western Europe to the Caspian Sea (55° East) in western Asia (Bauer & Glutz von Blotzheim 1968, Cramp & Simmons 1977, Philippona 1972, Rutschke 1987, Uspenski 1965, Voous 1960).

According to their geographical distribution in winter, Philippona (1972) suggested a tentative subdivision into 5 distinct populations (Fig.1), viz.:

1. the Baltic-North sea population, wintering in Germany, the Netherlands, Belgium and England,
2. the Pannonic population, wintering in Slovakia, Austria, Hungary, former Yugoslavia and Italy,
3. the Pontic population, wintering in the Ukraine, Rumania, Bulgaria and northern Greece,
4. the Anatolian population, wintering in central and southern Turkey, and finally
5. the Caspian population, wintering along the borders of the Caspian Sea in southern Kazakhstan and northern Iran.

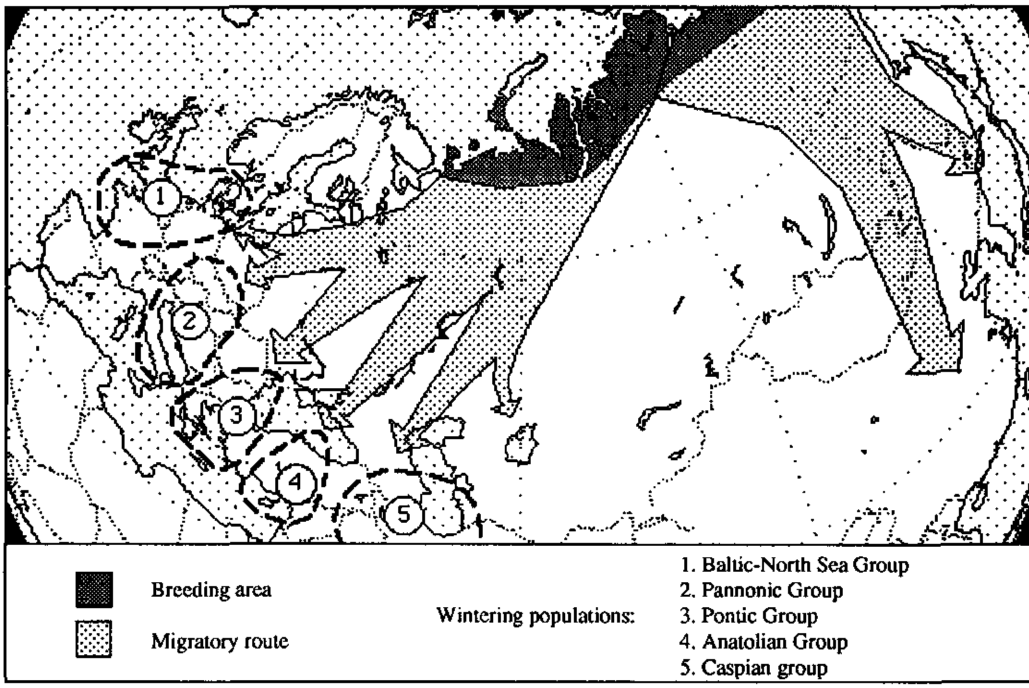

Fig. 1. Breeding area, migration routes and wintering populations of European White-fronted Goose (*Anser albifrons albifrons*) according to Cramp & Simmons (1977), Lebret et al. (1976), Philippona (1972), Rutschke (1987), Timmerman (1976) and Timmerman et al. (1976).

It was assumed that these different wintering populations remained largely discrete throughout their annual cycle, and were all derived from separate breeding areas (e.g. Bauer & Glutz von Blotzheim 1968, Cramp & Simmons 1977, Philippona 1972, Rutschke 1987).

This view was mainly based on a large sample of spring and summer recoveries of birds ringed during winter in the Netherlands and Great Britain, which were almost exclusively recovered in the westernmost part of the breeding range (Bauer & Glutz von Blotzheim 1968). However, Philippona (1972) indicated that one should not exclude the possibility of exchange of individuals between these various populations, because several recoveries of birds ringed in the Netherlands were from southeastern Europe, Turkey, Ukraine and Kazakhstan.

In order to estimate the rate of exchange it would be, however, necessary to ring birds else-where and measure how many of these would be recovered in the Netherlands.

The marked increase in numbers wintering in western Europe starting in the 1970s (Ebbinge 1985, Kuijken 1976, Madsen 1987, 1991 & 1992, Meire & Kuijken 1991, Mooij 1982, 1991a & c, 1993) was accompanied by a marked decrease in numbers at most of the wintering sites of the "Pannonic population" (Bauer & Glutz von Blotzheim 1968, Cramp & Simmons 1977, Dick 1986, 1987, 1990 & 1992, Farago 1992, Farago et al. 1991, Mikuska & Kutuzovic 1982, Sterbetz 1968, 1982a & b) as well as parts of the "Pontic population" (Munteanu et al. 1991). This development can be explained by a major westward shift of the population(s) that used to winter in Europe or by the hypothesis that the more or less separate populations show different mortality rates, e.g. as a result of differences in wintering conditions as well as in hunting pressure.
Therefore the central question is whether we are dealing with largely separated populations, that show some degree of mixing, or whether the breeding birds from northern Russia and Siberia mix to a considerable extent on the wintering grounds.

To answer this question we re-examine in this study the recoveries of White-fronted Geese ringed in the Netherlands in more detail. Besides we analyse recoveries of birds ringed elsewhere: during wing-moult on the Taimyr Peninsula.

METHODS

Ringing of geese in the wintering area (metal leg rings)

In the period 1953-1986 16 671 White-fronted Geese were ringed in the Netherlands with metal leg-rings in winter (December-March) by the DLO-Institute for Forestry and Nature Research (IBN-DLO) (formerly known as ITBON or RIN). The geese were caught by goose netters, who used living and dummy decoys and clap nets. The geese were aged, sexed and weighed, ringed with a metal legring and released in flocks as soon as possible. Subsequent records of these birds are almost exclusively of dead birds when found and reported.
Only recoveries east of 15° E reported to the Dutch ringing centre "Vogeltrekstation Arnhem" up to the end of 1987 are analysed here, which were reliable enough in regard to the precise data of recovery.

Ringing of geese in the breeding/moulting area (metal leg rings)

Between 1966 and 1970 Borzhonov (1975) marked 90 moulting White-fronted Geese with a metal ring ("Москва", Moscow ringing centre) at the Pura River Basin in the western part of the Taimyr Peninsula (Fig. 2): along the Pura River (about 72°00'N, 86°00'E) as well as at the Purinskoye Lake (about 72°00'N, 89°00'E).

Ringing of geese in the breeding/moulting area (coloured leg rings and neck-collars)

Since the summer of 1989 several joint expeditions of scientists of Germany, the Netherlands and the Russian Federation worked at the Taimyr Peninsula and a total of 838 moulting White-fronted Geese were caught and marked with colour-rings and neck-collars as well as metal rings. The different ringing schemes are shown in Table 1.

SUMMER	RINGING SITE		No. RINGED	RINGING SCHEME
	NAME	COORDINATES		
1989	Taimyr River	74.10 N, 99.50 E	93	red leg ring left leg, metal ring (Helgoland) right leg
	Logata River	73.23 N, 98.24 E	79	metal ring (Helgoland) left leg, red leg ring right leg
1990	Lydia Bay	74.07 N, 86.50 E	34	metal ring (Helgoland) left leg, green leg ring right leg
	Taimyr River	73.50 N, 99.05 E	134	metal ring (Washington DC USA) left leg, white neck-collar 500-699
1991	Lydia Bay	74.07 N, 86.50 E	183	green leg ring left leg, metal ring (Moscow) right leg
1992	Taimyr River	73.50 N, 99.05 E	315	metal ring (Moscow) left leg, white neck-collar 000-315
1989-1992			838	

Table 1. Ringing sites, number of ringed geese and ringing schemes of the White-fronted Goose ringing programme on the Taymyr Peninsula 1989-1992

The ringing took place at different sites (Fig. 2):

- 1989: at the inner delta of the Taimyra River entering the Taimyr Lake (about 74°10'N, 99°50'E) and along the rivers Logata and Taimyra (about 73°23'N, 98°24'E).
- 1990: at the Lydia Bay in the Piasina delta (74°07'N, 86°50'E) and at the innerdelta of the Taimyra river (about 73°50'N, 99°05'E).
- 1991: at the Lydia Bay in the Piasina delta (74°07'N, 86°50'E)
- 1992: at the innerdelta of the Taimyr river (about 73°50'N, 99°05'E)

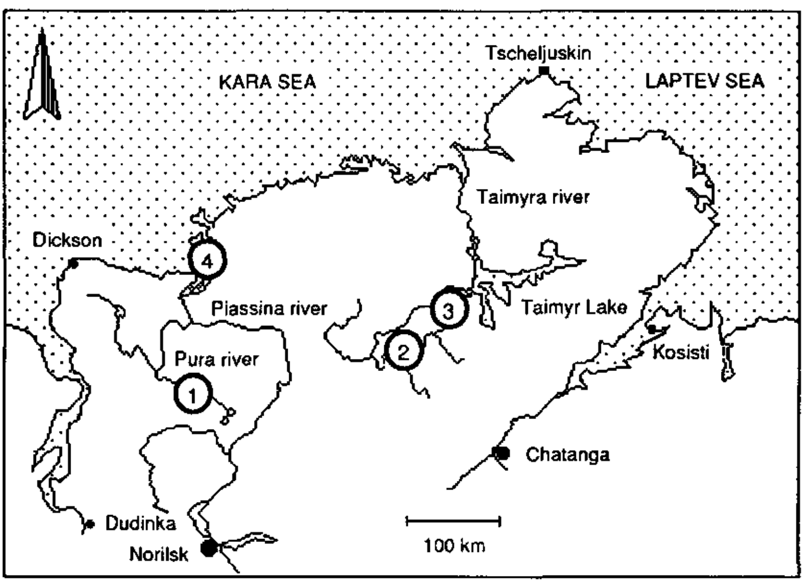

Fig. 2. Map of the Taimyr Peninsula. Sites of the White-fronted Goose ringing: 1. Pura River basin in summer 1966 - 1970, 2. valley of the rivers Taimyra and Logata in the summer of 1989, 3. inner delta of Taimyra river in the summer of 1989, 1990 and 1992, 4. Lydia Bay at the Piassina delta in the summer of 1990 and 1991.

For this study only recoveries (live or dead) collected up to the end of 1994 were analysed.
To analyse the data we have split the available data according to the method of recovery, rather then according to the way of ringing, to allow comparisons to be made and to reduce bias.

There are thus two data-sets: recoveries of birds shot by hunters and resightings of colour-ringed or neck-banded birds.
As to the first category of shot birds we had to assume that the probability that a hunter reports a marked bird, which he has shot does not depend on whether this bird is only marked with a metal ring or whether this bird was also carrying a neckband or a extra colour ring. So all shot birds have been combined.
Further we had to assume that, although hunters are not equally distributed over the range over which the geese occur and that not all hunters are equally likely to report rings of birds they kill, these spatial differences in reporting possibilities likely did not change so much over the study period, that it significantly influenced the results of the comparitive parts of this study.
To analyse whether there is a trend in time we have grouped the data from the birds ringed in the Netherlands in two groups: 1955-1970 (16 years) and 1971-1987 (17 years). For these two periods we have analyzed whether the proportion of birds recovered along the southerly migratory flyway (Kazakhstan, Ukraine, Turkey, Greece, Romania, Bulgaria) has changed between the two periods.

As to the second category the probability to identify the inscription on a neckband is undoubtedly much higher in western Europe, where many active ornithologists are well equipped with powerful telescopes, and where the geese are relatively easy to approach. Therefore the resightings will show a strong bias towards reporting in western Europe.

The weather data were taken from the "Klimaatlas Europa" (WMO 1970) and the "Klimaatlas Asien" (WMO 1981).

RESULTS

1. Ringing data

1.1. Records from metal leg rings from the programme in the wintering range

Between 1953-1986 16671 White-fronted Geese were ringed on the wintering sites of the Netherlands. From these birds a total of 2449 birds were recorded until the end of 1987 from which 856 east of 15°E. Of these recordings east of 15°E 825 (5%) could be used for analysis. Their distribution is shown in Tab. 2 & 3 and Fig. 3-6.
Ninety-six of these 825 recordings of metal rings (12%) were reported from sites in southeastern Europe and western Asia (wintering sites of the Pannonic, Pontic, Anatolian and Caspian population) or en-route to these areas in subsequent years (former Yugoslavia, Hungary, Rumania, Bulgaria, Greece, Turkey, Ukraine, Southern Russia and Kazakhstan), i.e. 4% of all recordings. Twohundred and twenty-one recordings came from the breeding areas (27% of the sample, 9% of all recordings), from which two from the Taimyr Peninsula (1% of the recordings of the breeding area, 0.2% of the sample, 0.08% of all recordings).
The catch of 30 July 1991 in the Lydia Bay at the Piassina delta (Fig. 2) in western Taimyr included one recapture of a bird ringed in the Netherlands on 5 January 1991.

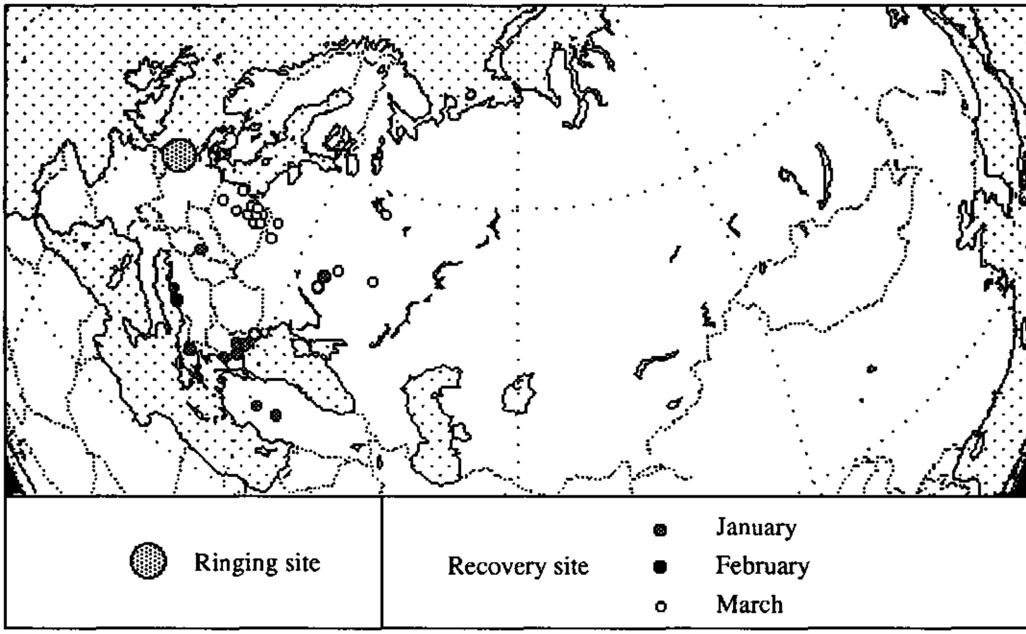

Fig. 3. Ringrecoveries from January - March of White-fronted Geese ringed in the Netherlands 1953-1986.

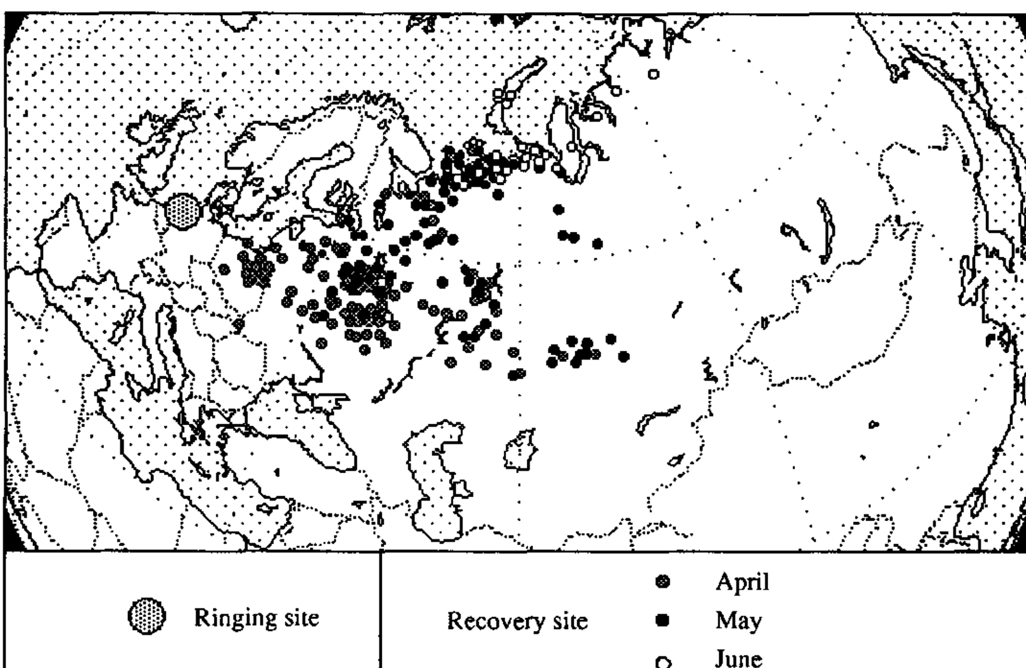

Fig. 4. Ringrecoveries from April - June of White-fronted Geese ringed in the Netherlands 1953-1986.

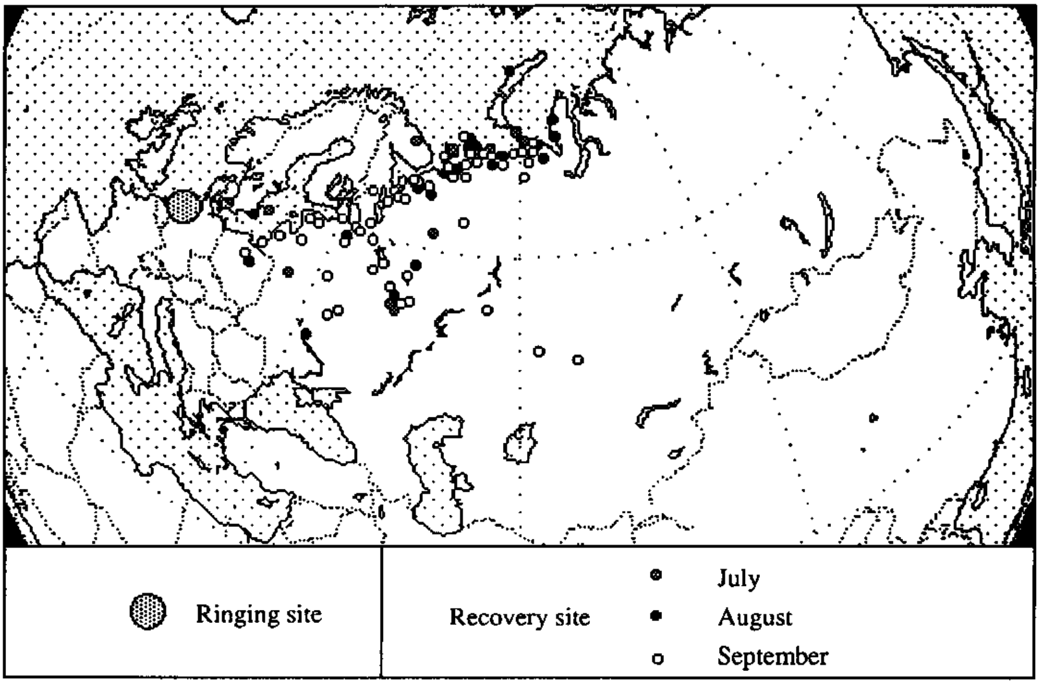

Fig. 5. Ringrecoveries from July - September of White-fronted Geese ringed in the Netherlands 1953-1986.

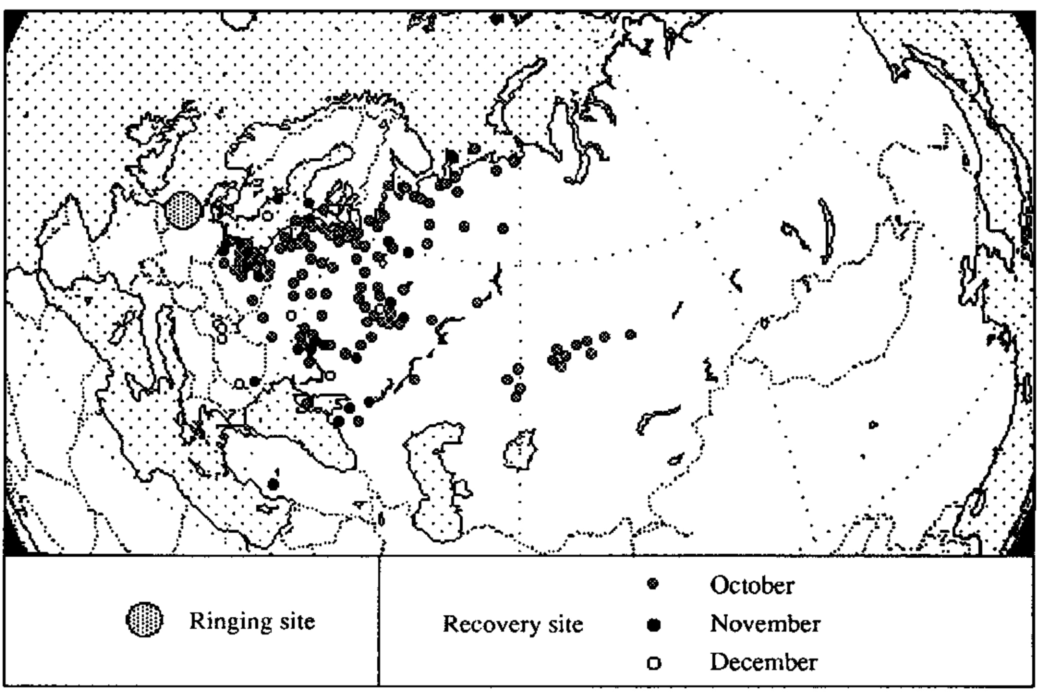

Fig. 6. Ringrecoveries from October - December of White-fronted Geese ringed in the Netherlands 1953-1986.

MONTH OF RECOV.	NO. OF RECOV.	AREA OF RECOVERIES:	Fig.
JANUARY	10	Slovakia (1), central Russia (1), former Yugoslavia (1), Greece (1), Bulgaria (4), Turkey (2).	3
FEBRUARY	1	Coast of former Yugoslavia (1).	3
MARCH	16	Poland (10), central Russia (3), Rumania (1), Ukraine (2).	3
APRIL	255	Poland (25), Lithuania (2), Belarus (7), Ukraine (2), Kazakhstan (2) and Russia (217), esp. basins of Oka and Wolga rivers (162). First birds reached breeding area (Kanin, Kolgujev Isl.).	4
MAY	245	Ukraine (1), Kazakhstan (1) and Russia (243), especially northern Russia (80), the area between Moscow and Ural Mountains (41), midwest Siberia (12).	4
JUNE	47	Central Russia (2), Turkey (1), and breeding areas (44): northern Russia (39), Jamalo-Nenezki area (3) and Taimyr Peninsula (2).	4
JULY	11	Breeding areas of northern Russia (5), Kola Peninsula (1), northern Russia (1), central Russia (2), Belarus (1), Sweden (1).	5
AUGUST	22	Breeding areas (14): northern Russia (12), Jamali-Nenezki area (2), further outside the breeding areas: northern Russia (2), western Russia (1), central Russia (2), Sweden (1), Poland (1), Ukraine (1).	5
SEPTEMBER	60	Breeding areas of northern Russia (22), northern Russia (13), central Russia (11), western Russia (6), Estonia (2), Latvia (2), Poland (1), Kazakhstan (2), Ukraine (1).	5
OCTOBER	126	Breeding areas of northern Russia (4), northern Russia (22), central Russia (20), western Russia (21), Belarus (3), Finland (1), Estonia (6), Latvia (8), Poland (13), Kazakhstan (13), southern Russia (6), Ukraine (9).	6
NOVEMBER	24	Northern Russia (3), central Russia (2), Finland (1), Estonia (1), Sweden (1), Poland (6), southern Russia (3), Ukraine (5), Rumania (1), Turkey (1).	6
DECEMBER	8	Central Russia (1), Belarus (1), Sweden (1), Ukraine (1), Rumania (1), Hungary (3).	6
TOTAL:	825		

Tab. 2. Distribution of the recoveries of White-fronted Geese ringed in the Netherlands according to the month of recovery.

If we compare the regional distribution of the recoveries over the european flyways from the period before 1971 with that after 1971, a significant difference in distribution between the two periods (Tab. 3, Chi square test) is evident. The total number of recordings since 1971 is less than half the number of the period before 1971, this decrease is less marked in the breeding areas and along the Southern Flyway as along the Northern Flyway.

	Breeding areas		**Outside the breeding areas**						**Total**
	n	%	Total		Northern flyway/W.Europe		Southern flyway/SE.Europe		n
PERIOD			n	%	n	%	n	%	
			ALL RECOVERIES						
1955-70	133	23	446	77	384	86	62	14	579
1971-87	88	36	158	64	124	78	34	22	246
Total	221		604		508		96		825
			AUTUMN RECOVERIES						
1955-70	18	16	92	84	70	76	22	24	110
1971-87	17	17	83	83	61	73	22	27	100
Total	35		175		131		44		210

Tab. 3. Distribution of the recordings of White-fronted Geese ringed in the Netherlands and recovered in the Western Palearctic east of 15° E during the year and during autumn migration (September - November).

About 66% of all recoveries is reported from April, May and June (spring hunting) and the lower number of recoveries from the second period is mainly caused by a reduction of the number of recoveries from this period, especially from April. These differences could be caused by a decrease of hunting pressure as indicated by Ebbinge (1991) accompanied by a decrease in reporting rate as indicated by Gurtovaya & Litvin (1995). An analysis of the birds recorded during autumn migration (September-November) shows that there is no difference in the distribution of the recoveries between both periods in autumn. According to the data from this ringing scheme there are no indications of a change in distribution of the Western Palearctic Whitefronts.

1.2. Records from metal leg rings from the programme in the breeding range

Between 1966 and 1970 Borzhonov (1975) marked 90 White-fronted Geese with metal rings, from which 19 birds (21%) were recovered until the end of 1983, all of them shot. From these recoveries 18 were recovered until 1975. From these recoveries 17 (89.5%) were recovered from the wintering sites of southeastern Europe (Austria: 2, Greece: 1, Rumania: 1, Syria: 1, former Yugoslavia: 2) or from the flyway to them (Ob-Valley: 1, Jamal Peninsula: 1, Kazakhstan: 7, Middle Russia: 1), two (10.5%) from an area belonging to both the Southern and Northern Flyway (Bolschesemelskaja Tundra) (Fig. 7). Although the total sample is small, it is noteworthy that not a single bird was recovered in the north-western European wintering area.

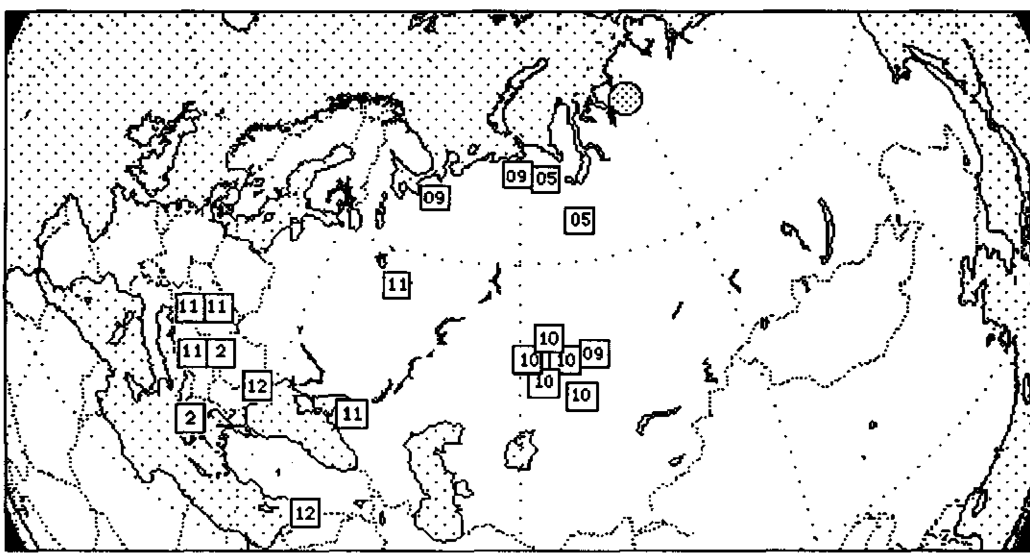

Fig. 7. Recoveries of White-fronted geese ringed at Taimyr Peninsula with metal rings between 1966 and 1970 according to Borzhonov (1975) supplemented by data from the Russian Ringing Centre, Moscow (The numbers refer to the month of recovery).

1.3. Records from coloured leg rings and neckcollars from the programme in the breeding range

From summer 1989 - 1992, 838 White-fronted Geese were ringed and marked with coloured legrings or neck-collars. Up to the end of 1994 200 records of 112 individual birds (13%) have been received, of which 37 were reported shot, 18 birds from eastern Europe and western Asia and 19 from western Europe. From the total of 200 records 25 of 22 individual birds (20%) came from southeastern Europe and Asia or enroute to them, 175 of 88 individual birds from western Europe (Fig. 8-11 and Tab. 4 & 5).

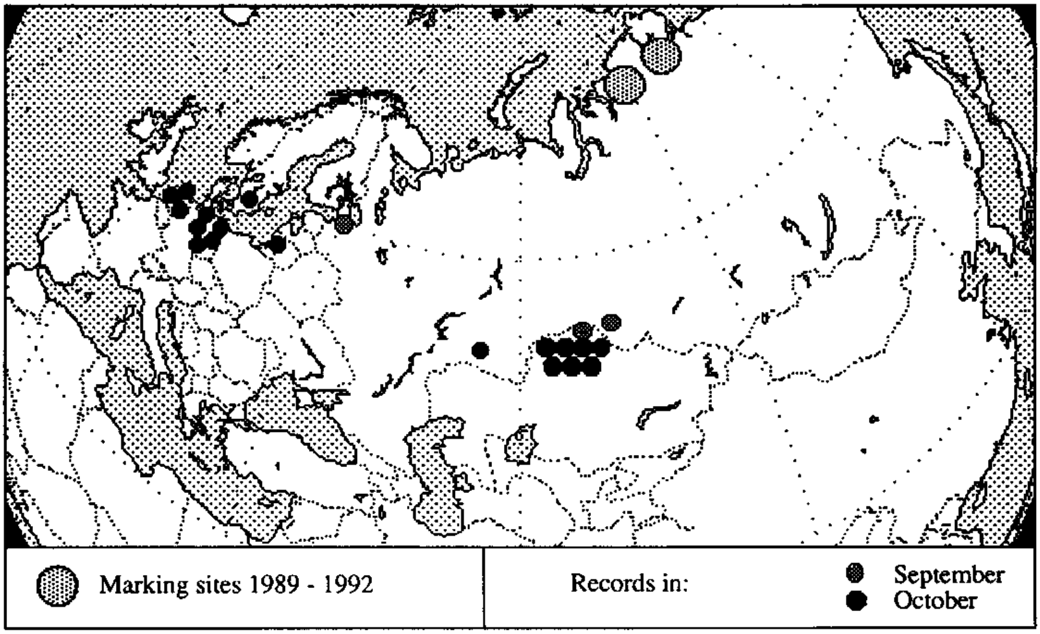

Fig. 8. Records from September and October 1989/90 - 1993/94 in western Eurasia of White-fronted Geese marked on the Taimyr Peninsula in summer 1989 - 1992.

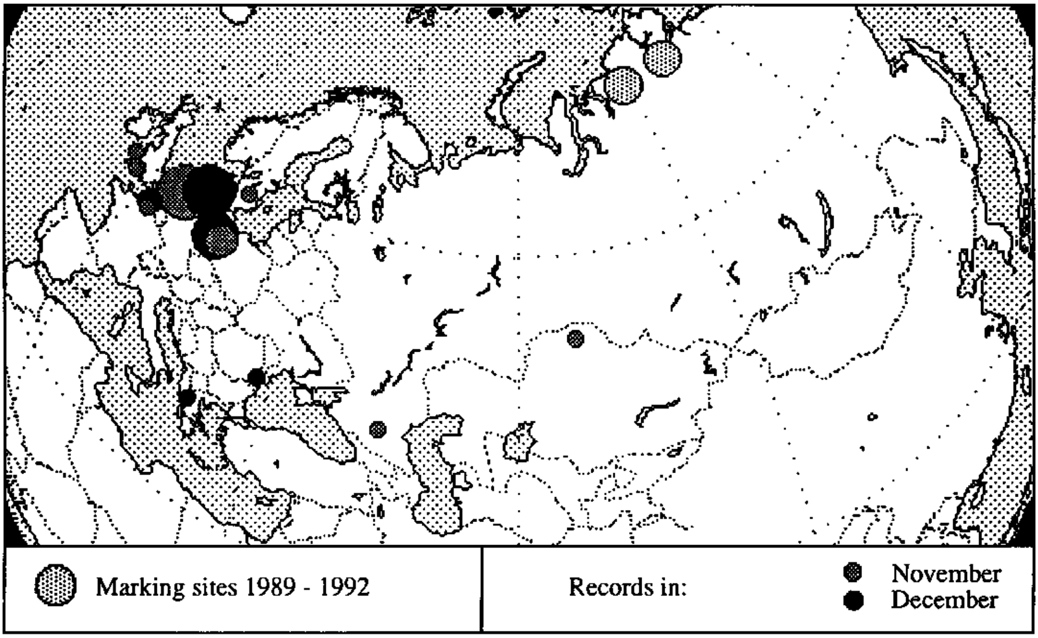

Fig. 9. Records from November and December 1989/90 - 1993/94 in western Eurasia of White-fronted Geese marked on the Taimyr Peninsula summer 1989 - 1992.

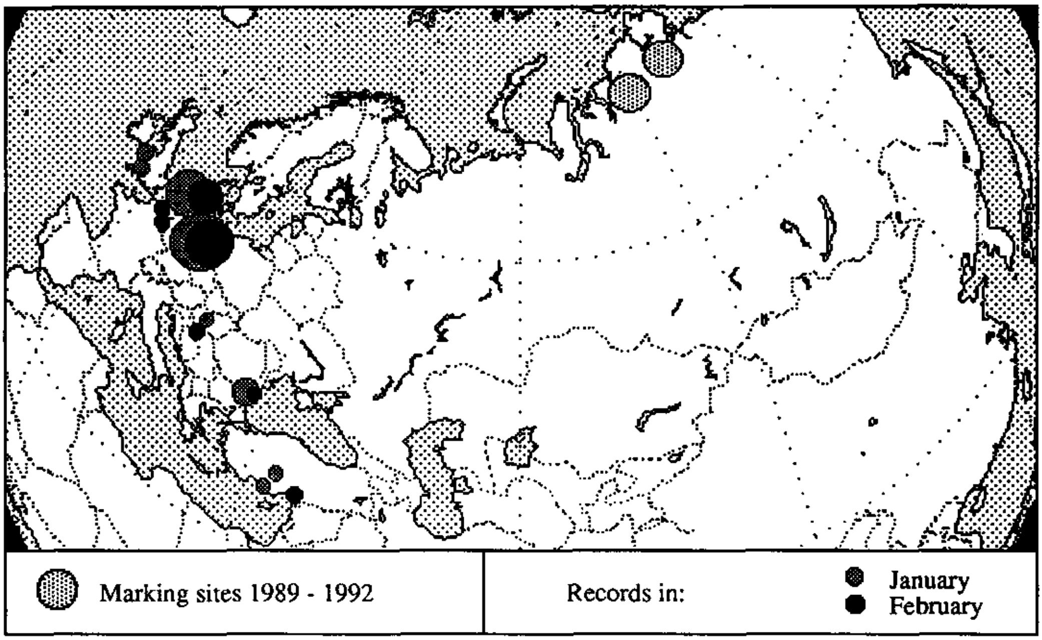

Fig. 10. Records from January and February 1989/90 - 1993/94 in western Eurasia of White-fronted Geese marked on the Taimyr Peninsula in summer 1989 - 1992.

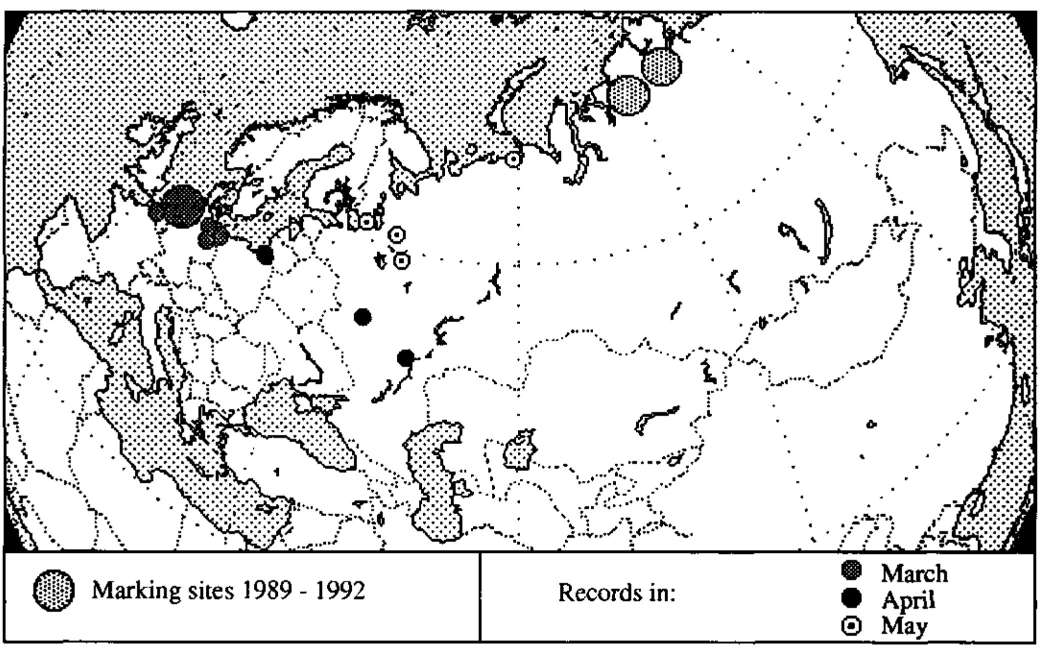

Fig. 11. Records from March, April and May 1989/90 - 1993/94 in western Eurasia of White-fronted Geese marked on the Taimyr Peninsula in summer 1989 - 1992.

MARKED GEESE	WINTER						
	1989/90	1990/91	1991/92	1992/93	1993/94	1994	TOTAL
Western Europe							
leg rings:	4	7 (1)	15 (6)	5 (3)	9 (2)	2 (1)	42 (13)
neck-collars	-	34	20 (1)	35 (2)	34 (1)	10 (2)	133 (6)
TOTAL Western Europe	**4**	**41 (1)**	**35 (7)**	**40 (5)**	**43 (3)**	**12 (3)**	**175 (19)**
Eastern Europe & Asia							
leg rings:	5 (5)	2 (2)	2 (2)	1 (1)	2 (2)	0	12 (12)
neck-collars	-	1	3 (3)	7 (1)	2 (2)	0	13 (6)
TOTAL E. Europe & Asia	**5 (5)**	**3 (2)**	**5 (5)**	**8 (2)**	**4 (4)**	**0**	**25 (18)**
TOTAL 1989-1994	**9 (5)**	**44 (3)**	**40 (12)**	**48 (7)**	**47 (7)**	**12 (3)**	**200 (37)**

Tab. 4. Recoveries of White-fronted Geese marked during the ringing programme on the Taimyr Peninsula 1989-1992 until the end of 1994 (in brackets the number recorded shot).

MONTH	9	10	11	12	1	2	3	4	5	TOTAL
COUNTRY										
Great Britain	-	-	2	-	2	-	-	-	-	**4 (0)**
The Netherlands	-	3	24 (3)	24(2)	16 (4)	13	8	-	-	**88 (9)**
Belgium	-	-	1	3	1	3	1	-	-	**9 (0)**
Germany	-	5 (1)	7	13(1)	20	16	3	-	-	**64 (2)**
Sweden	-	1	1	-	-	-	-	-	-	**2 (0)**
Latvia	-	1 (1)	-	-	-	-	-	-	-	**1 (1)**
Hungary	-	-	-	-	1	-	-	-	-	**1 (0)**
Croatia	-	-	-	-	-	1	-	-	-	**1 (0)**
Romania	-	-	-	1 (1)	-	-	-	-	-	**1 (1)**
Bulgaria	-	-	-	-	4 (1)	1	-	-	-	**5 (1)**
Greece	-	-	-	1 (1)	-	-	-	-	-	**1 (1)**
Turkey	-	-	-	-	2 (1)	1 (1)	-	-	-	**3 (2)**
Russia	2 (2)	1 (1)	1 (1)	-	-	-	-	3(3)	4(4)	**11 (11)**
Kazakhstan	1 (1)	7 (7)	1 (1)	-	-	-	-	-	-	**9 (9)**
TOTAL	**3 (3)**	**18 (10)**	**37(5)**	**42 (5)**	**46 (6)**	**35 (1)**	**12 (0)**	**3 (3)**	**4 (4)**	**200 (37)**

Tab. 5. Distribution of recoveries from winter 1989/90 until the end of 1994 of White-fronted Geese marked on the Taimyr Peninsula in summer 1989 - 1992 (in brackets the number reported shot).

Of 389 birds marked with red and green legrings between 1989 and 1991, 54 birds (14%) were recorded until the end of 1994: 28 birds were resighted and 25 birds reported shot.

From these birds 12 (22%) were reported from the wintering sites of southeastern Europe and southwestern Asia or en route to them, all of them shot. The other 42 birds were reported from western European wintering sites or enroute to them, 13 of them reported shot.

Of 449 birds marked with neck-collars between 1990 and 1992 58 individual birds (13%) were reported until the end of 1994. Of these birds a total of 146 records were reported. Forty-six birds were resighted, 10 birds were reported shot and two birds were resighted once and reported shot later, i.e. 8% of the recordings and 21% of the individuals were shot.

Of the total records, 13 records (10%) of 10 individual birds were reported from the wintering sites of southeastern Europe and southwestern Asia or enroute to them, six of them were reported shot and one was shot in Kazakhstan after being resighted in Croatia. The other 133 records of 48 individual birds were reported from western European wintering sites. In western Europe six neck-collared birds were reported shot, one in Germany after being resighted earlier in the Netherlands.

Some neck-collared birds were resighted several times: 12 birds were repeatedly resighted at one site in the same winter, seven birds were seen at one site in different winters and 17 were reported more than once from different sites.

2. Analyses of the ringing data

2.1. Records from marked birds reported shot

From the marking programme at the wintering sites of the Netherlands with metal rings 2449 birds were reported (overall reporting rate 14.7%, annual reporting rate 0.4%) - almost without exception shot -, from which 96 (4% of all recordings, 12% of the sample east of 15° E) in southeastern Europe and southwestern Asia.

From the 90 Whitefronts ringed with metal rings before 1970 in the scope of the Russian marking programme of Borzhonov at the breeding sites of the Taimyr Peninsula 19 birds (overall reporting rate 21%, annual reporting rate 2.3%) were recovered. From these recoveries 17 (89.5%) were recovered in southeastern Europe and southwestern Asia, including 4 from the wintering sites. There were no recordings from the western European wintering sites and two from an area that belongs to both flyways, but in this study were assumed to fly to western Europe (Fig. 7).

From the marking programmes with coloured leg rings and neck-collars in the moulting/breeding area at the Taimyr Peninsula since 1989 thirty-seven birds (overall reporting rate 4.4%, annual reporting rate 1.0%) were reported shot, including 18 birds (49%) from southeastern Europe and southwestern Asia (Fig. 12, Tab. 6).

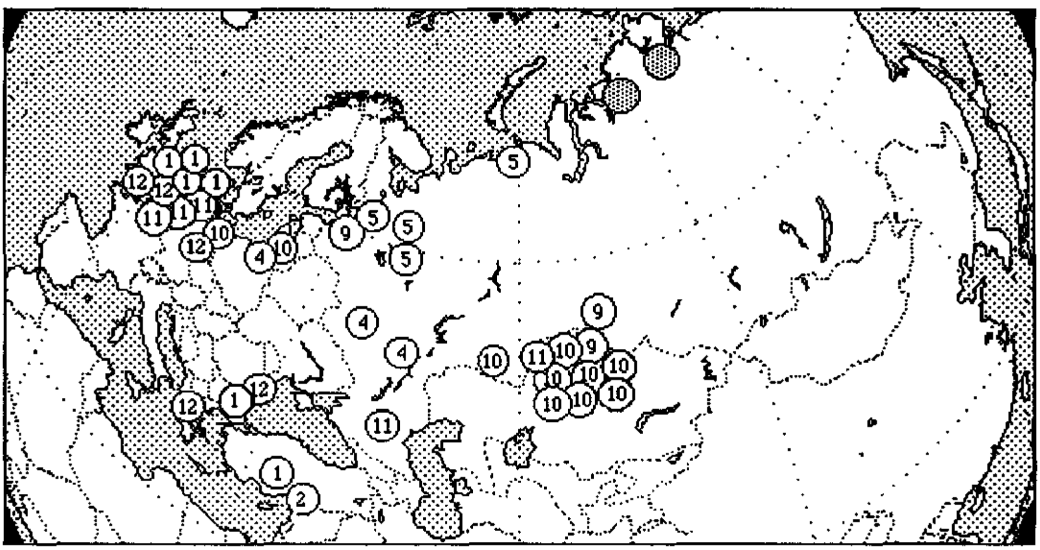

Fig. 12. Recovery sites of White-fronted Geese ringed at the Taimyr Peninsula 1989-1992 that were reported shot (The numbers refer to the month of recovery).

A more thorough analysis of the data (Tab. 6) shows that there are not only differences in the rate of recoveries from the northern and southern flyways between the two marking periods but also between the marking regions in the present data. The statistical analysis of the data shows that the differences in distribution between the Borzhonov ringing scheme and that of Ebbinge & Spaans as well as that of Kostin & Mooij are significant ($P < 0.001$ and $P < 0.05$, Chi-square test).

The difference in distribution between the two recent datasets of Ebbinge & Spaans and Kostin & Mooij are not significant. All data sets contain a variable number of spring recoveries (Borzhonov: 2, Ebbinge & Spaans: 6 and Kostin & Mooij: 1) that significantly influenced the result of the analysis. In a number of cases it is not clear from which wintering areas these birds migrated to the place where they were recovered. To allow comparisons and to reduce bias the birds shot in spring were not considered for futher analysis.

Ringer	Borzhonov				Ebbinge & Spaans				Kostin & Mooij			
Place of ringing	Pura river				Piassina river				Taimyra river basin			
Year of ringing	1966-70				1990 & 1991				1989, 1990 & 1992			
Type of ring	metal ring				green legring				red legring/white neckband			
	all recoveries		autumn/winter		all recoveries		autumn/winter		all recoveries		autumn/winter	
	n	%	n	%	n	%	n	%	n	%	n	%
Number ringed	90		90		217		217		621		621	
Number recovered	19	21	17	19	32	15	26	12	80	13	79	13
Number shot	19		17		14		8		23		22	
Area of recovery												
Northern flyway	2		2		10		4		9		9	
Southern flyway	17	89.5	15	88	4	29	4	50	14	61	13	59
Total	19		17		14		8		23		22	

Tab. 6. Distribution of recoveries of shot White-fronted Geese marked at the Taimyr Peninsula 1966-1970 and 1989-1992.

If the analysis is restricted to the recoveries from autumn and winter, the differences in distribution between the 1966-70 recoveries (Borzhonov ringing scheme) and the recoveries from 1989-92 (Ebbinge & Spaans as well as those of Kostin & Mooij pooled) are significant ($P < 0.05$, Chi-square test) and there are no significant differences in distribution between the two recent datasets of Ebbinge & Spaans and Kostin & Mooij (Tab. 6 & Fig. 13) .

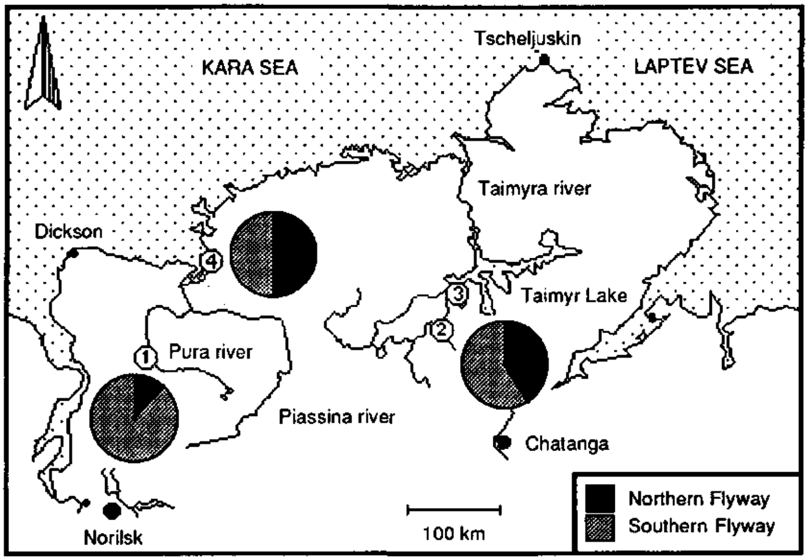

Fig. 13. Differences in the autumn and winter distribution over the main western Palearctic flyways of the recordings of shot White-fronted Geese marked at the Taimyr Peninsula at the Pura river (1966-1970; site 1), at the Taimyra and Logata river (1989, 1990 & 1992; site 2 & 3) and at the Piassina river (1990 & 1991; site 4).

The significant difference in distribution between the data sets of 1960's and 1990's could indicate that at present more White-fronted Geese from the Taimyr Peninsula migrate to western Europe than was the case during the end of the 1960's and the beginning of the 1970's.

From the Whitefronts marked at the Taimyr Peninsula before 1970 seventeen birds were reported shot during autumn and winter, including 15 on the southern flyway. From these Whitefronts 6 were shot on the Turgaiskoje Plateau in northwestern Kazakhstan (Fig. 7), i.e. 40% of the birds from the southern flyway and 35% of all.

From the Whitefronts marked in the same region since 1989 thirty birds were reported shot during autumn and winter, including 17 using the southern flyway and 9 of them from the Turgaiskoje Plateau as well as another two from the neighbouring areas, which brings the total reported shot from the region to 11birds (Fig. 12), i.e. 65% of the birds from the southern flyway and 37% of all Whitefronts reported.

We note that the proportion of ringed Whitefronts recorded from the Tugaiskoje Plateau (35% and 37% in the two periods considered) is close to the proportion of the waterfowl bag in the former USSR reported from this area (34% during the 1980s, Priklonski & Sapetina 1990). Although changes in hunting pressure (or reporting rate) elsewhere may bias our results, at present we are unable to critically evaluate if other regions along the southern flyway are in reality underrepresentated in the recent data.

2.2. Records from marked birds that were resighted

From 838 birds marked with coloured legrings and neck-collars 165 resightings of 77 individual Whitefronts (two birds were subsequently shot) were reported, i.e. an overall reporting rate 9.2%, annual reporting rate 2.0% for the individuals. From these birds seven resightings of five birds (6.5%) came from southeastern Europe and southwestern Asia.

DISCUSSION

1. Migration research by means of ringing and marking

1.1 General remarks

According to Berthold (1990) and Owen & Black (1990) the recovery rates of banded quarry waterfowl can reach 15-25% and there is a direct relationship between recovery rate and shooting intensity. Assuming that hunters are widely spread and the timing of local open hunting season mostly coincides with a mass presence of geese, the recoveries of shot birds could provide information about the distribution of geese during migration.

To get reliable information about the distribution of the geese it further would be necessary to assume that in all countries the hunters are equally spread over the range of the geese and are equally likely to report the rings of shot geese.

From Table 7 it becomes clear, that the hunters of the former USSR, Poland, Germany and the Netherlands are responsible for about 87% of the estimated total goose bag and for more than 90% of the reported metalring recoveries and 86.5% of the colour ring recoveries of shot geese, which seems to support this assumption. A more detailed view however shows that there are considerable differences in reporting rate between these countries.

Country	Estimated goose bag/year	Author	%	hunter density/km² (Wiese 94)	recoveries *A.albifrons* metalrings n		legring/collar n	
					n	%	n	%
Former USSR (w. part)	200000	Priklonski & Sapetina 1990	66.6	0.1-0.3	743	30.34	21	56.8
Poland	12000	Landry 1990, Wieloch 1992	4.0	0.3	56	2.29	0	0
Danmark	12 000 - 13 000	Jepsen & Madsen 1992	3.7	4.0	0	0	0	0
Sweden	7500	Hedlund 1992	2.5	0.7	4	0.16	0	0
Germany	10000	Mooij 1991b & 1992, Wiese 1991	3.3	1.1	573	23.40	2	5.4
The Netherlands	35000 - 50000	Oosterbrugge et al. 1992, Wiese 1991	14.2	1.0	834	34.05	9	24.3
Hungary	7000 - 7500	Farago 1992 & Landry 1990	2.4	0.4	3	0.12	0	0
former Czechoslovakia	ca.1500	Urbanek 1992	0.5	0.9	1	0.04	0	0
Austria	ca. 2000	Dick 1992	0.7	1.3	0	0	0	0
Rumania	ca. 5000	Munteanu 1992	1.7	0.2	3	0.12	1	2.7
former Yugoslavia	unknown	-		1.0	2	0.08	0	0
Bulgaria	unknown	-		0.7	1	0.04	1	2.7
Turkey	unknown	-		-	3	0.12	2	5.4
other countries	-	-		-	226	9.23	1	2.7
TOTAL	292 000 - 308 500				2449	100	37	100

Tab. 7. Estimated annual goose bags, hunter density and ring recoveries of shot birds in the Western Palearctis during the 1980s (Data about the distribution of metal ring recoveries according to Ebbinge 1991).

Another important factor is the hunter density. The figures of Table 7 show, that the hunter density is very variable within Europe and much higher in some western European countries than in eastern Europe. Besides the hunter density in Russia is high in areas with a high human population density (e.g. more than 2 hunters per km² in the Moscow region) and low in the more natural areas (e.g. 0.03-0.08 hunters per km² in northwestern Siberia and about 0.1 in northern Russia), but in some goose staging areas that easily can be reached by people the density of goose hunters can be rather high during the staging of the geese (e.g. surroundings of Moscow, southern part of the westsiberian lowland, Turgaiskoje Plateau in Kazakhstan, some parts of the breeding areas). In northwestern Kazakhstan the hunters density is about 0.3 and in the Ukraine about 0.8 hunters per km² (Kostin 1994, Priklonski & Sapetina 1990).

There are no exact figures about the density of hunters that actually shoot waterfowl, but according to Landry (1990) in most European countries the proportion of waterfowl hunters is 40-60%.

The Turgaiskoje Plateau in northwestern Kazakhstan is a well known goose site, within reach of a high number of hunters and with a high pressure of traditional goose hunting. There is no area with a comparible hunting pressure in northwestern Siberia (Kokorev, Kostin & Sagitov pers.comm.). The annual waterfowl hunting bag in the northwestern part of Russia is about 25 birds per year and in Kazakhstan about 44 birds per year. Although only about 6% of the hunters at the territory of the former USSR lived in Kazakhstan during the 1980s about 34% of the waterfowl bag of the former USSR was shot in this country (Priklonski & Sapetina 1990). Therefore the high proportion of Whitefronts from the Taimyr Peninsula recorded as shot from the autumn flyway to southeastern Europe is strongly biased by the high rate of birds reported from the Turgaiskoje Plateau. Because of these facts it has to be concluded that the hunters are not equally spread over the range of the geese and they are not equally likely to report the rings of shot geese, which means that it is not possible to get reliable information about the actual distribution of the goose numbers as well as actual mortaliy rates based on the recoveries of shot geese.

Nevertheless, the total lack of recoveries from western Europe in the early data set (Borzhonov) cannot be discounted on the assumption of hunter bias, and we take this to indicate that the exchange of geese between the Taimyr Peninsula and the wintering sites of western Europe seems to have increased since that time.

The method of marking birds with coloured rings and neckbands can increase information enormously, because the same bird can be resighted several times during its life time. The resighting rate of marked geese depends on the density of observers and the knowledge about the marking programme. At present there only is a close-meshed network of observers and a relatively broad knowledge about goose marking programmes in northwestern Europe (British Isles, Belgium, The Netherlands, Germany, Denmark, Sweden).

In most of the range of the White-fronted Goose the reporting rate of the less known marking programme with coloured legrings and neckcollars even might be considerably lower than of the traditional metalring programmes (Table 7). Therefore most of the resightings came from a few western european countries and most of the recoveries of birds marked with coloured leg rings or neckbands in the rest of the range refer to birds that were shot (18 out of 25 recoveries). Therefore the number of resightings of neckcollars will be strongly biased towards Western Europe (Tab. 4 & 5).

1.2. Wintering populations of European White-fronted Geese

The differences in the distribution of the recoveries of the goose marking programmes at the Taimyr Peninsula of Borzhonov (1975) from the end of the 1960s and of our legring and neck-colar programme since 1989 (Tab. 6 & Fig. 13) could indicate that there were changes in migratory behaviour and that since that time an increasing number of geese from the Taimyr Peninsula headed for western Europe to winter. In table 6 the proportion of Taimyr Whitefronts at present using the northern flyway to western Europe was calculated at 40-50%. The fact that two birds ringed in the Netherlands were reported from the Taimyr Peninsula, one from June 1959 and one from June 1966, suggest that birds from these breeding grounds also wintered in western Europe in former times.

That at least a part of these geese winter in western Europe was already contended by Cramp & Simmons (1977) and Rogacheva (1992).

Several White-fronted Geese of the "Baltic-North Sea population", ringed in the Netherlands and England, were recovered in southeastern Europe in subsequent winters, on the wintering sites of the "Pannonic" and "Pontic population" and from breeding grounds between the Kanin and the Taimyr Peninsula (Tab. 2, Fig. 2-6; Bauer & Glutz von Blotzheim 1968, Cramp & Simmons 1977, Rogacheva 1992), i.e. from all breeding grounds of the western Palearctic population. Although the recovery rate of ringed and marked birds in southeastern Europe surely is much lower than in northwestern Europe 96 of 825 recoveries of metalrings (11.6%) were recovered on sites of southeastern Europe and southwestern Asia (wintering sites of the Pannonic, Pontic, Anatolian and Caspian population) or on the flyway to them in the following years and marked birds from the Taimyr 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 southwest Asia, on the sites of the "Anatolian" and "Caspian group".

Thus the wintering populations of the Western Palearctic are not as clearly separated as has been thought and there is much more interchange between these groups than has been assumed up till now e.g. by Bauer & Glutz von Blotzheim (1968), Cramp & Simmons (1977), Lebret et al. (1976), Philippona (1972), Rutschke (1987), Timmerman (1976) and Timmerman et al. (1976).
This means that instead of largely separated populations we are dealing with more or less mixing breeding groups; the breeding birds of one area are distributed over several wintering sites in winter. On each of these wintering sites we therefore find more or less a mixture of several regional breeding populations from the breeding range between Kanin Peninsula and Chatanga river.

There are several indications that new pair bonds are formed 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 vast breeding area on the tundra between the Kanin Peninsula and Kolyma river (over a distance of about 4 500 km) without appreciable geographical variation, could indicate that there must have been a permanent interchange between local breeding populations on all winter sites.
The results of the ringing programme of Greenland White-fronted Geese *Anser albifrons flavirostris* also seem to support this hypothesis. Allthough these birds were caught and ringed in a very limited area in west Greenland (400 km^2) 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).

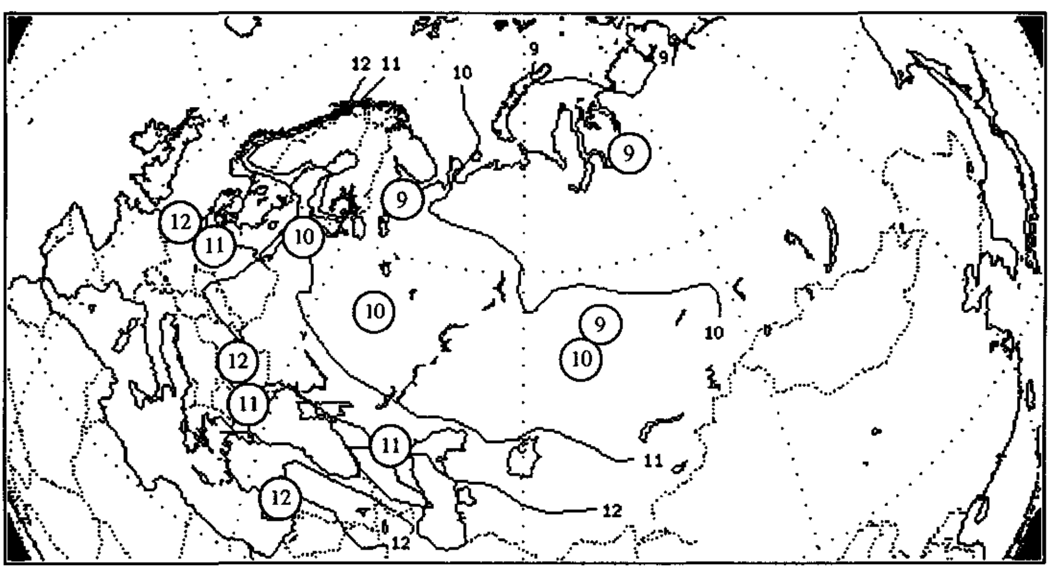

Fig. 14. Mean monthly air-isotherm of 0 °C of July (7) - December (12) (Data WMO 1970 & 1981) and monthly concentrations of White fronted geese based on recoveries.

1.3. Movements in relation to weather conditions

If we compare the recovery data of migrating geese with the movements of the frost frontier during the year (Fig. 14 & 15), it seems that during migration the majority of the geese remains on the warm side of the frost frontier.

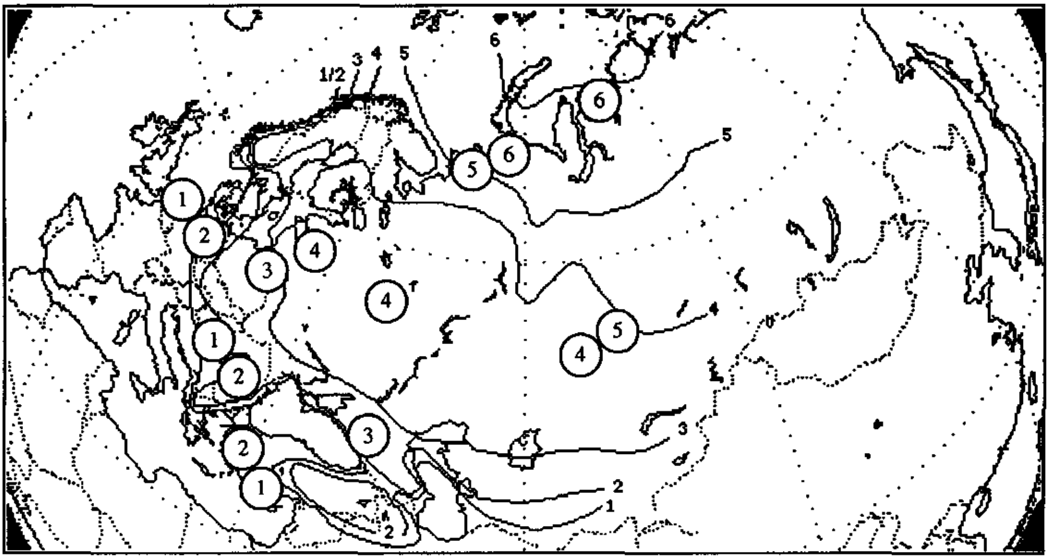

Fig. 15. Mean monthly air-isotherm of 0 °C of January (1) - June (6) (Data WMO 1970 & 1981) and monthly concentrations of White fronted geese based on recoveries.

Peacock (1975) stated that leaf growth of Graminae starts at air temperatures between 2 and 4 °C when the soil reaches temperatures above the 0 °C threshold.

The breeding range of White-fronted Geese is situated between the July-isotherms of 4 °C and 10 °C (Voous 1960) and most of the wintering sites between the January-isotherms of 0 °C and 10 °C.

This could mean that White-fronted Geese utilize areas where there is at least for a part of the time some grass growth during their staging, i.e. where they can exploit fresh grass that is more highly digestible for them.

ACKNOWLEDGEMENTS

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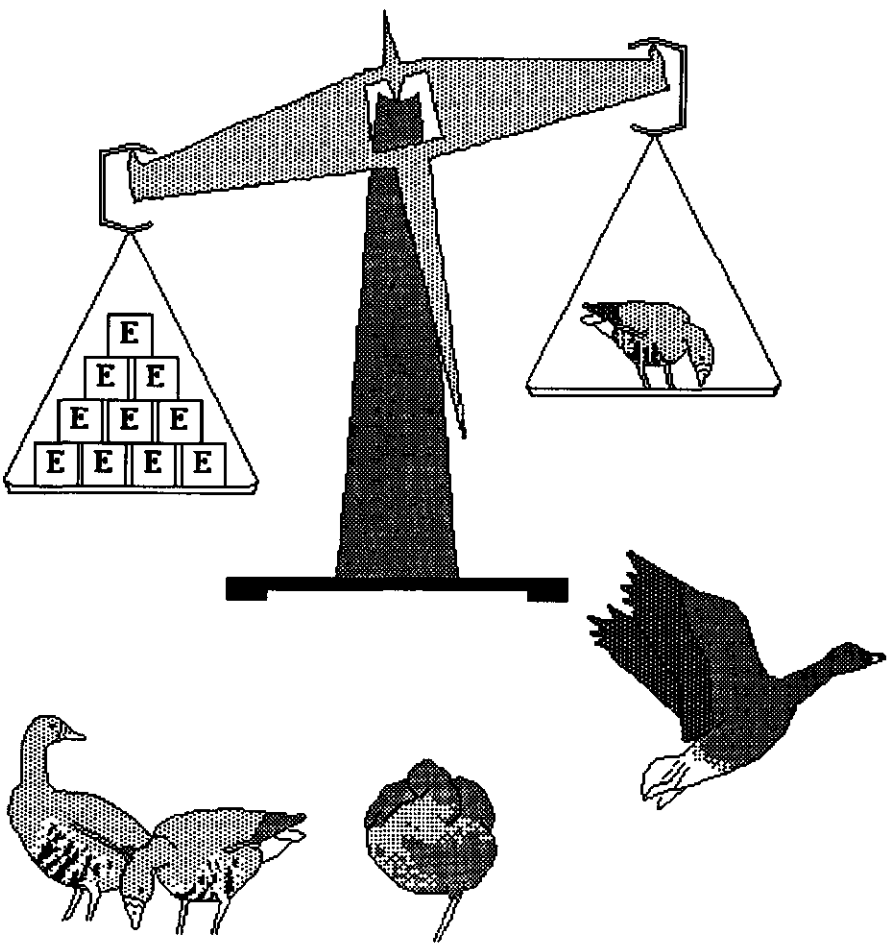
Chapter 6

Behaviour and energy budget of wintering geese in the Lower Rhine area of North Rhine-Westphalia, Germany.

Johan H. Mooij



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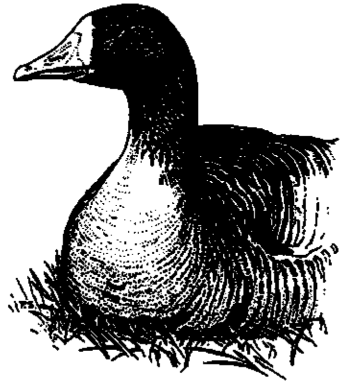
Behaviour and energy budget of wintering geese in the Lower Rhine area of North Rhine-Westphalia, Germany



J.H. MOOIJ

The most important activity of wintering geese in the Lower Rhine area is feeding, which accounts for approximately 55% of a 24-hour day. Almost 40% of this feeding takes place at night. Sleeping occupies about 30% of a 24-hour day, more than 80% of which takes place during the hours of darkness distributed among 4-5 sleeping bouts of 1-1¼ hours each. The remainder is spent drinking/preening (about 8%) and in bouts of alertness, social behaviour and flying (about 2% each).

The average flight distance of the geese between roosts, roost and feeding site and between feeding sites is 5.1 km, the average flight velocity is 43.8 km/h.

A White-fronted Goose (mean weight 2.4 kg) requires about 1500 g fresh weight (300 g dry matter) and a Bean Goose (mean weight 3.5 kg) about 1950 g fresh weight (390 g dry matter) of grass daily respectively. A gooseday (gd) is therefore a variable quantity, depending on the species. The feeding intensity measured in goosedays per hectare (gd/ha) only has validity for a specific goose species.

The disturbance of geese promotes activities with a high energy consumption and reduces all activities that save energy. In addition every disturbance prevents food intake and thereby energy intake and fat deposit accumulation. Nocturnal feeding and roosting on land are common for the geese of the Lower Rhine area and maybe are also more common for geese feeding mainly on grassy vegetation at other wintering sites than has been assumed. Both phenomena can be explained by the high energy costs of roosting on cold water during the night (about 1000 kJ, i.e. almost 25 g of body fat).

The Lower Rhine (Unterer Niederrhein) is the biggest Ramsar site in North Rhine-Westphalia (Fig. 1) and a traditional goose wintering area. Besides old farm names, such as "Gansward" and Gänseward", or fields, like "Gänsekuhl" and "Gänsespeck", there are several references in the older literature (Hartert 1887, Le Roi 1906, Le Roi & Geyr von Schweppenburg 1912) which indicate that the Lower Rhine has been a wintering area for the tundra race of the Bean Goose *Anser fabalis rossicus* since the 19th century. Neubaur (1957) stated that the wintering population of the Lower Rhine, numbering about 1000 Bean Geese during the 1950s, was smaller than it had been previously. White-fronted Geese *Anser albifrons albifrons* were only seen irregularly and in very small numbers. At the beginning of the 1960s, a gradual increase in Bean Goose numbers began, continuing to the winter of 1978-79 when a peak of about 20,000 individuals was reached. In the next two winters, the peak was 40,000 to 50,000 birds, and numbers have decreased since then.

Since the beginning of the 1960s, an appreciable number of White-fronted Geese have wintered in the Lower Rhine area. Their numbers rose slowly to about 3000 individuals (winter 1973-74) and then stabilised for some years (winter 1973-74 to 1977-78). In the following four winters, there was a rapid increase to about 20,000 geese (winter 1978-79 to 1981-82), followed by a period of explosive growth to almost 140,000 individuals in the winter of 1987-88. To date, there are some signs that this rate of increase is slowing down (Fig. 2, Mooij 1982a, 1991, 1992).

The enormous increase in goose numbers brought many complaints from the farmers of the region and, since the early 1970s, claims for financial compensation as

Wildfowl 43 (1992): 121-138

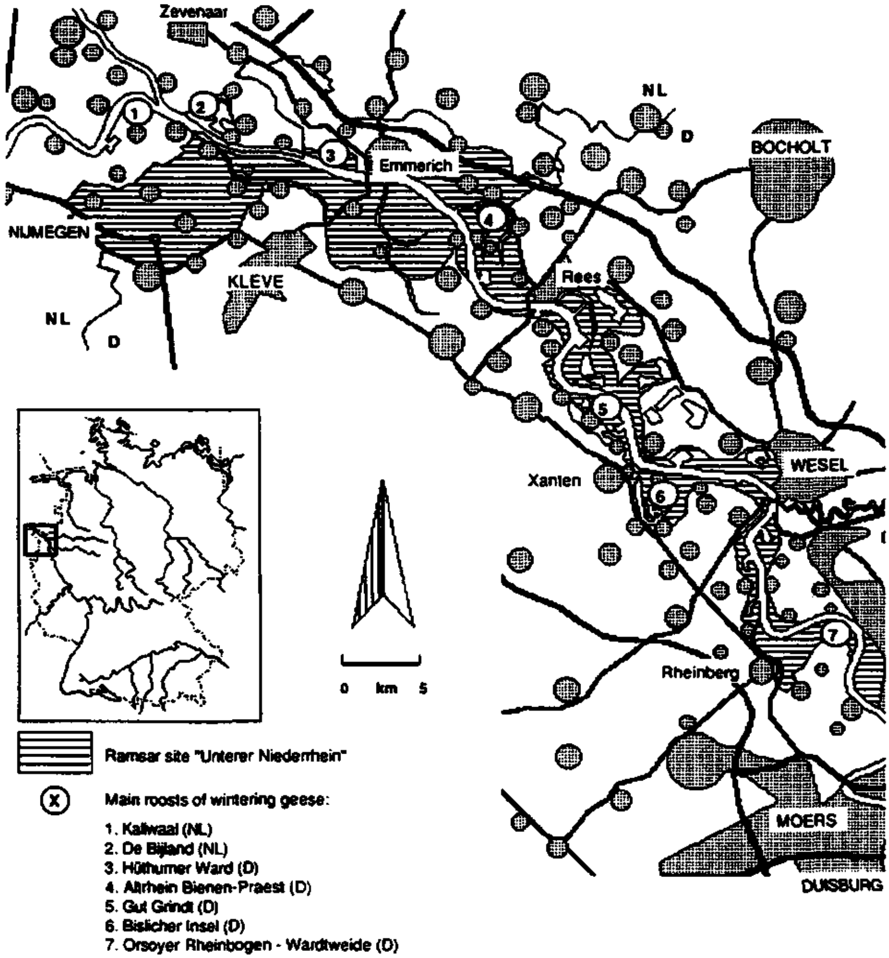


Figure 1. Ramsar site "Unterer Niederrhein" (Lower Rhine) in North Rhine-Westphalia (D) with main roosts of wintering geese.

well as requests to reopen goose hunting have been made. These developments made it necessary to start a programme to investigate goose feeding ecology, to attempt to assess goose damage and to develop management schemes for these refuging birds.

Before we can investigate the problem of goose damage and develop management schemes, it is important to know how much energy a goose needs, how it uses this energy and how much food must be consumed daily to sustain energy expenditure.

Methods

For 40 days (14 in December, 10 in January, eight in February and eight in March) a total of 14,552 wild geese (in 64 flocks) was observed for a total of 440 hours on their feeding sites from the moment they arrived until they flew off spontaneously. Data from White-fronted and Bean Geese were recorded separately. To minimize the influence of disturbance on the behaviour of the geese only those groups were observed that were feeding at a distance of more than 350 m from a source of disturbance (see Mooij 1982b). At half-hourly intervals, the activities of these birds were recorded to following categories: feeding (standing or sitting), sleeping (standing or sitting), drinking/preening, alertness, flying and social behaviour (i.e. greeting, threatening etc.). The period between these observations of group activities was used to observe single geese in these flocks for a longer period. All their activities as well as the production of droppings were recorded in a time table. All field observations were made with the help of binoculars (9x63) and a telescope (20-60x70).

The results of all these observations were compared with the results of about 300 hours of observation of eight captured geese (two pairs Bean and two pairs White-fronted Geese) feeding on pasture.

of droppings per heap as well as recording the positions of these heaps on the roost after the geese left for the feeding sites.

In order to obtain information about behaviour of the geese during flight within the wintering site (flying speed, flight distance, flight time etc.) almost two million geese in more than 8000 flights were followed and observed during flight (morning flights, drink flights and evening flights). The speed of flying goose flocks was mea-

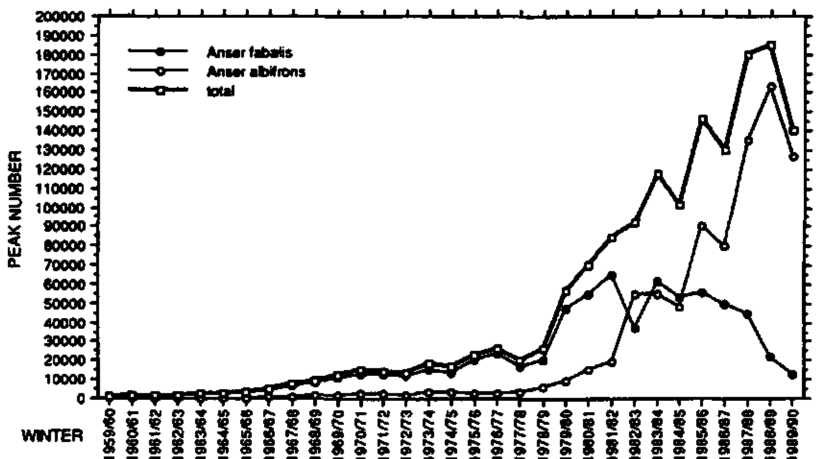


Figure 2. Peak numbers of Bean and White-fronted Geese in the Lower Rhine area from winter 1959/60 to 1989/90.

For 20 nights the geese were observed on their roost. The nights were selected at random and covered both moonlit and moonless, cloudless and cloudy nights. Although it was difficult to see all activities during the night - especially on cloudy and moonless nights - (there was no light-itensifier available and all field observations were made with the help of binoculars (9x63)), it was possible to record night-time activities. A total of 4522 geese (depending on the light conditions about 100-280 birds per night) out of sleeping groups of several thousands was observed for a total of 320 hours. It was noted at half-hourly intervals how the activities of the birds were distributed over following categories: feeding (standing or sitting), sleeping (standing or sitting), drinking/preening, alertness, flying and social behaviour (i.e. greeting, threatening etc.). Besides optical observations of geese in the direct neighbourhood of the observer information was gained by acoustic observations and by counting the number

sured by means of speedometer and by recording the flight time of known distances. Flights as a result of disturbance were not used for this part of the study.

Results

Roost sites

All the roosts of the Lower Rhine goose wintering site are close to water, although no geese were found sleeping on water. Two of the seven roosts are situated on the banks of a former gravel pit, all the others and their alternatives lie on the banks of the River Rhine and its old river arms. Without exception, roosts are open grasslands, hard to reach by man and seldom disturbed.

After leaving their feeding site in the evening, the geese did not fly directly to the roost, but flew first to drink and bathe on the Rhine, one of its old river arms or, more seldom, on gravel pits.

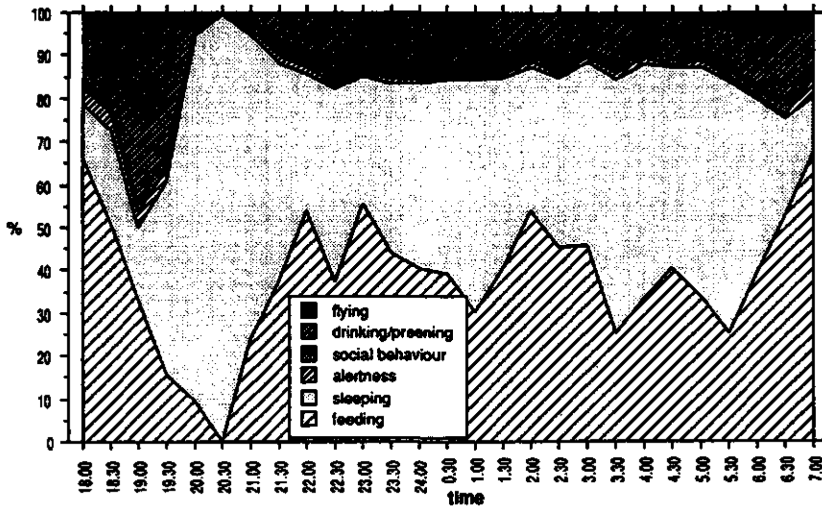


Figure 3. Night-time activities of geese on the roosts of their wintering site at the Lower Rhine.

Roost activities

After the birds land, they commence drinking and bathing (Fig. 3), with much associated calling, family social interaction and aggression. After 10-30 minutes most of the geese swim to the shallow edge of the water and start preening. This activity, in the course of which the feathers are cleaned, combed and oiled, takes 10-20 minutes. After this time the birds walk up the bank to find a place to sleep. If this bathing-drinking place is at a greater distance from the roost the birds fly to their roost.

If the geese are not disturbed, at the latest ½ - ¾ hour after the arrival of the majority of the geese on the roost, everything is quiet. Most of the birds sleep sitting on the ground, bill between the feathers of the back, feet hidden between the feathers of the belly. Some birds sleep standing on one leg.

By acoustic and optical observation it was found that the first resting phase of a night took 1½ - 2 hours. During this period almost all geese slept and the silence on the roost was only occasionally disturbed by the sounds of birds that arrived later (Fig. 3).

During the night geese continue to produce droppings which, when the birds stay on one spot (e.g. sleeping on land or ice) are produced in a heap. As the droppings are produced at regular intervals (see later) the average number of droppings per heap is used as a unit of measurement for the time the geese sleep or rest on one spot.

At six roosts of the geese wintering at the Lower Rhine the number of droppings per heap was counted in 543 heaps. The average number of goose droppings per heap is 9.43 (Fig. 4). More than 55% of the heaps contained 2-7 droppings. A mixed group of captured geese (four White-fronted and four Bean Geese) produced 2246 droppings during six nights of 11.5 hours each, i.e. each member of this group produced 46.8 droppings per night, thus producing one dropping every 15 minutes.

During 417 daily and nightly hours these captured geese produced 22,763 droppings, i.e. 2845 droppings per goose or 164 droppings per goose per day. This means that each goose produced 6.8 droppings per hour or one dropping every 8-9 minutes.

From the observation of 16 grazing geese on the feeding site for 39 hours it was calculated that these birds had an average production of 10.7 droppings per hour and goose, i.e. one dropping every 5-6 minutes. This would mean a daily production of almost 260 per goose.

With the help of these values for the daily dropping production and the average number of droppings per heap, it can be stated that the geese rest 1-2½ hours, i.e. an average of 1½ hours on one spot.

After this first quiet sleeping period some geese started feeding again, at the begin-

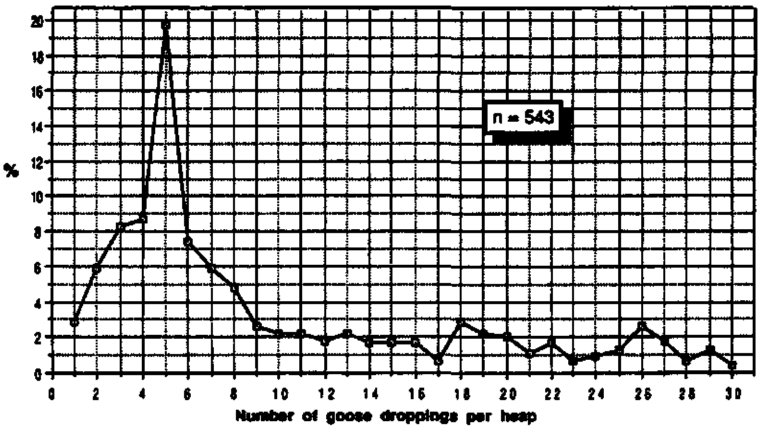


Figure 4. Number of goose droppings per heap on the roosts of the goose wintering site at the Lower Rhine.

ning in a lying position, but after a short time walking between their (still) sleeping companions. Some birds started calling softly and gradually more and more geese joined in. Some geese walked to the water to bathe and drink, but most of the birds started feeding again. Now and then there were aggressive interactions, perhaps because sleeping geese were disturbed by feeding birds.

During the night 4-5 sleeping phases alternated with feeding periods (Fig. 3). With the exception of the first sleeping phase there were always noises of active geese to be heard. Only the first sleeping phase seems to coincide for all geese of a roost, during the others there are always some geese sleeping while others are active. Some nights the noises of active geese were so loud the whole time that it was impossible to decide if the majority of the geese had a sleeping or a feeding phase without optical observations.

Roost activity budget

Based on the half hourly observations of goose behaviour on the roost (Fig. 3), it was calculated that the geese use their time as follows:

The average time that the geese are on the roost is about 13½ hours, used for (rounded off to ¼ hour):

- SLEEPING (44.3%)	6 hours
- FEEDING (38.7%)	5¼ hours
- DRINKING/PREENING (10.6%)	1½ hours
- SOCIAL BEHAVIOUR (2.8%)	¼ hours
- FLYING (2.0%)	¼ hours
- ALERTNESS (1.6%)	¼ hours
TOTAL	13½ hours

Assuming these six hours of sleep are distributed among 4-5 sleeping phases, this means that one sleeping phase takes 1-1½ hours.

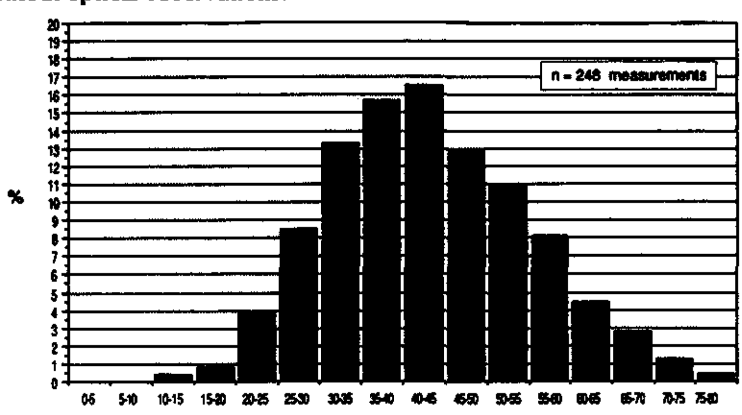


Figure 5. Velocity of flying goose flocks in the goose wintering site at the Lower Rhine.

Flight speed

The goose flocks flew with a velocity of 10-80 km/h over the Lower Rhine wintering site (Fig. 5). About one third of the flights had a velocity between 35 and 45 km/h and more than half of all registered flocks flew with a velocity between 30 and 50 km/h. The average flight velocity of all flocks was 43.8 km/h (*n* = 248 flocks).

Flight distance

The geese of the Lower Rhine area usually flew short distances between roost and feeding site (Table 1). More than a quarter of all flights were shorter than two kilometers and about half of all flights shorter than five kilometers. Less than 5% of the flights were longer than 10 km. The average flight distance was 5.1 km (*n* = 63.457 flocks).

This means that an average flight between roost and feeding site takes about seven minutes.

Feeding site activities

With the exception of the time they spend on the roost and in the air the geese are to be found on the feeding site. This means that they spend an average of 9 hours 30 minutes in November, 8 hours 45 minutes in December, 9 hours 30 minutes in January, 10 hours 30 minutes in February and 12 hours in March on the feeding site. There were no differences in behaviour between White-fronted and Bean Geese, except for the selection of feeding site (Mooij 1992).

Every winter both goose species spend an average of 10 hours 30 minutes a day on the feeding sites. The number of feeding geese declines during the day and reaches its lowest level between 12.00 and 14.00 h

Table 1. Distance between main roosts and feeding sites at the goose wintering site of the Lower Rhine area.

Roost	Distance between main roost and feeding site	
	Range	Average
Kaliwaal De Bijland Hüthumer Ward	0-20 km	7.2 km
Altrhein Bienen-Praest	0- 8 km	3.1 km
Gut Grindt	0- 7 km	3.2 km
Bislicher Insel	0- 4 km	1.5 km
Orsoyer Rheinbogen-Wardtweide	0- 5 km	2.8 km
Average distance between roost and feeding site		5.1 km

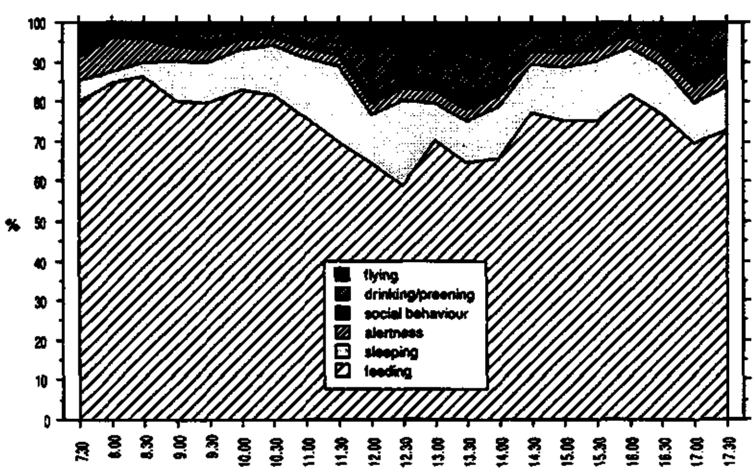


Figure 6. Day-time activities of geese on the roosts of their wintering site at the Lower Rhine.

(Fig. 6). In this period most of the geese make a drinking flight.

The geese of the Lower Rhine wintering site sleep almost 30% of the day: 82.2% of these sleeping hours are during darkness and 17.2% during daylight (Table 2). The sleeping phases on the feeding site lasted 10-65 minutes with an average of 15.7 minutes (n = 127 geese). This means that the geese need 4-5 sleeping phases on the feeding site to reach a total of 75 minutes,

Feeding site activity budget

This average period of 10½ hours the geese spend on the feeding site, are used as follows (rounded off to ¼ hour):

- FEEDING (75.0%)	8 hours
- SLEEPING (11.5%)	1¼ hours
- DRINKING/PREENING (5.1%)	½ hours
- ALERTNESS (3.5%)	¼ hours
- SOCIAL BEHAVIOUR (2.7%)	¼ hours
- FLYING (2.2%)	¼ hours
TOTAL	10½ hours

Table 2 shows that the most important activity of the geese on the roost is sleeping and on the feeding site is grazing. At the same time it becomes clear that of all activities feeding is the most important and takes 13 hours and 15 minutes daily of which 60% takes place on the feeding site and 40% on the roost.

Table 2. Average time spent during a 24-hour period by the geese of the Lower Rhine wintering site on their main activities. (All data are rounded off to ¼ hour.)

	Place of activity		
Kind of activity	Feeding site	Roost	Total
Feeding	8 hours (33.3%)	5¼ hours (21.9%)	13¼ hours
Sleeping	1¼ hours (5.2%)	6 hours (25.0%)	7¼ hours
Alertness	¼ hours (1.1%)	¼ hours (1.0%)	½ hours
Social behaviour	¼ hours (1.1%)	¼ hours (1.0%)	½ hours
Drinking/preening	½ hours (2.1%)	1½ hours (6.3%)	2 hours
Flying	¼ hours (1.0%)	¼ hours (1.0%)	½ hours
Total	10½ hours (43.8%)	13½ hours (56.2%)	24 hours

Dropping production as an indicator of daily consumption

Captured geese produced an average of 46.8 droppings per goose and night of 11.5 hours, i.e. one dropping every 15 minutes, i.e. 4 droppings/hour. During 417 daily and nightly hours these captured geese produced 164 droppings per goose and day, i.e. one dropping every 8-9 minutes or 6.8 droppings/hour. During 75 nightly hours these birds were mainly resting and produced 4 droppings/hour, during 342 daylight hours being active 7.5 droppings/hour. From these data it becomes clear that geese produce more droppings during the time they are active than during times of rest, as was also found by Owen (1972) and Rutschke (1983).

From the observation of free-living geese on the feeding site it was calculated that these birds had an average production of 10.7 droppings per hour and goose, i.e. one dropping every 5-6 minutes. Drent *et al.* (1978) stated that the food consumption of captured geese is about 75% of that of free-living birds. This would mean that (assuming dropping weight being constant) the dropping production of captured birds would also be about 75% of free-living ones. It follows that free-living geese do not produce an average of 46.8 but of about 62 droppings per night of 11.5 hours (5.4 droppings per hour and goose) and not 164 droppings per 24 hours but about 219 droppings per day (9.1 droppings per hour and goose).

During 24 hours, the geese of the Lower Rhine area slept for 7¼ hours and were active for the remaining 16¾ hours (mainly feeding).

During the active phase of the day the free-living geese of the Lower Rhine area produced 10.7 droppings per hour and goose. This means for the active time of the day:

- 10.7 droppings/h x 16.75 hours = 10.7 droppings/h x 1005 minutes = 1 dropping every 5.6 minutes and about 180 droppings altogether.

During the inactive phase of the day wild geese produce 5.4 droppings per hour and goose. This means for the inactive time of the day:

- 5.4 droppings/h x 7.25 hours = 5.4 droppings/h x 435 minutes = 1 dropping every 11.1 minutes and about 40 droppings altogether.

Thus these free-living Lower Rhine geese (mixed groups of White-fronted and Bean Geese) produce about 220 droppings in 24 hours.

This value corresponds closely to the corrected value of the caged geese and the data of Rutschke (1983), who found an average daily dropping production of 230 droppings for the Bean Goose. Given that Bean Geese produce 230 droppings per day and that in the Lower Rhine area we found an average dropping production of 220 droppings for mixed groups of White-fronted and Bean Geese, this means that White-fronted Geese have a daily production of 200-210 droppings.

Having arrived at a reliable value for the daily dropping production, we can now make a first assumption of the daily consumption of free-living geese.

A dropping of a White-fronted Goose has an average dry weight of 0.87 g (Kear 1963, Kear in Atkinson-Willes 1963) and of a Bean Goose of 1.0 g (Rutschke 1983). Based on these data it can be calculated that the daily faecal production of a White-fronted Goose is about 180 g and of a Bean Goose is about 230 g dry weight. By a mean digestive efficiency of 30% (Owen 1972, Ebbinge *et al.* 1975, Drent *et al.* 1978, Vorobeva 1982) and a dry matter percentage of the grass of 19-20% (Kear in Atkinson-Willes 1963) this would mean a daily food intake for a White-fronted Goose of about 257 g dry and 1300 g fresh weight and for a Bean Goose of about 330 g dry and 1700 g fresh weight.

In the next section these approximations for the daily food intake of free-living geese will be compared with estimates made on the basis of energetic calculations and values found by other workers.

Daily energy expenditure

White-fronted geese have a mean body weight of 2.4 kg and Bean Geese of 3.5 kg (Bauer & Glutz 1968, Cramp & Simmons 1977). Because of the mixture of these species in the Lower Rhine area, it is tenable in this region to assume a mean body weight of wintering geese of about 3 kg.

Based on the data of Drent *et al.* (1978) and Rutschke (1983) a goose with a body weight of 3 kg needs about 830 kJ per day to maintain its basal metabolism (Basal metabolic rate = BMR) and 2.5-2.6 x BMR to live and be active, i.e. a goose of 3 kg has a daily energy requirement (Daily Energy Expenditure = DEE) of 2000-2200 kJ/day.

With the help of the metabolic weight (body weight $kg^{.75}$) it is possible to estimate the DEE of other goose species:

- *Branta bernicla*, body weight 1350 kg, 55.1% of 2100kJ/day is 1160 kJ/day,
- *Anser erythropus*, body weight 1500 kg, 59.5% of 2100 kJ/day is 1250 kJ/day,
- *Branta leucopsis*, body weight 1900 kg, 71.0% of 2100 kJ/day is 1500 kJ/day,
- *Anser albifrons*, body weight 2300-2400 kg, 82.0-84.7% of 2100 kJ/day is 1750 kJ/day,
- *Anser caerulescens*, body weight 2600 kg, 89.9% of 2100 kJ/day is 1890 kJ/day,
- *Anser fabalis*, body weight 3500 kg, 112.3% of 2100 kJ/day is 2360 kJ/day.

These data were put together in a graph (Fig. 7) and show a clear correlation:

$y = 5.4\,x^{0.745}$ or $\ln y = \ln 5.4 + 0.745 \ln x$ (1)

Based on this formula we can calculate the following general values:
- a goose of 1 kg body weight has a DEE of about 0.93 kJ/g & day,
- a goose of 2 kg body weight has a DEE of about 0.78 kJ/g & day,
- a goose of 3 kg body weight has a DEE of about 0.70 kJ/g & day,
- a goose of 4 kg body weight has a DEE of about 0.65 kJ/g & day.

According to Owen (1972) the grass that is grazed by the geese has an energy content of 17.7 kJ/g dry matter. Assuming the geese can utilize all the energy included in the food they consume, they would need a daily intake of about 120 g dry matter of grass in order to cover their energy requirements of 2100 kJ/day. With a portion of about 20% dry matter this means about 600 g fresh weight. Taking into account the quality of grass in winter and the digestibility of grass in winter and the digestibility of grass for geese as discussed by Drent *et al.* (1978), Ebbinge *et al.* (1975), Owen (1972) and Vorobeva (1982), it is realistic to say that the geese can only digest about 30% of the food they consume in winter. This means that they have to take up more than three times the amount of grass that was previously calculated. Thus the daily food requirement of a mean goose in the Lower Rhine area is about 2000 g fresh weight or 400 g dry matter of grass. A mean White-fronted Goose weights 2400 g (metabolic weight 1930 g, i.e. 85% of 2280 g) and needs 85% of 2000 g, which is about 1700 g fresh weight or 340 g dry matter of grass daily. A mean Bean Goose of 3500 g (metabolic weight 2560 g, i.e. 112% of 2280 g) needs 112% of 2000 g, i.e. about 2240 g fresh weight or 450 g dry matter of grass daily.

After these theoretical reflections we will compare the above approximations with the estimates of other authors.

Owen (1972) found for the DEE of White-fronted Geese at Slimbridge (body weight 2300 g) a value of 1365 kJ/day, using a value of the BMR of 525 kJ calculated by Lachlan. Compared to the BMR found by Rutschke (1983) this value is substanially too low. If we replace the value of the BMR of Lachlan by the BMR-value calculated by Rutschke, the DEE of Owen (1972) for the White-fronted Goose is 1725 kJ/day instead of 1365 kJ/day. Rutschke (1983) calculated 2400 kJ/day for the Bean Goose and 1700 kJ/day for the White-fronted Goose.

Several authors calculated the DEE of other goose species. For a Snow Goose *Anser caerulescens*, with an average weight of about 2.6 kg (Cramp & Simmons 1977), Frederick & Klaas (1982, in Frederick *et al.* 1987) calculated a DEE of about 1760 kJ/day and Bedard & Gauthier (1989) a mean value of 1690 kJ/day. All these values are very well comparable with the estimates found above. Dijkstra & Ebbinge (in Drent *et al.* 1978) calculated 842 kJ/day for a Brent Goose *Branta bernicla* (mean body weight 1350 g), Vorobeva (1982) 900 kJ/day for a Lesser White-fronted Goose *Anser erythropus* (mean body weight about 1500 kg) and Ebbinge *et al.* (1975) 943 kJ day for a Barnacle Goose *Branta leucopsis* (mean body weight 1900 g). All these values are substantially lower than the estimates found in this study.

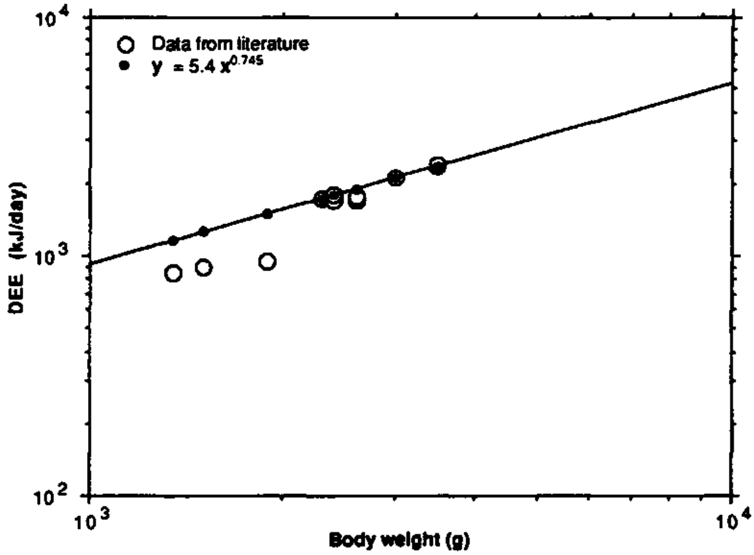


Figure 7. Relationship between body weight (g) and daily energy expenditure (= DEE, kJ/day) in geese after data of Bedard & Gauthier 1989, Drent *et al.* 1978, Ebbinge *et al.* 1975, Frederick *et al.* 1987, Owen 1972 (corrected), Rutschke 1983, Vorobeva 1982 and own data.

These data and those gathered by Drent *et al.* (1978), Ebbinge *et al.* (1975), Walsberg (1983) and Vorobeva (1982) were assembled in one graph (Fig. 8). In this way we can compare the total DEE of almost 80 bird species with a body weight of 3.2-25,200 g and these data show a clear relationship between DEE (y, in kJ/day) and body weight (x, in g) that is expressed by the following formula:

$$y = 13.05\,x^{0.6052} \text{ or}$$

$$\ln y = \ln 13.05 + 0.6052 \ln x \quad (2)$$

This formula is not new, but was already deduced by Walsberg (1983) with the help of data from 41 bird species, most of them

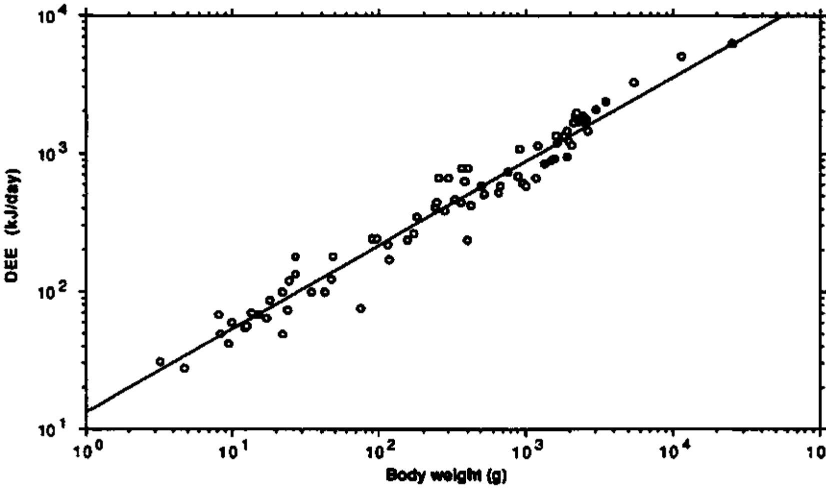


Figure 8. Relationship between body weight and daily energy expenditure (= DEE) in birds, (n = 79). Graph after data of Bedard & Gauthier 1989, Drent *et al.* 1978, Ebbinge *et al.* 1975, Frederick *et al.* 1987, Owen 1972 (corrected), Rutschke 1983, Walsberg 1983, Vorobeva 1982 and own data. (Black points: values of

with a body weight below 1000 g. This analysis shows that there seems to be a general relation between body weight and DEE for all free-living birds, although there can be considerable differences from the predicted value. These differences most likely are caused by the different conditions under which these data were gathered.

As a result of these reflections it should have become clear that a gooseday is a rather variable quantity; a gooseday of Brent Geese means the extraction of about 1 kg fresh weight of vegetation, whereas a gooseday of White-fronted Geese means the extraction of more than 1.5 kg fresh weight of vegetation. A feeding intensity of 1500 goosedays/ha of Brents have to be compared with 1000 goosedays/ha of Whitefronts.

Daily energy budget

As a result of Drent *et al.* (1978) and Rutschke (1983) we know that:

Daily Energy Expenditure (=**DEE**) =

2.55 x Basic Metabolic Rate (=**BMR**) (3)

According to several authors (for instance Bezzel 1977) there are great differences between the metabolic rate during phases of activity and phases of rest that can reach as much as 20-25%. Apart from the fact that there are no exact data about the extent of these differences in geese, it is possible that they are not very well pronounced in geese, because they have no marked day-night rhythm. Phases of activity and resting alternate in geese during day and night and it is possible that the fluctuations in metabolic rate are equally spread over 24 hours.

Therefore the possible fluctuations in the metabolic rate are not taken into consideration in the following theoretical reflections and we can state that the mean Hourly Metabolic Rate (= HMR) is theoretically 1/24 of the BMR:

$$BMR = 24 \times HMR \quad (4)$$

A combination of the formulae 3 and 4 results in:

$$DEE = 2.55\ BMR = 2.55 \times 24 \times HMR = 61.20\ HMR = 2100\ kJ \quad (5)$$

$$HMR = 2100 : 61.20 = 34.31\ kJ \quad (6)$$

Theoretically the Hourly Energy Expenditure (= HEE) is 1/24 of the DEE:

$$DEE = 24 \times HEE \quad (7)$$

This means that:

$$HEE = 2.55 \times HMR \quad (8)$$

According to Lachlan (in Owen 1972) and Bezzel (1977) the metabolic rate during flight is ten times higher than the HMR, so that for every hour of flight HEE = 10 x HMR instead of 2.55 times. When a bird sleeps the HEE is much lower than the HEE of an active bird, but because the bird has to maintain its temperature and to digest the contents of its intestines the HEE cannot return to the level of the HMR. That is why in this theoretical calculation the HEE of a sleeping bird is calculated as being 1.5 x HMR.

The following formula is based on these reflections:

$$\text{HEE} = n\ \text{HMR} \quad (9)$$

in which "n" can vary between 10 (flying) and 1.5 (sleeping). The n-values for "feeding", "drinking/preening", "alertness" and "social behaviour" are expected to lie between these extremes. The mean value of "n" for a whole day of 24 hours is 2.55. In order not to complicate the theoretical calculations, it is stated that with the exception of "flying" and "sleeping" for all other activities "n" is the same.

On the basis of ethological observations (Table 2) it is known that the geese of the Lower Rhine area use 24 hours as follows:

- FEEDING	13.25 hours (55.2%)
- SLEEPING	7.25 hours (30.2%)
- DRINKING/PREENING	2.00 hours (8.3%)
- ALERTNESS	0.50 hours (2.1%)
- FLYING	0.50 hours (2.1%)
- SOCIAL BEHAVIOUR	0.50 hours (2.1%)+
TOTAL	24.00 hours

The following calculation for the daily energy budget has been made with the help of these data:

Sleeping: 7.25 x HEE =

$$\left.\begin{array}{r} 7.25 \times n \times \text{HMR} \\ n = 1.5 \end{array}\right\} = 7.25 \times 1.5 \times \text{HMR} = 10.88\ \text{HMR}$$

Flying: 0.50 x HEE =

$$\left.\begin{array}{r} 0.50 \times n \times \text{HMR} \\ n = 10.0 \end{array}\right\} = 0.50 \times 10.0 \times \text{HMR} = 5.00\ \text{HMR} \; +$$

Total energy for "sleeping" and "flying": 7.75hours 15.88 HMR (10)

The combination of the formulae 5 and 10 means that for other activities, such as "sleeping" and "flying", there remain 16.25 hours and 45.32 HMR.

Other activities:

$$16.25 \times n \times \text{HMR} = 45.32\ \text{HMR}$$
$$n = 45.32 : 16.25 = 2.79$$

The daily energy budget is as follows:

- FEEDING
  13.25 x 2.79 x HMR = 36.96 HMR = 1268 kJ (60.4%)
- SLEEPING
  7.25 x 1.50 x HMR = 10.88 HMR = 373 kJ (17.7%)
- DRINKING/PREENING
  2.00 x 2.79 x HMR = 5.58 HMR = 191 kJ (9.1%)
- ALERTNESS
  0.50 x 2.79 x HMR = 1.39 HMR = 48 kJ (2.3%)
- FLYING
  0.50 x 10.00 x HMR = 5.00 HMR = 172 kJ (8.2%)
- SOCIAL BEHAVIOUR
  0.50 x 2.79 x HMR = 1.39 HMR = 48 kJ (2.3%)+
- TOTAL
  24.00 x 2.55 x HMR = 61.20 HMR = 2100 kJ

According to Drent *et al.* (1978) caged birds consume an amount of energy 2 x BMR as so-called "Existence Metabolism". The energy that free-living birds need to survive in addition to this existence metabolism is defined as the "foraging costs", i.e. the energy expenditure that is needed for all activities at obtaining food.

In our case the foraging costs are:

$$\text{FC} = 24.00 \times (2.55 - 2.00) \times \text{HMR}$$
$$= 13.20 \times \text{HMR} = 453\ \text{kJ} \quad (11)$$

$$\frac{\text{FC}}{\text{DEE}} = 21.6\% \quad : \quad \frac{\text{DEE}}{\text{FC}} = 4.6$$

This means that foraging takes 21.6% of the daily energy expenditure and every kilojoule put into foraging activities brings the bird almost five times more energy. These values are much the same as those found for other bird species by Drent *et al.* (1978) and confirms Drent's thesis that in non-breeding birds foraging takes in general about 20% of the DEE.

The geese that winter in the Lower Rhine area have to collect their DEE of 2100 kJ in 13.25 hours, i.e. 158 kJ/hour. This means that they have to ingest 151 g fresh weight/hour or 30.2 g dry matter/hour of vegetation. At the wintering site in the Lower Rhine area the wintering geese have a mean pecking rate of 98.9 pecks/minute (Mooij in prep.). This means that they peck 5934 times in one hour and with every peck take up 25.4 mg fresh weight, 5.1 mg dry matter of grass, with 0.027 kJ of energy.

If we convert the hourly intake to dry matter weight (in gram) per metabolic kilogram (kg body weight to the 0.75 exponent), as practised before by Drent *et al.* (1978), we find a value of 13.2 $g/kg^{0.75}.h$.

Table 3. Hourly food intake by geese.

Species	Body-weight (g)	Food intake per hour (g/birds.hour)	(g/kg$^{0.75}$hour)	Author
Branta bernicla	1350	19.9	15.9	Drent *et al.* 1978
Branta leucopsis	1900	20.4	12.6	Drent *et al.* 1978
Anser caerulescens	2950	30.9	19.9	Harwood 1975 in Drent *et al.* 78
Geese of Lower Rhine	3000	30.2	13.2	Mooij
Anser albifrons	2400	24.2	12.6	Mooij
Anser fabalis	3500	35.5	13.6	Mooij

For the White-fronted Goose it follows that they have an hourly intake of 121 g fresh weight and 24.2 g dry matter of grass, with 128 kJ. Converted to dry matter weight per metabolic kg Whitefronts have a value of 12.6 g/kg$^{0.75}$.h. For Bean Geese these values are 177 g fresh weight, 35.5 g dry matter, 181 kJ and 13.6 g/kg$^{0.75}$.h.

These values are very comparable with similar values for other birds gathered by Drent *et al.* (1978) (Table 3). Drent *et al.* suggest that this agreement can hardly be fortuitous "and suggests that there is a limit to the rate of passage of food down the alimentary canal, such that an increase of intake beyond this limiting rate can only be achieved by increasing the length of the foraging period". If this thesis is correct, it means that - based on the extreme values of Drent *et al.* - a mean goose wintering in the Lower Rhine area, with a weight of 3 kg, has a maximum intake of 29-45 g dry matter of grass. This means that these birds, in addition to the necessary hourly intake of 30 g dry matter, can take up at the most another 15 g dry matter of grass; i.e. 80 kJ. This additional amount of energy can be used to compensate energy deficits originating from disturbance, bad weather conditions or migration or can be stored in about 2 g of fat. Under favourable conditions it is possible for the birds to increase their fat deposit daily by 25-30 g, i.e. by 1% of the body weight. It can be assumed that under normal conditions a daily fat increase of about 15 g is within reach.

Comparable values are found by several authors (Prokosch 1981, 1984, St Joseph *et al.* in Ebbinge *et al.* 1982) for other goose species.

This energy budget is calculated for average winter conditions: in the Lower Rhine area the mean winter temperature from November to March is +3.7°C.

Under cold weather conditions the DEE will undoubtedly be much higher (Evans 1976). This additional need of energy can only partly be compensated for by a higher food intake. Most of it must be compensated by economizing on energy consumption.

One of the first reactions is the reduction of the loss of body heat by feeding under cover of hedges or rises in the ground facing to the wind and lying on the ground with the legs protected by the body feathers. Sunshine helps the birds because the dark plumage of the geese absorbs up to 80% of the radiation energy of the sun (Bezzel 1977). Added to this they show a statistically significant higher pecking rate to increase food intake; *Anser albifrons* 101.1 and 116.5 pecks/min, *Anser fabalis* 78.2 and 99.4 pecks/min by temperatures respectively above and below 0°C, Student's t-test; $P<0.01$ (Mooij in prep.).

During periods with frost and closed snow cover a great number of geese shift from grasslands to fields with winter-grains. Although winter grain fields show a lower number of plants per square meter and the leaves have a 9% lower energy content per weight unit compared to grass (Kear in Atkinson Willes 1963), the advantages (plants easy to find under snow cover, relatively long and broad leaves in rosettes) seem to exceed the disadvantages under cold weather conditions.

Under extremely cold weather conditions most of the geese save energy by sleeping on their feeding sites. Dispensable activities like flying, social activities and alertness are reduced at a minimum under these conditions and the theoretical DEE is reduced on the level of the Existence Metabolism, i.e. about 1650 kJ/day. Because of the increased expenditure of energy in order to maintain the body temperature, the DEE can be considerably higher under these conditions. This energy expenditure is covered by the decomposition of body fat. The decomposition of one gram of fat brings the bird about 40 kJ. With a mean body-fat-deposit of 10-15% of the body weight (Bauer & Glutz 1968, Bezzel 1977), i.e. 300-400 g, this means that the geese can theoretically sleep 7-10 days without food, assuming that there is no extra energy needed to maintain the body temperature. In reality most of them leave the area after 2-4 days of extremely cold weather. They do not hold out until the fat deposit is exhausted.

According to the data of Markgren (1963) and Schröder (1975) geese of the size of Bean and White-fronted Goose can take 100-130 g fresh weight of grass or 220 g of grains in their oesophagus and stomach from the feeding site to the roost. In the case of grass, together with the rest of the food in the gut, this food store in the alimentary canal supplies the geese with 130-170 kJ and is enough to cover the energy expenditure of a sleeping goose for 2½ - 3¼ hours. In the case of grains this amount could be enough to cover the energy expenditure for the whole night, but this food source is not avilable for wintering geese at the Lower Rhine.

Observations show that the average goose of the Lower Rhine wintering site flies seven minutes between feeding site and roost and subsequently spends 15-30 minutes drinking and preening before it goes to sleep. In terms of energy this means that these birds use about 40 kJ for flying and 23-47 kJ for drinking and preening and go to sleep on the banks of the river with a residue of 43-88 kJ, which is just enough to sleep for 50-100 minutes. Sleeping longer would mean consumption of fat. At the Lower Rhine wintering site staying the night on a roost without feeding would mean 13½ hours consumption of energy without energy intake. Such a night would cost 695 kJ, of which 525-565 kJ have to be gained by the decomposition of 13.5-17 g body fat. When these geese are active for at least part of the night, as found by Lebret (1969, 1970), Loosjes (1974), Markgren (1963), Mathiasson (1963) and Philippona (1969, 1972), this waste of fat has to be increased with a quantity of energy up to 250 kJ, i.e. another 6.5 g of body fat.

It would be a poor survival strategy physiologically to roost on cold water for the entire night without feeding and thereby wasting body fat, while being surrounded on the banks of the river/lake by an abundance of food. That is why the geese of the Lower Rhine wintering site sleep on the banks of the water in several bouts of 1½ hours alternating with feeding periods of 1½-2 hours each, as observations showed. As a result of these reflections it seems tenable to state that for geese that mainly feed on grassy vegetations roosting on land and night feeding must be more frequent than has been assumed till now.

Conclusions

These theoretical reflections about the energy budget certainly contain a number of uncertainties, but these do not necessarily cast doubt on the following general conclusions:

- A mean White-fronted Goose weighing 2.4 kg needs 1300-1700 (m = 1500) g fresh weight or 257-340 (m = 300) g dry matter of grass, i.e. 1780 kJ daily and a mean Bean Goose of 3.5 kg 1700- 2240 (m = 1950) g fresh weight or 330-450 (m = 390) g dry matter of grass, i.e. 2360 kJ daily.

  Although bigger geese need more energy than smaller ones, there is a clear correlation between the need of energy per g body weight and the body weight of the birds: the bigger birds need relatively less energy.
- A gooseday is a variable quantity, depending on the goose species. Therefore a feeding intensity measured in goosedays/ha is only valid for a specific goose species and is not freely transferrable to other species.
- For geese mainly feeding on grassy vegetation roosting on land and night feeding are not the exception, but confer physiological advantages.
- Feeding is the most energy consuming activity of the geese. They not only spend about 55% of their time on feeding, they also consume about 60% of their daily energy while feeding. More than 20% of this energy is used for foraging costs. At the same time feeding is the only activity that not only costs but also provides energy.
- There seems to be a limit to the hourly intake of food that is higher than the energetically necessary hourly food intake. The surplus can be used to compensate for energy deficits caused by migration, bad weather conditions or disturbance or it can be deposited in fat.

- Flying is the activity with the highest energy costs per time unit.
- Sleeping is the best way for a free-living goose to save energy. Although the geese use about 30% of their time budget for sleeping, they only consume about 18% of their DEE by sleeping.
- All other activities take about 12.5% of the time budget and almost 14% of the energy budget of the geese.
- The disturbance of geese promotes activities with a high energy consumption and prevents all activities that save energy. Besides this, every disturbance prevents food intake and thereby also the intake of energy and prevents the building-up of fat deposits. Disturbance means a double energy loss for the geese; waste of energy and loss of energy intake.

Discussion

The observations on night-time behaviour were made without a night-sight device. Although it was possible to record each night, depending on the light conditions, the activities of up to 280 birds continuously during the whole night, it cannot be excluded that there were some effects of the author on the roost. However, the acoustic observations of geese at a greater distance from the hide never showed much difference to the optical observations. For this reason the author considers these observations to give a good impression of the night-time activities of the geese of the Lower Rhine area.

The diel activity budget of Snow Geese, studied by Gauthier *et al.* (1988), only shows minor differences to that of the geese of the Lower Rhine wintering site. In this study even a comparable high level of night feeding was found. The overall feeding level of about 55% of the time budget in both studies lies between data of other areas and species, for instance Burton & Hudson (1978) found for Lesser Snow Geese and Ebbinge *et al.* (1975) for Barnacle Geese (about 80% during daylight hours) about 30% of a 24-hour day and for White-fronted Geese Owen (1972) recorded that about 40% (about 95% during daylight hours) and Fox & Madsen (1981) that 68% of diurnal activity was spent feeding. In winter Lesser Snow Geese, mainly feeding on waste grains, spent only about 20% of daylight time feeding (Davis *et al.* 1989), maybe because of the high energetic value of their food source, and in spring Barnacle Geese spent 50-70% of a 24-hour day (70% of 17 hours and 84% of a 20 hours activity budget) feeding (Black *et al.* 1991). Because most of these studies did not record activity budget during the dark hours of the day it cannot be excluded that there was also a certain level of night feeding. Because of the high energy content feeding on wasted grain can shorten feeding time considerably. Also Amat *et al.* (1991) found that the chemical composition and digestibility of the food influenced feeding time.

All these facts show that the calculated activity budget of this study provides a reliable basis for reflections about the energy budget.

Except for the selection of feeding sites (Mooij 1992) there were no behavioural differences found between White-fronted and Bean Geese. This could be a result of the fact that all observations were made in mixed groups and the larger number of Whitefronts on the roosts and feeding sites influenced the behaviour of the Bean Geese.

The energy budget of birds wintering in a specific area is a useful tool for the development of management schemes for these refuging birds (Frederick *et al.* 1987). In spite of the fact that the theoretical reflections of this study about the energy budget of the geese of the Lower Rhine contain a number of uncertainties (for instance: fluctuations of metabolic rate during the day and winter, exact value of "*n*" for several activities, exact influence of cold weather conditions on the DEE) the author considers his conclusions valid because these uncertainties do not influence the overall model.

The value of "*n*" in this study varied between 1.5 (sleeping) and 10 (flying). In a comparable study of Gauthier *et al.* (1984, in Belanger & Bedard 1990) for Snow Geese "*n*" varies between 1.3 (resting) and 15 (flying). Gauthier's value for foraging is somewhat higher and for the other activities somewhat lower, the mean value is about 2.5-2.7. These values are closely comparable with the values found in this study and support the reliability of the model.

Flying is the activity with the highest energy costs per time unit. Human activities in the wintering area modify the distribution of the geese within the site and reduce feeding time by disturbance and by forcing the geese to fly long distances between the roost and various feeding sites. This factor becomes important to the birds from the moment that these energy costs and the reduction of energy intake cannot be compensated for anymore by increased food intake during undisturbed periods (undisturbed feeding sites, night-time feeding). Belanger & Bedard (1990) found that the disturbance rates of 0.5-2.5/hour caused a 2-5-fold increase in flight time. They found that depending on disturbance levels daylight foraging time could be reduced by up to 50%. Therefore the most important aims of goose management at the wintering site have to be to provide the geese with undisturbed roosts and feeding sites, good quality of food in sufficient quantity and short flyways.

The flight velocity of geese flying over the Lower Rhine area lies between 10 and 80 km/h with an average of 43.8 km/h. This value corresponds closely to values found in other studies for the same species, for instance Gerdes *et al.* (1978) found 41-45 km/h, Mathiasson (1963) 60 km/h, Jellmann (1979, in Rutschke 1987) 52 km/h and Wierenga (1976) 44 km/h. For *Anser caerulescens*, a goose of comparable size, average flight velocities of 48 km/h (Frederick *et al.* 1987) and 43 km/h (Cooch 1955 in Philippona 1972) were found.

Less than 5% of the goose flights over the Lower Rhine area were longer than 10 km. The average flight distance was 5.1 km. These short distance flights seem normal for wintering geese. In the Netherlands (Lebret 1959, Philippona 1966, 1972, 1981, Lebret *et al.* 1976, Wierenga 1976) and Southern Sweden (Mathiasson 1963) flight distances between 1 and 15 km were found for wintering White-fronted and Bean Geese, whereas both species in northwest Germany (Gerdes *et al.* 1978) and White-fronts in Great Britain (Owen 1971, Patterson *et al.* 1989) seldom made flights longer than 5 km. In Scotland Pink-footed Geese had average flight distances of about 4 km and Greylag Geese of about 10 km (Bell 1988).

Based on these data it can be stated that daily flight distances between 10 km and 20 km (roost to feeding site and vice versa, with or without drinking flight) are normal for geese wintering on western European inland sites. This means that daily flight times between 15 minutes and half an hour (between 1-2% of the daily time budget) and an energy expenditure between 5% and 10% of the daily energy budget for flying are common in Western Europe. During their studies Gauthier *et al.* (1988) found that Snow Geese in Canada also spent about 2% of their time budget flying.

Management implications

Flight time can be reduced by improvement of feeding conditions by the temporary closure of roads to enlarge undisturbed favourable feeding sites, 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 and by a total ban on hunting at the wintering site. Also a good farming strategy on agriculturally used feeding sites could help to shorten flyways and to increase energy output of feeding. The favourite feeding sites of the geese can be made more attractive to them by the cultivation of interim crops on fallow fields, the transformation of arable land into grassland in the central parts, the improvement of grasslands and guaranteed undisturbed feeding. By this type of management and farming strategy the energy budget of wintering geese can be improved and the risk of goose damage be reduced.

A management plan for the wintering sites only makes sense within the scope of a "Western Palearctic Goose Management Plan". This plan - that has to be developed within the scope of the "Western Palearctic Waterfowl AGREEMENT" under the Bonn Convention - has to concentrate on creating a network of protected areas, throughout their annual cycle and along their whole migration route, where geese can breed, moult, roost, feed and winter with a minimum of disturbance.

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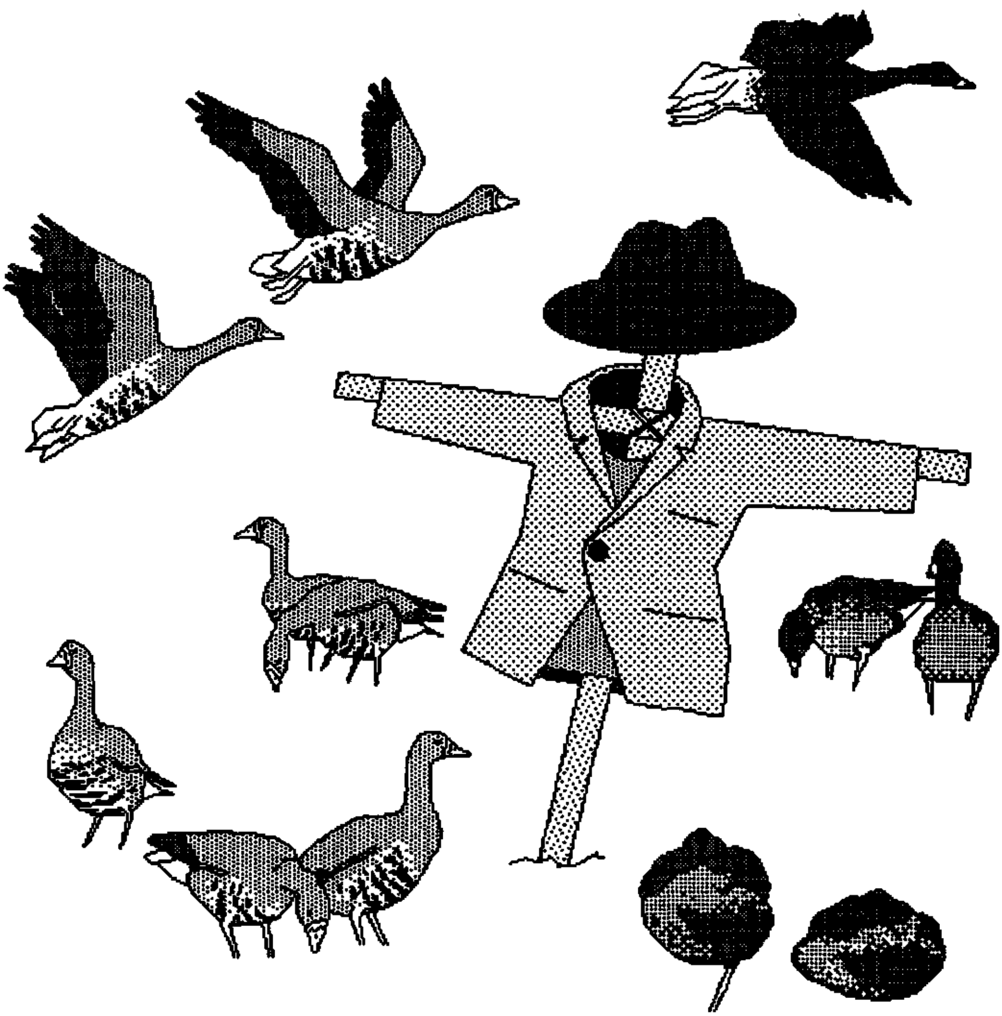
Chapter 7

Goose damage to grassland and winter cereals by White-fronted and Bean geese in the Lower Rhine area, Germany.

Johan H. Mooij



Goose damage to grassland and winter cereals by White-fronted and Bean geese in the Lower Rhine area, Germany.

by Johan H. Mooij

SUMMARY

1. The effect of different intensities of winter and early spring grazing by both White-fronted and Bean geese, *Anser albifrons* and *A.fabalis*, on the yields of agricultural grasslands and autumn-sown wheat and barley was studied in the lower Rhine area of Germany. Paired plots of grazed and ungrazed portions of the same fields provided information on loss of yield at harvest (first cut of grass and total yield of grain respectively).

2. On both crops the field observations indicated a loss of yield due to goose grazing at grazing intensities associated with damage claims (accumulated grazing pressure 3000 goose-days per hectare) but only in the more homogeneous cereal fields were the results statistically satisfactory.

3. To confirm the field observations trials were conducted with captive geese held in movable cages on both grassland swards and cereal fields. Trials at various grazing intensities were carried out, and analysis at 3000 goose-days grazing pressure corresponding to intensities measured in the field confirmed a loss of yield in both crops (first cut of grass and total yield of grain respectively).

4. Yield losses in the study area (10-15% on grassland, 12-14% on cereals) at a grazing intensity of 3000 goose days per hectare are closely comparable to results from improved grasslands in the Netherlands and on wheat and barley crops in both England and Scotland, and comparable to values obtained on hayfields in Eastern Canada.

5. Further studies are called for to calibrate trials with captive geese to the field situation with wild congeners, as captive birds are expected to require less feed per day.

INTRODUCTION

Recent studies on effects of winter grazing by geese have uniformly shown loss of yield in both improved grasslands (Bedard, Nadeau & Gauthier 1986; Groot Bruinderink 1989; Percival & Houston 1992) and cereal crops (wheat: Summers 1990; wheat and barley: Patterson, Abdul-Jalil & East 1989) under levels of grazing intensity commonly occurring over at least part of the wintering area.

Increasing goose usage of the Lower Rhine wintering area (see Mooij 1993) have been a cause of concern for the local authorities administering the goose damage scheme aimed at compensating farmers for crop losses. Table 1 details the levels of compensation paid out in recent years under this government scheme.

The aim of this study was to ascertain if these goose damage studies undertaken elsewhere have validity for the Lower Rhine study area, and in particular to answer the question of whether the intensity of grazing accumulated during goose wintering in the area results in actual yield loss to the farmer.

Winter	peak number	goose damage in DM
1977/78	20.100	0
1978/79	26.100	0
1979/80	56.200	0
1980/81	70.000	0
1981/82	84.000	6.000
1982/83	92.000	10.000
1983/84	117.000	16.000
1984/85	101.000	30.000
1985/86	146.000	640.000
1986/87	130.000	1.530.000
1987/88	180.000	360.000
1988/89	185.000	1.010.000
1989/90	140.000	1.067.000
1990/91	125.000	1.880.000
1991/92	170.000	1.849.000
1992/93	146.500	1.979.000

Tab. 1. Goose numbers and compensated goose damage at the Lower Rhine area between 1977/78 and 1992/93.

Two approaches have been taken, first to gain an impression of grazing impact by paired comparisons of plots in grazed and ungrazed portions of fields frequented by the geese, by analogy with previous studies. Additionally grazing trials with captive birds were implemented, allowing exact dosage of grazing intensity, and replication both within and between seasons (six seasons on grasslands, three seasons on cereals).

For the purpose of this paper, the Lower Rhine area is defined as the region between the coordinates 51.50 N, 5.52 E (Nijmegen, NL) and 51.30 N, 6.45 E (Duisburg, D) in the natural floodplains of the Rhine between Rhinekilometer 793 and 883. Land usage at the time of the study can be summarized as follows: about 60% of the study area is used as grassland and about 40% as arable land (Mooij 1993).

Table 1 presents census data of the peak numbers of the wintering geese in the years of study. Since winter 1975/76 no shooting of geese has been permitted in the study area, and management aims at spreading the wintering geese as evenly as possible by avoiding disturbance, to minimize the areas where damage occurs.

On a small scale scaring devices (scarecrows, flags) as well as the distribution of liquid manure are employed by the farmers to keep the geese from their land.

MATERIALS AND METHOD

To assess grazing intensity all geese in the study area (about 25 000 ha) were counted at least once weekly, and goose flocks entered on detailed topographic maps (grid 50 x 50 m). Information on land use was also entered at this scale. These data were used to calculate the grazing intensity of each site in goosedays per hectare (taking the two species, White-fronted and Bean Geese, often occurring in mixed flocks, together). At 34 sites with known feeding density droppings were counted in 50 plots of 1 m² at each site (1 700 plots) to find a relation between dropping density and feeding intensity.

In the early years of the study the method of paired plot comparison was employed at feeding sites where geese were prevented from using the entire field on account of obstacles or proximity of roads. At such sites above-ground biomass of grass was ascertained by clipping plots of 1 m² with hand shears to ground level, on a date in May, timed to precede by a few days the harvest by the local farmer. The clipped material was oven-dried to constant weight at 90° C.
After winter 1978/79 six grassland feeding sites and after winter 1980/81 nine grassland feeding sites were studied. At each site a number of plots were sampled, in equal numbers in both grazed and ungrazed conditions: in 1979 at two sites 18 plots, at two sites 10 and at two sites 8 plots, in 1982 at 3 sites 16 plots and at 6 sites 8 plots were sampled.

Similar procedures were followed in cereal fields (date of harvest July, again conforming to the farmer's dates). Here after the winters 1979/80 and 1980/81 at each site 20 plots and after winter 1983/84 forty plots of 1 m² were sampled. In 1985/86 the yield of 3 745 m² grazed and 3 431 m² non-grazed winter barley was harvested by the farmer in July and weighed separately.

In Winter 1982/83 sward height was determined 10 times between the beginning of November until the end of April by employing a movable disk of polystyrene (radius 10 cm, weight 10 g.) mounted on a stick with a centimeter scale. By this method, used also by Groot Bruinderink (1987 & 1989) grazed and ungrazed portions of seven pastures were sampled (each time about 100 samples of 1 m² per site and category).

Inconsistencies in the field results prompted a series of grazing trials carried out with captive geese confined to movable cages mounted on wheels. These wire mesh cages (floor area 5 x 5 meters, 1 meter high) could be displaced over a field (Fig. 1). By varying the number of occupants or the duration of grazing at a site the desired grazing intensity could be achieved.
In six consecutive winter seasons (1982/83 - 1987/88) trials were conducted on improved grassland managed at the grassland research station of the "Landesanstalt für Ökologie, Landschaftsentwicklung und Forstplanung Nordrhein-Westfalen (LÖLF NW)" to conform with local farming practice (fertilizer input amounted to 60 kg N/ha, applied between April and July annually). In the three first seasons grazing intensities of 0, 500, 1500 and 3000 goosedays/ha were established and grazing implemented in the period December through February, corresponding to the period of usage by the wild geese. In the final three seasons a grazing intensity of 6000 gd/ha was implemented in a limited number of trials, and the 500 gd\ha level omitted.

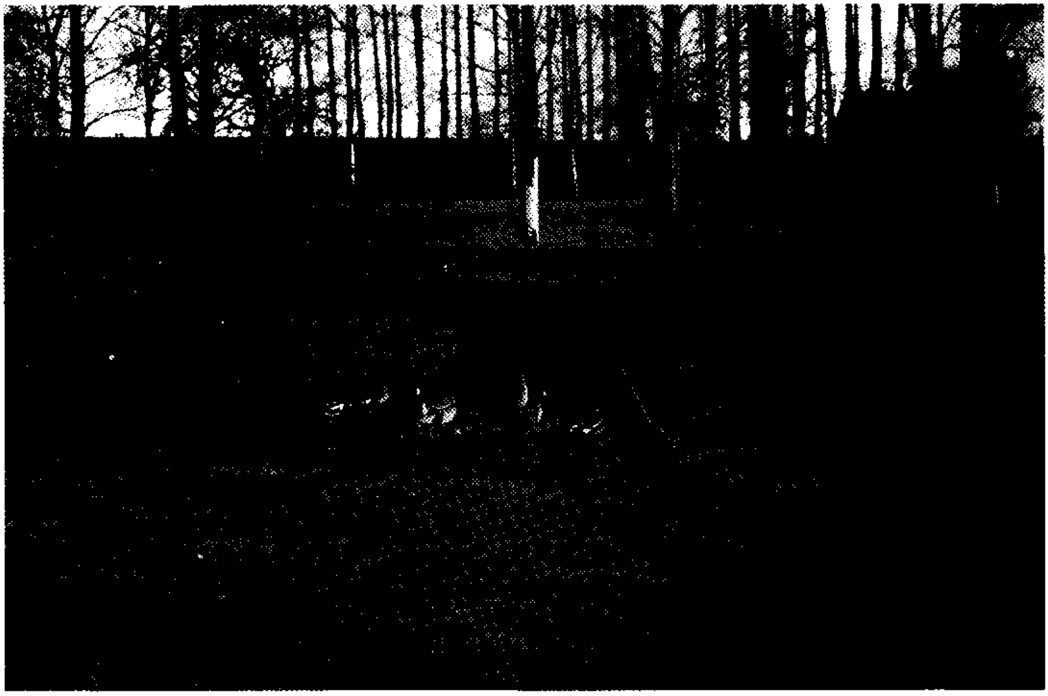


Fig. 1. Movable wire mesh cages with captive geese on the experimental plots

In a supplementary series the grassland plots were irrigated by a pipe network during the grazing trials to simulate puddling conditions.

The effect of goose grazing on the dry matter yield in the subsequent growing season was determined by comparison of harvest results from grazed and ungrazed treatments. The plots were harvested by means of a mechanical mower equipped with yield collector, which covered each plot in two swaths. Material for each plot was pooled and subsequently dried to constant weight at 90° C ovens. The time of harvest (mid-May) was selected to coincide with the first cut of the local farmers, the period when according to the farmers impact of goose grazing was deletrious. Subsequent harvests were carried out in mid-June and mid-July, but as these failed to indicate compensatory growth they will not be further considered here.

In the winters of 1986/87 and 87/88 these grazing trials were extended to winter cereals as well. Autumn-sown barley and wheat were grazed by semi-tame White-fronted and Bean Geese (two pairs each) with feeding intensities of 750, 1 500, 3 000 and 6 000 gd/ha. On cereals harvest was accomplished by means of a mechanical mower equipped with yield collector and subsequently dried to constant weight at 90° C ovens. The cereal plots were harvested in July at the time the grains were ripe for harvest.

The years of study can be considered average according to the long-term weather data of the area Weather data were gathered by the weather station of the LÖLF NW in Kleve for all winters. (Tab. 2). Severe frost damage to the experimental plots that might have masked effects of goose grazing (cf. Groot Bruinderink 1987 &1989) did thus not occur.

Period	long-term Ø	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88
	Average temperature in oC									
November-February	3.3	3.9	3.2	2.2	4,4	3.2	1.7	1.3	3.4	5.2
Difference to Ø		+0.6	-0.1	-1.1	+1.1	-0.1	-1.6	-2.0	+0.1	+1.9
March-April	7.3	6.6	9.0	7.2	8.2	5.2	6.8	4.9	7.0	7.1
Difference to Ø		-0.7	+1.7	-0.1	+0.9	-2.1	-0.5	-2.4	-0.3	-0.2
Ø November-April	4.6	4.8	5.1	3.9	5.6	3.9	3.4	2.5	4.6	5.8
Difference		+0.2	+0.5	-0.7	+1.0	-0.7	-1.2	-2.1	0.0	+1.2

Tab. 2. Average monthly temperatures between November and April in the study area during the years of this study (1979/80 - 1987-88) according to data of the LÖLF NW in Kleve-Kellen.

RESULTS

1. Goose usage in relation to land use

As stated before, grassland accounted for about 60% (58.1%) of all agricultural land use in the study area during the period concerned. Both goose species utilized the grassland preferentially. Both species spend about 87% of all goose days on grasslands: *Anser albifrons* 96% and *A.fabalis* 82% of their feeding time (the remainder being devoted to arable land, see Mooij 1984 & 1993). Pastures in the study area are dominated by *Lolium perenne* (35%), *Festuca ovina* and *Festuca rubra* (33%) and *Poa* spp. (10%, the percentages refer to per cent of 5 grassland sites favoured by feeding geese where vegetation was sampled quantitatively). *Alopecurus* spp., *Phleum pratense, Dactylis glomerata, Bromus mollis*, and *Cynosurus cristatus* and the herbs *Taraxacum officinale, Urtica dioica, Ranunculus* spp., *Trifolium* spp., *Rumex* spp., *Polygonum* spp. and *Plantago* spp. were also found in the sward.

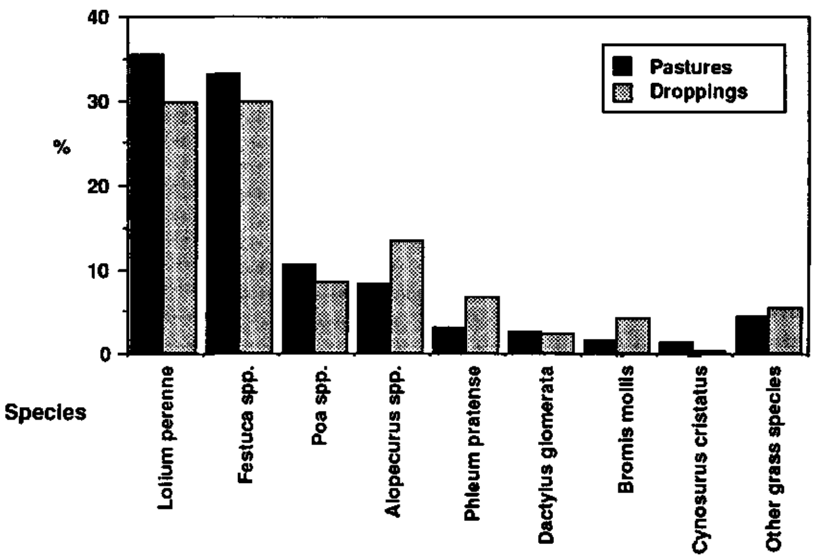


Fig. 2. Composition of the sward on five pastures at the Lower Rhine goose wintering site and in dropping samples of these pastures.

The composition of the sward is considered typical for the area, where grasslands are usually classified as belonging to the association Lolio-Cynosuretum (Foerster 1983 & pers. comm.).
From analysis of droppings (Mooij, unpublished) it was found that geese accepted *Festuca, Lolium* and *Poa* in approximately the same proportion as in the plants on offer, these species groups accounting for slightly more than two-thirds of the epidermal fragments identified in the microscopic analysis (Fig. 2). The herbs *Taraxacum* and *Trifolium* were also identified in the droppings.

Arable land is visited briefly at the beginning of winter when remnants of harvest, e.g. sugar beets and maize, are still available (3% of all goosedays) and during periods of cold weather (especially with snow) when winter cereals are utilized (10% of all goosedays). Further information on use of the site can be found in Ernst & Mooij 1988, Mooij 1984, 1991 & 1993.

2. Field estimation of goose damage

The sward height of the grazed and ungrazed parts of seven pastures that were measured showed great differences after the geese left the wintering site mid-March (Fig. 3), the sward height of the ungrazed area was 0-25 cm (n = 769; mean = 8.8 cm) and of the grazed parts 0-13 cm (n = 818; mean = 4.9 cm). 60% of the samples on grazed pasture measured 1-5 cm. When the mean sward height of the grazed area reached a level of 2-4 cm this area usually was left by the geese until the sward had recovered. By the end of April most of the difference in sward height between the grazed and ungrazed parts of a feeding site was gone, but the sward of the grazed parts (15.9 cm, n = 700) was still about 5% lower than that of the ungrazed (16.8 cm, n = 700).
The grass sward of the grazed parts of a pasture seemed to grow more uniformly than that of the non-grazed

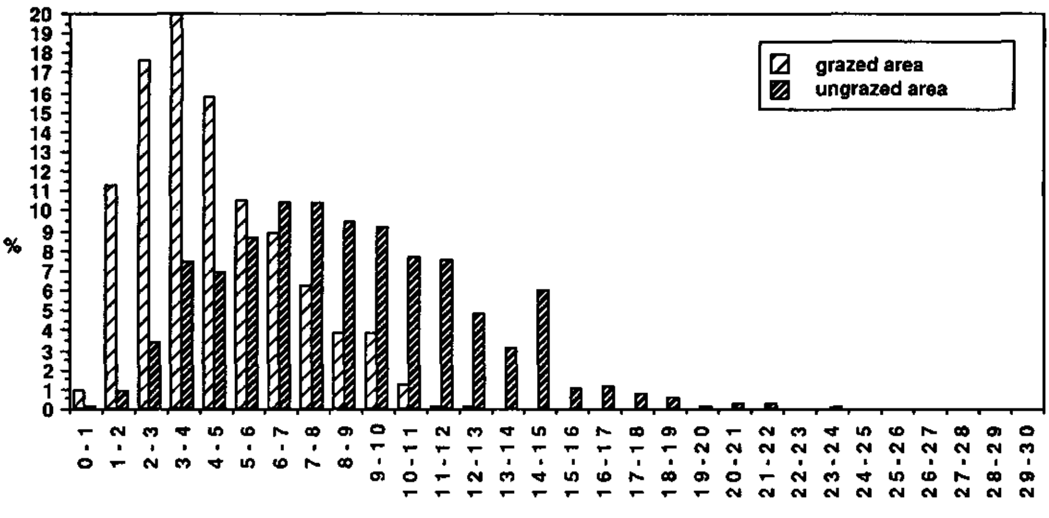


Fig. 3. Sward height on grazed (more than 1 500 gd/ha) and ungrazed parts of 7 pastures at the goose wintering site at the Lower Rhine after the departure of the geese in the middle of March.

The most reliable data on goose-days accumulated during the winter season were obtained from the systematic counts, and results for the sites where the farmers expected goose damage are collected in Table 3 (pastures) and 4 (cereal crops).

Winter	Plot no.	Feeding intensity in gd/ha	Yield in kg dry matter/ha: grazed area (g) Ø yield in kg	no. of plots	S.E.	ungrazed area (ug) Ø yield in kg	no. of plots	S.E.	relative yield (g/ug) in %	significance (Wilcoxon)
1978/79	1	1292	4504	9	482	4239	9	494	106.3	n.s
	2	1950	3925	9	516	4928	9	520	79.6	0.005
	3	2608	3645	5	710	4740	5	546	76.9	0.005
	4	2968	4070	4	657	4730	4	418	86.0	n.s
	5	3004	4275	4	384	5160	4	304	82.8	0.025
	6	3016	4850	5	508	3850	5	497	126.0	0.025
	Ø	2473	4212	36	712	4608	36	702	91.4	n.s
1981/82	1	1066	3563	8	332	3155	8	370	112.9	n.s
	2	1382	3940	8	448	4783	8	413	82.4	n.s
	3	2332	2419	8	398	2714	8	359	89.1	0.025
	4	2654	4240	4	364	6020	4	532	70.4	n.s.
	5	2700	2405	4	80	2565	4	310	93.8	0.005
	6	2964	2435	4	276	2865	4	269	85.0	n.s.
	7	3011	3845	4	553	3245	4	498	118.5	0.005
	8	3110	3640	4	455	3545	4	544	102.7	n.s.
	9	3120	3280	4	347	3065	4	196	107.0	n.s.
	Ø	2482	3307	48	820	3551	48	1207	93.1	n.s.
Ø		2478	3669	84	892	3974	84	1154	92.3	n.s.

Tab. 3. Results of the yield comparison between grazed and ungrazed parts of grasslands at the goose wintering site at the Lower Rhine (significance of the differences tested with Wilcoxon-test).

Winter	Feeding intensity in gd/ha	Yield in kg dry matter/ha: grazed area (g) Ø yield in kg	no. of plots	S.E.	ungrazed area (ug) Ø yield in kg	no. of plots	S.E.	relative yield (g/ug) in %	significance of difference (Wilcoxon)
WINTERBARLEY									
1979/80	2366	6279	10	336	7096	10	265	88.5	0.05
1980/81	1676	6998	10	209	6911	10	264	101.3	-
1985/86	2630	7100	1	-	8150	1	-	87.1	-
Ø	2224	6792	-	-	7386	-	-	92.0	-
WINTERWHEAT									
1983/84	3520	4902	20	237	6020	20	280	81.4	0.005

Tab. 4. Results of grain yield (in kg dry matter/ha) comparison on grazed and ungrazed parts of fields with winter cereals at the goose wintering site at the Lower Rhine.

Earlier studies (Mooij 1984) indicated a damage threshold of 2 000 - 3 000 goosedays/ha for grasslands, and at a somewhat lower level for winter grain crops. In the case of the rather homogeneous wheat field sampled in 1983/84 (grazing intensity 3500 gd/ha) a loss of yield at harvest was confirmed statistically.

The same is true for the barley field sampled in 1979/80 (grazing intensity 2400 gd/ha) but no effect of goose grazing at the lower intensity observed in 1980/81 (1700 gd/ha) could be established (Tab. 4).

Results for grazing impacts on grass yields (Tab. 3) are unsatisfactory given the variability of the sward and the very limited sampling regime. The data show lower as well as inceased yields at grazed plots as well as a tendency to a more homogeneous grass sward at the grazed plots. A part of the yield differences could be the result of influences other than goose grazing, because the condition of the plots before goose feeding was not investigated. The data are nevertheless valuable in establishing the grazing intensity expected to transgress the damage threshold, and as such form the starting point for the detailed experimental work.

3.Experimental demonstration of grazing impact

The results of the cage experiments on pastures at a grazing intensity of 3 000 gd/ha are summarized in Table 5.

Analysis of variance on the paired data set (controls versus grazed) reveal no significant interaction with year, and the total data set demonstrate a significant reduction in grass yield at first cut (mid-May). The average yield reduction for the 35 trials was 10% of the control yield, and a virtually identical result was obtained in the trials with additional irrigation (15% yield reduction, n = 15). The difference was caused by the low result of the irrigated plot in 1982/83 and as a whole not significant. Therefore irrigation had no additional deletrious effect under the conditions of the experiment.

Closely comparable results were obtained for both wheat (14% yield reduction) and barley concerning losses at the grazing intensity of 3 000 goosedays/ha (12% yield reduction). In both cases a statistically robust result was obtained despite the small sample size (resp. n = 9 and n = 12) no doubt due to the greater homogeneity of the crop compared to the grassland (Tab. 6).

In 1986 a chance observation provides a field check concerning goose impact on barley. A 6.5 hectare barley field was bisected by a high-voltage power line inhibiting goose visitation on half of the area. The utilized half accumulated 2650 goosedays per hectare (as determined from the weekly census). Yield of the ungrazed portion was 8150 kg (dry matter)/ha compared to 7100 kg/ha on the grazed portion, a reduction of 13%. Unfortunately this result was obtained from total harvest by combine (weighing one run on each portion) and without subsamples it is not possible to substantiate this difference statistically.

Nevertheless the similarity to the captive trials is tantalizing.

	Yield in kg dry matter/ha							
	Without irrigation				With irrigation			
WINTER	ungrazed (u)	3000 gd/ha (g)	% g/u	n	ungrazed	3000 gd/ha (g)	% g/u	n
First cut in May								
1982/83	3380	2930	86.7	5	3031	1428	47.1	5
1983/84	3566	3389	95.0	6	3483	3341	95.9	2
1984/85	2765	2477	89.6	6	2857	2599	91.0	2
1985/86	1624	1305	80.4	6	1471	1264	85.9	2
1986/87	2809	2649	94.3	6	2664	2497	93.7	2
1987/88	3578	3153	88.1	6	3260	3094	94.9	2
Ø	2954	2651	89.7	35	2794	2371	84.9	15
Second cut in June								
1982/83	2837	3032	106.9	5	2653	2694	101.5	5
1983/84	3182	3191	100.3	6	3086	3065	99.3	2
1984/85	3173	3253	102.5	6	3404	3524	103.5	2
1985/86	2426	2510	103.5	6	2296	2332	101.6	2
1986/87	2273	2345	103.2	6	2318	2397	103.4	2
1987/88	2171	2264	104.3	6	2109	2110	100.0	2
Ø	2677	2766	103.3	35	2644	2687	101.6	15
Third cut in July								
1982/83	4464	4509	101.0	5	3756	3649	97.2	5
1983/84	2148	1992	92.7	6	1926	1962	101.9	2
1984/85	2903	2759	95.0	6	2746	2616	95.3	2
1985/86	3184	3393	106.6	6	2942	3293	111.9	2
1986/87	2210	1917	86.7	6	1962	2022	103.1	2
1987/88	1517	1582	104.3	6	1691	1695	100.2	2
Ø	2738	2692	98.3	35	2504	2540	101.4	15
All three cuts (total yield)								
1982/83	10682	10472	98.0	15	9440	7772	82.3	15
1983/84	8930	8604	96.3	18	8494	8367	98.5	6
1984/85	8840	8489	96.0	18	9008	8739	97.0	6
1985/86	7234	7208	99.6	18	6710	6889	102.7	6
1986/87	7291	6911	94.8	18	6944	6916	99.6	6
1987/88	7265	6998	96.3	18	7059	6898	99.1	6
Ø	8374	8114	96.9	105	7943	7597	95.6	45

Tab. 5. Yield results of the grazing experiment with captive geese on grassland with a feeding intensity 3 000 goose days/ha).

	Yield in kg dry matter/ha							
	Winterbarley				Winterwheat			
WINTER	ungrazed (u)	3000 gd/ha (g)	% g/u	n	ungrazed	3000 gd/ha (g)	% g/u	n
1986/87	5145	4848	94.2	6	7172	6059	84.5	9
1987/88	6814	5340	78.4	3	5103	4682	91.7	3
Ø	5701	5012	87.9	9	6655	5715	85.9	12

Tab. 6. Yield results of the grazing experiment with captive geese on winter cereals with a feeding intensity 3 000 goose days/ha).

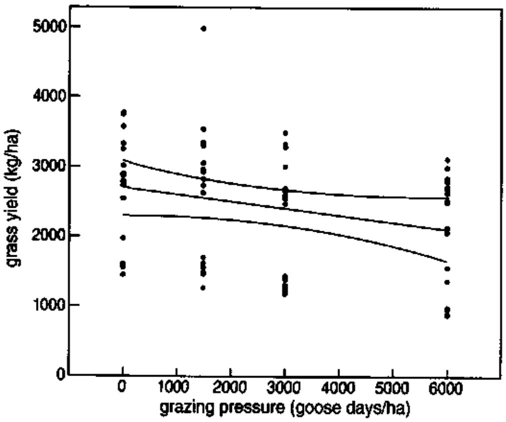


Fig. 4. Yield results of the grazing experiment with captive geese on grassland in relation to different feeding intensities.

Besides confirming yield losses at a grazing intensity of 3000 gd/ha, the data from the captive trials can be employed to provide a dose-response relationship. For the grassland series, in all years 0, 1500, and 3000 gd/ha treatments were run (six replicates in each season). Subjecting these data (108 samples in all) to an ANOVA analysis confirms that there is a significant effect of goose grazing on yield at first cut (F-ratio 16.09, $p < 0.001$, df = 2, r-squared=0.89, no significant interaction between year and grazing pressure).

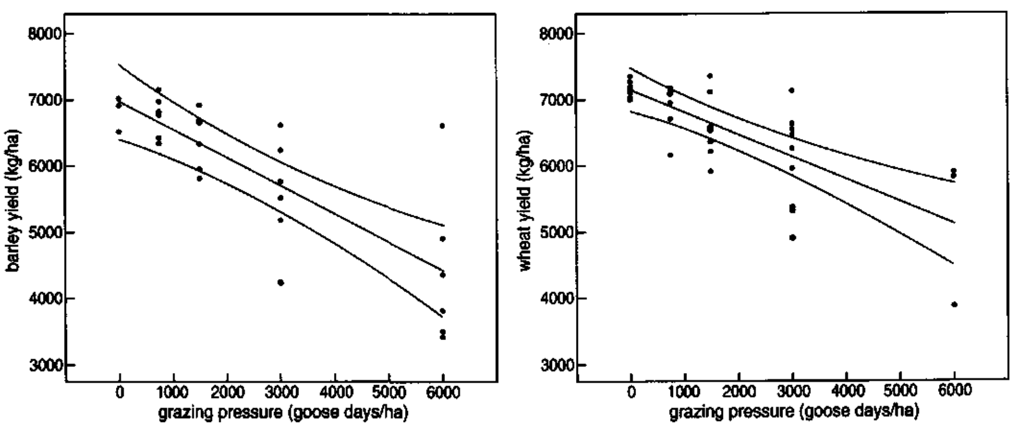


Fig. 5. Yield results of the grazing experiment with captive geese on cereals (winterbarley and winterwheat) in relation to different feeding intensities (with 95% confidence intervals).

This analysis was repeated for the last three seasons only, when the series 0, 1500, 3000 and 6000 goosedays/ha were undertaken (six replicates each year, total 72 plots) and again an ANOVA analysis substantiates the impact of goose grazing on yield (F-ratio 14.13, $p < 0.001$, df = 3, r-squared = 0.90). Fig. 4. displays these data.

The most comprehensive data for the cereal trials are collected in fig. 5.
For wheat, the 1986/87 data (four levels of grazing intensity in addition to controls, nine replicates) an ANOVA confirms a significant effect of grazing on yield (F-ratio 9.57, $p < 0.001$, df = 4, r-squared = 0.55).
For barley, the 1987/88 data (displayed in the right-hand panel of fig. 5) involve four levels of grazing as in the wheat trial, in addition to the controls (6 replicates) and the ANOVA confirms the significant effect of grazing on grain yield (F-ratio 9.79, $p < 0.001$, df = 4, r-squared = 0.64). A linear dose-response relation seems justified (entered in the figure).

DISCUSSION

Recently grazing trials with captive geese have been undertaken in the Northern Netherlands following virtually the same protocol employed in this study (Teunissen, in prep.).
Whitefronts confined to autumn-sown wheat at a grazing intensity of 3 000 goosedays/ha caused a loss in yield of 17% (28 trials over three winter seasons, corrected for seasonal effects by analysis of covariance, Teunissen 1995). A similar decrement in yield was established for grass grown for seed (12% loss in seed yield, 30 trials spread over three seasons, Teunissen 1995).
It will be noted that these values are closely similar to those obtained in the Lower Rhine study (barley 12%, wheat 14% at the same grazing intensity).

The main difficulty in extrapolating from these captive trials to the field situation lies in equating the grazing day of a semi-tame experimental subject with its wild counterpart.
Detailed observations on tame Brent, *Branta bernicla*, are compared with wild individuals by Drent, Ebbinge & Weijand (1978/79), and tend to the conclusion that the tame birds consumed 2/3 of the intake typical for unrestrained individuals.
We may thus assume that the damage threshold confirmed by captive grazing at 3000 gd/ha is in reality a conservative value, and that grazing by wild geese at levels somewhat below this may already cause measurable loss of yield.

Several investigators have reported yield losses in relation to the mean grazing intensity concerned, often expressed in terms of the mean density of goose droppings accumulated at the site. These values can in turn be converted to goosedays if the number of droppings deposited on the foraging sites during one feeding day can be determined.

By observing the average number of droppings produced per hour (10.7, n=64) and the mean time spent at the feeding sites in the study area (10.5 hours) the feeding day of the Whitefront was calculated to equate with 112 droppings at the feeding site. Owen (1972) obtained a closely similar value for this species (120), and constants for other species are in the same range (112 droppings/day in Brent Geese, *Branta bernicla*, according to Ebbinge & Boudewijn 1984; 135 droppings/day in the Barnacle Goose, *Branta leucopsis*, as reported by Ebbinge, Canters & Drent 1975). The hourly rate of production of droppings has been reported for Pink-footed Geese, *Anser brachyrhynchus*, as 11.2, again close to my observation on Whitefronts (10.7) so in this group of species dropping counts will be closely comparable.

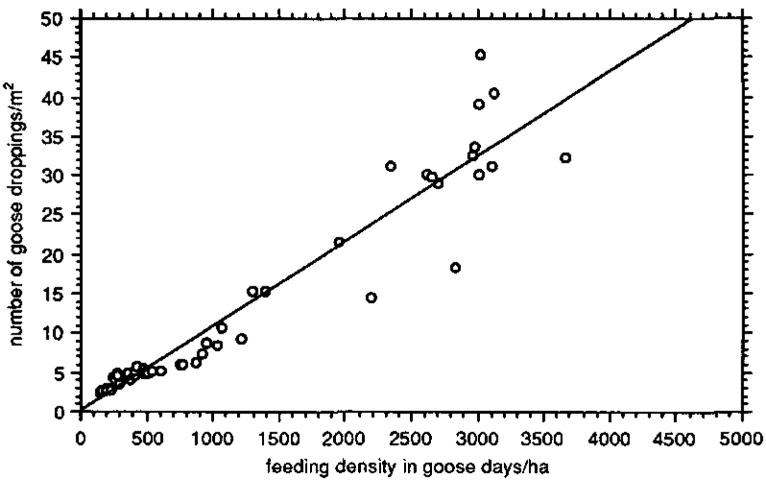


Fig. 5. Relation between feeding intensity (gd/ha) and the number of droppings per m^2 at the goose feeding sites of the Lower Rhine

According the results of the dropping counts at sites with a known feeding density there seems to be a relation between the number of droppings/m² and the feeding density (Fig. 5). A feeding density of 3 000 goose days/ha seems to equate with about 30 droppings/m².

Crop	droppings/sm	rel. yield loss	goose species	Author
Grass	15-45	- 8-9 %	*A. albifrons, A. fabalis*	This study, field
Grass	8	- 14 %	*Anser caerulescens*	Bedard, Nadeau & Gauthier 1986
Grass	11.3-23.6	- 6-19 %	*A. albifrons, A.fabalis, A. brach.*	Groot Bruinderink 1987 & 1989
Grass	10	- 19 %	*Branta bernicla*	Percival & Houston 1992
Barley	14.1	- 8 %	*A. albifrons, A. fabalis*	This study, field
Barley	4.5	- 7 %	*A. anser, A.brachyrhynchus*	Patterson, Abdul Jalil & East 1989
Wheat	22.1	- 19 %	*A. albifrons, A. fabalis*	This study, field
Wheat	5.4	- 15 %	*A. anser, A.brachyrhynchus*	Patterson, Abdul Jalil & East 1989
Wheat	3.4-21.8	- 6-10 %	*Branta bernicla*	Summers 1990

Tab. 7. Field observations relating crop damage to goose grazing (in droppings/m²).

Table 7 assembles the data I have been able to find relating yield loss to goose grazing at sites intensively used, reflected in counts of dropping densities. It will be noted that in general the loss of yield in both pasture and cereal crops falls within the range 6-20% of the controls. This must not be taken to necessarily mean that throughout the entire study area this figure applies, but clearly more or less exhaustive attempts to ascertain the impact of goose grazing in the unrestrained situation, regardless of the species concerned, show that winter grazing can be associated with yield losses when densities of goose droppings exceed about 5 droppings/m² (cereals) or 10 droppings/m² (grasslands). These densities of droppings equate to approximately 500 goosedays/ha (cereals) and 1 000 goosedays/ha (grasslands) which can be regarded as empirically determined thresholds of yield loss. These field values are considerably lower than the levels at which farmers in the study area tended to register complaints.
The main gap in the data so far is a systematic investigation of the significance of the temporal grazing pattern as distinct from the accumulated pressure without regard to timing. Furthermore of the studies cited only one dealt with late spring grazing, and the impact of Snow Geese, *Anser caerulescens*, on the St Lawrence estuary cannot be taken as representative for conditions elsewhere. For my study area and in the Netherlands, where the goosedamage problem on grasslands was investigated both with the same species and the same grazing period, the goose damage can be expected when densities of goose droppings exceed about 20 droppings/m² which equates about 2 000 goosedays/ha. For cereals these values seem to be 15 droppings/m² and about 1 500 goosedays/ha.

Costs of goose damage

The yield reduction on grasslands after goose grazing with a feeding intensity of 3 000 gd/ha was about 260 kg dry matter/ha, i.e. 3% of the yield up to July. Good quality hay, that could compensate this loss of animal feed, would cost about DM 25,-- per 100 kg. The yield reduction after goose grazing with a feeding intensity of 3 000 gd/ha was about 300 kg dry matter/ha, i.e. 10 % of the yield at the first cut in May, which should be compensated by grass silage or concentrated feed, which will cost 8-10 DM/100 kg (silage) or 10-13 DM/100 kg (concentrated feed). This means that the goose damage found on grassland would cost between DM 25,-- and DM 70,-- per hectare. On winter cereals yield reduction with a feeding intensity of 3 000 gd/ha is about 500-1 000 kg dry matter grain-yield/ha (12-20%). With wintergrain prices between DM 35,-- (barley) and DM 40,-- (wheat) per 100 kg a goose damage case can cost between DM 175,-- and DM 400,-- per hectare. These figures are based on average prices of hay and grain at the level of 1995. Changes in these prices will change the financial level of goose damage.
The average annual compensation rates paid per hectare for goose damage by the North Rhine-Westphalian government between 1986 and 1993 were about 170 DM/ha on grassland and about 542 DM/ha on arable land and reached a comparable level as the mean compensation paid in the Netherlands over the last 12 years (1978-1989: grassland: Hfl. 135,-, arable land: Hfl. 484,- per hectare, according to data of the Dutch Ministry of Agriculture, Naturemanagement and Fishery 1990).

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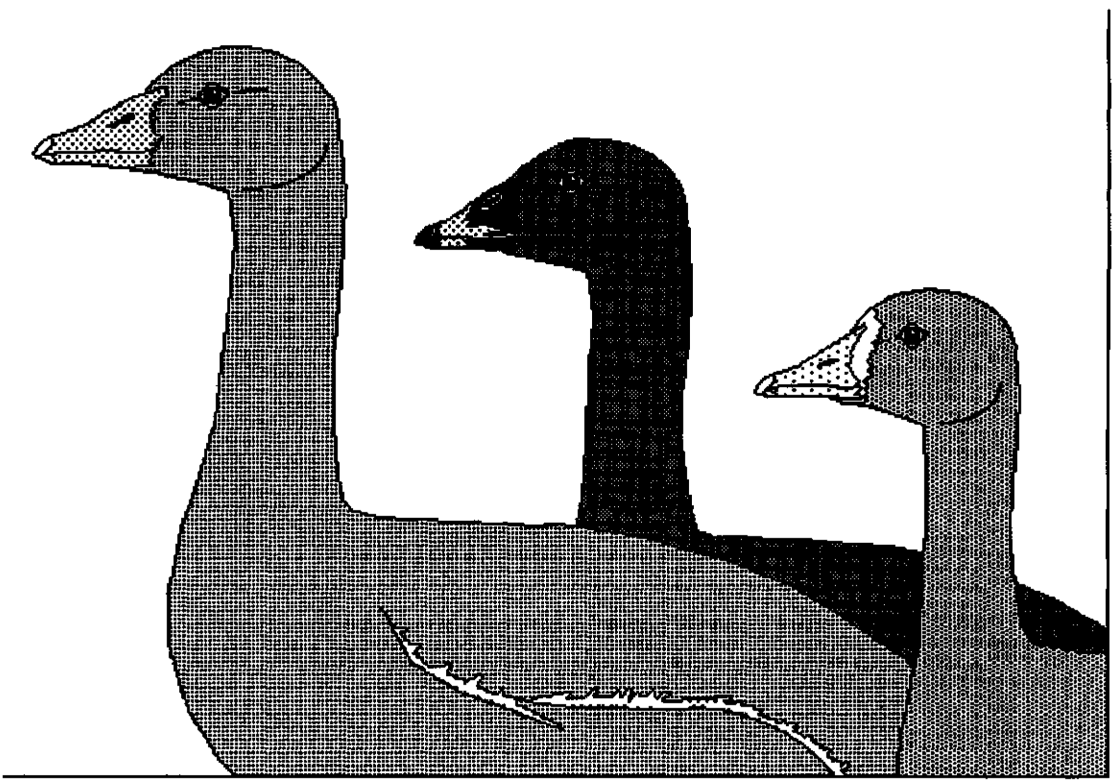
Chapter 8

Bestandsentwicklung der Gänse in Deutschland und der westlichen Paläarktis sowie Bemerkungen zu Gänseschäden und Gänsejagd.

Johan H. Mooij



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Bestandsentwicklung der Gänse in Deutschland und der westlichen Paläarktis sowie Bemerkungen zu Gänseschäden und Gänsejagd

von Johan H. Mooij

Abstract: Development of goose populations in Germany and the Western Palearctic with some notes on goose damage and goose shooting.

Since more than 30 years goose counts have been carried out on the territory of the present Federal Republic of Germany. After 25 years of seperate counts in the western and eastern part of Germany, since 1990 all waterfowl counts in the reunited republic are coordinated by the "Zentrale für Wasservogelforschung und Feuchtgebietsschutz in Deutschland" (= Central Institute for Waterfowl Research and Wetland Protection in Germany), a voluntary union of the former coordinators for East and West Germany under the umbrella of the "Dachverband Deutscher Avifaunisten (DDA)" (Union of German Avifaunists).

An analyses of the all-German goose counts since winter 1988/89 showed the following:

- The German wintering populations of Canada Geese, Greylag Geese, Bean Geese and White-fronted Geese were about stable from 1988/89 until 1992/93. The populations of Brent Geese and Barnacle Geese showed some increase during the same period. Due to the fact that the results of 1992/93 still are preliminary and the reviewed period is rather short these trends have to be confirmed in the coming years.
- During the last years there has been a shift from west to east of concentrations of White-fronted and Bean Geese within Germany. This shift probably is the result of a series of mild winters.
- In Germany there is no simple relationship between goose damage reported and the number of geese migrating through or wintering in the same area. Moreover, it was found that only a part of the crop damage reported as goose damage was actually caused by geese.
- It is recommended that in cases of actually prooven goose damage the affected individual farmers should be financially aided by means of the programmes to reduce agricultural production in the European Union.
- Goose hunting is shown to be one of the most unfit methods to reduce goose damage because, on the contrary, in most cases hunting increases the risk of goose damage.
- Goose hunting in Germany has been more than trebled in the last few years. There is no reasonable argument for a further increase. Moreover a further increase of hunting pressure could become a serious threat to the hunted populations.
- It is recommended that until flyway-wide management concepts for each of the hunted species are implemented, sport hunting on geese should be forbidden resp. strongly limited in western Europe. The management concepts which should be developed under the Bonn Convention must include annual monitoring of population size, bag size, reproduction and mortality rates, and must set up annual bag limits for each of the species and each country.

1. Einführung

Die internationalen Gänsezählungen werden mittlerweile seit mehr als 30 Jahren in Deutschland durchgeführt. Bis 1989 erfolgte dies in beiden Teilen Deutschlands getrennt.

In der ehemaligen DDR wurden alle Aktivitäten, die mit der Wasservogelforschung und dem Feuchtgebietsschutz verbunden waren, von der "Zentrale für Wasservogelforschung der DDR" in Potsdam koordiniert, während die nationalen Gänsezählungen in den alten Bundesländern organisatorisch im Dachverband Deutscher Avifaunisten verankert waren und bis zur Saison 1987/88 von Prof. D. Hummel aus Braunschweig geleitet wurden (Hummel 1976, 1977, 1980, 1981, 1982, 1983, 1984). Seit der Zählperiode 1988/89 wurde die Koordination der nationalen Gänsezählungen von der Biologischen Station im Kreis Wesel-NAB e.V. in Wesel übernommen. Seit der deutschen Wiedervereinigung werden die gesamtdeutschen Wasser- und Watvogelzählungen von der "Zentrale für Wasservogelforschung und Feuchtgebietsschutz in Deutschland" (ZWFD), die dem "Dachverband Deutscher Avifaunisten" (DDA) zugeordnet ist, betreut. Die mittlerweile in "Forschungsstelle für Ökologie der Wasservögel und Feuchtgebiete an der Universität Potsdam" umbenannte "Zentrale für Wasservogelforschung der DDR" ist im Rahmen der neuen ZWFD für die Organisation und Durchführung der Wasservogel- und Gänsezählungen in den neuen Bundesländern zuständig, während die Biologische Station Rieselfelder Münster die gesamtdeutschen Wasser- und Watvogelerfassungen und die Biologische Station im Kreis Wesel-NAB die gesamtdeutschen Gänsezählungen koordiniert (Mooij 1992d).

Zur Zeit besteht das deutsche Gänsezählnetz aus über tausend ehrenamtlichen Mitarbeitern, die mit großem Engagement Jahr für Jahr die in ihrem Zählgebiet rastenden Gänsebestände ermitteln und die Daten zu den regionalen bzw. nationalen Koordinatoren schicken (siehe Mooij 1995b). Ohne dieses ehrenamtliche Engagement wäre das langjährige Gänsemonitoring nicht möglich - eine Tatsache, die bei einem Teil der offiziellen Stellen, die gerne auf die Daten dieser Zählungen zurückgreifen, häufig zu wenig berücksichtigt wird. Deutschland ist noch eines der wenigen westeuropäischen Länder, in denen das nationale Wasser- und Watvogelmonitoring weitgehend ohne finanzielle Unterstützung durch die öffentlichen Hände durchgeführt werden muß.

Obwohl seit 1963 eine enorme Fülle von Zähldaten für den gesamtdeutschen Raum vorliegt, ist es zur Zeit noch nicht möglich, die Entwicklung der gesamtdeutschen Gänsebestände seit 1963 zu rekonstruieren, da nur die Daten aus dem westdeutschen Raum bisher in die EDV eingegeben werden konnten. Wenn in den kommenden Jahren der ältere Datenbestand der östlichen Bundesländer (1963-1988) in die EDV eingegeben werden könnte, wäre es möglich, eine exakte Übersicht der Bestandsentwicklung der Gänse in Gesamtdeutschland in den letzten 30 Jahren zu erstellen. Zur Zeit ist dies aufgrund mangelnder Finanzen und fehlendem Personal nicht möglich.

2. Bestandsentwicklung in Deutschland

Parallel zur Zunahme der Gänsebestände in West-Europa nahmen seit den 60er Jahren auch die Gänsezahlen in Deutschland zu, insbesondere in den Bundesländern Brandenburg und Mecklenburg-Vorpommern im Osten sowie im niedersächsichen Dollart-Gebiet und am Unteren Niederrhein in Nordrhein-Westfalen. Mit über 150.000 Bläß- und in manchen Wintern 50.000 Saatgänsen wurde der Untere Niederrhein in der zweiten Hälfte der 80er Jahre eines der bedeutendsten Gänseüberwinterungsgebiete West-Europas (Gerdes 1994, Mooij 1991a, 1993 & 1995b).

Die Bestandsentwicklung der wichtigsten in Deutschland überwinternden Gänsearten, dokumentiert anhand der gesamtdeutschen Zählungen Winter 1987/88 bis 1993/94 (Tab. 1), zeigt, daß die Herbstbestände dieser Arten in den letzten Jahren nicht mehr zugenommen haben (siehe auch Mooij 1995b).

Aufgrund der Zählergebnisse kann festgestellt werden, daß wahrscheinlich ein Großteil der westpaläarktischen Bläß- und Saatgans-Population sich auf der Herbstwanderung zeitweilig in Deutschland aufhält und unter Umständen für wenige Tage im Osten Deutschlands rastet (Naacke 1993). Dies bedeutet, daß Deutschland als Durchzugsgebiet für beide Arten von größter Bedeutung ist.

Die Winterbestände der wichtigsten Gänsearten scheinen - möglicherweise als Folge milder Winter - vornehmlich in den östlichen Bundesländern etwas zuzunehmen. Dies wird möglicherweise durch eine witterungsbedingte Verschiebung der Winterbestände in die östlichen Bundesländer bewirkt (Tab. 1, Mooij 1995b). Die Frühjahrsbestände von Ringel- und Weißwangengans sowie der Brutbestand der Graugans zeigen weiterhin eine zunehmende Tendenz (Mooij 1995b).

3. Bestandsentwicklung in der westlichen Paläarktis

Seit Beginn regelmäßiger Gänsezählungen in den 50er Jahren stellte man fest, daß die Bestände der Bläß- und Saatgans auf den meisten westeuropäischen Winterrastplätzen - mit Ausnahme der Britischen Inseln - stark zunahmen (Van den Bergh 1983 & 1985, Ebbinge et al. 1987, Ganzenwerkgroep 1976, 1977, 1978, 1979, 1980, 1981, 1983, 1984a & b, 1986, 1987a & b, 1989, 1990, 1991 and 1992, Gerdes et al. 1978 & 1983, Kuyken 1975, Lebret et al. 1976, Meire & Kuyken 1991, Mooij 1991a, & c & 1993, Philippona 1972, Timmerman 1976, Timmerman et al. 1976). Aufgrund dieser Zählergeb-

Tab. 1. Ergebnisse der November- und Januar-Stichtagzählung in Deutschland der Winter 1987/88 - 1993. - Results of the November and January goose counts in Germany in the winters 1987/88 - 1993/94.

NOVEMBER							
JAHR	1987	1988	1989	1990	1991	1992	1993
ART							
Graugans (*Anser anser*)	8.252	6.324	9.157	4.763	6.281	5.651	4.435
Saatgans (*Anser fabalis*)	279.960	239.299	170.580	226.023	305.470	278.685	261.750
Bläßgans (*Anser albifrons*)	397.932	342.841	156.309	235.909	490.271	218.529	333.015
Kanadagans (*Branta canadensis*)	1.641	1.749	454	2.734	3.536	1.493	4.737
Weißwangengans (*Branta leucopsis*)	3.009	8.288	14.614	884	1.639	12.019	7.278
Ringelgans (*Branta bernicla*)	110	723	348	6.629	49	1	23
Sonstige Arten (*Anser spec.* &*Branta spec.*)	5	2	32	5	2	4	2
INSGESAMT:	**690.904**	**599.224**	**351.462**	**476.942**	**807.246**	**516.378**	**611.238**

JANUAR							
JAHR	1988	1989	1990	1991	1992	1993	1994
ART							
Graugans (*Anser anser*)	9.899	3.404	10.130	3.757	4.775	5.800	26.275
Saatgans (*Anser fabalis*)	130.583	106.338	178.782	193.278	233.670	200.735	132.900
Bläßgans (*Anser albifrons*)	191.969	203.702	228.043	248.628	319.611	258.013	297.011
Kanadagans (*Branta canadensis*)	8.644	9.049	16.252	14.494	14.954	17.519	10.619
Weißwangengans (*Branta leucopsis*)	1.689	9.585	11.516	5.230	19.063	22.299	35.325
Ringelgans (*Branta bernicla*)	19	-	1.622	2.092	1.659	2.118	4.046
Sonstige Arten (*Anser spec.* & *Branta spec.*)	22	15	35	2	69	33	2
INSGESAMT:	**342.803**	**332.078**	**446.345**	**467.479**	**593.732**	**506.484**	**506.176**

nisse entstand in den 60er Jahren der Eindruck eines Bestandsanstieges von Saat- und Bläßgans in der gesamten westlichen Paläarktis.

Die Ausdehnung der regelmäßigen Bestandserfassungen auf die übrigen Gänserastplätze Europas zeigte jedoch bald, daß trotz der enormen Zunahme der Gänsezahlen in West-Europa nicht von einer generellen Bestandszunahme der westpaläarktischen Gänsepopulationen gesprochen werden kann. In Südost-Europa stellte man starke Bestandsrückgänge bei Bläß- und Saatgans fest (Boyd & Pirot 1989, Cramp & Simmons 1977, Dick 1986, 1987, 1990 & 1992, Madsen 1987 & 1991, Rose & Scott 1994, Sterbetz 1968, 1971, 1982a & 1982b und pers. Mitt.), während die grönländische Subspezies der Bläßgans (*Anser albifrons flavirostris*), die auf den Britischen Inseln überwintert, zur Zeit gerade ein Bestandstief überwunden hat und sich langsam erholt (Boyd & Pirot 1989, Fox & Stroud 1981, Greenland White-fronted Goose Study 1990, Madsen 1987 & 1991).

Addiert man die seit Mitte dieses Jahrhunderts aufgrund der Gänsezählungen in den einzelnen Teilen Europas geschätzten Bestände der Bläß- und Saatgans, dann zeigt sich keine Bestandszunahme, sondern eine relativ konstante Bestandsgröße.

Es scheint in den letzten 40 Jahren größere innereuropäische Verlagerungen überwinternder Bläß- und Saatgänse von Südost- nach West-Europa gegeben zu haben (Tab. 2).

Die vorhandene Literatur über die Zahl überwinternder Gänse in Asien (Perennou et al. 1990, Rogacheva 1992, Scott & Rose 1989, Rose & Scott 1994, Van der Ven 1987 & 1988, Yokota et al. 1982) zeigt, daß die Zählungen in diesem Raum zwar noch sehr unvollständig sind, aber ebenso, daß insgesamt ein deutlicher Abwärtstrend besteht.

Aus diesen Daten läßt sich ableiten, daß man auf die paläarktischen Bestände der Saat- und Bläßgans bezogen, eher von einer rückläufigen Tendenz als von einer Zunahme sprechen muß, wobei die westpaläarktischen Bestände wahrscheinlich stabil und die ostpaläarktischen Bestände wahrscheinlich stark rückläufig sind. Insgesamt wird klar, daß eine regionale Betrachtung der Bestände wandernder Tierarten außerordentlich gefährlich ist und leicht zu Fehlschlüssen führt.

Auch Untersuchungen aus den Brutgebieten der arktischen Gänse geben keinerlei Hinweise auf Bestandszunahmen. Bei Brutdichte-Untersuchungen in mehreren Brutgebieten (Insel Vaygach und Halbinsel Taimyr; dort brüten über 50% der westpaläarktischen Bläßgänse) wurden zwischen 1968 und 1992 Brutdichten zwischen 0,1 und 4,0 (Mittelwert: 0,9) Nester/km^2 für die Bläßgans und zwischen 0,03 und 6,0 (Mittelwert: 0,9) Nester/km^2 für die Saatgans gefunden (Ebbinge & Boere 1991, Mooij 1992c & 1995a, Kokorev 1985, Spaans 1992, Syroechkovsky et al. 1991). Obwohl diese Daten möglicherweise nicht repräsentativ für das gesamte Brutgebiet sind, sind die in den einzelnen Gebieten gefundenen Werte gut vergleichbar und zeigen nirgendwo eine steigende, sondern eher eine fallende Tendenz (Tab. 3).

Die russischen Forscher Flint & Krivenko (1990) stellen fest, daß die Populationen der Bläß- und Taigasaatgans (*Anser fabalis fabalis*) in Rußland stabil zu sein scheinen, während der Bestand der Tundrasaatgans (*Anser fabalis rossicus*), die bei uns überwintert, stark rückläufig ist. Rogacheva (1992) schreibt, daß die Taimyr-Population der Bläßgans

Tab. 2. Geschätzte Populationsgröße der westpaläarktischen Bläß- und Saatgänse seit 1950 bzw. 1960 nach Schätzungen von Bauer & Glutz von Blotzheim 1968 (BG 68), Bezzel 1985 (B 85), Cramp & Simmons 1977 (CS 77), Fog 1982 (F 82), Ganzenwerkgroep 1992 (GW 92), Madsen 1991 & 1992 (M 91 & 92), Philippona 1972 (P 72), Rose & Taylor 1993 (RT 93), Rose & Scott 1994 (RS 94), Timmerman et al. 1976 (Tea 76) und Daten der Zentrale für Wasservogelforschung und Feuchtgebietsschutz in Deutschland (ZWFD) ( )* = unvollständige Zählung). – Estimated population sizes of western palearctic White-fronted Geese and Bean Geese since 1950 resp. 1960 according to estimates of Bauer & Glutz von Blotzheim 1968 (BG 68), Bezzel 1985 (B 85), Cramp & Simmons 1977 (CS 77), Fog 1982 (F82), Ganzenwerkgroep 1992 (GW 92), Madsen 1991 & 1992 (M 91 & 92), Philippona 1972 (P 72), Rose & Taylor 1993 (RT 93), Rose & Scott 1994 (RS 94), Timmerman et al. 1976 (Tea 76) and data of the Zentrale für Wasservogelforschung und Feuchtgebietsschutz in Deutschland (ZWFD)( )* = incomplete count)

BLÄßGANS (*Anser albifrons*)

Periode	Nordsee-Ostsee-Gruppe	Pannonische Gruppe	Pontische-Anatolische Gruppe	Populationsgröße	Autor
1950-59	20.000	400.000 - 500.000	?	-)*	BG 68
1960-69	50.000 - 100.000	up to 150.000	500.000 - 600.000	ca. 775.000	BG 68, CS 77, Tea 76
1970-79	100.000	100.000	500.000 - 600.000	ca. 750.000	P 72
1980-89	400.000	100.000	250.000	ca. 750.000	M 91 & 92
1993	400.000 - 450.000)*	9.000 - 10.000	200.000 - 250.000		RT93
1990	590.000			ca. 825.000	GW 92, ZWFD
1994	450.000	100.000	265.000	ca. 815.000	RS 94

SAATGANS (*Anser fabalis*)

Periode	West-Europa	Südost-Europa	Populationsgröße	Autor
1960-69	ca. 50.000)*	ca. 100.000)*	ca. 150.000)*	BG 68, Tea 76
1970-79	150.000 - 200.000	50.000 - 100.000	200.000 - 300.000	BG 68, B 85, CS 77, F 82
1980-89	200.000 - 250.000	100.000 - 150.000	300.000 - 400.000	F 91, M 91 & 92
1993	ca. 200.000)*	30.000 - 50.000		RT 93
1990	250.000 - 300.000		280.000 - 350.000	GW 92, ZWFD
1994			ca. 380.000	RS 94

(geschätzte Populationsgröße ca. 430.000 Vögel, das sind ca. 57% der westpaläarktischen Bläßgänse) seit den 40er Jahren stark abgenommen und sich gegenwärtig wahrscheinlich auf einem wesentlich niedrigeren Niveau als früher stabilisiert hat. Für Saatgänse fand Rogacheva (1992) einen dramatischen Bestandsrückgang. Auf der Halbinsel Taimyr ist der abnehmende Brutbestand der Saatgans seit 1980 hinter den der Bläßgans zurückgefallen, so daß seitdem die Bläßgans die häufigste auf Taimyr brütende Gänseart ist (Kokorev 1985, Rogacheva 1992).

Zusammenfassend läßt sich feststellen, daß in den Brutgebieten in den 80er Jahren ein konstantes Populationsniveau für die Bläßgans und ein starker Rückgang für die Saatgans zu verzeichnen ist. Da über dieselbe Periode nicht nur eine starke Zunahme beider Arten im relativ gut bekannten westeuropäischen Wintergebiet, sondern auch ein starker Rückgang in den weniger gut bekannten Wintergebieten Südost-Europas beobachtet wurde, scheint es sehr wahrscheinlich, daß die Zunahme in Westeuropa eher auf innereuropäische Verschiebungen von Überwinterungsschwerpunkten, als auf einer realen Zunahme der Bestände beider Arten in der westlichen Paläarktis zurückzuführen ist.

Die Situation der Saatgans wird darüber hinaus noch unüberschaubarer, weil bei den vorliegenden europäischen Zähldaten vielfach nicht zwischen den beiden Subspecies "*fabalis*" und "*rossicus*" unterschieden wurde und die "*fabalis*"-Gänse aufgrund ihres spezifischen Verhaltens (u.a. Überwinterung in kleinen Gruppen, Vorliebe für wenig gestörte Moor- und Feuchtwiesenbereiche, (van den Bergh 1985, Huyskens 1986) wesentlich schwieriger zu erfassen sind. Für einen Teil dieser Gänse ist der Winterrastplatz bis heute unbekannt. Es wird noch weitere Forschung nötig sein, um dieses Problem definitiv lösen zu können.

Der westpaläarktische Bestand bei der Graugans wurde in den 1970er Jahren auf ca. 185.000 (Cramp & Simmons 1977), in den 1980er Jahren auf ca. 325.000 (Rutschke 1987, Madsen 1991) und 1994 auf ca. 370.000 Vögel (Rose & Scott 1994) geschätzt, so daß bei dieser Art von einer deutlichen Bestandszunahme in der West-Paläarktis ausgegangen werden kann.

4. Gänseschutz, Gänseschäden und Gänsejagd

Gänse gehören traditionell in ihrem gesamten Lebensraum zum beliebtesten Federwild. In Deutschland haben Ringel- und Kanada-, Saat- und Bläßgans (1. November - 15. Januar) sowie Graugans (August sowie 1. November - 15. Januar) eine Jagdzeit, die von den einzelnen Bundesländern in unterschiedlichen Maße ausgenutzt wird. Abweichend von der Verordnung des Bundeslandwirtschaftsministeriums über die Jagdzeiten vom 2. April 1977 darf zur Zeit die Jagd auf Gänse in Baden-Württemberg, Hessen, Rheinland-Pfalz, Thüringen, auf Bläß-, Saat-, Ringel- und Kanadagans in Niedersachsen und Nordrhein-Westfalen sowie auf Ringelgänse in Mecklenburg-Vorpommern nicht ausgeübt werden. In Sachsen dürfen Graugänse nicht im August bejagt werden. In den anderen Bundesländern gelten zur Zeit die Jagdzeiten der Jagdzeiten-Verordnung des Bundeslandwirtschaftsministeriums (Wiese 1995).

Anfang der 1980er Jahre lag die gesamtdeutsche Gänsejagdstrecke bei 7.000 - 8.000 (Rutschke 1990, Wiese 1984) und in der zweiten Hälfte der 1980er Jahren bei ca. 10.000 Gänsen (Wiese 1988, 1989, 1990, 1991). Anfang der 1990er Jahren wurde die

Tab. 3. Mittlere Brutdichten von Saat- und Bläßgans auf der Taimyr-Halbinsel nach Uspenski 1965 (1950-er Jahre), den Daten verschiedener örtlicher Ornithologen (u.a. Chupin, Kokorev, Zirianov) sowie eigene Daten (Größe der untersuchten Fläche zwischen 10 und mehrere 100 qkm). – Average breeding densities of Bean and White-fronted Goose at the Taymyr Peninsula after Uspenski 1965 (1950s) and local ornithologists (e.g. Chupin, Kokorev, Zirianov) as well as own data (Area checked between 10 and several 100 sq.km).

	West-Taimyr			**Ost-Taimyr**		
Periode	**Brutdichte in Brutpaare/qkm**		**n**	**Brutdichte in Brutpaare/qkm**		**n**
	Anser albifrons	***Anser fabalis***	**Jahr**	***Anser albifrons***	***Anser fabalis***	**Jahr**
1950-er	5	5	-	5	5	-
1960-er	1,2	2,1	3	2,5	3,7	3
1970-er	0,2	0,2	3	1,3	1,8	2
1980-er	0,5	0,1	3	0,4	0,2	6
1990-er	0,3	0,1	3	0,3	0,1	3

Gänsejagd, speziell in den östlichen Bundesländern, wesentlich intensiviert. So wurden seit 1990 allein in Mecklenburg-Vorpommern jährlich durchschnittlich fast 11.000 (Schriftl. Mitteilung des Landwirtschaftsministeriums Mecklenburg-Vorpommern) und in Brandenburg ca. 5.000 Gänse erlegt (Mündl. Mitteilung des Landwirtschaftsministeriums Brandenburg). In der gleichen Periode erreichte die jährliche Gänsestrecke im restlichen Deutschland fast 10.000 Gänse (Wiese 1994). Diese Zahlen belegen, daß die Gänsestrecke sich in Deutschland seit Anfang der 1980er Jahre von ca. 7.500, über 10.000 in der zweiten Hälfte der 1980er auf 25.000-30.000 Gänse Anfang der 90er Jahre stetig erhöht, damit innerhalb von 10 Jahren mehr als verdreifacht und in nur wenigen Jahren mehr als verdoppelt hat (Tab. 4). Dabei ist zu bedenken, daß die angegebenen Gänsestrecken immer nur einen Teil der tatsächlich erlegten Gänse beinhalten, da zusätzlich noch ca. 25% der angegebenen Vögel als Folge der indirekten Auswirkungen der Jagd und durch "Krankschießen" stirbt (Ebbinge 1991, Mooij 1990 & 1991b, Morehouse 1992). Dies verdeutlicht, daß die tatsächliche Zahl der in Deutschland jährlich durch die Jagd getöteten Gänse sicherlich wesentlich höher anzusetzen ist, als die offiziellen Streckenzahlen vermuten lassen, und zur Zeit sicherlich über 30.000 Vögel liegt.

In diesem Licht sind die in der Bundesrepublik zur Zeit erkennbaren starken Bestrebungen, die Gänsejagd noch weiter zu intensivieren, als äußerst unerwünscht anzusehen. Die offizielle Begründung für eine "verschärfte Bejagung" der Gänse sind die durch große Gänsekonzentrationenen stellenweise verursachten Schäden an landwirtschaftlichen Kulturen (vornehmlich in Brandenburg, Mecklenburg-Vorpommern, Niedersachsen, Nordrhein-Westfalen und Schleswig-Holstein) sowie die in Westeuropa in den letzten Jahrzehnten stark angestiegene Gänsezahl.

Die Zunahme der Gänsejagd in Deutschland ist in Europa nicht einmalig. Auch in den Niederlanden stieg die Jagdstrecke seit den 1970er Jahren von weniger als 10.000 (Doude van Troostwijk 1974), auf 35.000 - 50.000 Mitte der 1980er Jahre (Oostenbrugge et al. 1992, Wiese 1991) bis auf 60.000 - 70.000 (vornehmlich Bläß-) Gänse Anfang der 1990er (KNJV, pers. Mitt.).

Die Situation wird noch weiter dadurch verschärft, daß aufgrund der angespannten Wirtschaftssituation und der zum Teil mangelhaften Kontrollmöglichkeiten auch in mehreren ehemaligen Ost-

Tab. 4. November- und Januar-Bestände der Grau-, Saat- und Bläßgans in Relation zur Gänsejagdstrecke in Deutschland der Winter 1987/88 - 1993/94. – November and January wintering populations of Greylag Geese, Bean Geese and White-fronted Geese in winter 1987/88 - 1993/94 in Germany in relation to the annual goose hunting bags.

NOVEMBER							
JAHR	1987	1988	1989	1990	1991	1992	1993
ART							
Graugans (*Anser anser*)	8.252	6.324	9.157	4.763	6.281	5.651	4.435
Saatgans (*Anser fabalis*)	279.960	239.299	170.580	226.023	305.470	278.685	261.750
Bläßgans (*Anser albifrons*)	397.932	342.841	156.309	235.909	490.271	218.529	333.015
INSGESAMT:	**686.144**	**588.464**	**336.046**	**466.695**	**802.022**	**502.865**	**599.200**
Jagdstrecke Gänse:	**8.400**	**8.800**	**10.300**	**7.660**	**28.850**	**27.900**	**30.600**
Bestandsanteil in %:	**1**	**1**	**3**	**2**	**4**	**6**	**5**
JANUAR							
JAHR	1988	1989	1990	1991	1992	1993	1994
ART							
Graugans (*Anser anser*)	9.899	3.404	10.130	3.757	4.775	5.800	26.275
Saatgans (*Anser fabalis*)	130.583	106.338	178.782	193.278	233.670	200.735	132.900
Bläßgans (*Anser albifrons*)	191.969	203.702	228.043	248.628	319.611	258.013	297.011
INSGESAMT:	**332.451**	**313.444**	**416.955**	**445.663**	**558.056**	**464.548**	**456.186**
Jagdstrecke Gänse:	**8.400**	**8.800**	**10.300**	**7.660**	**28.850**	**27.900**	**30.600**
Bestandsanteil in %:	**3**	**3**	**2**	**2**	**5**	**6**	**7**

Tab. 5. Geschätzte jährliche Gänsestrecke in der westlichen Paläarktis zwischen 1980 und 1990. – Estimated annual goose bag *in the western Palearctis between 1980 and 1990.*

Land	**Geschätzte Gänsestrecke/Jahr**	**Autor**
Westlicher Teil der ehem. UdSSR	200.000	Priklonski & Sapetina 1990
Polen	12.000	Landry 1990, Wieloch 1992
Dänemark	12.000 - 13.000	Jepsen & Madsen 1992
Schweden	7.500	Hedlund 1992
Deutschland	10.000	Mooij 1991b & 1992b, Wiese 1991
Niederlande	35.000 - 50.000	Oosterbrugge et al. 1992, Wiese 1991
Ungarn	7.000 - 7.500	Farago 1992 & Landry 1990
ehem. Tschechoslowakei	ca. 1.500	Urbanek 1992
Österreich	ca. 2.000	Dick 1992
Rumänien	ca. 5.000	Munteanu 1992
ehem. Jugoslavien	unbekannt	-
Bulgarien	unbekannt	-
Türkei	unbekannt	-

blockländern (verstärkt durch kapitalkräftige Jagdtouristen aus Westeuropa) der Jagddruck erheblich zugenommen hat.

Diese Daten zeigen, daß die Jagd auf die westpaläarktischen Gänsepopulationen (vornehmlich Bläß-, Saat- und Graugans) in den letzten Jahren stark zugenommen hat und zur Zeit sicherlich über das für die 1980er Jahren geschätzten Niveau von 300.000 Vögel jährlich liegt (Tab. 5), während z.B. die Fortpflanzungsrate bei der Bläßgans - als stärkst bejagte Gänseart - seit den 1950er Jahren rückläufig ist (Tab. 6).

Der von mehreren Seiten immer wieder hergestellte Zusammenhang Gänsezahl-Gänseschäden-Gänsejagd ist wissenschaftlich nicht haltbar. Wie schon bei einer Vielzahl von wissenschaftlichen Untersuchungen festgestellt, gibt es keinen statistisch belegbaren Zusammenhang zwischen Gänsezahlen und Gänseschäden, sondern gibt es Wachstumsverzögerungen und Ertragsverringerungen auf landwirtschaftlichen Nutzflächen nur dort (meist in relativ störungsarmen Bereichen), wo durch eine stellenweise Konzentration von Gänsen eine Überbeweidung der Vegetation stattfindet. Solche von Gänsen bevorzugt angenommene Gebiete werden auch dann noch von größeren Gänseschwärmen besucht, wenn der Gesamtbestand geringer ist. Ein Bestandsrückgang zeigt sich zuletzt in den optimalen Bereichen, weshalb eine generelle Reduktion der Gänsezahlen zunächst keinen Einfluß auf die Häufigkeit und das Ausmaß von regionalen Gänseschäden hat (Ernst 1991, Jepsen 1991, Mooij 1984, 1991b & in Vorber.). Der fehlende Zusammenhang zwischen Gänsezahl und Gänseschäden wird auch belegt durch die Tatsache, daß trotz dem seit mehreren Jahren stagnierenden Gänsebestand in Nordrhein-Westfalen der Gesamtbetrag der gemeldeten Gänseschäden weiter angestiegen ist (Tab. 7).

Tab. 6. Durchschnittlicher jährlicher Jungvogelanteil (ermittelt auf den Winterrastplätzen West-Europas) sowie die hieraus errechnete theoretische jährliche Reproduktionsrate im Brutgebiet (bei 15-30% Jungvogelmortalität im ersten Halbjahr) und die durchschnittliche jährliche Mortalitätsrate 1957-1979 errechnet nach Ebbinge 1991 und 1980-89 nach Mooij 1995c für die westpaläarktische Bläßgans seit 1957. – Average annual rate of first-year birds (at West European wintering sites), the estimated annual reproduction rate in the breeding area (based at the average rate of first-year birds and a mortality rate of 15-30% in the first half year) and the annual mortality rate (calculated after Ebbinge 1991 for the period 1957-1979 and after Mooij 1995c for 1980-1989) of White-fronted Geese.

	Jungvogel (%)	**Reproduktions-rate (%)**	**Mortalitäts-rate (%)**
Periode			
1957-1959	34,8	41-50	32,5
1960-1969	30,8	36-44	36,4
1970-1979	29,4	35-42	33,7
1980-1989	29,8	35-43	34
1990-1994	27,1	32-39	?
Ø	29,98	35-43	34,15

Die jährlich in mehrere Mio DM gehenden Forderungen der Landwirtschaft nach Ausgleich von Gänseschäden bedürfen noch einer kurzen Betrachtung.

Zuerst muß festgestellt werden, daß bei weitem nicht alle gemeldeten Gänseschäden auch tatsächlich von Gänsen verursachte Schäden sind. Häufig handelt es sich um durch abiotische bzw. anthropomorphe Faktoren (z.B. Witterungseinflüsse, Bodenqualität, Staunässe, Ackernutzung von nicht ackerfähigen Flächen, Bearbeitungsunterschiede innerhalb der Fläche) verursachte Aufwuchsbeeinträchtigungen. Diese werden als Folge einer psychologischen Sensibilisierung für mögliche Schäden, aufgrund der beeindruckenden Massierung durchziehender bzw. überwinternder Gänse und der Nichterfassung des Vegetationszustandes vor der Gänsebeweidung den Gänsen zugeschrieben. Die Schadensursache ist im nachhinein schwer feststellbar.

Hinzu kommt, daß die tatsächliche Ertragsminderung für den Landwirt wesentlich geringer ist, als die von den nahrungssuchenden Gänsen gefressene Vegetationsmenge. Ein Großteil der von Gänsen gefressenen oberirdischen Pflanzenteile würde ohne Gänsefraß im Laufe des Winters absterben und steht einer landwirtschaftlichen Produktion sowieso nicht zur Verfügung. Darüber hinaus wird in vielen Fällen die im Frühjahr fehlende Biomasse durch ein verstärktes Wachstum sowie eine verstärkte Bestockung der Gräser während der Vegetationsperiode weitgehend ausgeglichen. Je günstiger die Lichtverhältnisse vor allem in den tieferen Bestandsschichten der grasigen Vegetation sind, desto besser bleibt die Photosyntheseaktivität in Bodennähe lokalisierter Assimilationsorgane erhalten (Voigtländer & Jacob 1987). Mit Ausnahme von örtlichen Überweidungssituationen fördert die übliche Beweidung von Grünland durch Gänse das Wachstum der Gräser, wie Untersuchungen in seminatürlichen und natürlichen Habitaten zeigen (Beaulieu et al. 1995, Mooij et al. in Vorber., Prop 1991).

Alle bisherigen Untersuchungen der Gänseschadensproblematik haben gezeigt, daß es aufgrund der multifaktoriellen Einwirkungen auf landwirtschaftliche Kulturen außerordentlich schwierig ist, die tat-

Tab. 7. Gänsezahlen, Gänseweidetagen, Nahrungsfläche, mittlere Beweidungsintensität, gezahlte Gänseschäden und Aufenthaltsdauer der Gänse am Unteren Niederrhein zwischen 1977/78 und 1991/92. – Goose numbers, goose days, feeding area, mean feeding densities, goose damage compensation payed and the period of stay of wintering geese at the Lower Rhine wintering site between 1977/78 and 1991/92.

Winter	Wintermaximum	Gänseweidetage (Gt)	Nahrungsfläche (ha)	Ø Beweidungsintensität (Gt/ha)	Gänseschadenszahlung in DM	Aufenthalt in Tagen
1977/78	20.100	700.000	1.720	406,7	0	126
1978/79	26.100	670.000	1.430	469,9	0	128
1979/80	56.200	1.760.000	3.440	511,6	0	128
1980/81	70.000	3.650.000	7.520	485,3	0	126
1981/82	84.000	3.610.000	7.690	469,4	6.000	124
1982/83	92.000	4.210.000	7.920	531,9	10.000	128
1983/84	117.000	7.130.000	15.080	472,8	16.000	140
1984/85	101.000	4.770.000	10.090	472,8	30.000	140
1985/86	146.000	8.790.000	18.390	478,1	640.000	127
1986/87	130.000	7.060.000	14.780	477,6	1.530.000	143
1987/88	180.000	8.590.000	17.140	501,3	360.000	138
1988/89	185.000	11.800.000	24.060	490,5	1.010.000	148
1989/90	140.000	10.950.000	21.500	509,4	690.000	147
1990/91	125.000	9.890.000	19.780	500,1	1.881.000	181
1991/92	170.000	11.600.000	23.530	492,8	1.949.000	175

sächlichen Auswirkungen des Gänsefraßes festzustellen (u.a. Ernst 1991, Groot Bruinderink 1987 & 1989, Mooij 1984 & in Vorber., Mooij & Ernst 1988, Patterson 1991, Rutschke 1983, Rutschke & Schiele 1978, Schröder 1975, Summers 1990, Theunissen 1991).

Darüber hinaus verringern die Gänse im Falle tatsächlicher Gänseschäden die Getreideüberschüsse der Europäischen Union und tragen so eindeutig zur notwendigen Entlastung des Europäischen Agrarmarktes bei. Von einem Schaden für die Gesamtwirtschaft kann deshalb wohl kaum die Rede sein. Unzumutbare finanzielle Einbußen einzelner Landwirte sollten daher im Rahmen der Marktentlastungsprogramme der Europäischen Union ausgeglichen werden (siehe u.a. Edgell & Williams 1991, Warren & Sutherland 1992).

Zum Schluß noch einige Bemerkungen zur Jagd als Mittel zur Schadensverringerung. Die Jagd ist als Mittel zur Verringerung von Gänseschäden denkbar ungeeignet. Wie vorhin schon ausgeführt, wäre eine allgemeine nationale Reduktion der Bestände für die Behebung bzw. Reduktion örtlicher Gänseschäden wenig wirkungsvoll. Die Bejagung kann darüber hinaus zu Verhaltensänderungen sowie zur Verlagerung von Überwinterungs- (und damit ggf. von Gänseschadens-)schwerpunkten führen und könnte - da die Bejagungsintensität lebensraumweit schwer steuerbar ist - leicht zu einer Gefährdung einzelner Bestände führen (Bell & Owen 1990, Ebbinge 1991, Madsen 1994, Mooij 1991b, 1994 & in Vorber., Owen 1991, Owen & Black 1990, Rusanov & Khakin 1990). Daneben werden durch die Bejagung sehr viele Vögel - im allgemeinen 1 von 4-5 Vögeln! - "krank geschossen", und es werden die für die Jungvögel lebensnotwendigen Familienstrukturen gebzw. zerstört. Die Folge ist eine erhöhte Mortalität, insbesonders bei Jungvögeln (siehe auch Jönsson et al. 1985, Markgren 1963, Meltofte 1979 & 1982, Mooij 1990 & 1991b, Morehouse 1992, Owen 1982).

Durch den Abschuß einzelner Gänse auf gefährdeten landwirtschaftlichen Kulturen kann zwar eine Schadensverringerung auf der betroffenen Fläche erreicht werden, aber das Problem wird nur verlagert. Wie die Ergebnisse von Vergrämungsversuchen (durch Jagd bzw. mit Hilfe sonstiger Methoden) aus anderen Gebieten zeigen (z.B. Nordkehdingen in Niedersachsen sowie in Teilen der Niederlande), trägt die Vergrämmung wenig zur Lösung der Schadensproblematik bei.

Zu solchen Vergrämungsstrategien ist folgendes festzuhalten:

- Die in einem Wintergebiet rastenden Gänse haben vielfach keine Ausweichmöglichkeiten.
  Die örtlichen Vergrämungsmaßnahmen bewirken deshalb nur lokale Verschiebungen innerhalb des Gebietes. Dies führt nur zu einer innergebietlichen Verlagerung der Probleme.
- Die regelmäßige Beunruhigung der Vögel führt zu einer zunehmenden Scheu der betroffenen Vögel. Die Folge sind größere Konzentrationen und eine Verringerung der für die Vögel nutzbaren Nahrungsflächen. Durch eine höhere Nutzungsintensität einzelner Flächen erhöhen die Vergrämungsmaßnahmen damit eindeutig die Gefahr von Fraßschäden. Darüber hinaus reagieren regelmäßig beunruhigte Gänse verstärkt auch bei geringfügigen Störungen, was den generellen Energiebedarf der Vögel steigert.
- Fliegen kostet 10-mal mehr Energie als Nahrungssuche (Mooij 1992a). Jede Vertreibungsaktion erhöht damit den Nahrungsbedarf der vertriebenen Vögel und damit die Gefahr von Fraßschäden.

Vergrämungsmaßnahmen sind damit kontraproduktiv, sie schaden sowohl den landwirtschaftlichen als auch den Naturschutzinteressen und werden die Probleme wahrscheinlich eher verschärfen als lösen.

Die Störung der Gänse durch die Jagd bewirkt also Änderungen in Verhalten und Verteilung der Vögel über die Fläche (Bell & Owen 1990, Madsen 1994), trägt kaum zu Schadensverringerung bei und hat daneben tiefgreifende Auswirkungen auf Geschlechtsverteilung, Altersaufbau und genetische Zusammensetzung der bejagten Populationen, deren langfristigen Auswirkungen noch unbekannt sind (Rusanov 1990). Zur Abschreckung und Verjagung nahrungssuchender Gänse von landwirtschaftlichen Nutzflächen gibt es eine Vielzahl alternativer, gleichermaßen (in)effektiver Methoden, die jedoch nicht mit den Nachteilen einer Bejagung behaftet sind.

Obwohl die Gänsejagd, insbesondere auf Saat-, Bläß- und Graugans, in den letzten Jahren sowohl in Deutschland als in den meisten übrigen Länder ihres Lebensraumes nachweislich stark zugenommen hat, gibt es in der Bundesrepublik immer wieder starke Bestrebungen, die Gänsejagd noch weiter zu intensivieren.

Aufgrund regionalpolitischer, vornehmlich wirtschaftlicher Interessen droht die Bundesrepublik Deutschland - als Initiatorin des "Übereinkommens zur Erhaltung der wandernden wildlebenden Tierarten" (Bonner Konvention) vom 23. Juni 1979 - den Grundsatz dieses Übereinkommens aufzugeben. Der

Grundgedanke der Bonner Konvention ist, daß der Schutz wandernder Tierarten nicht von der regionalen bzw. nationalen Ebene, sondern vom Jahreslebensraum auszugehen hat und sich nicht von der lokalen Bestandssituation, sondern vom Gesamtbestand einer biogeographischen Population leiten lassen soll. Damit würde sich die Bundesrepublik nicht grundsätzlich anders verhalten als einige vielgerügte Staaten und die deutschen Proteste gegen norwegisch/japanischen Walfang oder südeuropäischen Vogelfang/-jagd werden in Zukunft wohl kaum noch ernst genommen.

5. Zusammenfassung und Zukunftsperspektiven

Aufgrund der Analyse der von den ehrenamtlichen Mitarbeitern des DDA-Gänse-Monitoringprogramms gesammelten Daten wurde festgestellt:

- Die Winterbestände der Kanada-, Grau-, Saat- und Bläßgans in Deutschland in der Periode 1988/89 bis 1992/93 waren weitgehend stabil und die der Ringel- und Weißwangengans haben wahrscheinlich noch zugenommen. Aufgrund der Tatsache, daß die Daten der Zählperiode 1992/93 zur Zeit nur unvollständig vorliegen, können diese Bestandstrends erst in den kommenden Jahren gesichert werden.
- Innerhalb Deutschlands gab es in den letzten Jahren eine Verlagerung von Überwinterungsschwerpunkten der Saat- und Bläßgans von West nach Ost, die möglicherweise eine Folge der milden Winter der letzten Jahre war.
- Die in Deutschland gemeldeten Gänseschäden stehen nicht in direkten Zusammenhang mit den in Deutschland durchziehenden und überwinternden Gänsezahlen und sind nur zum Teil von Gänsen verursacht.
- Im Falle tatsächlicher Gänseschäden sollte eine Entschädigung einzelner Landwirte im Rahmen der Marktentlastungsprogramme der Europäischen Union stattfinden.
- Die Jagd als Mittel zur Verringerung von Gänseschäden ist denkbar ungeeignet, sondern vielmehr kontraproduktiv. Eine gezielte Bejagung von Gänsen in Gebieten, wo regelmäßig Gänseschäden auftreten, ist aufgrund der unkontrollierbaren negativen
  Nebenwirkungen der Jagd sowohl für die bejagten Populationen wie auch für die Umwelt nicht akzeptabel.
- Die Gänsejagd in Deutschland wurde in den letzten Jahren schon wesentlich intensiviert. Für eine weitere Zunahme des Jagddrucks gibt es keine vernünftigen Gründe. Eine weitere Jagdverschärfung in Deutschland könnte zu einer direkten Gefährdung der bejagten Populationen werden und dem naturschutzpolitischen Ansehen Deutschlands im Ausland schaden.
- Bis im Rahmen der Bonner Konvention ein kontrollierbares Jagdsystem für die gesamte Zugroute der einzelnen Gänsearten entwickelt worden ist, sollte die (fast ausschließliche Freizeit-)Jagd auf Gänse in West-Europa unterbunden bzw. stark eingeschränkt werden.

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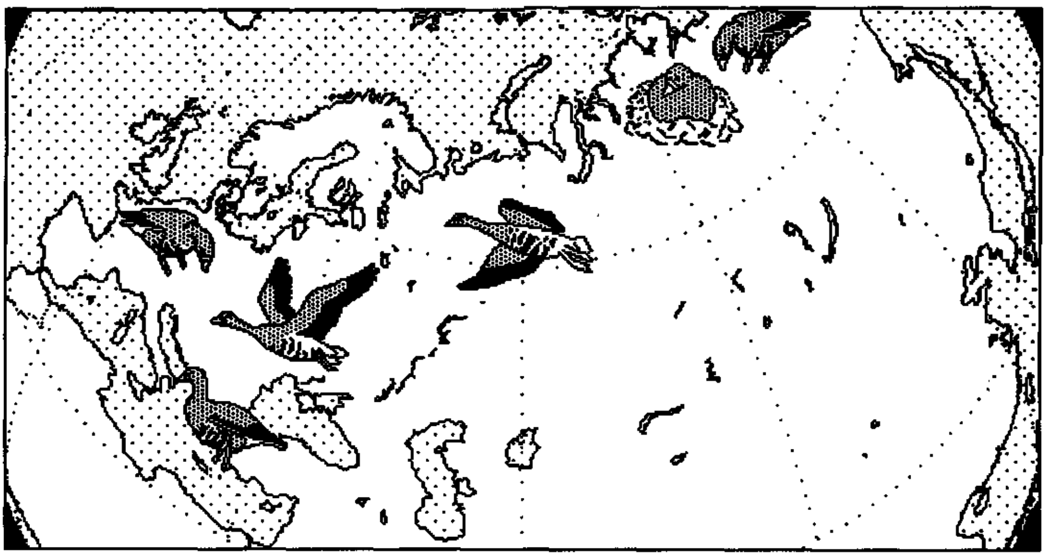
Chapter 9

Samenvatting



Samenvatting

"Die wilde Ganß hat viel und mancherley Nahmen / wird aber auch von etlichen Schnee=Ganß genennet / deweil sie zu Anfang deß Winters / wann der Schnee verhanden / sich bey uns aufhält" zo begon Conrad Gesner in de 17e eeuw zijn beschrijving van de ganzen. Ook tegenwoordig hebben ganzen nog weinig van hun fascinatie verloren. Elke winter, als zij in grote zwermen weer in hun wintergebieden aankomen, lokken zij duizenden geinteresseerde toeschouwers. Tegelijkertijd zien veel boeren hun aankomst met zorg, omdat zij bang zijn voor mogelijke schade aan weiden en gewassen. Overwinterden de meeste ganzen tot in de vorige eeuw nog voornamelijk in natuurlijke en semi-natuurlijke gebieden, zo dwong de toenemende ontginning van deze traditionele voedingsterreinen - voornamelijk ten bate van de landbouw -, de ganzen meer en meer in het cultuurlandschap te overwinteren. Deze verandering bracht hen aanvankelijk waarschijnlijk grote problemen, waardoor de ganzenaantallen in de loop van de tweede helft van de 19e en het begin van de 20e eeuw in West-Europa sterk terugliepen. Sinds het midden van deze eeuw schijnen de ganzen de voordelen van overwinteren op landbouwgronden, namelijk het groter aanbod en de betere kwaliteit van het plantaardig voedsel, te kunnen benutten en hun aantallen in West-Europa namen weer toe. Dit bracht hen in toenemende mate in conflict met de landbouw, omdat de grote ganzenzwermen door steeds meer boeren als direkte concurrenten beschouwd worden.

Ook in het traditionele ganzenwinterareaal in het duitse Nederrijn-Gebied in Noordrijn-Westfalen zijn de problemen tussen ganzen (Kol- en Rietgans) en landbouw in de laatste jaren sterk toegenomen. Werd hier nog in de eerste helft van de jaren 70 een door alle zijden geaccepteerd ganzenjachtverbod van kracht, zo werd aan het begin van de jaren 80 niet alleen steeds vaker geëist de veronderstelde ganzenschade te vergoeden, maar ook de jacht van de sterk gestegen ganzenaantallen weer toe te laten (Hoofdstuk 2, 3, 4, 7 & 8).
Met het doel gegevens voor een toekomstig ganzenbeleid in Noordrijn-Westfalen te verzamelen, begon de auteur 1976 met zijn ganzenorderzoek, dat zich in de loop van de jaren 80 ook tot andere ganzengebieden in Duitsland en aan het eind van de jaren 80 en het begin van de jaren 90 tot de siberische broedgebieden uitbreidde. Deze dissertatie is in zekere zin een samenvatting van de resultaten van dit onderzoek zoals die eind 1994 beschikbaar waren.

Op grond van de in de westeuropese wintergebieden doorgevoerde tellingen was men sinds de jaren 60 van mening, dat de bestanden van Riet- en Kolgans in de westelijke Palearctis sterk toenamen. In de broedgebieden werd voor de jaren 80 echter een constant populatieniveau voor de Kolgans en een sterke achteruitgang van de Rietgans vastgesteld. Daar over dezelfde periode niet alleen een sterke toename van beide soorten in het relatief goed getelde westeuropese wintergebied, maar tegelijkertijd een sterke teruggang in de minder goed getelde wintergebieden van Zuidoost-Europa vastgesteld werd, is het waarschijnlijk, dat de toename in West-Europa meer met verschuivingen van overwinterings-zwaartepunten binnen de West-Palearctis, dan met een reële toename der bestanden van beide soorten te maken heeft (Hoofdstuk 2, 4, 5 & 8).
Er is nog verder onderzoek nodig om dit probleem definitief op te lossen.

Ook de tot nu toe gangbare mening over de migratie van beide soorten schijnen niet houdbaar. Een analyse van de terugmeldingen van geringde en gemarkeerde Kolganzen voert tot de conclusie, dat de contacten tussen de verschillende winterpopulaties in de westelijke Palearctis veel intensiever zijn dan tot nu toe werd aangenomen en dat vogels van één broedgebied in ver uitelkaar gelegen wintergebieden aan te treffen zijn. Hierdoor is niet alleen een regelmatige genetische uitwisseling tussen de broedpopulaties gegarandeerd, maar ontstaat ook de mogelijkheid, dat de overwinterende vogels van een gebied relatief snel op ecologische veranderingen reageren en naar een ander (eventueel ook op grote afstand gelegen) wintergebied verhuizen kunnen (Hoofdstuk 2 & 5).

Ondanks tientallen jaren van onderzoek en discussie is het nog steeds onduidelijk hoeveel ondersoorten de Rietgans heeft, waar deze broeden en waar de grenzen tussen de verschillende ondersoorten liggen. Hierdoor is het trekverloop van de Rietgans uiterst moeilijk te reconstrueren. Zeker is, dat er een regelmatige uitwisseling tussen de wintergebieden in West- en Zuidoost-Europa bestaat, terwijl over een mogelijke uitwisseling tussen de overwinterende Rietganzen van Scandinavië en England enerzijds en die in de rest van Europa anderzijds geen gegevens beschikbaar zijn (Hoofdstuk 2).
Alhoewel zeker nog veel onderzoek nodig is om alle vragen over de trek van beide soorten op te lossen, schijnt zeker, dat zij gedurende het jaar in gebieden verblijven, waar de gemiddelde maandtemperatuur enige graden boven de 0°C ligt, waardoor zij in het algemeen over redelijk vers, en daardoor redelijk goed verteerbaar gras beschikken kunnen (Hoofdstuk 2, 6 & 7).

De toename van de ganzenaantallen in West-Europa ging gepaard met een toenemend aantal ganzen in Duitsland, in het bijzonder in de bondsstaten Brandenburg en Mecklenburg-Voorpommeren in het oosten en in het Dollart-gebied (Nedersaksen) en aan de duitse Nederrijn (Noordrijn-Westfalen). Met meer dan 150 000 Kolganzen en in sommige winters 50 000 Rietganzen werd de duitse Nederrijn in de tweede helft van de jaren 80 een van de belangrijkste ganzenwintergebieden in West-Europa (Hoofdstuk 2, 3, 4 & 8).

Tijdens vluchten over het wintergebied aan de duitse Nederrijn volgen de ganzen bepaalde vliegroutes. De belangrijkste verloopt langs de Rijn en verbindt de zes belangrijkste slaapplaatsen. Alle ganzenslaapplaatsen in dit gebied liggen op de oever van de Rijn, van een oude Rijnstrang of van een uiterwaarden-ontgronding, hebben een lage storingsintensiteit, vlakke oevers en grasvegetatie. De belangrijkste aktiviteit op de slaapplaatsen (oponthoud gemiddeld 13 1/2 uur) is slapen (gemiddeld 6 uur), direct gevolgd door voedselopname (gemiddeld 5 1/4 uur). De ganzen verdelen de voedselopname over de gehele dag: 60% gedurende daglicht en 40% gedurende de nacht.
In de vroege ochtenduren vliegen de ganzenzwermen van de "slaapplaatsen" naar de voedingsterreinen, voor een oponthoud van gemiddeld 10 1/2 uur. Hier is voedselopname (gemiddeld 8 uur) ongetwijfeld de belangrijkste aktiviteit, gevolgd door slapen (gemiddeld 1 1/4 uur).
Vanaf een slaapplaats vliegen de meeste ganzen 's morgens naar de voedingsgebieden in de directe omgeving en 's avonds van een voedingsterrein naar de dichstbijzijnde slaapplaats. Op deze wijze ontstaan eenheden, die uit een slaapplaats en een aantal voedingsterreinen bestaan en door de auteur "Complexen" genoemd worden (Hoofdstuk 2, 4 & 6).

De in het gebied van de duitse Nederrijn overwinterende ganzen zijn voornamelijk op grasland aan te treffen, slechts maximaal 15% van de ganzendagen worden op akkers doorgebracht. De voorkeur voor grasland is met meer dan 95% van de ganzendagen bij Kolganzen duidelijk groter dan bij Rietganzen, die ca. 80% van de ganzendagen op grasland doorbrengen.
De voedselopname is de belangrijkste aktiviteit van de aan de duitse Nederrijn overwinterende ganzen, die gemiddeld ca. 55% van een 24-uurs dag (13 1/4 uur) nodig hebben om de dagelijks benodigde grashoeveelheid van gemiddeld 1 500 g versgewicht (= 300 g drooggewicht) voor een Kolgans en van gemiddeld 1 950 g versgewicht (= 390 g drooggewicht) voor een Rietgans op te nemen. Als gevolg van het relatief weinig effektieve spijsverteringssysteem, verlaat - afhankelijk van het gehalte aan ballaststoffen in het opgenomen gras - 70% (of meer) van het opgenomen voedsel na een darmpassage van 3/4 - 1 1/2 uur het lichaam in de vorm van ganzenkeutels. Uit het voor de vogels bruikbare gedeelte van het opgenomen voedsel, winnen zij per dag ca. 2 100 kJ aan energie (Kolgans: 1 780 kJ/dag; Rietgans: 2 360 kJ/dag), waarmee zij hun dagelijkse energiebehoefte dekken Door de snelle darmpassage zijn de darmen van de ganzen bij voeding op gras na maximaal 2 uur zonder voedselopname leeg en zou de vogel op zijn vetreserves moeten terugvallen. Daar het fysiologisch weinig zinvol is, iedere nacht op de in de winter zo dringend nodige vetreserves te teren, terwijl aan de oever voedsel in overvloed staat, brengen de aan de duitse Nederrijn overwinterende ganzen het grootste deel van de nacht aan land door en verdelen de voedselopname over het hele etmaal (Hoofdstuk 2, 4 & 6).

Hun relatief hoge voedselbehoefte dekken de ganzen van de duitse Nederrijn bijna uitsluitend op landbouwgronden. Hieruit af te leiden, dat zij daarom automatisch een belasting voor de landbouw zijn, is niet juist. Er bestaat geen directe relatie tussen het optreden en de hoogte van ganzenschade enerzijds en het aantal ganzen, dat in het gebied overwintert, of de voedselbehoefte van de individueële gans anderzijds. Ganzenschade ontstaat veelal op plaatsen, waar een overbeweiding van de vegetatie plaatsvindt.
Beweidingsproeven met ganzen in kooien toonden, dat na een begrazing met een intensiteit van 3 000 ganzendagen/ha op grasland opbrengstverliezen van ca. 10% in de eerste snede (begin Mei) en van ca. 3% van de jaar-opbrengst optreden kunnen. Op de percelen met wintergranen trad bij deze beweidingsintensiteit een oogstderving van 10-15% op. Bij hogere beweidingsintensiteiten kunnen de oogstverliezen nog beduidend hoger liggen. Op grond van de onderzoeksresultaten werd duidelijk, dat op de landbouwgronden van de duitse Nederrijn ganzenschade op grasland bij het overschrijden van een beweidingsintensiteit van 2 000 ganzendagen/ha (vergelijkbaar met een keuteldichtte van ca. 20 ganzenkeutels/m^2) verwacht kan worden. Voor granen ligt deze grenswaarde lager, zodat ganzenschade op graanvelden bij het overschrijden van een beweidingsintensiteit van 1 500 ganzendagen/ha (vergelijkbaar met een keuteldichtte van ca. 15 ganzenkeutels/m^2) verwacht kan worden (Hoofdstuk 7).
Ganzen schijnen echter over natuurlijke mechanismen te beschikken, om een overbeweiding van hun voedingsgebieden te vermijden en zich optimaal over hun voedingsterreinen te verdelen. Aan de duitse Nederrijn wordt grasland door de ganzen meestal niet meer opgezocht als de vegetatiehoogte tot op een gemiddeld niveau van 2 - 4 cm afgevreten is. Dit is meestal na een begrazing met een intensiteit van ca. 2 000 ganzendagen/ha het geval.

Vanaf dat moment wordt waarschijnlijk de hoeveelheid energie, die nodig is om de dagelijkse voedselbehoefte op te nemen, groter dan de hoeveelheid energie die hier gedurende de dag opgenomen kan worden.
De duitse Nederrijn beschikt echter over een dicht wegennet en de storingsintensiteit is relatief hoog. Regelmatig worden de voedselzoekende ganzen door menselijke aktiviteiten gestoord. Iedere storing echter, die de ganzen laat opvliegen, zorgt voor een concentratie van de vogels in enige weinig gestoorde gebieden, waar het dan tot een veel hogere beweidingsintensiteit komt als zonder storingen het geval zou zijn geweest. Hier komt het dan tot een overbeweiding van de vegetatie, die ganzenschade tot gevolg kan hebben. De storingen van voedselzoekende ganzen heeft niet alleen tot gevolg dat de vogels tijd voor voedselzoeken verliezen en een hogere energiebehoefte hebben door het vliegen, maar beperkt ook de grootte van het beschikbare voedselgebied, omdat terreinen met een hoge storingsintensiteit gemeden worden. Storingen verhogen zo het risiko van ganzenschade door een sterkere concentratie en een verhoogde energiebehoefte van de gestoorde ganzen (Hoofdstuk 2, 4, 6 & 7).

Omdat er geen directe relatie bestaat tussen het optreden en de hoogte van ganzenschade enerzijds en het aantal ganzen, dat in het gebied overwintert anderzijds, is het weinig zinvol een algemene reductie van het aantal ganzen door middel van de jacht door te voeren om de ganzenschade te verminderen. De voor de ganzen optimale gebieden worden ook dan door grote ganzenconcentraties bezocht, terwijl hoogstens enige suboptimale terreinen door een geringer aantal ganzen bezocht worden. Verder bestaat het gevaar, dat de overlevingskans van hele ganzenpopulaties in gevaar gebracht wordt. Omdat er geen betrouwbare gegevens bekend zijn over de aantallen ganzen, die in andere landen langs de trekroute jaarlijks geschoten worden en het voortplantingssucces van de ganzen van jaar tot jaar grote verschillen vertoont, bestaat - vooral bij intensief bejaagde soorten als Kol- en Rietgans - het gevaar, dat de ongekoördineerde jacht op deze trekvogels binnen de westelijke Palearctis zich tot een akute bedreiging voor de bejaagde soorten ontwikkelt. Uit een aantal landen langs de trekroute van beide soorten zijn voorzichtige schattingen van de in de jaren 80 jaarlijks geschoten ganzenaantallen beschikbaar. Uitgaand van deze schattingen blijkt, dat in die periode jaarlijks ca. 150 000 - 200 000 Kol- en ca. 70 000 - 95 000 Rietganzen (ca. 20% van de westpalearctische populaties van beide soorten) geschoten werden. Hierbij komen nog ca. 5-6% van de populaties, die stierven door indirekte bijwerkingen van de jacht (b.v. aangeschoten vogels, loodvergiftiging), zodat gedurende de jaren 80 door de jacht jaarlijks minstens ca. 25% van het bestand van beide populaties onttrokken werd. Bij een jaarlijks voortplantingssucces van gemiddeld 39% voor de Kol- en 34% voor de Rietgans blijft voor de natuurlijke mortaliteit en een eventueel jaarlijks reproductie-overschot niet veel speelruimte meer over. Het feit, dat russische onderzoekers in de broedgebieden voor de jaren 80 een constant populatieniveau voor de Kolgans en een sterke achteruitgang van de Rietgans hebben vastgesteld, is mogelijkerwijze op de hoge jachtdruk terug te voeren.
Het gevaar van overbejaging bij Kol- en Rietgans is in de laatste jaren sterk gestegen, omdat de veranderingen in Oost-Europa in verscheidene staten een kontrole van de jachtwetten niet meer mogelijk en ganzenjacht voor de bevolking een welkome bron van voedsel en deviezen geworden is. Totdat een kontroleerbaar jachtsysteem voor de gehele trekroute mogelijk is, moet de (voornamelijk recreatieve) ganzenjacht in West-Europa sterk beperkt worden.

Ook een doelgerichte jacht op ganzen op terreinen waar regelmatig ganzenschade optreedt is niet aanvaardbaar vanwege de onkontroleerbare negatieve uitwerkingen die deze heeft op zowel de ganzenpopulaties als op het milieu, te weten: loodbelasting voor de ganzen en het milieu, verhoogde schuwheid waardoor de grootte van het voedselareaal verminderd wordt, onnodig grootschalige storing van voedselzoekende ganzen en concentratie van ganzen in gebieden met een geringe storingsfrequentie.

De beste manier om ganzenschade te voorkomen en/of te verminderen is het inrichten van ganzenreservaten, die groot genoeg zijn om alle daar overwinterende ganzen te voeden zonder dat het tot een overbegrazing van delen van het gebied behoeft te komen. Buiten deze reservaten kunnen de ganzen dan van voor schade gevoelige gewassen verjaagd worden, echter zonder jacht (Hoofdstuk 2, 4, 6, 7 & 8).

Acknowledgements and curriculum vitae.

I was born on April 24, 1949 in Zaandam (NL). My first contacts to ornithology I had when I was a small boy and my father G. Mooij and uncle Mr. D. Mooij took me on their ornithological excursions. From that time on I wished to become a biologist. During my youth my parents and my uncle stimulated my biological interests and I thank my parents for giving me the opportunity to realise my dream to become a biologist.

In 1967 I started my biological studies at the "Vrije Universiteit" of Amsterdam, where I was especially stimulated by Prof. Dr. K.H. Voous. The yearly goose excursions, organised by his department brought me in contact with the wintering geese for the first time. I was fascinated of these birds, but because there was no goose research in the research programme of the University I did scientific work on other items in the course of the university programmes. The main items during my "doctoraal" studies were an etho- and ecologigal study on Tawny Owl (*Strix aluco*), a study on the migration of songbirds at the Wadden sea island of Schiermonnikoog, a study on migration and moult of waders in the dutch Wadden Sea and a study on the reproductive cycle and systematics of *Trichobilharzia ocellata*, a schistosomatid usually living in snails and ducks, but every now and then causing "Swimmer's itch" in people swimming in natural waters.

In 1976 I finished my biological studies at the "Vrije Universiteit" with the "Dotoraalexamen" (magna cum laude) and moved over to the Lower Rhine area in Germany.
During my ornithological excursions to explore my new "range" I discovered the wintering geese in this area and the old fascination was there again. Although there was hardly any literature about this goose wintering site, older farmers told me that it was a goose wintering site as long as they knew and goose numbers were increasing since some time. At the same time some farmers complained about goose damage and blamed the northrhine-westphalian ban on goose hunting and the protection of the geese at the Lower Rhine area for their problems. This conflict between goose protection and land use made me decide to start a goose research project.
Most of the research was done in addition to a full-time job, but between 1982-1993 it was possible to integrate a part of the research programme into my work for WWF-Germany. Since then my goose research programme became a part of the research activities of the "Biologische Station im Kreis Wesel - NAB e.V." in Wesel, an independent institute founded in 1984, which employs me as its director.

In the course of this research programme the help of a number of people was very important.
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