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On the spring migration of the Whooper Swan *(Cygnus cygnus)* in the Helsinki region in the years 1950—61

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The aim of this paper is to summarize the numerous observations concerning the spring migration of the whooper swan (*Cygnus cygnus*) in the Helsinki region during the years 1950—61. These observations were made by more than fifty persons, mostly members of the junior section of the Finnish Ornithological Society. The records were collected by P. Linkola (1950), M. Rautkari (1951—57) and the author (1958—61 and additional data for 1954—57). I wish to thank all those who have made this investigation possible by placing their notes at my disposal. In this connection I also express my gratitude to Dr. J. Koskimies for his valuable criticism and corrections and to J. Rinne and P. Saurola, with whom I have had many discussions about the subject.

The observation points popular among the bird watchers of Helsinki from the Porkkala Peninsula in the west to about 20 km east of Helsinki are included in the area covered by the investigation. In Fig. 5 the most frequently occupied observation points are marked. Two others, located farther west, fall outside the map.

Almost all the swans observed were probably whooper swans, although by no means all of them were identified. A few Bewick's swans (*Cygnus columbianus*) may have been included among them, however.

The observations were generally made spontaneously without any prearranged plan.

Naturally a study of this kind is defective in many respects, but the swan offers some special advantages as an object of study. Every bird-watcher pays attention to a flock of swans and records it. A flock of swans can often be observed from a distance of at least 4—5 km. Generally the identity of flocks observed at different points can be verified on the basis of the size of the flock and the time of observation, as well as the direction and distance of the birds in relation to the observer's position, which are often recorded. Ninety per cent of the swans observed fly over the area concerned in direct migratory flight and thus only a few swimming or circling swans are seen.

However, the value of the data is considerably reduced by the following facts: 1. The intensity of bird-watching varies considerably in the course of a season, a week and even a single day; 2. Methods of bird-watching vary from year to year; 3. The watchers at the individual observation points are not always the same; 4. The usual observation points are not ideally situated (see Fig. 5); 5. Methods of collecting the records have not been consistent.

Most of these factors introduce systematic errors. Some of the latter are eliminated by random variation, because of the large amount of data and great number of bird-watchers. Further bias is caused by the irregular migration of the swans; the bulk may pass during a day or two of very intensive migration. Thus on April 29 and 30, 1960, one-third of all the swans of that year were seen, in spite of the fact that on April 29 no regular observation point was occupied. The swans were sighted by chance by some ornithologists on a boat trip. The observations of April 30 were made at a single point.

Preliminary examination of the data

The observations concern more than 5 000 swans and nearly 600 flocks. Table 1 shows how they are distributed over the different years.

The figures in column A/B indicate the average number of swans seen by each bird-watcher. An increase in these figures may depend not only on an increase in the number of migrating birds, but also on a change in the migration route and may partly be due to the fact that from the middle of the 1950's observations at fixed points were initiated. In 1959, the number of swans observed was smaller than expected; other comparisons between the years must likewise be made with considerable caution.

The number of swans observed each year in one-weekly periods is given in Table 2. Table 3 shows for each year: 1. The average date of observation of the first three flocks (»the first ones»); 2. The date by which half of the swans observed that year had migrated (»median»); 3. The date on which the largest numbers of swans migrated (»mode»); the proportion of migrants seen on the modal date relative to the total number seen on migration during that year is given in the next column 4. The average date of observation of the last three flocks (»the last

Table 1. Summary of the observations of the swan.

Year	Swans observed, A	Flocks observed	No. of observers, B	$\frac{A}{B}$
1950	147	18	16	9
1951	134	19	10	13
1952	114	13	7	16
1953	142	15	8	18
1954	206	35	19	11
1955	132	32	17	8
1956	479	44	21	23
1957	587	46	22	27
1958	1 077	119	28	38
1959	441	67	28	16
1960	1 020	98	28	37
1961	611	86	22	28

Table 2. The number of swans observed in different time periods.

Year	Before 25.III	25.III-31.III	1.IV-7.IV	8.IV-14.IV	15.IV-21.IV	22.IV-28.IV	29.IV-5.V	After 5.V	Total
1950	—	—	14	15	101	17	—	—	147
1951	—	—	10	48	9	65	2	—	134
1952	—	—	—	10	15	58	29	2	114
1953	7	—	59	46	30	—	—	—	142
1954	—	—	2	4	134	34	31	1	206
1955	—	—	—	2	28	62	38	2	132
1956	—	—	—	3	32	175	248	21	479
1957	—	—	39	—	60	488	—	—	587
1958	—	—	—	23	283	120	563	88	1 077
1959	6	14	11	148	84	74	98	6	441
1960	—	—	19	51	120	152	678	—	1 020
1961	36	4	21	75	376	87	2	10	611
Total	49	18	175	425	1 272	1 332	1 689	130	5 090

ones»). 5. The interval between the average dates of the first three and the last three flocks (»duration»).

The dates of the median and the mode often coincide, as the number of birds on the modal date generally constitutes a high proportion of that year's migrants. According to our data, in the beginning of the 1950's the last swans were seen earlier than in the subsequent years. This trend may be caused by the paucity of data in the early years of

Table 3. Comparisons between the migrations in different springs.

Year	The first ones	Median	Mode	Mode in % of year's total	The last ones	Duration (days)
1950	6. IV	19. IV	19. IV	70	22. IV	16
1951	9. IV	22. IV	28. IV	47	28. IV	19
1952	13. IV	28. IV	28. IV	36	28. IV	15
1953	31. III	8. IV	21. IV	17	15. IV	16
1954	9. IV	20. IV	20. IV	44	3. V	24
1955	16. IV	1. V	1. V	57	8. V	22
1956	16. IV	29. IV	29. IV	24	12. V	26
1957	4. IV	27. IV	27. IV	46	27. IV	23
1958	12. IV	1. V	1. V	32	15. V	33
1959	24. III	17. IV	12. IV	20	5. V	42
1960	4. IV	29. IV	1. V	27	1. V	27
1961	13. III	17. IV	18. IV	22	8. V	62

our study, however, and by differences in the methods of observation. The apparent duration of the migration has, probably for the same reason, also been prolonged. The period of migration was especially long in the springs of 1959 and 1961, when migration took place in both March and May. The time of the peak migration seems to be correlated at least to some extent with the date of arrival of the first swans, whereas the last swans are generally independent of the character of the spring. When the migration begins early in the spring, not only does it tend to be of long »duration» but also a greater number of swimming or circling swans are often seen (Fig. 1). Thus it looks as if the swans migrate more slowly in such springs.

Two different seasonal distributions of the overall data are given in Fig. 2; the first is the distribution of the number of flocks (solid line), the second that of the individuals (broken line). The time unit used is three days. To make the two curves comparable, the numbers both of flocks and of individuals observed in unit time are presented as percentages of the corresponding total number seen during the whole season. Before the percentages were calculated, however, the distributions were corrected by taking into consideration the relative number of holidays (included all the days around Easter) to the working days in the period in question. The reason for this is that in the time 3. IV—8. V, for instance, an average of 23 swans per day were observed on holidays, whereas on working days only 9, and the ratio between the numbers of holidays and working days differs from one period to another.

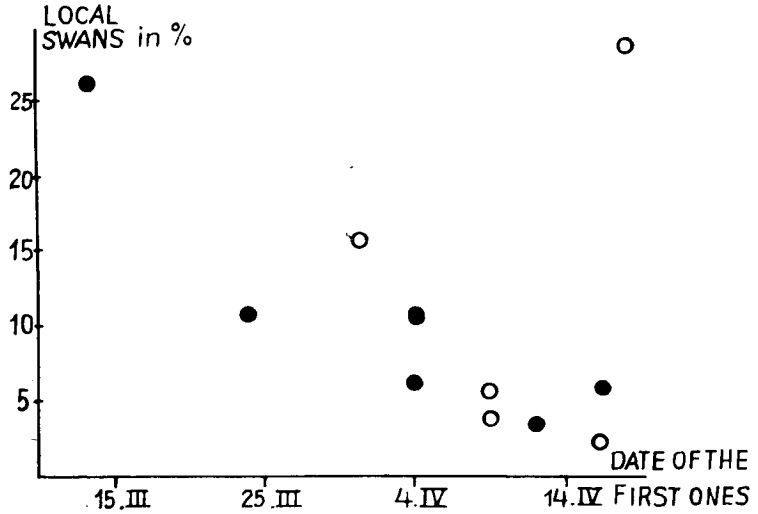

Fig. 1. Study of correlation between the migration time of »the first swans« and the percentage of the swimming or circling swans (local swans) observed to all swans observed that year; ● indicates a spring with quite a large number of observations, ○ a spring with few observations.

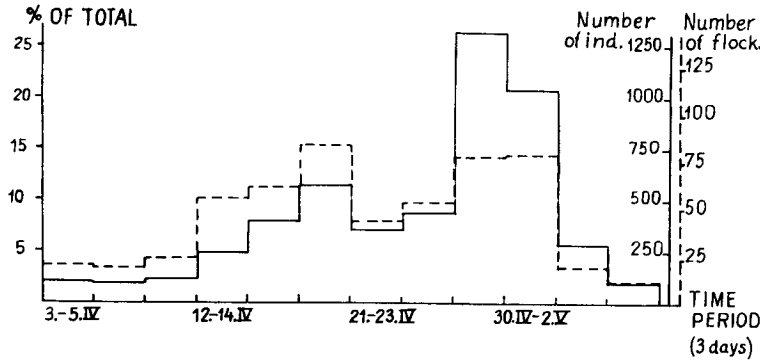

Fig. 2. The corrected (see the text) total seasonal distribution of the number of individuals (solid line) in relation to that of the number of flocks (broken line). Approximate absolute scales have been included on the right.

The correction has been made in the following way. First, within a given period the number of working days is multiplied by 9/23 and added to the number of holidays. This is the corrected number of days. Then the number of individuals (or flocks) observed in that period is divided by the corrected number of days. Finally, the distribution is transformed to a percentage distribution.

The distributions are fairly regular, except for the trough during the periods 21—23. IV and 24—26. IV. This may be due to pure chance, because the modal migration was never observed during those periods but always either earlier or later. The mode falls in the period April 27—29, when 14 per cent of all the flocks observed have passed over and as much as 26 per cent of the number of individuals.

From Fig. 2 it is also found that at the start of the migration the number of swans in the flocks is relatively small. By the end of April and the beginning of May the flocks are larger than average.

The average temporal pattern of migration

On the basis of the data presented, some figures indicating the average migration time can be calculated, it being kept in mind, however, that the results are based on a study rather limited in time and place. It is possible, for instance, that in the 1950's migration was later than average.

The median date of the yearly arrivals of the first swans (Table 3) is April 7. The interval between the second earliest and the next to last dates of arrival, i.e. 23 days, is arbitrarily chosen as a measure of variation. In March only 18 flocks were observed (in three different years) and of these only four before March 24 (in 1961).

The median of the yearly median dates of the number of individuals in Table 3 is April 24. The variation calculated as above is 14 days. If the corresponding statistic is calculated, taking a flock as the unit, we get the median date April 19 and the variation 15 days.

The median date for the last swans, according to Table 3, is May 2. The variation is 16 days. In recent years, however, swans have been observed in considerable numbers in May. The absence of observations in May in the first years of the period might have been due to the habits of observation. Therefore the author suggests that the median may be computed by taking into consideration only the years 1954—61. We then get the median date May 6 for the last swans.

As average dates for the onset of migration, the median migration and the end of migration, April 7, April 24 and May 6 are suggested. It must be remembered, however, that the variations between the different years are considerable.

Yearly variation in migration dates

The considerable variation in the migration dates in different years (see Table 2) is apparently dependent on weather and ice conditions. The correlation between the average temperature from March 15 to April 15 in Helsinki and the median migration date of the swans has been tested for the period 1950—1959. The correlation coefficient 0.65 indicates a significant correlation between the temperature and the date of migration of the swans.

Furthermore, a test of correlation between the times of migration of other birds and the swans was performed. O. HILDÉN's data (Luonnon tutkija 1960, pp. 51—56) on the arrival dates of ten early migratory birds (*Alauda arvensis, Sturnus vulgaris, Plectrophenax nivalis, Corvus frugilegus, Columba oenas, Vanellus vanellus, Falco tinnunculus, Larus ridibundus, Lullula arborea* and *Fringilla coelebs*) in the Helsinki district were used for comparison. From these data an »index of the migration time» was calcutated for each spring.

First, the mean ($\bar{x}_i$) and standard deviation (s_i) of the dates of arrival for each species (i) separately are calculated from the data for 1948—1959. The $\bar{x}$ and s are used as a basis for the index. The index (I(t)) of each year (t) is then calculated from the expression

$$I(t) = 100 + 5 \cdot \sum_i \frac{x_i(t) - \bar{x}_i}{s_i},$$

where x_i (t) means the date of arrival of the bird i in the year t. In the sum there is one term for every species. If the species i in question arrives earlier than usual in the years t, the arrival date $x_i(t)$ is smaller than the mean date $\bar{x}_i$ and vice versa. The difference $x_i(t) - \bar{x}_i$ has different meanings according to the variation of the arrival dates. To give every bird the same weight in the sum, every term is divided by s_i. As an example of calculating one term $\frac{x_i(t) - \bar{x}_i}{s_i}$, we take the term of *Plectrophenax nivalis* for the index of 1956. The snow bunting arrived on March 12 ($x_i(t)$), the mean arrival date of this species is March 16 ($\bar{x}_i$) and the standard deviation 6 days (s_i). Thus we get the term $\frac{12-16}{6} \sim -0.7$ for the snow bunting in the index of 1956. If migration begins early in the spring, the sum is negative whilst in »late springs» it is positive. The sum is multiplied by 5 (an arbitrarily chosen number) in order to obtain a suitable degree of variation. The number 100 is added so that the index number for a normal year would be 100.

The correlation coefficient between the date of arrival of the first swans and the index of the migration time in found to be 0.86; that is,

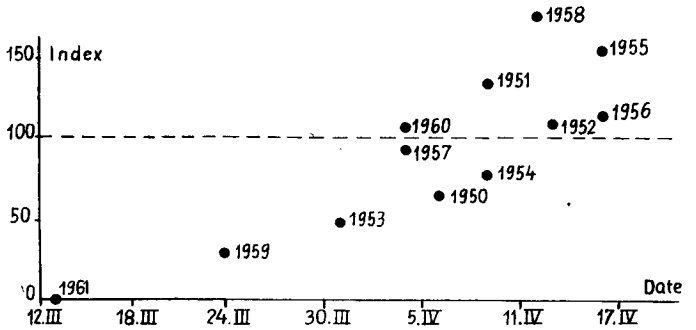

Fig. 3. The correlation between the »index of the migration time« and the onset of the swan migration.

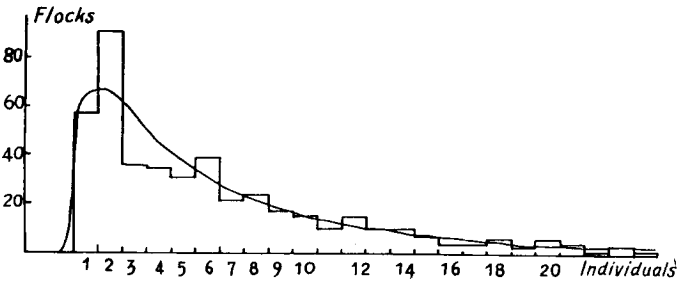

Fig. 4. Distribution of the size of the swan flocks. The histogram indicates the empirical distribution and the curve the corresponding theoretical one.

when spring is late with respect to the first migratory birds, i.e. the index number is high, the swan also generally arrives later than usual and vice versa (Fig. 3). Also there is a significant correlation between the median migration date of the swans and the index of the migration time, the correlation coefficient being 0.78.

The size of the migrating flocks

The distribution of the sizes of the migrating flocks (in 1950—1960) is presented in Fig. 4. The median is five and the average nine individuals. The commonest flock size is two individuals (91 flocks). Only 6 % of the flocks contain 30 individuals or more. The largest flocks observed are

a flock of 115 in 1960 and a flock of 78 in 1957. The distribution resembles a logarithmic normal distribution, which can be interpreted to reflect the growth process of the flock.

The larger the flock is, the more probable the incorporation of one more bird into the flock seems to be. Thus a small flock often remains small, but a large flock often grows still larger. If regularity in the formation of flocks is assumed, it is natural to assume that the growth of a flock will be proportional to the size of that flock. Thus, for instance, if one flock is twice as large as another, it may be equally probable that the former grows by six individuals and the latter by three, or the former by eight and the latter by four, etc. This hypothesis leads to a logarithmic normal distribution.

A suitable logarithmic normal distribution has been drawn in Fig. 4. There is no significant difference between the theoretical and empirical distributions ($\chi^2 = 35$, degrees of freedom 24). When the figure and the component values of χ^2 are studied, it is found that part of the distribution fits the theory surprisingly well. The value of χ^2 is for the most part determined by the flocks of two or three individuals (one half of the value of χ^2). From the figure it can be observed that even numbers of swans are found in the flocks more frequently than would be expected. Many swans apparently migrate in pairs. When the hypothesis of migrating in pairs is added to the hypothesis of the growth process of the flocks, a satisfactory explanation is obtained for the observed distribution of the flocks.

Migration routes

When the same flock of swans has been seen at several observation points, it is generally possible to determine with a fair degree of accuracy the flight route and the direction of migration of the flock. But a flight direction reported from a single observation point must often be regarded as uncertain. Even from one observation point, however, the flight direction can be reliably determined trigonometrically by measuring the times taken by the flock to cross successive lines drawn from the observation point to various fixed points.

Mainly on the basis of observations of one and the same flock seen at several points, a small and as yet inconclusive body of data has been gathered concerning the routes taken by the migrating swans. An example of such an observation is a flock of 12 swans seen on April 16, 1960, from five different observation points. It was first observed over

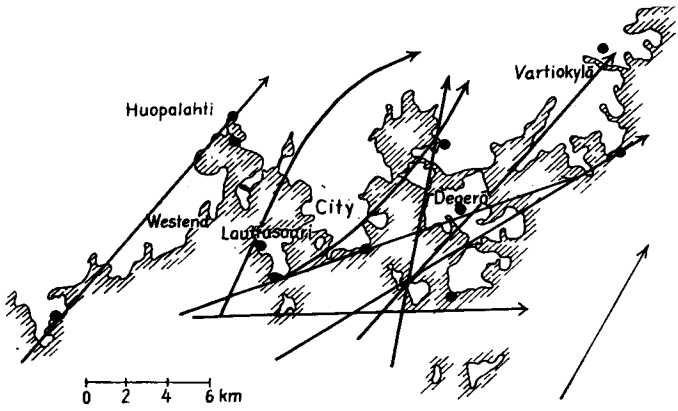

Fig. 5. The commonest observation points in the Helsinki region (solid circles) and a simplified presentation of the migration directions of the swan (the lines).

30 km west of Helsinki at 9.48 a.m. and the last observation was about 20 km east of Helsinki at 10.30 a.m. Fig. 5 shows the results of an attempt to compile the data on the flight directions of the swans on different sides of the city. It is advisable to regard the following conclusions with reservation. In no case should the lines in the figure be taken as the definite and only routes of migration, because over land the location of the observation points determines what routes have been recorded, whereas over the sea the lines represent only various observed flight directions. Nevertheless, the main direction seems to be north-east, although the direction of the coast of the Gulf of Finland is east-north-east. An explanation for this may be that near Helsinki there are many coastlines running in a northeasterly direction or that the birds migrate across the Gulf of Finland. It also seems that the swans avoid flying over the centre of the city. Thus, some of the swans observed at Lauttasaari fly from the west of the city to the north-northwest and others from the south of the city to the east-northeast. The reason may just as well be that they follow the water areas as that they avoid the city.

Mass migration

In this context a mass migration is a migration in which a great many of the migrating birds of the species in question pass the observa-

tion points during a short time. Mass migrations seem to be an essential feature of the migration of swans (see the percentages in Table 3). From 1957 on, mass migrations have been observed every year. Before that, the largest migration on record in one day was on April 29, 1956, when 106 swans were observed. In the following, periods are listed during which more than 140 migrating swans were seen:

Time of migration	No. of swans	migrating flocks	No. of observation points
April 27, 1957; 8.00 a.m. –2.00 p.m.	270	9	2–3
May 1, 1958; 5.00–10.35 a.m.	343	33	6
April 29, 1960; 3.40–5.10 p.m.	177	4	(1–2)
April 30, 1960; 9.50 a.m.–7.00 p.m.	144	7	1
May 1, 1960; 5.00–9.15 a.m.	260	15	7

During the remainder of these days hardly any swans were sighted: for instance, on May 1, 1958, only three swans were seen after 10.35 a.m. and May 1, 1960, ten swans in four flocks. Our data show that the migrants may pass over the area at different times of the day. This is also known from other data. The mass migration may sometimes consist of several small flocks, sometimes of a few large ones. In 1960, the mass migration seems to have started on the afternoon of April 29 already and continued until the morning of May 1. A similar mass migration lasting several days was observed in 1961, when on April 16, 101 swans were observed, on April 17 the number was 118 and on April 18 it was 142; the swimming or alighting swans have been included. The occurrence of a mass migration is probably dependent on weather conditions.

Summary

This paper summarizes data on the spring migration of the whooper swan collected from bird-watchers in the Helsinki region. The records relate to more than 5 000 swans observed over a period of eleven years (1950–1961). Over 1 000 swans were observed both in 1958 and in 1960. Fewer swans were seen in the earlier years of the 1950's than after the year 1956 (Table 1).

In different years the migration times have varied considerably (Tables 2 and 3). In the earliest spring of the period included, the first swans arrived a month earlier than in the latest one. The whole migration takes from one to two months, although most of the swans pass over in a few days. In spite of the great variation in the migration t mes, some average dates have been calculated: the onset of migration, April 7; the median migration, April 24 and the end of migration, May 6. A significant correlation is found between the onset of the migration of swans in different years and that of ten other early migrants.

The size of the flocks observed varied greatly, the largest consisting of 115 individuals. The average flock size is nine swans, but most of the flocks are smaller than average. Many of the swans seem to migrate in pairs (see Fig. 4). Often there are special migrating periods, a morning, an afternoon or sometimes even a few days, when large numbers of swans migrate. On May 1, 1958, for instance, 343 swans were observed during the morning.

The main direction of migration in the region of Helsinki seems to be north-east. Some of the numerous exceptions may occur because the flocks seem to avoid flying straight over the city.

Selostus: **Laulujoutsenen (*Cygnus cygnus*) kevätmuutosta Helsingin retkeilyalueella vuosina 1950—61.**

Esitys on yhteenveto Helsingin retkeilyalueen lintujenharrastajien joutsenhavainnoista. Aineisto käsittää yli 5 000 joutsenta 11 vuoden (1950—1961) ajalta. Vuosina 1958 ja 1960 on havaittu yli tuhat joutsenta. Tutkitun ajanjakson alkupuolella niitä nähtiin vähemmän kuin vuoden 1956 jälkeen (taulukko 1).

Muuttoaika vaihtelee eri vuosina huomattavasti (taulukot 2 ja 3). Tutkittavan ajanjakson aikaisimpana keväänä ensimmäiset joutsenet saapuivat kuukautta aikaisemmin kuin myöhäisimpänä keväänä. Koko kevätmuutto kestää yhdestä kahteen kuukauteen, vaikka päämuutto tapahtuukin muutamassa päivässä. Muuttoaikojen suuresta vaihtelusta huolimatta on laskettu joitakin mediaanipäivämääriä: muuton alkaminen 7. IV, päämuutto 24. IV ja muuton päättyminen 6. V. Joutsenten muuton alkamisen ja kymmenen muun aikaisen muuttajan tuloaikojen välillä on havaittu merkitsevä korrelaatio.

Parvien koko vaihtelee sekin suuresti. Suurin parvi on 115 yksilöä, keskiarvo on yhdeksän yksilöä, mutta useimmat parvet ovat kooltaan keskiarvoa pienempiä. Monet joutsenista muuttanevat pareittain (ks. kuvio 4). Useimpina vuosina on esiintynyt joukkomuuttoa, joka on kestänyt aamun, iltapäivän tai joskus jopa useamman päivän. Esimerkiksi 1. V. 1958 havaittiin aamun kuluessa 343 muuttavaa joutsenta.

Päämuuttosuunta Helsingin retkeilyalueella näyttää olevan koillinen. Eräät lukuisista poikkeuksista saattavat johtua siitä, että parvet välttävät keskikaupungin yli lentämistä.

The Crested Tit on the Åland Islands

Lars von Haartman

The Crested Tit (*Parus cristatus*) is notorious for its reluctance to cross open spaces. For istance, unlike the other tits, it is hardly ever seen in the isolated parks of Helsinki (Helsingfors) (Palmgren 1927, Linkola). I myself have seen it only once (end of August 1962) in the isolated little park of the Institute of Technology, despite walking by with my dog about twice a day every autumn, winter, and spring.

This peculiarity of the species is obviously the main cause of its