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THE DENSITY OF BIRDS IN TWO STUDY AREAS OF THE ALPINE REGION IN SOUTHERN LAPLAND IN 1964

BY

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Introduction

The bird fauna of the alpine region within Scandinavia is fairly well-known from a faunistic point of view owing to the great field activity of many ornithologists, especially during the last decades. However, exact quantitative investigations intending to describe the composition of the breeding bird fauna in detail are almost completely lacking. The only investigations we know are those by GRANIT (1938) and BAGGE, LEHTOVUORI & LINDQVIST (1963), who made strip surveys on alpine heaths in northern Finland.

In order to investigate the methods for census work on alpine heaths and to get a preliminary picture of the composition of the bird fauna in such habitats, we initiated, in 1964, a census project in low and middle alpine regions in the Ammarnäs area of southern Lapland. This project is a part of a large-scale census program we started in this part of Lapland in 1963 (ENEMAR 1964), mainly sponsored by the Swedish Natural Science Research Council.

Two areas were investigated, measuring one square kilometre each. One was situated in the low alpine region and the other near the upper limit of this region and extending to the lowest parts of the middle alpine region. The results of the census within these two areas will be presented in this paper.

Methods

Selection of census areas

Two requirements as to the nature and site of the census areas were established. First two areas, one square kilometre each, were to be selected; one in the low alpine region and the other if possible in the middle alpine region (for defintion of these regions, see DU RIETZ (1950) and the habitat descriptions below). Secondly the areas also had to be easily accessible from the base camp at Ammarnäs.

Suitable country was found on the slopes of the mountain Kuoltatjåkko, about 15 km SSE of Ammarnäs. It was possible to get by car almost to the upper limit of the subalpine birch forest. From there it was only half an hour's walk to the nearest area and one hour's walk to the more remote one.

No special investigation of the habitats was made before selection of the areas took place. An apparently suitable area was picked out. Then one point, easily visible from a distance, was chosen as a "base point" and the direction of a "base line" was determined.

Measuring and marking of the areas

When measuring the areas, ropes with a length of 50 m or measuring sticks 2 m long were used. Starting from the base point the base line, one kilometre in length, was measured and every hundred metres was marked out. Starting from these marked hundred metre points eleven lines, each one kilometre long and perpendicular to the base line, were measured and every hundred metres marked out in the same way as described for the base line. In this way an area covering one square kilometre, subdivided into one hundred smaller areas, 100 × 100 m each, was obtained.

The marking of all the corners of the subareas was effected as follows. Lengths of thick wire (110 cm long) provided with a loop at one end, were driven about 10 cm into the ground, thus reaching a height over the ground of about one metre. Coloured plastic bands were tied in the loops (Fig. 1). Bands of four different colours were used according to the following system. The base line was given one colour, next parallel line another and so on. Thus the fifth line was given the same colour as the first. The same sequence of colours was used in the lines perpendicular to the base line. By this method all the markers carried two bands and by the combination of the colours it was easy to determine the coordinates of a certain point within the area during census taking.

Method of census taking

We all had previous experience of bird census work, but only in forest habitats. It soon became evident that the situation was quite different in this open country of alpine heaths and that several new problems had to be taken into consideration. On one hand the areas were far easier to survey visually. In fact, it was possible to see the whole study area from some points within the areas. Of course this made the situation in some respects easier than it is in covered habitats. On the other hand, the open country of alpine regions is obviously connected with greater mobility of the individual bird, which had an opposite effect on the reliability of the figures obtained. However, the question of reliability will be further discussed below.

The census taker began at the base line, walking in zigzag within a strip 100 m wide between two marked lines perpendicular to the base line until he

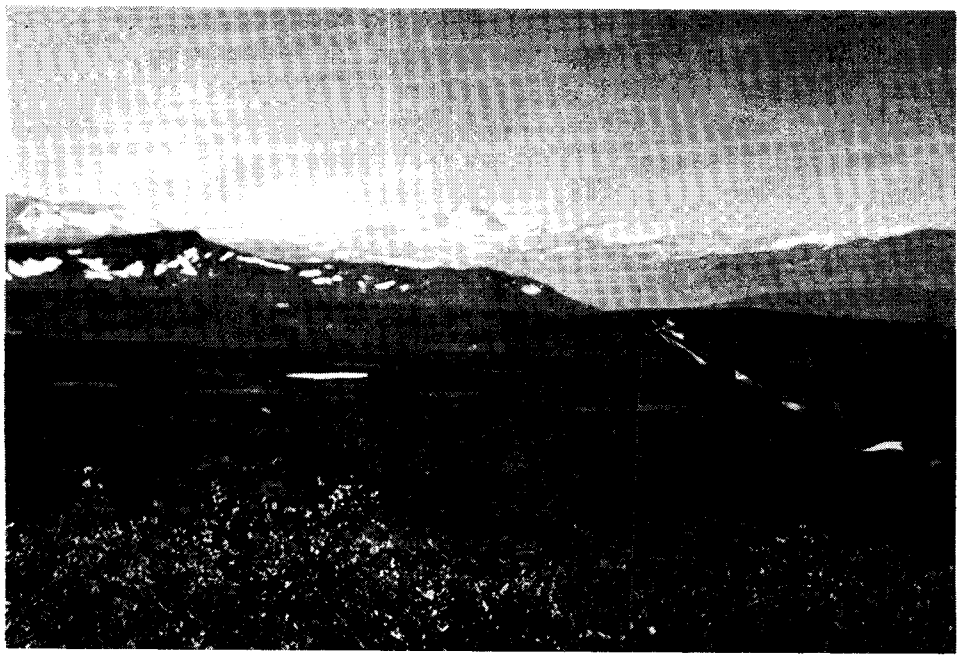

Fig. 1. Part of study area K 1 in the low alpine belt, showing one of the markings used.

Fig. 2. Habitat of the middle alpine belt in study area K 2.

reached the end of the area, and then returned in an adjacent strip in the same manner. Within every subarea he thus traversed the midline of the strip three or four times. The time taken for a survey of one such strip, 100 × 1000 m, was usually between 40 and 60 minutes, depending on the number of birds registered, the behaviour of the birds and the nature of the terrain.

Every bird observed was noted on a sketch map of the area. The behaviour of the bird was registered as follows: noted without further comments, singing, warning, two birds together (probably a pair), courtship, display, collecting nest material. If the behaviour of a bird could be connected with a probable nest nearby, we usually tried to find the nest, but no long search for the nest was made during the surveys. Only birds that appeared within the strip during a survey were noted. If a bird, or a flock of birds, were seen passing over the area, this was not recorded in connection with the census notations.

Four persons, the authors, undertook the principal part of the census work but they were also helped by other members of the expedition on some occasions. To these persons, SVEN ÅKE HANSON, ERIK NYHOLM, and BENGT SJÖSTRAND, we would like to express our gratitude for their invaluable assistance.

Principles used in evaluating the size of the populations

The method described by ENEMAR (1959) and then used in the subalpine and prealpine forests within the frame of the census program at Ammarnäs (ENEMAR 1964) was also applied in this study. This method, the mapping method, will not be recapitulated in detail here. Only a few comments of special significance for the present investigation will be made.

The unit of the countings—as regards the passerine species—is the stationary (sedentary) male, which permanently maintains a territory and most often corresponds to a breeding pair. This means that the bird will be discovered repeatedly and plotted on approx. the same spot on the above-mentioned sketches of the study area. This results in a group of plots, and such a group is considered to correspond to a stationary (sedentary) bird if the number of notations equals or exceeds half the number of surveys carried out in the study area.

When working up the field material the sum of the breeding pairs, established by the nests discovered, and the stationary males, represented by clear-cut groups of plots, constituted the minimum size of the stationary population. The maximum number was obtained by adding the number of indistinct and otherwise questionable groups of observations to the minimum population. The mean of these two figures was calculated and taken as a provisional value of the size of the stationary population.

The estimation of the number of waders was mostly based on nests discovered, on warning parents birds, and in certain cases on singing males.

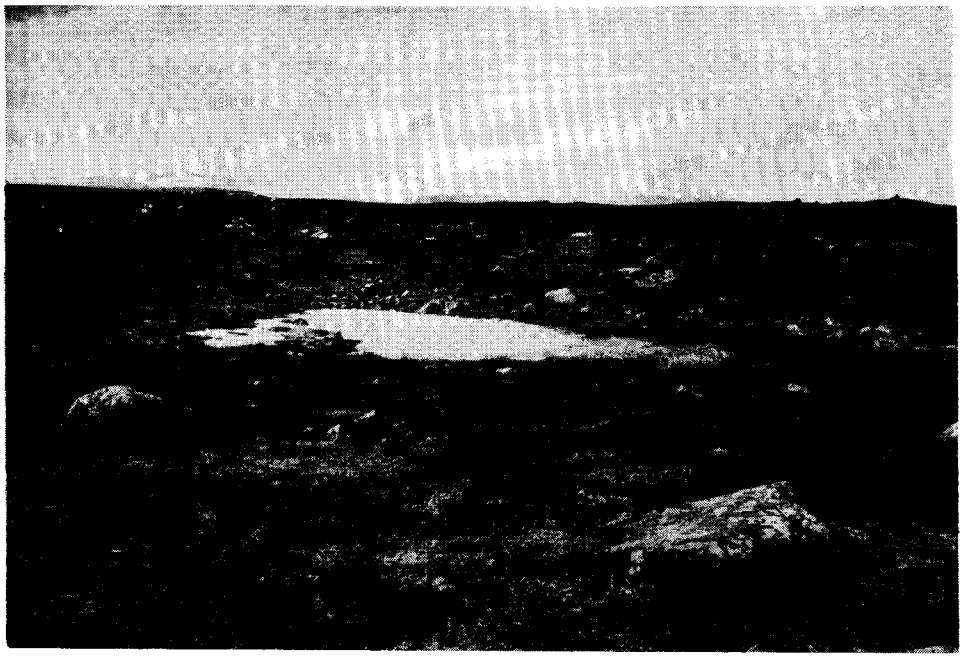

Fig. 3. Scrub heath of the low alpine belt in study area K 1.

Description of habitats

A short and schematic description of the habitats within the two areas will be given, though the vegetation was not specially investigated this year. In characterizing the areas the floral belt definitions by DU RIETZ (1950) are used.

Study area K 1 (Figs. 3 and 4.)

This area is completely restricted to the low alpine region. The area is situated on a slight slope at an approximate mean altitude of 775 metres above sea level. Within the study area three main types of vegetation can be distinguished:

1. Scrub heath with *Betula nana, Empetrum hermaphroditum, Arctostaphylos alpina,* and *Vaccinium myrtillus* as typical species. This type of habitat covers more than half the area, especially the higher and dryer parts.
2. Watershed bogs with almost complete dominance of *Carex* species. This habitat covers a smaller part of the study area than the first but is the dominating type in the lower and humid half.
3. Willow scrubs only covering limited parts, mostly at the bog borders and along a few small streams.

Study area K 2 (Fig. 2)

This area is situated on a mountain ridge. In the lower parts the vegetation is of low alpine character and in a diagonal strip, about two thirds of the total area, of middle alpine type. The altitude of the area varies between about 875 and 925 metres above sea level. The middle alpine part is characterized by very poor vegetation without any scrub and sometimes almost without vegetation. The low alpine parts can be divided into two parts of about equal distribution. On moist grounds willow scrubs dominate and on dryer grounds a sparse *Juniperus*-heath.

The breeding status during the census period

The scope of the study was to estimate the stationary population of the areas investigated, i. e. the birds which had their territories within the areas during the period when the surveys were carried out. For this reason we had to determine the breeding status of the birds during the census period. This was done by repeated controls of the nests found. As can be seen from the following, it appears that the census period coincided with the egg-laying or incubation period with only few individual exceptions for all species concerned.

Study area K 1

In this area census was taken on the following dates: 15, 18, 19, 21, 22, 23, 24, 25, 27, and 30 June—i. e. on ten different occasions.

Meadow Pipit (*Anthus pratensis*). In total 23 nests were registered (21 of them inside the study area). Of these 22 were found on the following dates: 19/6 (3 nests); 21/6 (3 nests); 22/6 (3 nests); 23/6 (2 nests); 24/6 (6 nests); 25/6 (4 nests), and 30/6 (1 nest). By repeated visits to the nests it could be ascertained that the clutches were complete by the dates when they were found. In one case only, the laying period definitely fell within the census period. This nest was found on 19/6 with 3 eggs and was complete on the 21/6. On 30/6, 20 of the 23 nests were inspected and in none were the eggs hatched. With the possible exception of the first census it seems probable that the whole census period coincided with the egg-laying or incubating period of the species.

Lapland Bunting (*Calcarius lapponicus*). Five nests were found, one each on 18/6, 19/6, and 25/6. They were inspected on 30/6 and still found to have the same number of eggs. One nest was found on 30/6 with 5 eggs, and another nest on 22/6 with 4 eggs and the following day with 5 eggs. This nest was later destroyed.

Willow Warbler (*Phylloscopus trochilus*). One nest was found a few metres outside the study area. The nest was under construction on 21/6. It contained 4 eggs on 25/6 and 6 eggs on 27/6.

Bluethroat (*Luscinia svecica*). Four nests. The first contained 2 eggs on 15/6, 5 eggs on 19/6 and 6 eggs on 21/6. The second nest, found on 19/6 with 2 eggs, had 3 eggs on 21/6. No more eggs were laid and the nest still contained eggs on 30/6. The third nest contained 6 eggs on 22/6 and they were still being incubated on 27/6. The fourth nest contained 2 eggs and 3 young on 24/6 and 3 young on 30/6.

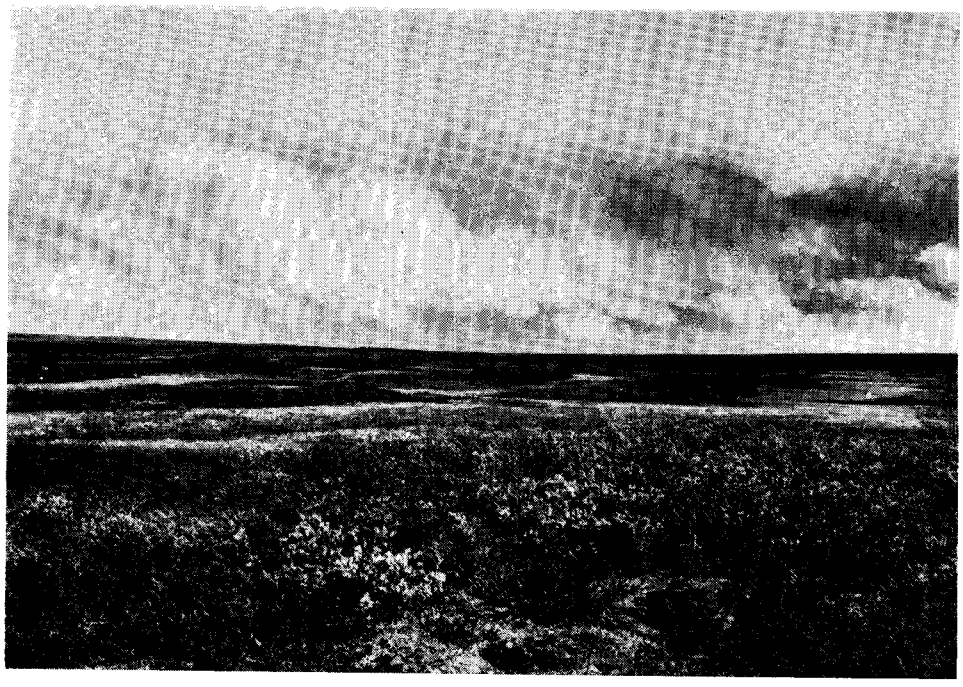

Fig. 4. View of study area K 1, showing willow scrubs and bogs.

Golden Plover (*Charadrius apricarius*). Three nests. The first had 4 eggs on 10/6 and the same number on 21/6 but was empty on 24/6. The second contained 1 egg on 21/6 and 2 the next day. There were still 2 eggs on 27/6. The third nest had 4 eggs on 21/6 but was empty on 23/6.

Dunlin (*Calidris alpina*). Four nests were found, two within the study area and two outside it. One nest was found on 21/6, two on 22/6, and one on 24/6. One was empty (eggs destroyed or hatched) on 25/6 and the other still contained eggs on 30/6.

Wood Sandpiper (*Tringa glareola*). One nest was found on 15/6 with 4 eggs. The eggs hatched on 27/6.

Ruff (*Philomachus pugnax*). One nest was found on 18/6 and still contained eggs on 25/6.

Study area K 2

Five surveys were performed on the following dates: 21, 22, 25, 26, and 28 June.

Meadow Pipit. 15 nests were found on the following dates: 21/6 (1 nest); 22/6 (4 nests); 25/6 (4 nests); 26/6 (4 nests), and 28/6 (2 nests). Through repeated inspection of the nests it became apparent that the census period started towards the end of the laying period. However, one nest containing one egg was found on 26/6. One nest with full clutch on 22/6 was found plundered on 26/6.

Wheatear (*Oenanthe oenanthe*). 6 nests were found during the census period: two on 21/6, 3 on 22/6, and one on 28/6. The last-mentioned nest contained only 4 eggs, but in the remaining nests full clutches were found.

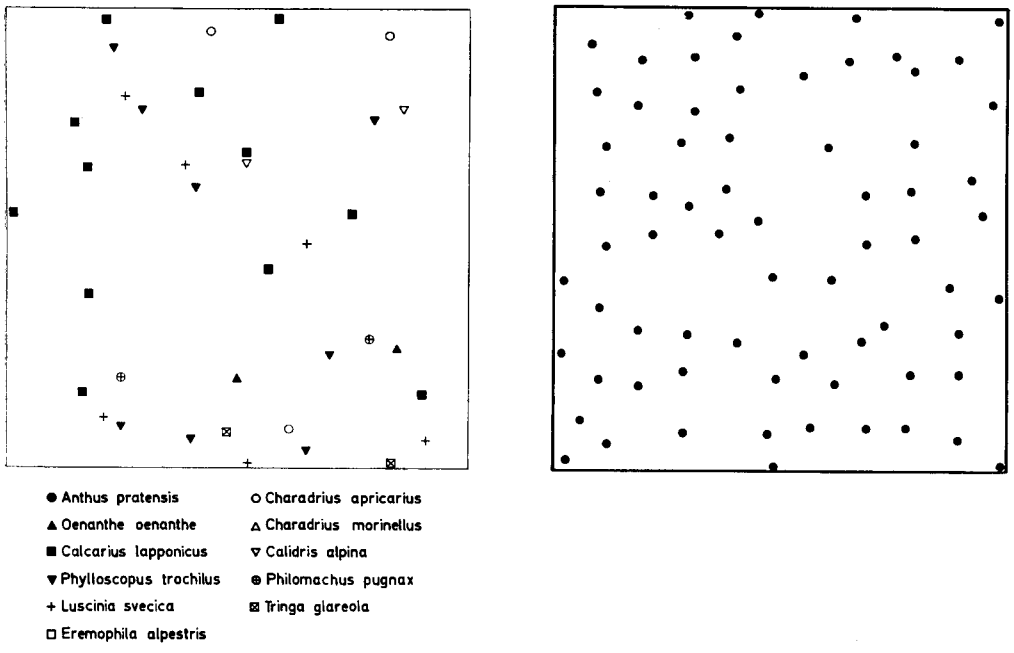

Fig. 5. Two sketches of study area K 1 showing the distribution of the stationary males or breeding pairs of the established population. The size of the area is one square kilometre.

Table 1. The size of the stationary populations of the different species in the study area K 1 determined by the mapping method, dominance values of the species (in per cent) and number of nests

Species	Maximum number	Minimum number	Mean number	Dominance value	Number of nests found
Anthus pratensis	72	66	69	65	21
Calcarius lapponicus	14	10	12	11	5
Phylloscopus trochilus	9	7	8	8	0
Luscinia svecica	6	6	6	6	4
Oenanthe oenanthe	3	1	2	2	0
Passerinae, total	104	90	97	92	30
Charadrius apricarius	3	3	3	–	3
Calidris alpina	3	2	2	–	2
Tringa glareola	2	2	2	–	1
Philomachus pugnax	2	2	2	–	1
Non Passerinae, total	10	9	9	8	7
Total	114	99	106	100	37

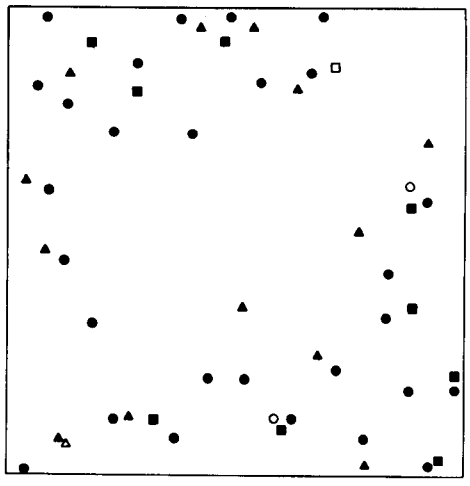

Fig. 6. Map of study area K 2 showing the distribution of the stationary males or breeding pairs. The size of the area is one square kilometre. The explanation of the symbols is found in Fig. 5.

Table 2. The size of the stationary populations of the different species in study area K 2 determined by the mapping method, dominance values of the species (in per cent) and number of nests

Species	Maximum number	Minimum number	Mean number	Dominance value	Number of nests found
Anthus pratensis	29	27	28	51	15
Oenanthe oenanthe	14	12	13	24	6
Calcarius lapponicus	9	9	9	17	4
Eremophila alpestris	1	1	1	2	0
Passerinae, total	53	49	51	94	25
Charadrius apricarius	3	1	2	–	1
Charadrius morinellus	2	1	1	–	1
Non Passerinae, total	5	2	3	6	2
Total	58	51	54	100	27

Lapland Bunting. Four nests were found: two on 22/6, one on 25/6, and one on 28/6. One nest contained 4 eggs on 22/6, but was found to be plundered on 26/6. This species was in the egg-laying period when the surveys were carried out, which may be a source of error.

Golden Plover. One nest with 4 eggs was found on 25/6.

Dotterel (*Charadrius morinellus*). One nest containing 2 eggs was found on 28/6.

Results

The size of the stationary populations within the areas can be seen in tables 1 and 2. The maximum number, as judged from the working maps, as well as the minimum number of the mean are given. The dominance in per cent and the number of nests are also shown.

In order to give a picture of the distribution of the pairs within the study areas the three maps (Figs. 5 and 6) were drawn. On the map of the study area K 2 the distribution of the spots shows clearly that the mountain ridge crosses the area diagonally.

The means given in the tables represent the density of the stationary population (expressed as total number of stationary males) per square kilometre (because the areas measured exactly one square kilometre each).

The following species were observed within the study areas on several occasions although they could not be established as belonging to the stationary populations of the areas: Short-eared Owl (*Asio flammeus*), Great Snipe (*Gallinago media*), Common Snipe (*Gallinago gallinago*), Long-tailed Skua (*Stercorarius longicaudus*), and Ptarmigan (*Lagopus mutus*).

Discussion

The density values obtained in the habitats covered by this investigation must be looked upon as provisional. First, the bird fauna of a certain habitat will never be fully characterized by a single season's work, and secondly, it is not yet possible to estimate the reliability of the census work in this particular terrain. The sources of error which generally interfere with the reliability of bird census work have been summarized earlier (cf. the survey by ENEMAR 1959). Therefore only short comments on the subject will be made here on certain points of special significance for the present investigation.

The efficiency of the census work apparently varied considerably for the various species. The waders presented special problems, because not all species concerned showed the type of territorial behaviour which is characteristic of the passerine species and which constitutes the basis for the mapping method. Several nests were found but obviously the incubating wader often left the nest and disappeared in the vegetation without being observed by the census-taker (Dunlin, Ruff). Therefore, some nests possibly remained undiscovered throughout the period of census work.

Double entries of the same stationary male or pair may be more frequent in the census material from a large study area which is divided into several survey strips than in the narrow study areas which we established in the forests and

which are covered by a single strip each. Especially the Meadow Pipit, a frequent and otherwise easily surveyed species, was subject to this source of error, since the single birds or pairs were often seen to move extensively over the different strips. Temporary visitors (unpaired birds, migrating pairs) offered further complications. Obviously we must gather more facts about the characteristic features of the behaviour of the breeding pairs or the unmated territory-defending males in this species before an effective evalution of the field observations can be made. However, so many nests of the species were found and so many (breeding) pairs were established by clear-cut groups of observations that the size of the estimated stationary population cannot be considered altogether misleading.

The number of surveys required for a reliable estimation of the bird population is intimately connected with the efficiency of the census work. This is not known for the alpine habitat. Ten to twelve surveys have appeared to be enough in forest habitats (ENEMAR 1959). When planning the census work in alpine habitats, the bird density and the difficulty of the survey work had been somewhat underestimated. Ten surveys in study area K 1 may be a sufficient number; the five surveys of study area K 2 are definitely too few to allow a reliable interpretation of the field results of all species concerned. The error of the bird densities obtained for the alpine habitats is probably restricted to the ± 10 per cent limits, a figure which has been calculated from the number of indistinct observation groups on the maps and from the number of "surprising" new discoveries of breeding pairs during the last few surveys.

As appears from Tables 1 and 2, the density of birds in the low alpine area (K 1) was one hundred stationary males or pairs per square kilometre (expressed as a round figure). The corresponding figure for the low-middle alpine area (K 2) was fifty. The bird density of the heath birch forest has been estimated at 180 to 190 pairs per square kilometre (ENEMAR 1963, 1964). This means that the density of the low alpine area seems to be approximately half that of the adjacent heath-birch forests of the subalpine belt.

There have been very few previous attempts to determine the density of birds in alpine regions, and as far as we know, census work of the type presented in this investigation has not been undertaken. KLINCKOWSTRÖM (1909) tried to estimate the bird population of alpine and subalpine regions in Frostviksfjällen, but his method was entirely different from that of later writers and involved such obvious errors that his work cannot be used for comparative purposes.

In northern Finland GRANIT (1938) and BAGGE, LEHTOVUORI & LINDQVIST (1963) made some strip surveys in alpine and subalpine regions. In neither of the papers were corrections made of the figures obtained, and therefore their figures must be too low. However, BAGGE, LEHTOVUORI & LINDQVIST present some figures comparable with those presented in our study. For *Betula nana*

heath they estimated 90–94 pairs per square kilometre (the corresponding figures given by GRANIT are 11–16 pairs per square kilometre).

Census works on breeding populations in open country have also been performed by the Oxford University Expedition to West Greenland (LONGSTAFF 1932) and by LACK (1935) on British heaths and moorland. Even if the problems are to some extent the same, the composition of the populations is so different that the results are not exactly comparable.

Summary

Two study areas, one square kilometre each, were established in the low and middle alpine regions in the Ammarnäs area, Swedish Lapland. The size and composition of the breeding bird population of the areas was determined. The census technique applied was the "mapping method". The density of birds in the study area of the low alpine region appeared to be one hundred pairs per square kilometre. The corresponding figure for the other area which partly extended into the middle alpine region was fifty. The Meadow Pipit was dominant in both areas (65 and 51 per cent, respectively, of the total bird population).

References

BAGGE, P., LEHTOVUORI, M. and LINDQVIST, O.: Quantitative Untersuchungen über die Vogelfauna der Kirchspiele Inari und Enontekiö in Nordlappland. Ornis Fennica *40*: 31 (1963). (Zusammenfassung.)

DU RIETZ, G. E.: Phytogeographical excursion to the surroundings of Lake Torneträsk in Torne Lappmark. Seventh Intern. Bot. Congr. Stockholm 1950. Excursion Guides CIIIc, Section PHG (1950). (Uppsala.)

ENEMAR, A.: On the determination of the size and composition of a passerine bird population during the breeding season. Vår Fågelvärld, Suppl. *2*: 1–114 (1959).

– The density of birds in the subalpine birch forests of the Abisko area, Swedish Lapland, in 1961. Kungl. Fysiogr. Sällsk. Handl. N.F. *58*, No 2 (1963).

– Småfågelfaunans täthet och sammansättning i några skogsbiotoper längs övre Vindelälven år 1963. Fauna och Flora *59*: 1–23 (1964).

GRANIT, O.: Versuch zur quantitativen Untersuchung der Vogelfauna einer Fjeldgegend in Nordfinnland. Ornis Fennica *15*: 53–65 (1938).

KLINCKOWSTRÖM, A.: En sommar i Frostviksfjällen. Fauna och Flora *4*: 2–18, 53–70, 101–120 (1909).

LACK, D.: The breeding bird population of British heaths and moorland. J. Anim. Ecol. *4*: 43–51 (1935).

LONGSTAFF, T. G.: An ecological reconnaissance in West Greenland. J. Anim. Ecol. *1*: 119–142 (1932).

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