Ann. Zool. Fennici 26:181–184. 1989

Problems of applying the line-transect method without repeated counts when the breeding season is long

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Pēterhofs, E. & Priednieks, J. 1989: Problems of applying the line-transect method without repeated counts when the breeding season is long. — Ann. Zool. Fennici 26:181–184.

The Finnish line-transect method has been used generally in Latvia since 1980, and since 1983 it has been used in ornithological monitoring and in computing relative densities of common species in different habitats. Because of the longer breeding season in Latvia than in Finland, each route was counted four times during the breeding season. Only material from Latvia was used for calculating species-specific coefficients of detectability (*k*). The data were grouped according to the value of the total main-belt percentage of the observations in the counts, and this has several advantages. It is suggested that the coefficient *k* obtained in such a way compensates for the influence on the total breeding density results, on the density and development of the vegetation, on bird singing activity, on the relative number of "loud" birds, and on the variation in the individual skills of the observers. The results show that it is important to adapt the Finnish line-transect method for application in different situations.

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1. Introduction

The Finnish line-transect (FLT) method described by Järvinen & Väisänen (1975) was used for the first time in Latvia in 1980, when Pēterhofs (1981, 1982) studied forest bird communities in the Slitere State Reserve. The method has been used in ornithological monitoring since 1983. It was necessary to modify the FLT method owing to Latvia's long breeding season, its great variety of landscape and its sharp differences in bird breeding densities. The main purpose of our study is to show the peculiarities of applying FLT in Latvian conditions.

2. Material and methods

The counts were carried out during the 1983–1987 breeding seasons along 67 transects with a total length of 162 km. The basic field procedures conformed to the international standard for line-transect censuses of breeding birds (Järvinen & Väisänen 1977). The transects were located in all eight geobotanical regions which occur in Latvian SSR, including more characteristic types of forests (46 transects, 71.9% of total length), mosaic landscapes with bushes (10 transects, 14.7%), fields, meadows, and pastures (9 transects, 9.2%), and bogs (2 transects, 4.2%).

Counts were repeated 3 to 7 times (mainly 4 times) during the breeding season. 29% of the transects were counted annually. The total material consists of about 70 000 observations on 117 bird species.

3. The planning of censuses

According to the standard for FLT, the transect must be planned so that the typical habitats are included approximately in those proportions in which they occur in the given geographical region. Such an approximation is almost impossible in Latvia. The main reasons include a large diversity of forests and sharp differences in breeding densities and in bird detectability. Therefore, we assume that representative samples of bird communities can be obtained if the transect is planned to run in a complex of habitats

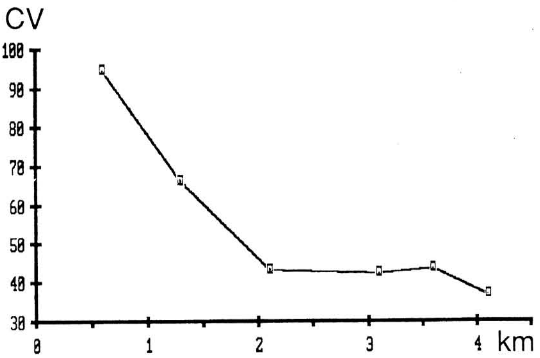

Fig. 1. The average values of coefficients of variation (CV) for the numbers of birds observed in transects of different lengths. Only census material for the 20 most numerous bird species from 6 annually (1983–1987) counted routes with different lengths is included.

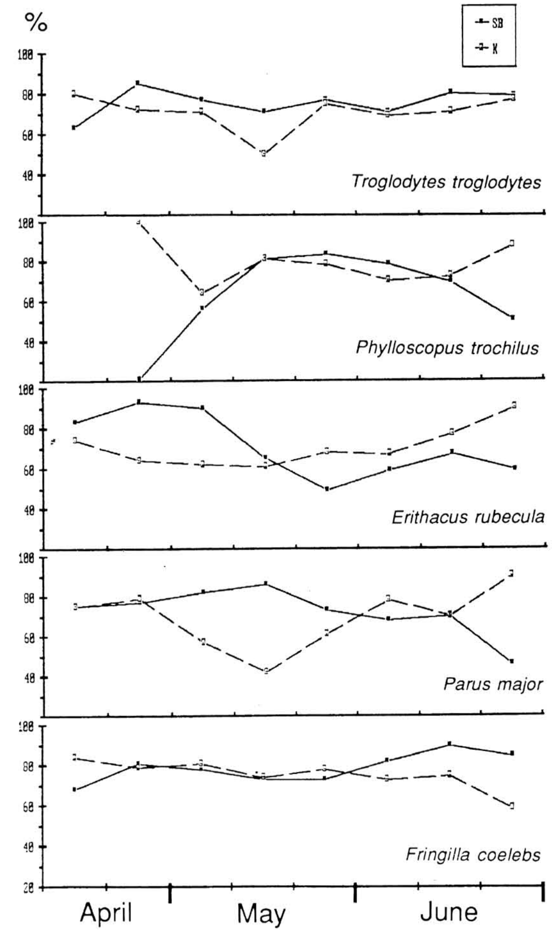

Fig. 2. The dynamics of species average number of records (*SB*) and detectability (*k*) for some of the most common species during the breeding season (1983–1987). The highest values of *SB* and *k* values in each transect was taken as 100%.

with similar census conditions. Those parts of transects with sharp differences in bird and plant communities should be marked and the corresponding records must be processed separately. The variation in the indices obtained in repeated counts greatly depends on the length of the transect. Census material for the 20 most numerous bird species taken from 6 annually counted routes with different lengths, show this dependence. For example, the average values of coefficients of variation (*CV*) for the number of bird records are considerably higher for transects shorter than 2 km (Fig. 1). Short transects also miss many species.

The standard for FLT suggests making only one count per transect in the breeding season. It has been noted that single-visit censuses can give incorrect results which may be affected by the weather conditions or by a shift in the phenological cycle of the season (Hildén 1981, Tomiałojć 1982, 1983, Hildén & Laine 1985). The breeding season in Latvia is relatively long, and activity periods of many bird species are rather short and often do not coincide.

Variation in the number of bird records in the survey belt (SB) and in *k* (species-specific coefficient of detectability) over the season in the five most abundant species was estimated as follows: We grouped the counts from different ten-day periods of the breeding season from mid-April to late June. As a technical standard of comparison for each species, defined as 100%, we used the highest value recorded in a single count. In Fig. 2 we show the average of each ten-day period as percentage of the standard. Only those counts in which the species were actually observed were included; the numbers of counts per ten-day period are shown in the following tabulation (for calculating *k* only those counts were used in which the species were observed in the main belt, and the numbers are somewhat lower):

	April		May			June		
	II	III	I	II	III	I	II	III
T. troglodytes	10	18	43	18	54	50	58	21
Ph. trochilus	–	6	37	20	64	59	66	24
E. rubecula	8	21	47	18	58	57	67	24
P. major	9	18	34	16	48	42	52	18
F. coelebs	9	21	54	20	67	65	72	27

The seasonal dynamics of the *SB* and *k* percentages show great differences between species (Fig. 2). Some species have only one most active period in the breeding season, others have two or no particular peak at all. This shows the necessity for repeated counts.

However, it must be emphasized that the purpose of the FLT method is to obtain a representative sample of bird communities and not to supply absolute data. To obtain most advantages of the FLT method, the number of repeated counts and best census periods must be selected for each study route in Latvia. It is assumed that a sufficient number of repeats ranges from 2 (for very poor habitats) to 4 (for rich habitats). Using the species-specific *SB* or *k* curves (Fig. 2) we can define the most effective census periods characteristic of a large region.

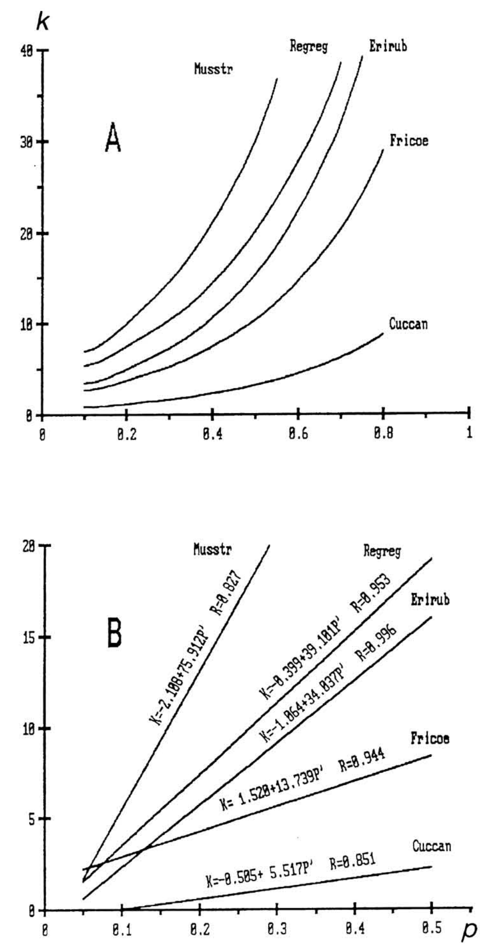

Fig. 3. The relation between the species-specific correction coefficient of detectability (*k*) values and the values of the main belt percentage of observations (p'). A. The exponential model of the *k* and p' relation. B. The linear model of the same relation.

4. The calculation of relative densities of breeding birds

One of the most important question in computing relative breeding bird densities is obtaining species-specific correction coefficients. According to the international standard for the FLT method, all the material is used for calculating *k* values. The average detectability of the species is represented in the *k* value.

The high *k* values for several species were calculated mainly from material with high main belt densities. Obviously, *k* depends on the total breeding bird density, but the influence of such factors as stage of vegetation development and density, singing activity of birds, time of day, and the corresponding number of "loud" singers on census results, are also very important (Järvinen et al. 1977).

Although the influence of total breeding bird density on detectability may by compensated by using a special correction factor "y" (Järvinen & Väisänen 1983), the changes in species detectability during the breeding season have not been taken into account in earlier work.

The grouping of census material according to the total main belt proportion (p'), and using *k* values computed from those groups, partly compensate for the influence of the above-mentioned factors. Theoretically, the values of p' range from 0 to 1. In our data, the ratio of birds observed in the main belt ranges from 0.0 to 0.5. We divided all the material to five groups for the calculation of *k*, with intervals of 0.1. When calculating breeding density for each species, the *k* values are used from those groups in which the corresponding census material is included. This is determined using the ratio of the birds observed in the main belt. When the sample sizes for the calculation of *k* was insufficient for rare species, we combined the total material into three habitat groups with similar census conditions:

1) forests,
2) mosaic landscape with bushes and saplings, and
3) meadows and pastures.

Fig. 3A shows how the coefficient *k* changes when the value of p' increases. The values of *k* here increase as an exponental function of the main belt observation ratio. The species with differing lateral detectability are: *Muscicapa striata* and *Regulus regulus* (low detectability), *Erithacus rubecula* and *Fringilla coelebs* (average detectability), and *Cuculus canorus* (high detectability). In such a way the models of k value changes can be obtained for other bird species if the sample size is sufficient. There are no essential differences between exponential and linear models in the interval $0.0 \leq p' < 0.5$, and $p' > 0.5$ mostly suggests mistakes in censusing. Therefore, in practical computing of relative breeding bird densities we suggest the use of linear models (Fig. 3B).

The FLT method in Latvia may be used for calculating relative breeding densities of 69 bird species. For other species this might be possible in cases when the territorial distribution of birds is relatively even and the total sample sufficient. The FLT method may be used more extensively if there is no need to obtain the density indices. The variation in the number of records during the season for rare species is very high. Therefore, the number of transects in which these species are recorded can itself be used as an index of their annual changes.

In conclusion, it should be noted that only the most important problems of the FLT method and of its application and possible solutions in Latvian conditions were given in this report. Accordingly, the results obtained in our studies show that it is important to adapt the international standard for the FLT method for use in different conditions. This means that the peculiarities characterising the region, for instance, dynamics and length of the breeding and vegetation seasons, structure of bird and plant communities, diversity of habitats and others, must be taken into account.

Acknowledgements. We are grateful to A. Kemlers, A. Strazds, M. Strazds, A. Petriņš and A. Mednis, who participated in the fieldwork.

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Received 27.VIII.1987
Printed 22.XII.1989