

## IV. STABILITY AND DYNAMICS IN THE SOCIAL STRUCTURE OF THE GREYLAG GOOSE (*ANSER ANSER*)

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### Introduction

For decades the biology and behaviour of the Greylag Goose has been the object of scientific investigation. An early but important study on their breeding biology was published by *Christoleit* (1929). *Lorenz* and *Tinbergen* (1938) who in studying the egg-rolling-movement came to a theoretically important conclusions on the combining of genetically fixed and learned behaviour. The detection of the phenomenon of imprinting took place by *Lorenz* on goslings of the Greylag Goose and *Lorenz*, Greylag-gosling "Martina" has become a world-famous animal. Further progress in the study of behaviour and biology has been obtained by *Fischer* (1965) and *Young* (1972).

On the other hand the population ecology and social behaviour of this species has not been so intensively investigated. The moult migration was studied at first by *Paludan* (1965) and later more precisely characterized in Central Europe by *Haack* and *Ringleben* (1972). The different types of social groups in this species are well-known and well described, however, there are many open questions on the mechanism of forming social groups and their function.

For instance, very little investigation has taken place on the forming mechanism of cohesion in non-breeder flocks. The biological importance of flocking behaviour on the White-fronted Goose (*Anser albifrons*) has as yet not been studied as well as by *Lazarus* (1978) or what has been done by *Drent* and *Swierstra* (1977) and *Drent* (1980) on the Barnacle (*Branta leucopsis*) and Brent Goose (*Branta bernicla*).

Furthermore, most of the knowledge about the biology and behaviour of the Greylag Goose has been obtained investigating captured animals. Only a few scientists have gone by the hard way of field observations.

For this reason we have strated field investigations on population ecology and social ethology in this species. At present this time-consuming work has not been completed. Therefore, the aim of this paper is to give a review of the first results and not the final picture.

### The study areas

#### 1. Nature reserve Lake Gülpe

The main important study area is Lake Gülpe, situated in the district of Potsdam on the river Havel. The breeding stock is between 40 – 80 pairs depending on the course of spring flooding. Furthermore, the area is a gathering-ground for non-breeders in spring (maximum number in the 3. May-

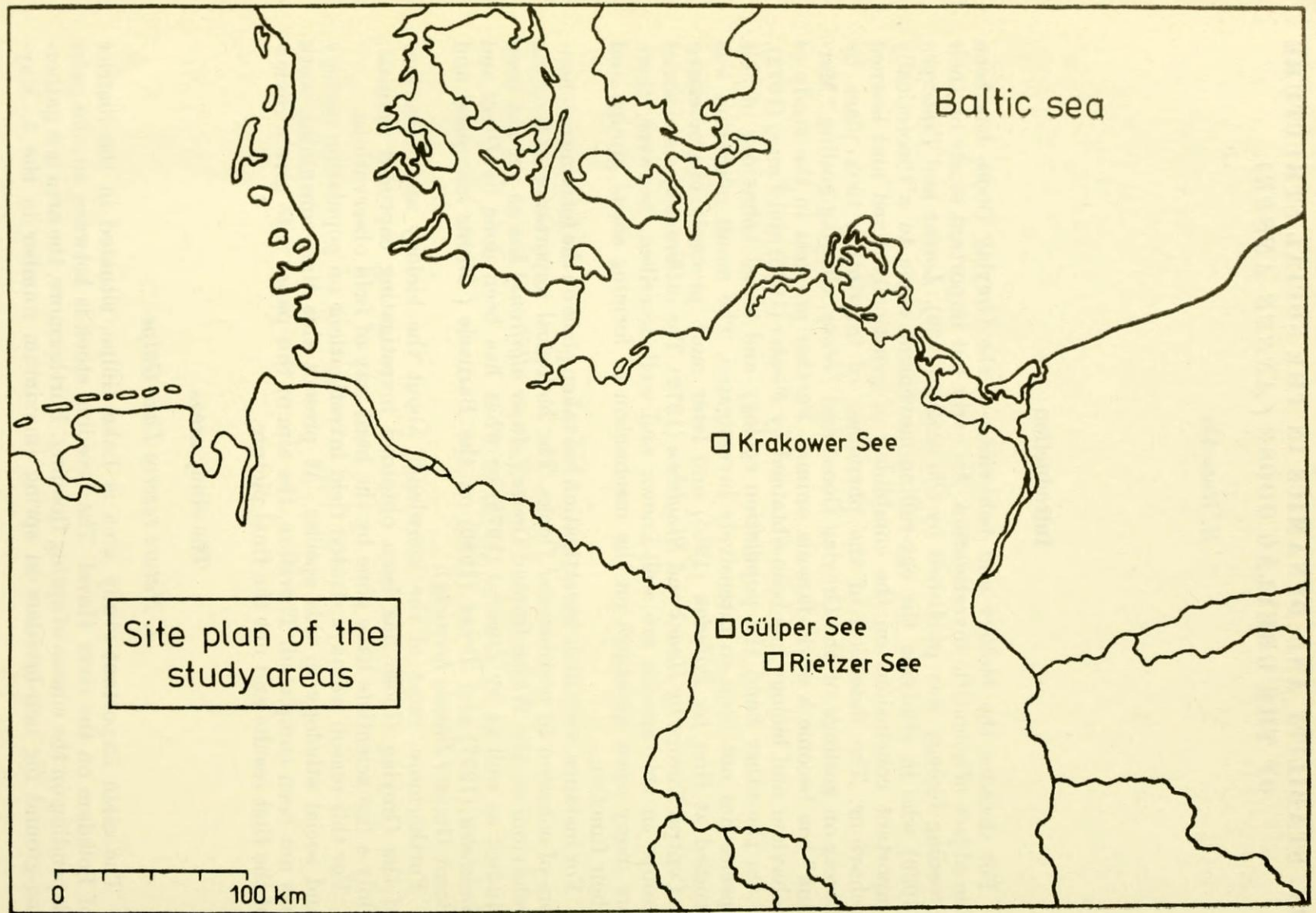


Figure IV/1: Site plan of the study areas

decade is 800) and summer gathering-ground. The gathering of geese in summer begins in mid-July (maximum number at the end of July 1981 approximately 3500) continuing until the end of August. At the beginning of September the stock is raised to 6000. The off-migration begins in October.

## 2. Nature reserve Lake Rietz

This lake is situated 50 km west of Potsdam. It is important only as a breeding area with a breeding population of up to 30 pairs.

## 3. Nature reserve Lake Krakow

The nature reserve Lake Krakow is situated in the western part of Mecklenburg inside the "Mecklenburgische Seenplatte". The breeding population of this area runs up to 40 pairs. Furthermore, this study area is a gathering and resting ground for non-breeders (800). Fig. 1. shows the position of the three study areas.

Additional knowledge about social behaviour has been obtained during excursions to other breeding, gathering and resting grounds of the Greylag Goose in the GDR.

## Methods

The main method of studying problems of socio-ethology was individual marking by coloured neck-collars after capturing by cannonnet-equipment. Neckbanding of the Greylag Geese at Lake Gülpe has taken place since 1973. At first neck-collars with pennants were used. Since 1975 neck-collars with engraved letters and numbers have been applied. During the first years a two-digit-code was in use. Based on an agreement obtained at Slimbridge in 1979 a three-digit-code is now used.

At Lake Gülpe were ringed families (in June), non-breeders (in May) and summer birds (August/September).

At Lake Rietz only families were caught and ringed.

At Lake Krakow only non-breeders (May) and summer birds (August) were ringed.

A summary of the number of all Greylag Geese caught and ringed since 1975 is given in Table 1.

Table IV/1.

*Numbers of ringed Greylag Geese in the study areas 1975 - 1981*

	1975	1976	1977	1978	1979	1980	1981	Total
Lake Gülpe	63	21	44	66	17	8	143	362
Lake Rietz	33	—	19	9	—	—	—	61
Lake Krakow	102	32	4	—	—	—	—	138
	198	53	67	75	17	8	143	561

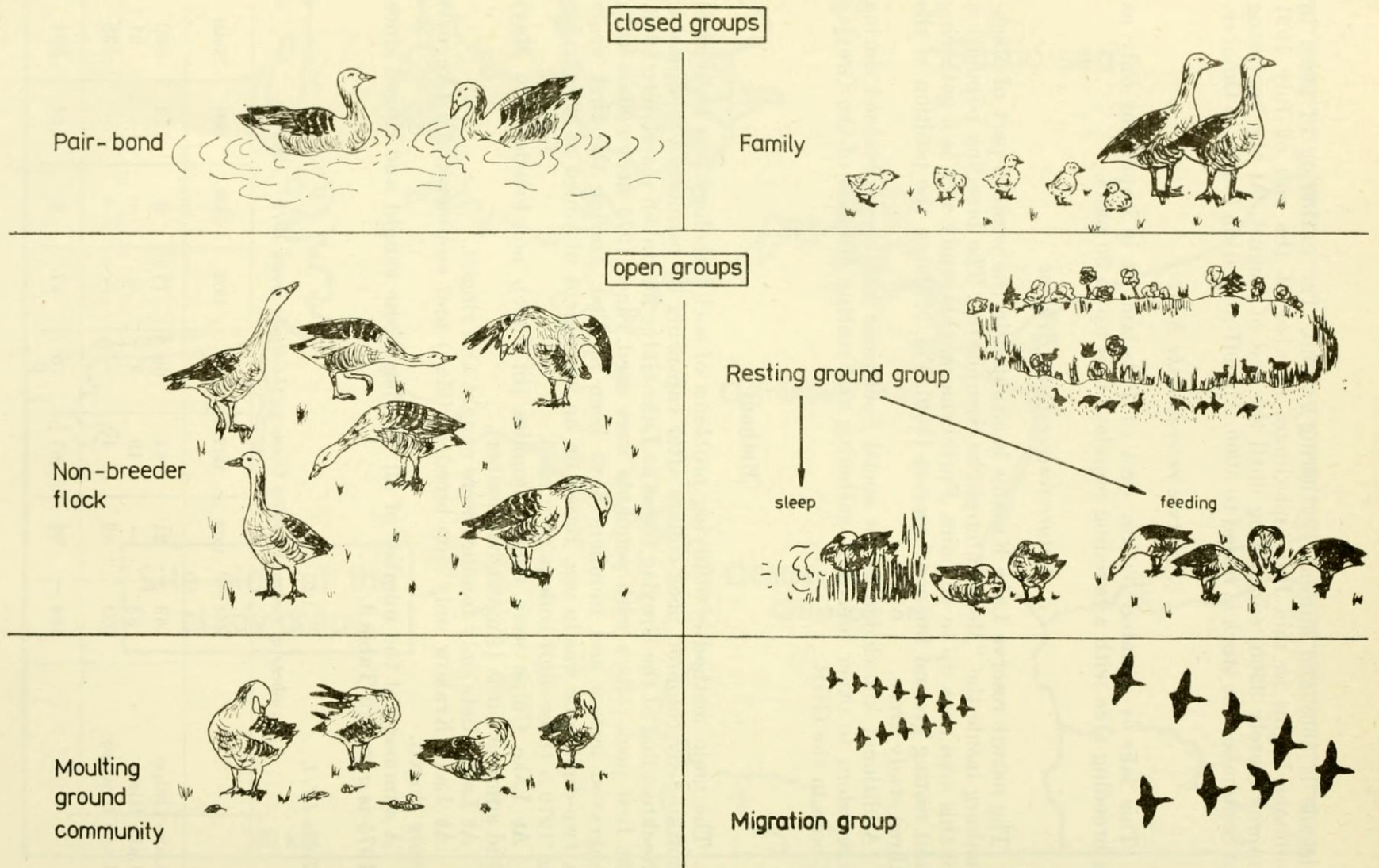


Figure IV|2: The various social groups of the Greylag Goose

I am very grateful to *dr. Litzbarski* and *dr. Warthold* for their helpful work and to a very large number of ornithologists for their assistance as members of the netting team and giving other technical assistance.

### Types of socializing in the Greylag Goose

Only for a short phase of their lives are Greylag Geese without adhesion to other birds, namely, immediately after hatching. A few hours later the first social contact is realized by imprinting. Normally, no phase of isolation follows during the life span and at most, only for a short time, as for instance, after the death of a member of a pair.

There are two different types of social structures in the Greylag Goose, namely, closed and open groups (Fig. 2). The first type is characterized by a defined and limited number of members knowing themselves and not interchangeable. These are the pair and the family. The second type is characterized by anonymity and a variable and changeable number of members. These are the non-breeder, moulting, resting, and gathering ground groups including groups with special biological functions (feeding, sleeping and migrating). Generally, the different structures are described by *Hudec* and *Rooth* (1970) (Fig. 3).

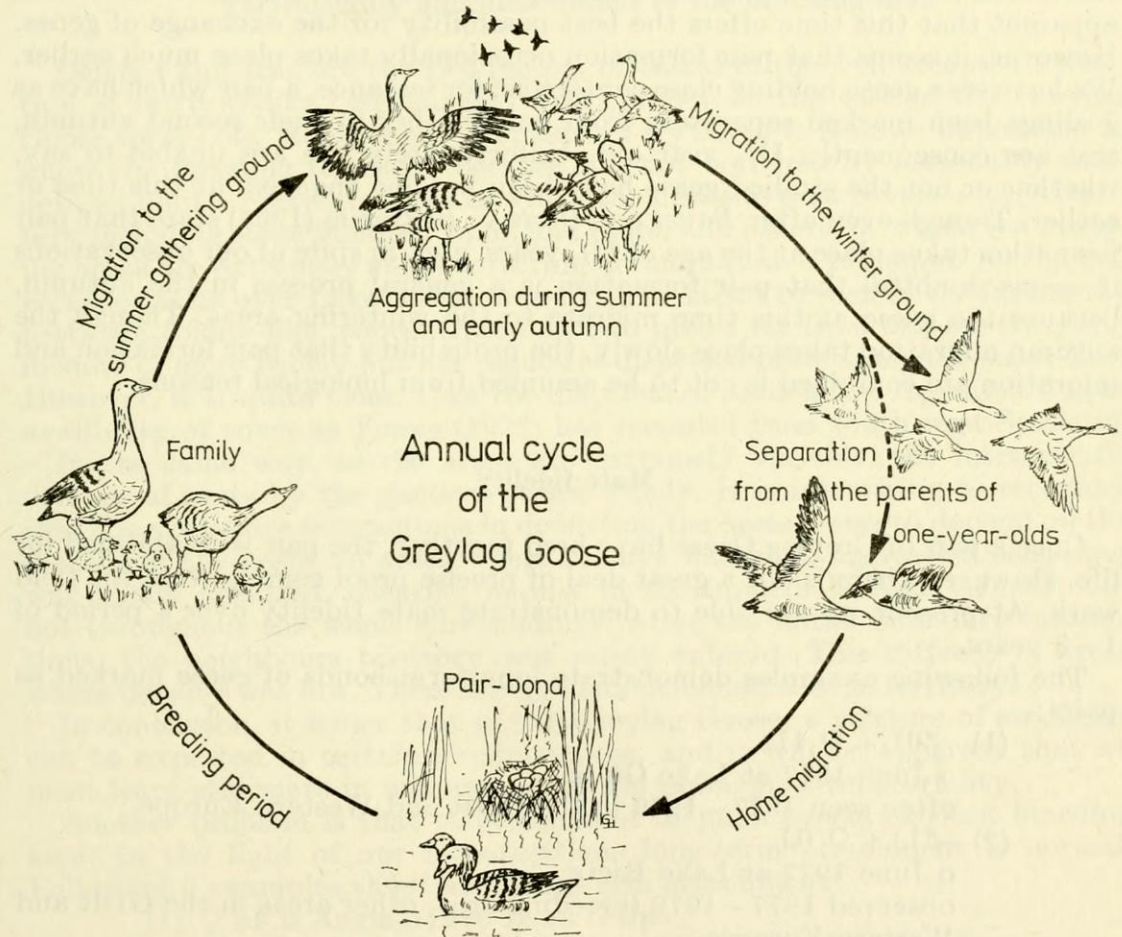


Figure IV/3: Annual cycle of the Greylag Goose

## Mechanism of forming, stabilization and disengagement of the various social groups

### *The pair*

Throughout the whole kingdom there are very few monogam species, but the Greylag Goose is one of them. There is extensive literature concerning the problem of pair forming in Greylag Geese, but, unfortunately, the observations are obtained in the first place from captured animals. Most authors follow *Lorenz*, who asserts that pair formation is a consequence of sexual imprinting.

There is no doubt, that pair formation takes place in the second year. However, from the point of view of population genetics, it is necessary to have more precise and detailed knowledge about the time of pair formation, and where it takes place, because, the possibilities for the exchange of genes depend on the number of possible partners in the population.

There are many indications that pair formation takes place during winter at the end of the first year. During this time practically the whole population coming from central and north-east Europe is concentrated in a relatively small area (the Marasmas of the Guadalquivir in Spain). From the above it is apparent that this time offers the best possibility for the exchange of genes. However, it seems that pair formation occasionally takes place much earlier. We have seen geese holding close contact as, for instance, a pair which have as goslings been marked separately from one another in their second autumn, and are consequently 1<sup>1</sup>/<sub>2</sub> year old. Unfortunately, we are unable to say, whether or not the studied geese have been become engaged, at this time or earlier. Though even after *Bauer and Glutz v. Blotzheim* (1968) state that pair formation takes place at the age of 1<sup>1</sup>/<sub>2</sub> years, and, in spite of our observations it seems doubtful that pair formation is a general process in the autumn, because the geese at this time migrate to the wintering areas. Though the autumn migration takes place slowly, the probability that pair formation and migration are combined is not to be assumed from biological reasons.

### Mate fidelity

Once a pair of Greylag Geese have bred together, the pair is established for life. However, there is not a great deal of precise proof coming from the field work. At present we are able to demonstrate mate fidelity over a period of 1–3 years.

The following examples demonstrate long-term bonds of geese marked as pairs:

- (1) ♂0L + ♀ 1L  
o June 1977 at Lake Gülpe  
often seen 1977–1979 in the GDR and Western Europe
- (2) ♂1J + ♀ 0J  
o June 1977 at Lake Rietz  
observed 1977–1979 (breeding area, other areas in the GDR and Western Europe)

We are unable to detect the take-over of mates. However, from our ob-

servations this question cannot be regarded as definitively solved, because the number of marked pairs and well-documented courses of life are much too narrow. Formerly, it was assumed that new-pairing by the loss of a mate didn't take place. We know of some cases where one member of a pair has newly-paired after the loss of its mate.

### Age of mating (or sexual maturity)

In literature there are contradictory opinions as to the age of mating. According to *Delacour* (1954) the first breeding takes place in the third calendar year (22 months old). According to *Bauer and Glutz v. Blotzheim* (1968) breeding is most frequently successful in the fourth year. Our investigations don't allow a definite answer, but, in some cases we have found successful breeding before the 2nd year was complete (third calendar year) (Fig. 4). However, it should be noted, that a young male was paired with an old female of undefined age.

### Territoriality and attachment to the breeding area

Defence and area are the two factors intended in the well accepted definition of territoriality (*Mineau and Cooke*, 1980). In the case of the Greylag Goose from both factors arise problems. Very often it is quite impossible to know the breeding territory, because it is not bordered by reasonably well-defined limits. There are cases in which the nest site area covers a large territory including some hundred sq.m. and more, and others, in which the breeding areas are extremely small, covering no more than a few sq.m. As the dispersal of nests over Lake Gülpe shows Fig. 5. As can be seen in the figure, the nests are colony-like, concentrated on two places far from one another, and in spite of more widely but not regularly dispersed nests along the shore-line. However, it is quite clear, that the dispersal of nests is not regulated by the availability of cover as *Young* (1972) has recorded from south-west Scotland.

In the same way, as the areas are extremely variable, the intraspecific defence of nests by the ganders varies widely. It is interesting to recognize that the aggressive interactions in defending the nests seems to depend on the density of the nests. In areas where density was high, aggressive behaviour was highly localized, occurring mainly in the immediate nest vicinity, but not throughout the whole surroundings. After the initial boundary interactions, the neighbours territory was rarely entered. This differed in areas where density was low. There the ganders defended a large territory.

In conclusion, it seems that in the Greylag Goose, a mixture of strategies can be expected in certain circumstances, and it will be apparent that we must learn still more in understanding the problem of territoriality.

Another problem is that of attachment of pairs to the chosen breeding area. In the light of our investigations long-term attachment is normal. Following 3 examples show such long-term attachments.

- (1) ♀ 6F o August 1976 Lake Gülpe  
Observations 1976 – 1980 in the GDR and Western Europe  
Breeding 1977 – 1980 Lake Gülpe (4 periods)

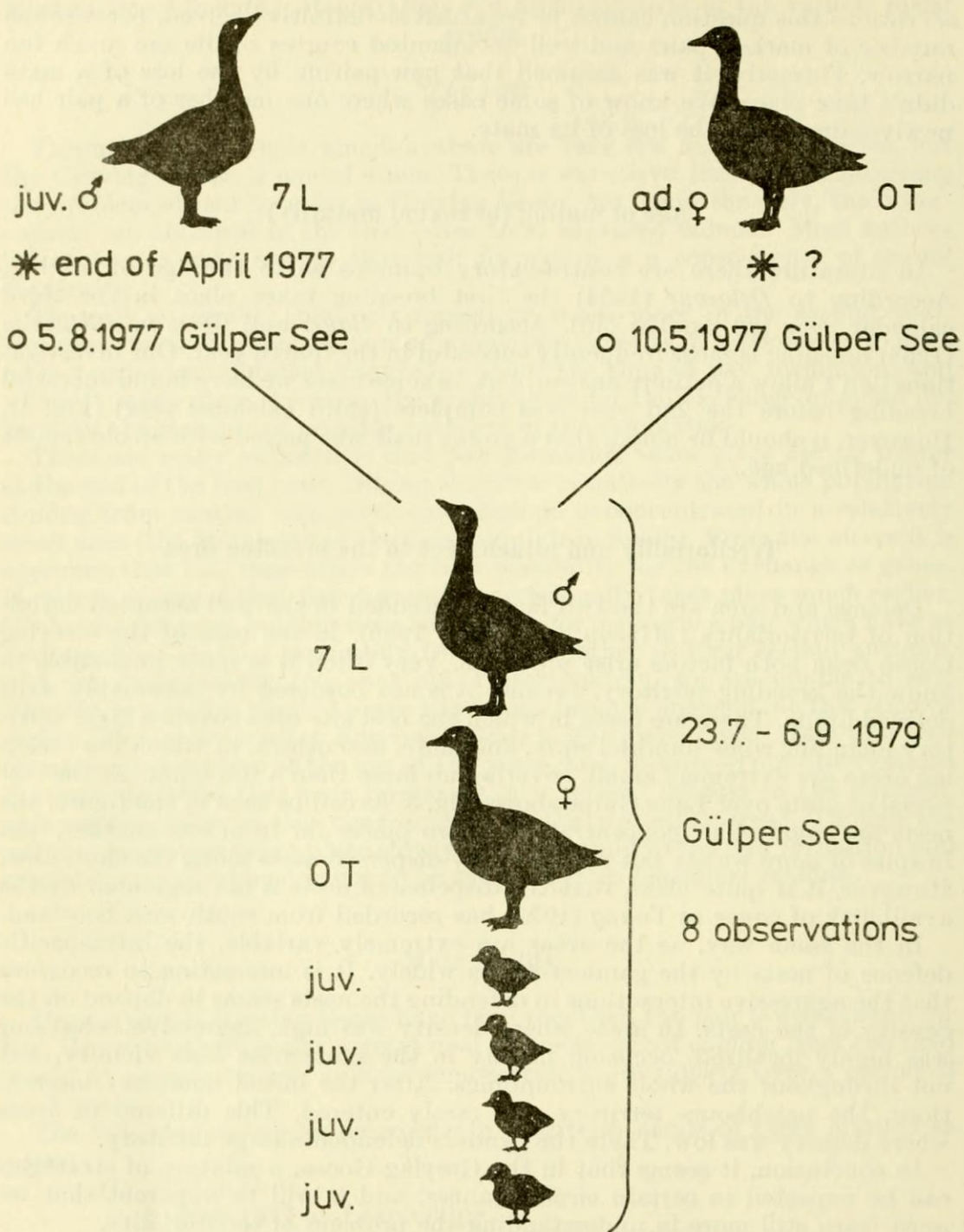


Figure IV/4: Early age of mating of a young male

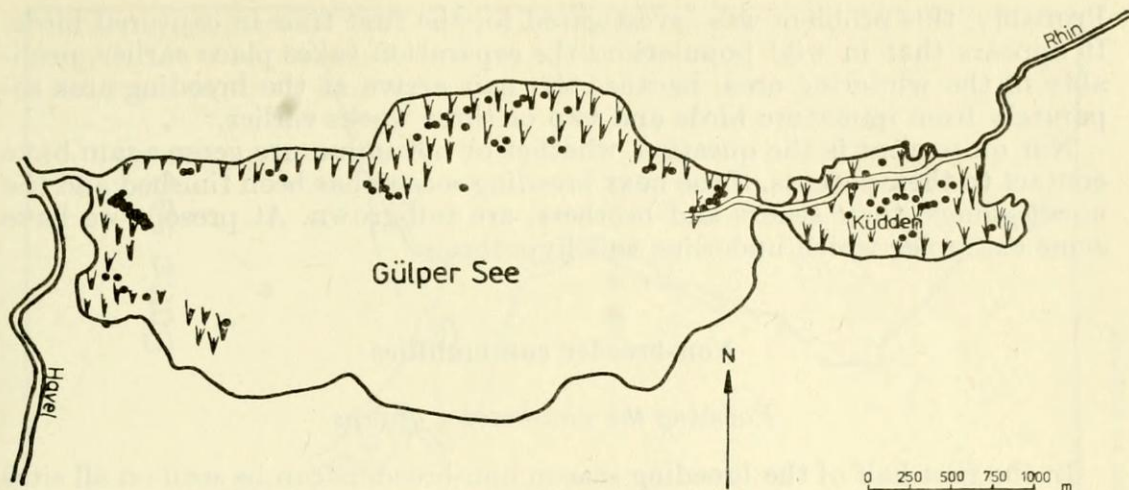


Figure IV/5: Distribution of nests of the Greylag Goose over Lake Gülpe

- (2) ♀ 8A o May 1976 Lake Krakow  
 Observations 1976 – 1980 in the GDR and Western Europe  
 Breeding 1976 – 1980 Lake Krakow (5 periods)
- (3) ♀ CO1 o May 1975 Lake Gülpe  
 Observations 1975 – 1979 in the GDR  
 Breeding 1976 – 1979 Lake Gülpe (4 periods)

### The family

The term “family” includes the pair and their youngs. Therefore, the term is not quite identical with the use in man. The pair and the under one-year-olds keep together until the new nesting season comes. From observations in captured Greylag Geese, there are many indications that between the goslings exist a rank order. The development of rank order in groups of sisters and brothers has been investigated by *Kalas* (1977). The goslings are bonded to their parents by imprinting. Unfortunately, it is very difficult under natural conditions to prove both rank order and imprinting. However, it will be noted that cases of adoption of foreign goslings by Greylag Geese are not rare. In geese breed in high density, up to 35 goslings join in one “family” (*Prill* 1980). This leads to the question, whether in conditions of high breeding density, the Greylag Geese form a nursery creche as is known from sea-ducks. However, the development of large groups of goslings is not well understandable by filial imprinting, therefore, it should be furthermore proved. As on the example of Mallard filial imprinting, *Sjölander* (1980) has criticized the concept of imprinting from a methodical point of view.

### Separation of the young birds from their parents

The separation of parents and young which takes place is influenced and controlled by sexual hormones at the beginning of the new mating period. The separation takes place by the active driving off of the young by the parents in the breeding area (Lit. see *Bauer* and *Glutz v. Blotzheim*, 1968).

Probably, this problem was investigated for the first time in captured birds. It appears that in wild populations the separation takes place earlier, probably in the wintering area, because the pair arrive at the breeding area separately from immature birds and two or three weeks earlier.

Not quite clear is the question, whether or not immature geese again have contact to their parents, if the next breeding season has been finished and the new goslings, their sisters and brothers, are full-grown. At present we have some examples which underline this hypothesis.

### Non-breeder communities

#### *Forming the non-breeder groups*

In the first half of the breeding season non-breeders can be seen on all sites where Greylag Geese breed in more than 5–10 pairs. The non-breeders are live separately from the pairs, organized in relatively stable flocks. The size of the flocks depend on the size of the breeding stock. The larger the breeding stock the larger the non-breeder flock. From mid-March to the end of April the non-breeders move from most breeding sites. They all gather at a few sites called main resting or gathering sites for non-breeders. On these sites the non-breeders stay from the end of April until the end of May.

Summarizing, the process of forming non-breeder flocks takes place in two steps: (1) the non-breeders of one breeding site form the local non-breeder flock, (2) all non-breeder flocks existing in a large area, gather on one non-breeder gathering ground.

In the GDR are located up to 10 main non-breeder resting grounds. They are also in all cases, important breeding areas in which usually more than 30 Greylag pairs breed. The non-breeders live absolutely separate from the pairs. The rhythm of daily activity can be described as follows. In the morning they fly in one group to the feedings grounds. After returning to the lake, they rest for the greater part of the day at defined places, cleaning and preening the plumage. In the late afternoon they once again fly to the feeding grounds.

During the summer the non-breeders don't stay all the time at one place. We have found within a short time a quick change of resting grounds (Fig. 6).

In summer and autumn failed breeders also have the tendency to change the resting ground. This is demonstrated by the following example:

♂ ad. 4U

o Mai 1978 Lake Gülpe

Summer- and autumn observations 1980:

August – Müritz sea area

September – Iceland of Poel

October – Lake Gülpe

At present we do not have knowledge about the size of the area from which the non-breeders come to the main gathering grounds. We hope to obtain more information by individual markings at numerous breeding sites, though it is difficult for methodical reasons. However, during the following year it is possible to draw conclusions from marking experiences at main resting grounds, if the non-breeders fly back to their home range. At present we have many observations of non-breeders marked in April at the main non-

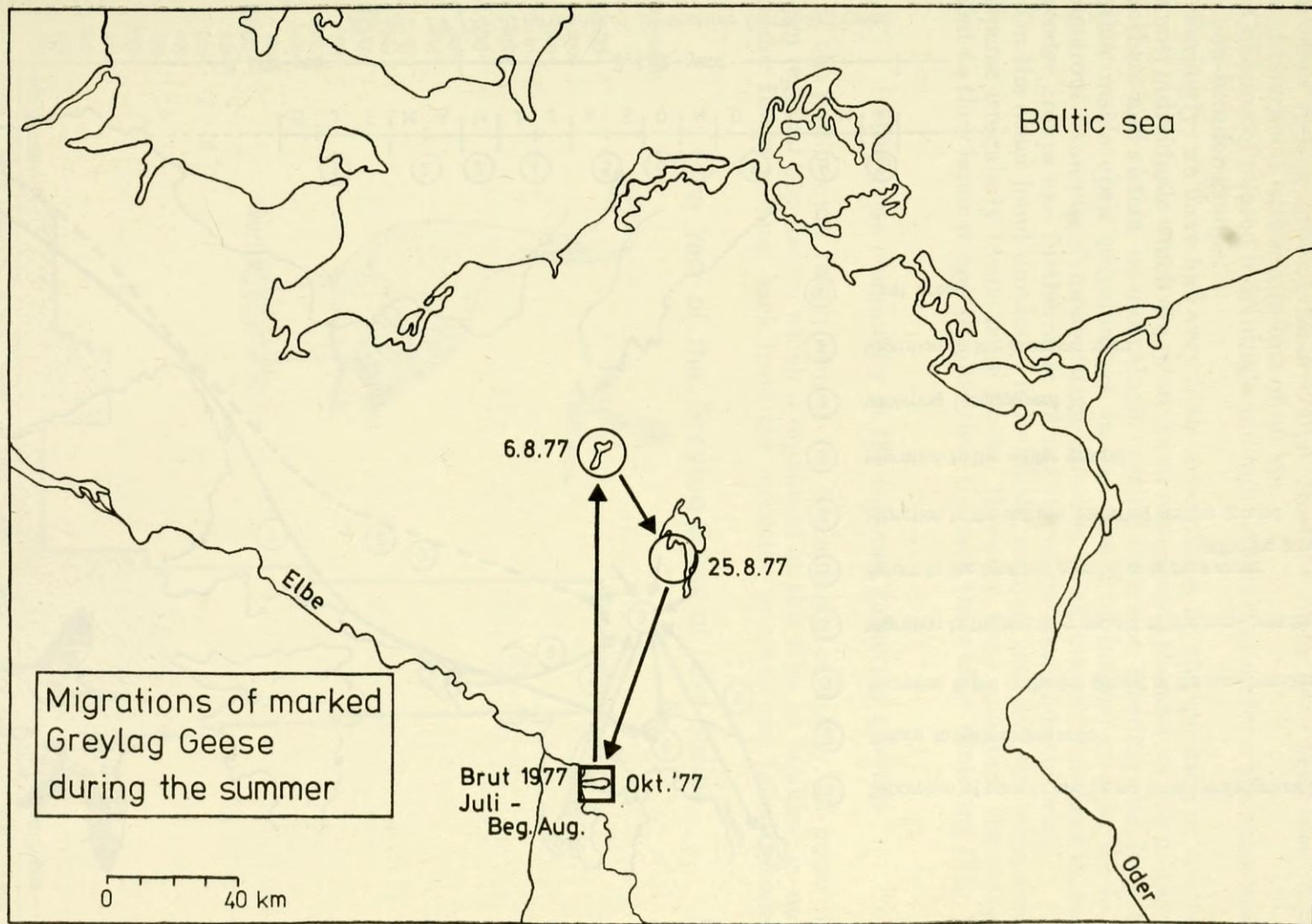


Figure IV/6: Migrations of marked immature Greylag Geese in summer

## Migration of immature Greylag Geese

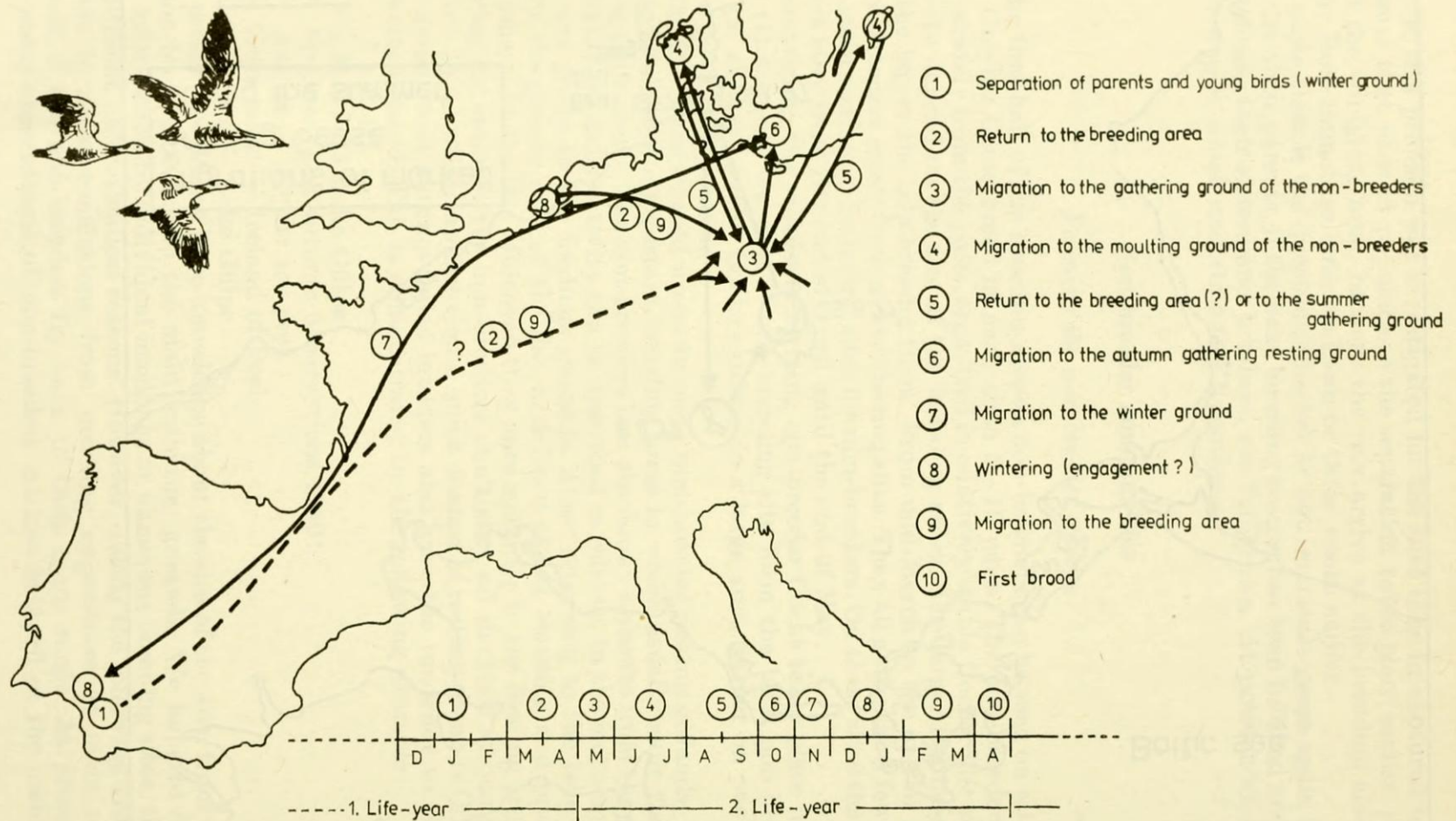


Figure IV/7: Migration of immature Greylag Goose

breeders resting ground Lake Gülpe. Most of them have been seen in the neighbourhood within a radius of 80 km.

Cohesion of related individuals and individuals coming from the same areas in non-breeder groups.

Formerly, we have had very little information on the question of whether or not, individuals which are related and recognizing themselves, for instance, brothers and sisters, or individuals coming from one breeding site, keep together inside open communities, in our case in on-breeder groups. We have numerous examples demonstrating cohesion of sisters and brothers in non-breeder groups and furthermore during the migrations and wintering.

On the other hand unrelated individuals, coming yet from the same areas, disperse irregularly inside large flocks. However, they maintain the attachment to their home range, because they fly back there after wintering (Fig. 7).

### The geese community at the summer gathering grounds

If the goslings are full-grown, at the beginning of mid-July, all geese of a given regional population which is organized at this time in families, in non-breeder flocks coming back from the moulting grounds and failed breeders

### The Year of the Greylag Goose at Lake Guelpe

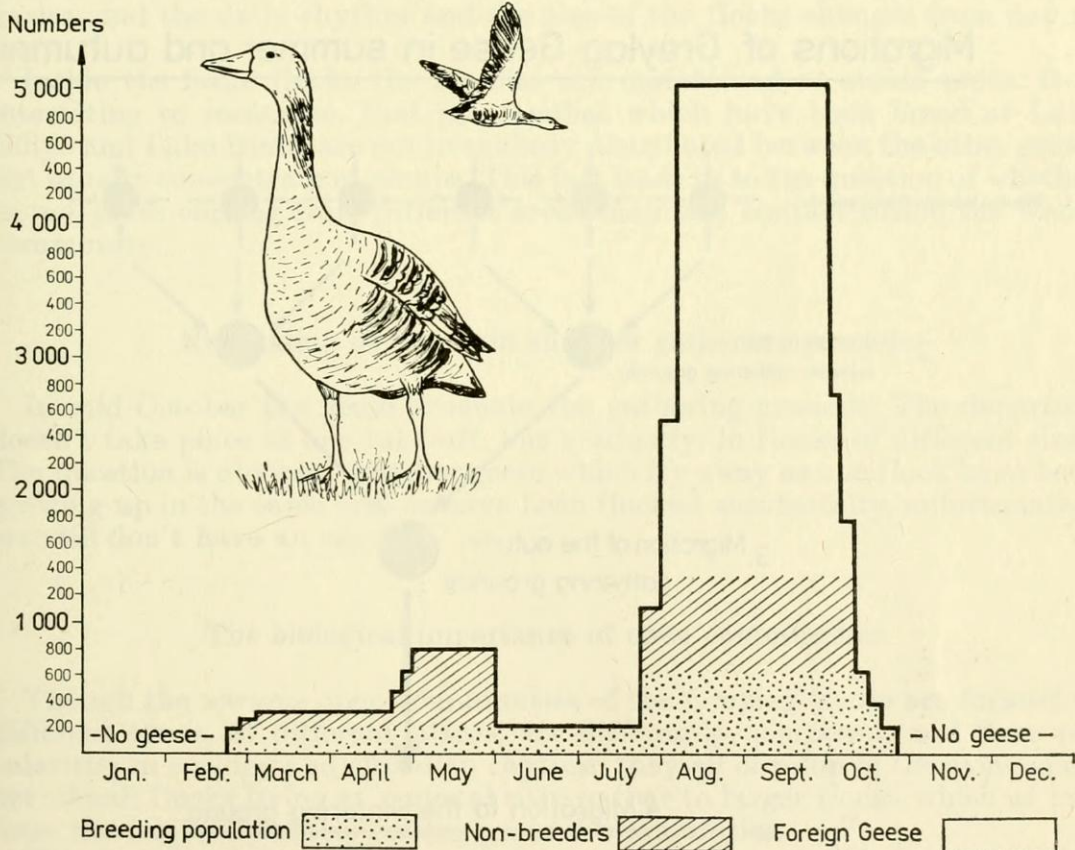


Figure IV/8: The year of the Greylag Goose at Lake Gülpe

begin to collect on a few sites. These sites we call summer gathering or resting grounds. These sites are used by geese from the end of July to mid-October, until the migration to the wintering grounds begin.

In the GDR in summer the geese gather at a few sites only. The most important inland gathering ground is Lake Gülpe. From 1979 to 1981 5000 – 6000 geese have been concentrated there in summer and early autumn: the largest inland concentration in Central-Europe (Fig. 8). The other large summer gathering site is situated at the Baltic Sea coast between Rügen and Hiddensee. Here the maximum number in summer is 10 000. In autumn the stock increases to 35 000.

### The development of summer gathering ground communities

The gathering of the geese after the nesting period probably develops in the same manner as the gathering of non-breeders before departure to moult migration. In the first place the families from one breeding site and the neighbouring smaller breeding sites gather at one suitable place. Duration at these local sites and the size of the flocks are very different depending on food supply, weather and tradition. It is interesting to recognize that normally no more than 200 to 400 geese gather at local sites. The flight to the main gathering sites usually takes place at the end of August, at the latest the end of September (Fig. 9).

## Migrations of Greylag Geese in summer and autumn

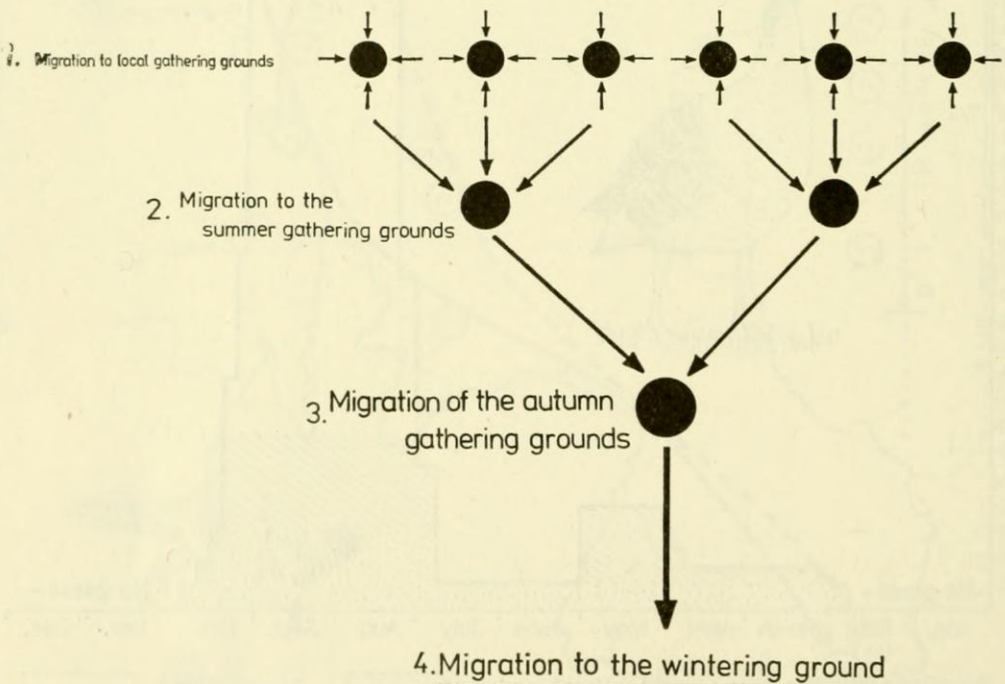


Figure IV/9: Summer and autumn migration of the Greylag Goose

However, the process of gathering is not clear in all its details. The important question is whether or not the geese fly every year to the same gathering ground, the size of the area surrounding the main summer gathering grounds, and, the stability of attachment to the chosen site.

By our investigations the migration of geese breeding at Lake Rietz to the main gathering ground site at Lake Gülpe (distance 80 km) is at present well documented. Mid-August these geese fly from the local gathering ground at Lake Rietz to Lake Gülpe. This fact has been documented by numerous observations by marked geese.

However, the maximum number of geese at Lake Gülpe is 6000. Since the geese breeding north of Lake Gülpe migrate to the Baltic Sea, a large part of the geese resting at Gülpe must come from southern areas, probably from Poland and northern Czechoslovakia. Unfortunately, this hypothesis is not documented by ring recoveries.

Only a loose cohesion exists between the geese resting at the summer gathering ground. They are mostly organized by some changeable large flocks. With the exception all 6000 geese are concentrated in one large flock on the shore. Such dense flocking only takes place during periods of good weather when the geese are absolutely undisturbed.

The daily activity in summer is characterized by an early flight to the feeding grounds (6.00 – 9.00 a.m.) followed by a period of rest and the cleaning and preening of plumage (9.00 – 17.00 h), and second feeding flight from 5.00 – 8.00 p.m. After disturbances and during bad weather periods the picture varies, and the daily rhythm and the size of the flocks changes from day to day.

Inside the large flocks the families are maintained as stable units. It is interesting to recognize, that the families which have been bred at Lake Gülpe and Lake Rietz, are not irregularly distributed between the other geese, but usually concentrate in groups. This fact leads us to the question of whether or not geese coming from different areas maintain contact inside the whole community.

### **Evacuation of the main summer gathering grounds**

In mid-October the geese evacuate the gathering grounds. The departure doesn't take place as one take-off, but gradually, in flocks of different sizes. The question is obvious, whether geese which fly away as one flock have been growing up in the same area or have been flocked accidentally, unfortunately we still don't have an answer.

### **The biological importance of open communities**

Though the various open communities of the Greylag Goose are formed at different times, at different places, are differently composed, and have peculiarities in ecology and circadian rhythm, they all develop in the same manner: Small flocks living at regional sites gather to larger flocks which at last form the relatively stable resting ground communities.

This survey of the different social structures of the Greylag Goose shows

a very multiform picture. Many questions on mechanism of flock cohesion and structure are open. However, it seems still more important to centre further research on the question of the biological function of the different social groups. Most studies of bird flocking during the last years, has been carried out from the point of view from which the adaptiveness of flocking, is seen as a food function as well as an antipredator function (*Krebs and Barnard 1980; Drent and Swierstra 1977; Drent 1980; Lazarus 1980*). *Lazarus (1980)* in studies on White-fronted Geese has been found that the number of alert animals compared with the number of eating or sleeping birds, relatively decreases depending on the size of the flock, whereby the single individual benefits because in larger flocks it has more time for feeding and resting. Comparable results have been obtained in investigations on the distance between the single birds during feeding and, more distinctly the individual density per area, in relation to their behaviour. The higher the density of geese, the bigger the time budget for food uptake and vice versa.

We have planned to prove these theories in further studies of the Greylag Goose. This species seems to be particularly suitable for studying problems of sociobiology, taking into consideration its richness of social structures in connection with an extremely high capacity of learning.

Further progress in the field of sociobiology and socioethology of the Greylag Goose could be obtained from more individually marked animals, if possible, marked on different places in the entire distribution area and an increase in the intensity of observation.

In principle, the work is directed on the solution of a problem of general importance, namely the biological importance of social life types throughout the kingdom: with that we remain totally at the beginning.

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