Finnish line transect censuses

OLLI JÄRVINEN & RISTO A. VÄISÄNEN

JÄRVINEN, O. & VÄISÄNEN, R. A. [Dept. Genetics, University of Helsinki, P. Rautatiekatu 13, SF-00100 Helsinki 10, Finland] 1976. — *Finnish line transect censuses.* Ornis Fenn. 53:115—118.

The field procedure for the line transect censuses of breeding birds is described in detail. Applications of the line transect material are briefly reviewed. They include the elucidation of long-term faunal changes; for example, the Finnish population of *Carpodacus erythrinus,* estimated at 10 000 pairs in about 1945, is now estimated at 360 000 pairs.

Introduction. "Only ideas won by walking have any value", wrote NIETZSCHE in his vigorous style in *Götzen-Dämmerung.* Whatever may be thought of Nietzsche, it must be admitted that Prof. EINARI MERIKALLIO's unique idea of walking around in Finland censusing birds has proved to be of great value. His last study (MERIKALLIO 1958) summarizes the results of censuses covering 1092 km of line transects. Almost all his data have been included in the census material collected by us. The data available now (up to 1975) comprise 2537 km of transects, which give fairly even coverage of the whole of Finland and certain adjacent areas (parts of the Soviet Union and Norway). The first full description of the field procedure in English is given below (for supplementary details, see JÄRVINEN & VÄISÄNEN 1973).

Field procedure. These instructions are a translation of those distributed by us to ornithologists helping with field work.

1. *Census period.* The best period seems to be 1—20.6. in southern Finland and 10—30.6. in northern Finland.

2. *Census hours.* The best time for censusing seems to be between 4 and 9 a.m., though a slightly earlier start may perhaps be recommended in northern Finland. After a cold night, it is advisable to start the census a little later, but in no case should it be continued past 9 o'clock.

3. *Weather.* No census should be made if rain or wind interfere appreciably with the intensity or audibility of bird song.

4. *Census route.* As the purpose of the census is to obtain a representative sample of the bird communities of a region, with the exception of the waterbirds, the transect should be planned beforehand on a map. Typical habitats, such as forests, peatlands and fields, should be included in approximately those proportions which are characteristic of a larger region (e.g. 50 × 50 km²). It is not allowed to combine the census with other field work, e.g. visits to nest-boxes, because this introduces a heavy bias into the results. It is recommendable to plan the transect in

the form of a square with sides measuring 1 km. It is possible to census 5—6 km in the morning if the density of the birds is low.

5. *Walking speed.* The highest numbers of birds are recorded if the census-maker walks slowly and stops very often to listen to the birds and to write down his observations. Walking slowly also permits careful determination of the exact census route (with the aid of a map and a compass) and sufficiently accurate estimation of the distances walked (by counting the number of paces). If the census-maker walks too hurriedly, the result will be poorer. It is recommended that 1 km is censused in 45 to 60 minutes, depending on the density of the birds. It is not advisable to stop very close to a highly alarmed bird, because the alarm calls (mobbing) may attract extra pairs from the neighbourhood to the main belt.

6. *Observations.* Good knowledge of bird identifying is a prerequisite for the censusing. All birds which are not *behind* the observer are registered. (Omission of the birds observed behind decreases the risk of double registrations.) A male heard singing, or otherwise observed, is interpreted as one pair. If a male is not observed, a female, a group of fledglings or an inhabitated nest is also interpreted as one pair. Certain species of birds (e.g. *Loxia* spp., partly *Sturnus vulgaris)* breed so early that they are commonly observed in flocks during the census. An average brood (2 adults and the average number of young in a brood) is interpreted as a pair; the number of birds in larger flocks is usually divided by 5 to obtain the number of pairs (expressed in integral numbers).

The pairs are registered in two lists: (1) the birds observed within 25 m of the transect, i.e. within the *main belt* (which is 25 + 25 m wide), and (2) those observed more than 25 m from the transect, i.e. the birds of the *supplementary belt.* Together, the two belts form the *survey belt.* The distance of the birds (from the transect, not from the census-taker) is estimated from the place where the bird was when first observed. Birds flying over the main belt belong to the supplementary belt, even if first detected above the main belt. An inexperienced census-taker has difficulty in estimating the distance of 25 m. It is *a common error to underestimate distances;* in consequence, far too many pairs are recorded from the main belt. The distance estimated should be checked many times in sufficiently varied habitats; the ability to make correct estimates generally develops rapidly.

7. *Records.* Forms, tested extensively in the field work, are available from the authors. One form is used for 1 km in the field. In addition to the bird pairs, the habitats of the main belt are recorded (usually 50 m accuracy).

8. *Census results.* All observations from the census are summarized on a data form (available from the authors). In addition to the bird observations, the census-maker has to give the length of the transect (0.1 km accuracy), date, census hours, the geographic coordinates of the midpoint of the transect, the coordinates of the midpoint in the Finnish uniform grid system (grid 27°E, 10 km accuracy), name of the transect, and comments on the weather. Other information is coded after the data forms have been returned to us.

Estimation of densities. At present densities are estimated according to the linear model of JÄRVINEN & VÄISÄNEN (1975), as shown in Appendix (see also JÄRVINEN 1976, JÄRVINEN et al. 1976 and JÄRVINEN & VÄISÄNEN 1976b). All observations can be

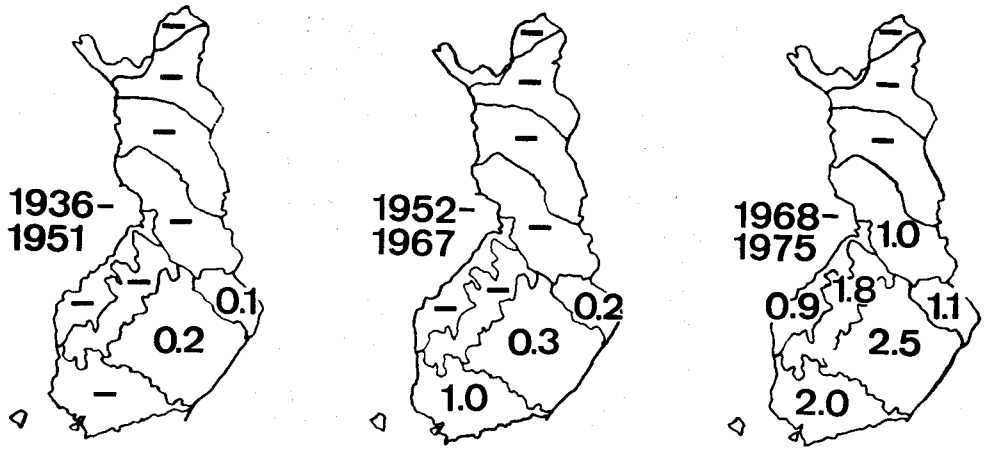

FIG. 1. Estimated densities (pairs/km²) of the Scarlet Grosbeak *Carpodacus erythrinus* in Finland in three different periods. All estimates are based on line transect censuses. Relatively comprehensive data are available from all nine regions and all periods. See text for further details.

used for the estimates, which greatly improves the accuracy of most estimates.

Results. Our work is pursued at three levels: Finland (with adjacent areas), zones of Finland, and biotopes (habitats) within zones. Relatively extensive computer programs have been devised for estimating different parameters of the bird communities (see JÄRVINEN & VÄISÄNEN 1973).

Finland. Since new results will probably soon be available, we wish merely to make one general remark. MERIKALLIO (1958) apparently underestimated the numbers of many southern species, because his transects give poor coverage of the southernmost parts of Finland.

Zones. For the zoogeographical zonation, see JÄRVINEN & VÄISÄNEN (1973).

Biotopes. Examples of work at the biotope level are furnished by a study on the transition between taiga and tundra (JÄRVINEN & VÄISÄNEN 1976a) and a report on coastal bird communities (VÄISÄNEN & JÄRVINEN 1977).

Prospects. Our program for supplementing previous censuses is now approaching completion and the data provided can be used in a variety of ways. For example, they can provide quantitative information on a great number of faunistic changes observed in Finland during recent decades. This may be illustrated by the case of *Carpodacus erythrinus,* known to have expanded widely in Finland. We have calculated the density of the species using MERIKALLIO's (1958) regions (Fig. 1), so that comparison is easy. The censuses have been divided into three periods, each comprising about the same amount of transects. Our estimates for the total number of pairs are

10 000 pairs in ca. 1945
60 000 pairs in ca. 1955
360 000 pairs in ca. 1974.

This indicates that the Finnish population has increased 30-fold in 30 years!

Changes have been observed both in the range and in the densities within regions. Our two earlier estimates differ from that of MERIKALLIO (1958); this is explained by the facts that MERIKALLIO was restricted to the main belt data (in fact, he happened to observe the species unusually often in the supplementary belt), and the data used for the estimates are not the same.

The census material can also be used in studying the effects of climatic changes, forestry, the use of woods as pastures, and the drainage of peatlands, in estimating theoretical parameters (such as species diversity) for the whole of Finland, in comparing different methods for studying wildfowl populations and in developing ornithological indicators of the human impact on the environment.

Selostus: Suomen pesimälinnuston linja-arviointi

Kirjoituksessa esitellään osittain asioita, joita VÄISÄNEN & JÄRVINEN (1974) ovat käsitelleet. Lisäksi esitetään lukuisia esimerkkejä linjalaskentaan perustuvan aineiston käyttömahdollisuuksista. Aineistoja voidaan mm. käyttää pitkäaikaisten faunamuutosten kvantitatiiviseen tutkimukseen. Kuvassa 1 on esitetty punavarpusen tiheyksien kasvu Suomen eri osissa viime vuosikymmeninä. Tämä muutoshan on laadullisesti hyvin tunnettu, mutta kvantitatiivisesti ei. Arvioidemme mukaan kanta on kasvanut 10 000 parista (n. 1945) noin 60 000:een (n. 1955) ja jopa 360 000:een (n. 1974).

References

JÄRVINEN, O. 1976. Estimating relative densities of breeding birds by the line transect method. II. Comparison between two methods. — Ornis Scandinavica 7:43—48.

— & VÄISÄNEN, R. A. 1973. Species diversity of Finnish birds, I: Zoogeographical zonation based on land birds. — Ornis Fennica 50: 93—125.

— & VÄISÄNEN, R. A. 1975. Estimating relative densities of breeding birds by the line transect method. — Oikos 26:316—322.

— & VÄISÄNEN, R. A. 1976a. Species diversity of Finnish birds, II: Biotopes at the transition between taiga and tundra. — Acta Zool. Fennica 145:1—35.

— & VÄISÄNEN, R. A. 1976b. Estimating relative densities of breeding birds by the line transect method. IV. Geographical constancy of the main belt observations. — Ornis Fennica 53: 87—91.

— & VÄISÄNEN, R. A. & HAILA, Y. 1976. Estimating relative densities of breeding birds by the line transect method. III. Temporal constancy of the proportion of main belt observations. — Ornis Fennica 53:40—45.

MERIKALLIO, E. 1958. Finnish birds. — Fauna Fennica 5:1—181.

VÄISÄNEN, R. A. & JÄRVINEN, O. 1974. Suomen pesimälinnuston linja-arviointi. — Lintumies 9:1—6.

— & JÄRVINEN, O. 1977. Quantitative structure and primary succession of coastal bird communities in a Finnish archipelago. — Ornis Scandinavica 8 (in press).

APPENDIX. A hypothetical example illustrating the method of estimating the density (D in p/km²) of *Fringilla coelebs* from line transect results.

The following data are required:

L = transect length (4.0 km in the example).
N = the number of pairs of *Fringilla coelebs* observed in the census (62 pairs on the survey belt).
k = a species-specific correction factor; 0.00475 for *Fringilla coelebs*. The correction factors have been calculated from the total line transect material.
x = the number of pairs (of all species) observed in the main belt (in our example, 42 pairs/4 km = 10.5 p/km).
y = a general correction factor, also derived from the total line transect material. It is calculated from $y = 0.0346x + 0.6963$.

The following calculations must be made:
First,
$y = 0.0346 \times 10.5 + 0.6963 = 1.0596$
Second, the figures are substituted in the following formula $D = \frac{1000\ kyN}{L} =$

$$\frac{1000 \times 0.00475 \times 1.0596 \times 62}{4} = 78.0$$