Correction coefficients for line transect censuses of breeding birds

Olli Järvinen & Risto A. Väisänen

Järvinen, O. & Väisänen, R. A. 1983: *Correction coefficients for line transect censuses of breeding birds.* — Ornis Fennica 60:97—104.

In line transect censuses of the Finnish type, breeding land birds are recorded in two lists: (1) pairs observed within 25 m of the transect, on the main belt (MB, width 50 m), and (2) pairs on the supplementary belt, which includes all birds beyond 25 m as far as they can be detected. Together, the two belts form the survey belt (SB). This paper gives species-specific, empirically derived correction coefficients that make it possible to convert the survey belt data to values corresponding to the main belt data. This is of great practical importance, because main belt data comprise only about 20 % of all the pairs observed.

Sets of coefficients are given for: (A) the boreal and arctic zones, data from 1973—83; (B) the boreal and arctic zones, data from 1941—83; (C) the southern taiga, 1973—83; and (D) the northern taiga and arctic zone, 1973—83; and, finally, as a novel methodological device, so-called standard coefficients, (E) are presented. The standard coefficients are based on the assumption that increasing bird density impairs detectability in all species in an identical manner. As data for northern species mostly come from areas characterized by low total density, and the opposite is true of southern birds, densities of northern species tend to be underestimated and those of southern species overestimated, when both southern and northern species are observed on one and the same transect. This bias is corrected by the standard coefficients.

Although the line transect coefficients developed in Fennoscandia have been found to be applicable in a number of arctic, boreal and even temperate environments, they may not be adequate for new sets of data. All observers ought to test, preferably species by species, whether their data differ statistically from the extensive data base of this study (over 150 000 pair observations). For this reason, the numbers of pairs observed on MB and SB are given for the various data sets. Formulae are given for calculating new coefficients, if the new data deviate substantially from the present data sets.

Olli Järvinen & Risto A. Väisänen, Department of Zoology, University of Helsinki, P. Rautatiekatu 13, SF-00100 Helsinki 10, Finland

Introduction

In line transect censuses of breeding land birds (Järvinen & Väisänen 1976b, 1977a) the observations fall into two categories: the *main belt* observations, i.e. pairs (see Järvinen & Väisänen 1976b for a definition of the concept) observed within 25 m of the transect, and the *supplementary belt* observations (all other observations). The main belt comprises, on average, only about 20 % of the observations (Järvinen & Väisänen 1975).

This problem can be solved in many ways. One alternative is to discard the use of the two belts and estimate the (right-angle) distances at which the observations are made. Very effective mathematical techniques then become available (Burnham et al. 1980), but we doubt whether accurate distance estimates can be made in forested or semi-open habitats, particularly if all species are censused at the same time. Another alternative is to broaden the main belt. We have not accepted this for two reasons; even the 25-m limit causes errors and substantial interobserver variation unless the observers are very careful, and it is evident that the accuracy of the census cannot be good in the outer parts of a broad main belt.

We have therefore adopted a third option, which is to find correction coefficients that make it possible to convert the supplementary belt data to values corresponding to the main belt data. There are several ways to accomplish this. One is to calculate the proportion of main belt observations; let us assume that it is 0.2. Then all observations, whether from the main or from the supplementary belt, are treated as 0.2 observations each. For a density estimate, the total numbers observed are divided by the area of the main belt. The technique chosen by us (Järvinen & Väisänen 1975) is similar but incorporates the additional assumption that detectability decreases linearly with distance, even within the main belt. Specific correction coefficients are applied to the data in order to derive densities. Such coefficients, called here K (in our previous work $1000k$, see e.g. Järvinen & Väisänen 1975), have earlier been presented only in a stencil, available from us (Järvinen & Väisänen 1977b). As new data have accumulated and as the coefficients can be used in various ways, e.g. for estimating census efficiency (Järvinen 1978a), for estimating confidence limits of density estimates (Järvinen & Väisänen 1983) and for estimating densities in point counts (Järvinen 1978b), we here give the necessary information for those using the Finnish model to make line transect censuses of breeding birds. For a general review of the method, see Järvinen & Väisänen (1981).

Data base

The data stem from standard line transects made in Finland and adjacent areas in 1941—83. The study area is the same 0.5 mill. km^2 area as in Järvinen & Väisänen (1980). For the present purpose we discarded a number of censuses that differed strikingly from the bulk of the censuses, i.e. were probably made without sufficient attention to the estimation of the 25-m limit of the main belt. Our decisions were based on comparison of the proportions of main belt observations of the most common species in censuses made in similar habitats and the same general area.

The observations made in the field are naturally whole numbers. In our data some species have 0.5 pairs (rounded off to the next higher integer in Table 1). This is because we have included only one half of some transects that were made in exceptional habitats for the region.

In many species detectability varies with the season. We have taken this into account only as regards the Black Grouse *Tetrao tetrix*. Data for *T. tetrix* were analysed separately for censuses made before 16 June and from 16 June onwards (this date maximized the detectability difference between early and late June). The data given here pertain to censuses made before 16 June. Results (*SB*, i.e. main +supplementary belts) of censuses made on 16 June or later should be multiplied by 2.058 before applying the *K* value in Table 1. This constant is based on the ratio between the *K* values of late-June and early-June censuses.

Correction coefficients *K*

Table 1 gives the complete data. Before explaining each column in detail, we wish to make a few general points regarding the use of *K*.

The coefficients may not be applicable to new sets of data, although experience shows that Finnish coefficients may be applicable to new areas as different as a mountain birch forest in Swedish Lapland (Järvinen et al. 1978a) and a primaeval forest in eastern Poland (Järvinen et al. 1978b). We therefore urge that new observers test whether their data differ statistically from our extensive data set (over 150 000 observations). The tests should be made, if possible, species by species, or by species groups. The expected values for the χ^2 or G tests can be derived from Table 1. *MB* is used as such, and the supplementary belt is equal to *SB* minus *MB* (*SB* should not be used as it includes *MB* and so the number of observations would be inflated in the test). Application of our data to single-habitat censuses requires extreme caution, as our line transects were made in a great variety of habitats.

The observer's own data can be added quite easily to those given in Table 1. The formula for *K* is (Järvinen & Väisänen 1975)

$$K = 40 - 40\sqrt{1-p},$$

where p = proportion of main belt observations (range 0–1). Calculation of a new value for *K* is advisable if the observer's data add substantially to the data base given in Table 1.

Because of earlier misunderstandings (Svensson 1980), we wish to point out that the correction coefficient *K* does *not* remove the bias caused by the incompleteness of one-visit transects (Järvinen & Väisänen 1975:320; see also Järvinen 1978a, Järvinen et al. 1978a, 1978b, Tiainen et al. 1980). Hence, the densities obtained are *not* absolute densities (cf. Hildén 1981). For the statistics of *K*, see Järvinen (1976). Finnish readers are also advised to consult Vickholm (1982).

Let us now turn to the five columns in Table 1. The whole study area (columns A–B) represents the arctic and boreal zones in Finland and adjacent areas. The southern part of the study area (column C) mainly represents the Finnish south-boreal zone, but includes part of the hemiboreal zone near Leningrad in the USSR. The northern part of the study area (column D) mainly represents the north-boreal zone, but includes most of the mid-boreal zone and large areas in the hemiarctic and (oro)arctic zones. For the biogeographical terminology, see Järvinen & Väisänen (1980).

Column A: Whole study area 1973—83. Except for a number of rare species (see below), we recommend this column for use if densities are estimated using the method given in Järvinen & Väisänen (1975) and modified in Järvinen & Väisänen (1976a). Simply, density is obtained by dividing the number of all observations (main belt + supplementary belt) by the length of the transect (in km), and the ratio is multiplied by *K*. The result must finally be multiplied by y (Järvinen & Väisänen 1976a), which depends on bird density. Instead of the formula given in Järvinen & Väisänen (1976a) or in Järvinen & Väisänen (1977b), the new data now yield

$$y = 0.0302\,x + 0.684,$$

where x = number of main belt observations of all species per km. The method based on y is not entirely satisfactory, as its applicability *must* be checked each time (see Järvinen & Väisänen 1980:68).

For a number of rare species the data are insufficient (see especially Järvinen 1976). If the data are more extensive for the years 1941—83, we have referred the reader to column B (a tentative estimate of *K* has been given in column A if the number of observations exceeds 10). For cases in which even the data for 1941—83 are insufficient, we have presented our 'guesstimate' (always denoted with an asterisk after the *K* value). The 'guesstimates' follow a logarithmic scale from 0.5 through 1, 2, 4 and 8 to 16.

Column B: Whole study area 1941—83. These data are for nearly all the species more extensive than those given in column A. They can be used in the same way as those in column A, but, with the exception of a number of rare species (see above), we recommend the temporally more homogeneous column A. The 'guesstimates' are indicated by asterisks (see above).

Column C: Southern part of the study area, 1973—83. These data can be used in typical South Finnish areas south of the Finnish uniform grid coordinate 71 (approximately south of Lake Oulujärvi). Here *K* is generally higher than in A because densities are higher in the south than in the north. We do not recommend that the correction based on *y* (see above) be made if column C is used. In Central Finland, close to coordinate 71, the data for the whole country are probably more representative.

Column D: Northern part of the study area, 1973—83. As for C, but the data stem from areas north of the uniform grid coordinate 71.

Column E: Standard coefficients for main belt density 200 pairs/km^2 (or 10 main belt observations per km of transect). This column is based on the assumption that density affects detectability as expressed in our formula for *y*, and, moreover, that this effect is identical for all species. We have therefore calculated the average main belt density at which the observations of each species were made; many northern species were usually observed at low densities and southern species at high densities. We then corrected the *K* value (column A; column B was used only if we recommend that B be used instead of A), using the formula for *y*, so that the *K* values in column

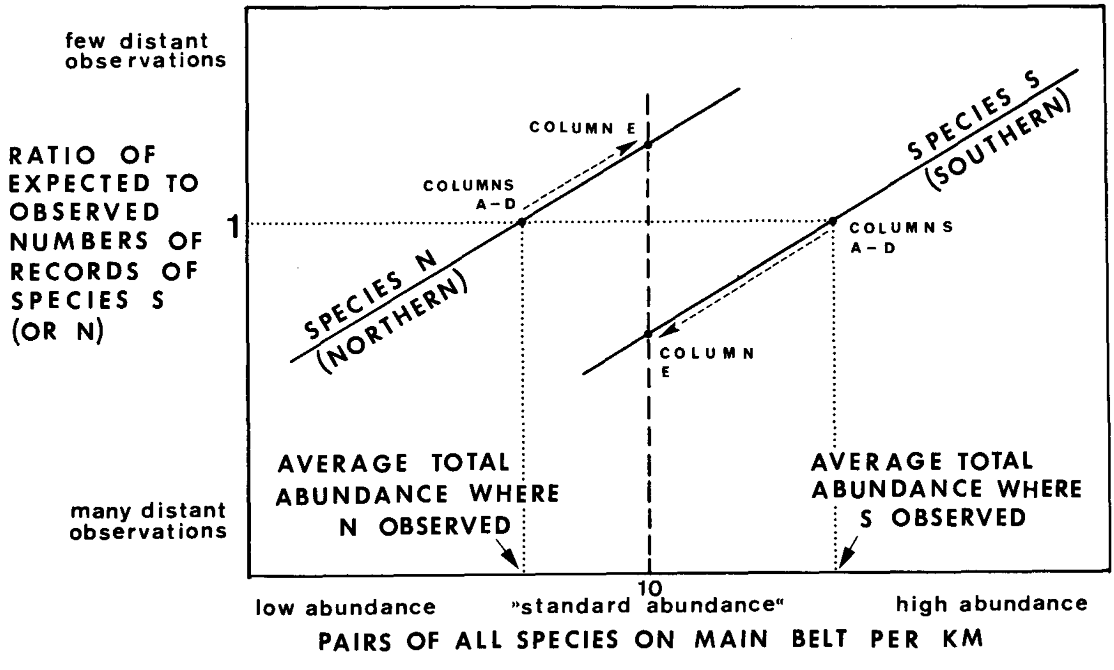

Fig. 1. An example illustrating the assumptions and effects of the method used for column E (see Table 1). Main belt abundance (x = observations of all species per km) on the abscissa; the ratio of expected to observed numbers of observations (main belt + supplementary belt) on the ordinate. The two parallel lines (for a northern species N and for a southern species S) show the assumed effect of density on detectability: the higher the density, the fewer observations are made (at greater distances) as compared to the expectations based on main belt densities. Here we assume that the relationship for each species has the same slope as that derived empirically for all species together. The *K* value for species N is thus based on northern transects, where main belt abundances are probably lower than 10 pairs/km; the opposite is true of species S. Let us now assume that a census is made in an area where the average main belt abundance is 10 pairs/km: this is called the standard abundace here. Using columns A–D tends to give too low a *K* for species N and too high a value for species S. This effect is corrected in column E, so that the *K* values correspond to the standard abundance for all species. As most transects will have densities clearly differing from the standard, the results must finally be multiplied by *Y* (see text).

E correspond to a constant density (10 pairs of main belt observations per km). Thus these K values should be maximally comparable, provided that the assumptions are valid. The general effect was that K values for northern species were increased, while those for southern species were decreased. Densities can be calculated by multiplying the number of observations (main belt + supplementary belt) by K and dividing by the length of the transect (in km). Then the effect of density is corrected by multiplying the results by

$$Y = 1 + 0.0302\,(x–10),$$

where x = number of main belt observations of all species per km (i.e. the same definition as above). Y is necessary because the abundance of all birds on the main belt is x instead of 10 pairs/km.

Fig. 1 shows the assumptions and effects of the method used for calculating column E. In brief, *if the assumptions are correct,* northern species will be underestimated and southern species overestimated, unless column E is used.

Concluding remarks

Our Table 1 is useful for several purposes, listed in our Introduction. Table 1 also reveals patterns of bird-observer interaction. For example, with two similar congeners, the rarer tends to have a higher K (cf. *Anthus pratensis* and *A. cervinus*). This probably has a natural explanation, for the observers tend to identify the distant birds as belonging to the common species. The observers assume that this has a negligible effect on the results, which is indeed correct. This misidentification problem is serious only if *main belt* observations are not identified correctly.

Similarly, it may be pointed out that some species are more active in the evening or outside the census period (e.g. in early May). This is undoubtedly true, but the effect is significant only if census efficiency on the *main belt* is affected (an increased number of observations from the supplementary belt does not increase final estimates of density, as K would be decreased). The efficiency of line transect censuses of the Finnish type is a function of censusing the *main belt,* and the present coefficients *(K)* are merely a simple way to interpret the relationship between the main belt and the supplementary belt. We believe that Hildén (1981) has erected an abominable straw man in his attempt to demolish the line transect method. As the title of our main series of methodological papers is "Estimating relative densities of breeding land birds by the line transect method", as opposited to "Estimating absolute densities. . .", we doubt whether our readers have been misled.

Svensson (1980) also argues that we (Järvinen & Väisänen 1975) assume census efficiency to be 100 % along the transect. This is not true. Järvinen & Väisänen (1975:320) actually estimated that the true densities are about 1.3 to 1.6 times those found along the transect, and later empirical data (Järvinen et al. 1978a, 1978b, Tiainen et al. 1980; see also Järvinen 1978a) have supported this interpretation.

We wish to make a final comment upon our columns A-E. As emphasized by Järvinen (1976), a definitive advantage of our method lies in the possibility of using a "memory", the data accumulated in a large number of previous censuses. Our choice of five sets of K reflects the availability of different options. Columns A and B are almost interchangeable. If temporal heterogeneity is accepted (involving changes in densities), the column indicated is B. C and D are recommended for southernmost and northernmost Finland, respectively. Statistical tests will certainly be the best guide here. Finally, we recommend column E to all authors who are willing to explore the possibility that our formula for y is more or less applicable to all species separately.

Selostus: **Tiheyksien laskeminen linja-arvioinnin tutkimussaran havaintomääristä**

Linja-arvioinnissa noin 20 % parihavainnoista kertyy 50 m leveältä pääsaralta ja noin 80 % sen ulkopuoliselta apusaralta, jolta lintuja lasketaan niin kaukaa kuin ne voidaan ilman erityistä kaukohavaintojen kiikarointia havaita. Yhdessä nämä kaksi sarkaa muodostavat tutkimussaran. Tässä kirjoituksessa annetaan vuosina 1941—83 kertyneestä yli 150 000 parihavainnon aineistosta lasketut lajikohtaiset kuuluvuuskertoimet (tai "havaittavuuskertoimet"). Niiden avulla voi muuntaa tutkimussarka-aineiston pääsarkaa vastaavaksi. Tämä on suomalaisen linjalaskentamenetelmän huomattava etu, koska näin saadaan tiheydet lasketuksi monin verroin suuremmasta aineistosta kuin pelkkää pääsarkaa käytettäessä.

Taulukon 1 sarakkeessa A esitetään Suomen, Pohjois-Ruotsin, Ruijan ja Leningradin seudun kattavalta tutkimusalueelta v. 1973—83 kerätystä aineistosta kullekin lajille kuuluvuuskerroin (K) sekä havaintomäärät (MB = pääsarka, SB = tutkimussarka). Kerroin K on laskettu käyttäen kaavaa $K = 40 - 40\sqrt{1 - p}$, missä p tarkoittaa pääsarkahavaintojen osuutta (vaihteluväli 0–1) kaikkien havaintojen määrästä. Tiheydet saadaan jakamalla aineiston tutkimussarkahavaintojen määrä laskentalinjan pituudella ja kertomalla osamäärä kuuluvuuskertoimella K. Tulos kerrotaan vielä kertoimella y, jonka suuruus riippuu kokonaislinnuston tiheydestä. Kerroin saadaan kaavasta $y = 0.0302\,x + 0.684$, missä x tarkoittaa koko maalinnuston pääsarkahavaintojen määrää reittikilometriä kohden. Tätä korjausta ei pidä tehdä automaattisesti, vaan y-kertoimen mielekkyys on tutkittava erikseen kussakin aineistossa (ks. Järvinen & Väisänen 1980:68).

Useista harvinaisista lajeista aineisto ei ole ollut riittävä kuuluvuuskertoimen laskemiseen. Tällöin sarakkeessa A voi olla K-kertoimen perässä tähti, joka tarkoittaa, että kerroin on valittu harkinnan mukaan arvoista 0.5, 1, 2, 4, 8 tai 16. Mikäli kertoimen perässä on koodi B, käyttöön suositellaan sarakkeen B suuremmasta vuosien 1941—83 aineistosta laskettua *K*-kerrointa. B-sarakkeen kuuluvuuskerrointa käytettäessä on myös syytä tutkia *y*-korjauksen soveltamista.

Tutkimusalue jaettiin yhtenäiskoordinaattia 71 pitkin etelä- ja pohjoispuoliskoon (raja kulkee Oulujärven eteläpuolella). Taulukon 1 sarakkeissa C ja D esitellään kuuluvuuskertoimet Etelä- ja Pohjois-Suomelle. Sarakkeen C kertoimet ovat yleensä suurempia kuin sarakkeen D arvot, mihin vaikuttaa biotooppien rakenne ja Etelä-Suomessa suurempi linnuston tiheys (ja hälyvaikutus). Sarakkeiden C tai D kertoimia käytettäessä ei tarvitse soveltaa *y*-korjausta. Jos näissä sarakkeissa on koodi A tai B, otetaan käyttöön vastaavan sarakkeen kuuluvuuskerroin. Lähellä yhtenäiskoordinaattia 71 olevilla tutkimusalueilla kannattaa käyttää koko tutkimusalueelle laskettuja kuuluvuuskertoimia sarakkeista A tai B.

Taulukon 1 sarakkeessa E annetaan lopuksi uusi kuuluvuuskerroin, ns. standardikerroin, jonka teoria esitetään kuvassa 1.

Vaaka-akselilla esitetään koko maalinnuston runsaus pääsaralla ja pystyakselilla odotettujen ja havaittujen parimäärien suhde tutkimussaralla. Kuviosta näkyy, miten oletetun eteläisen (S) ja pohjoisen (N) lajin havaittavuus muuttuu koko linnuston tiheyden (eli hälyvaikutuksen) muuttuessa: mitä enemmän lintuja on laulamassa, sitä vaikeampi on havaita yksittäisen lajin S tai N laulajia etäältä kulkulinjasta. Oletamme, että hälyvaikutus vähentää yksittäisten lajien havaittavuutta etäisyyden kasvaessa samassa suhteessa koko linnustossa, joten lajien kuvaajat ovat kuviossa samansuuntaisina. Lajin N kuuluvuuskerroin tulee lasketuksi enimmäkseen pohjoisilta linjoilta, joilla kokonaislintutiheys on todennäköisesti alhaisempi kuin standardiksi valittu 10 paria pääsarkakilometriä kohden (= 200 paria/km^2); eteläisellä lajilla asia on päinvastoin. Jos laskenta tehdään "keskimääräisellä" alueella, missä tiheys on suunnilleen 200 paria/km^2, ovat taulukon 1 sarakkeiden A–D kuuluvuuskertoimet liian alhaisia lajille N ja liian korkeita lajille S. Tämän seurauksena pohjoisen lajin tiheys tulee jossakin määrin aliarvioiduksi ja eteläisen lajin tiheys yliarvioiduksi.

Standardikertoimella pyritään poistamaan tämä harha, mutta laskutoimitusten määrä kasvaa, koska suosittelemme, että kukin laskentalinja käsitellään erikseen. Sarakkeen E kuuluvuuskerrointa sovelletaan, kuten edellä neuvottiin sarakkeen A kuuluvuuskertoimen yhteydessä, mutta korjauskerroin *y* muuttuu uudeksi: $Y = 1 + 0.0302\,(x-10)$, missä x tarkoittaa — kuten edelläkin — kokonaislinnuston pääsarkahavaintojen määrää reittikilometriä kohden. Kerrointa Y käytetään, koska yleensä lintujen runsaus pääsaralla ei ole täsmälleen 10 paria/km, vaan x.

Taulukosta 1 havaitaan, että samantyyppisissä ympäristöissä asustavista sukulaislajeista harvalukuisempi saa korkeamman kuuluvuuskertoimen (esim. niittykirvinen ja lapinkirvinen). Tämä johtuu siitä, että laskijat silloin tällöin erehtyvät lukemaan kaukaa kuuluvan linnun yleisempään lajiin. Ongelma on vakava vain jos *pääsarkahavaintoja* ei määritettäisi oikein. — Yleensäkin linja-arvioinnin tehokkuuteen liittyvät väärinkäsitykset ovat saaneet alkunsa siitä, että ei ole ymmärretty sen määräytyvän pääsaran laskennan tehokkuudesta (joka lienee keskimäärin 60 % normaalilaskennoissa). Kuuluvuuskertoimet vain kuvaavat yksinkertaisella tavalla pääsarka- ja apusarkahavaintojen suhdetta ja muuntavat apusarkahavainnot laskelmia varten sopiviksi.

Vaikka kuuluvuuskertoimet ovat osoittautuneet hyödyllisiksi mitä erilaisimmissa ympäristöissä Ruijan tunturinummilta Keski-Euroopan ikimetsiin, ne eivät kenties sovi uusiin aineistoihin. Erityisesti yhtenäisestä biotoopista muutaman päivän aikana kerättyjen aineistojen suhteen on syytä olla varuillaan. Ensin on — mieluiten laji lajilta — verrattava χ^2- tai G-testillä, poikkeaako aineiston pääsarka- ja *apu*sarkahavaintojen (tässä vertailussa ei saa käyttää tutkimussarkahavaintoja) jakautuma taulukossa 1 annetuista havaintomääristä. Jos erot ovat tilastollisesti selviä, voi lajille laskea uuden kuuluvuuskertoimen joko kokonaan omista aineistoista tai yhdistämällä omat ja taulukon 1 sopivan sarakkeen havaintomäärät.

References

Burnham, K. P., Anderson, D. R. & Laake, J. L. 1980: Estimation of density from line transect sampling of biological populations. — Wildl. Monogr. 72:1—202.

Hildén, O. 1981: Sources of error involved in the Finnish line-transect method. — Stud. Avian Biol. 6:152—159.

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

Järvinen, O. 1978a: Species-specific census efficiency in line transects. — Ornis Scand. 9:164—167.

Järvinen, O. 1978b: Estimating relative densities of land birds by point counts. — Ann. Zool. Fennici 15:290—293.

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

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

Järvinen, O. & Väisänen, R. A. 1976b: Finnish line transect censuses. — Ornis Fennica 53:115—118.

Järvinen, O. & Väisänen, R. A. 1977a: Line transect method: a standard for field-work. — Pol. Ecol. Stud. 3(4):11—15.

Järvinen, O. & Väisänen, R. A. 1977b: Constants and formulae for analysing line transect data. — Mimeogr., 11 pp., Helsinki.

Järvinen, O. & Väisänen, R. A. 1980: Quantitative biogeography of Finnish land birds as compared with regionality in other taxa. — Ann. Zool. Fennici 17:67—85.

Järvinen, O. & Väisänen, R. A. 1981: Methodology for censusing land bird faunas in large regions. — Stud. Avian Biol. 6:146—151.

Järvinen, O. & Väisänen, R. A. 1983: Confidence limits for estimates of population density in line transects. — Ornis Scand. 14:129—134.

Järvinen, O., Väisänen, R. A. & Enemar, A. 1978a: Efficiency of the line transect method in mountain birch forest. — Ornis Fennica 55:16—23.

Järvinen, O., Väisänen, R. A. & Walankiewicz, W. 1978b: Efficiency of the line transect method in Central European forests. — Ardea 66:103—111.

Svensson, S. 1980: Comparison of bird census methods. — *In* Oelke, H. (ed.): Bird census work and nature conservation, pp. 13—22. Göttingen.

Tiainen, J., Martin, J.-L., Pakkala, T., Piiroinen, J., Solonen, T., Vickholm, M. & Virolainen, E. 1980: Efficiency of the line transect and point count methods in a South-Finnish forest area. — *In* Oelke, H. (ed.): Bird census work and nature conservation, pp. 107—113. Göttingen.

Vickholm, M. 1982: Tutkimussarka ja korjauskertoimet (Summary: The survey belt and correction coefficients). — Lintumies 17:69—72.

Received September 1983

Table 1. Five sets (A–E) of correction coefficients for line transect censuses of breeding land birds. The five columns are explained in detail in the text. *MB* indicates the number of main belt observations, and *SB* the number of survey belt (= main belt + supplementary belt) observations. For column E, the numbers of observations are as in A or B (see text). Asterisks denote *K* values that are not based on direct computation, but are presented as 'guesstimates'. *K* values given as A or B indicate that these columns should be consulted for the species in question. B following a *K* value (column A) indicates that column B is to be preferred because of a substantially larger data base in column B than in column A. *Loxia curvirostra* includes *Loxia* sp.

	A			B			C			D			E
	Total 1973-83			Total 1941-83			South 1973-83			North 1973-83			Standard
	K	MB	SB	K	MB	SB	K	MB	SB	K	MB	SB	K(10 p/km)
Botaurus stellaris	1.000 *	0/	1	1.000 *	0/	2	A	0/	1	A	0/	0	A
Ardea cinerea	1.000 *	0/	2	1.000 *	0/	2	A	0/	2	A	0/	0	A
Pernis apivorus	7.929 B	5/	14	6.534	6/	20	B	4/	8	B	1/	6	7.146
Haliaeetus albicilla	0.500 *	0/	2	0.500 *	0/	2	A	0/	1	A	0/	1	A
Circus aeruginosus	0.500 *	0/	5	0.500 *	0/	5	A	0/	5	A	0/	0	A
Circus cyaneus	3.819	4/	22	3.205	4/	26	A	1/	5	A	3/	17	4.172
Accipiter gentilis	5.806	7/	26	5.746	8/	30	A	6/	18	A	1/	8	5.623
Accipiter nisus	5.021 B	4/	17	3.819	4/	22	B	4/	15	B	0/	2	3.674
Buteo buteo	4.079	9/	47	2.680	9/	70	4.889	7/	31	B	2/	16	4.150
Buteo lagopus	0.899	2/	45	0.696	2/	58	A	0/	0	0.899	2/	45	1.042
Aquila chrysaetos	0.500 *	0/	3	0.500 *	0/	5	A	0/	0	A	0/	3	A
Pandion haliaetus	0.500 *	0/	24	0.500 *	0/	29	A	0/	18	A	0/	6	A
Falco tinnunculus	0.879 B	1/	23	1.231	2/	33	B	0/	13	B	1/	10	1.320
Falco columbarius	- B	2/	8	2.762	2/	15	B	0/	0	B	2/	8	3.180
Falco subbuteo	- B	1/	12	1.013	1/	20	B	0/	5	B	1/	7	1.084
Falco peregrinus	0.500 *	0/	1	0.500 *	0/	2	A	0/	0	A	0/	1	A
Bonasa bonasia	15.650	107/	170	16.403	148/	227	16.336	91/	140	12.675	16/	30	14.842
Lagopus lagopus	12.927	49/	90	13.420	65/	116	A	2/	5	13.176	47/	85	15.001
Lagopus mutus	9.449	15/	36	9.865	16/	37	A	0/	0	9.449	15/	36	11.409
Tetrao tetrix	3.798	73/	404	4.446	125/	595	3.741	54/	303	3.971	19/	101	3.729
Tetrao urogallus	16.503	47/	71	17.844	92/	132	15.000	20/	32	17.812	27/	39	17.888
Perdix perdix	16.000 *	0/	0	16.000 *	1/	1	A	0/	0	A	0/	0	A
Coturnix coturnix	16.000 *	0/	0	16.000 *	0/	1	A	0/	0	A	0/	0	A
Phasianus colchicus	1.270	10/	160	1.262	10/	161	1.270	10/	160	A	0/	0	1.143
Rallus aquaticus	4.000 *	0/	7	4.000 *	0/	7	A	0/	7	A	0/	0	A
Porzana porzana	4.000 *	1/	3	4.000 *	1/	4	A	1/	3	A	0/	0	A
Crex crex	8.377 B	6/	16	6.913	6/	19	B	6/	16	B	0/	0	5.904
Grus grus	0.338	2/	119	0.553	5/	182	0.352	1/	57	0.324	1/	62	0.355
Haematopus ostralegus	0.920	1/	22	0.920	1/	22	1.013	1/	20	A	0/	2	0.770
Charadrius dubius	5.359 B	3/	12	6.971	7/	22	B	2/	8	B	1/	4	7.148
Charadrius hiaticula	7.801	22/	63	7.889	24/	68	A	3/	7	7.562	19/	56	8.553
Eudromias morinellus	9.565 B	8/	19	9.449	10/	24	B	0/	0	B	8/	19	11.445
Pluvialis apricaria	3.374	106/	656	3.385	112/	691	2.518	5/	41	3.432	101/	615	3.958
Vanellus vanellus	3.398	102/	627	3.254	118/	756	3.412	90/	551	3.293	12/	76	3.157
Calidris temminckii	11.336	9/	19	11.336	9/	19	A	0/	0	11.336	9/	19	12.946
Calidris maritima	8.000 *	1/	1	8.000 *	1/	1	A	0/	0	A	1/	1	A
Calidris alpina	7.451	13/	37	7.451	13/	37	A	0/	0	7.451	13/	37	8.534
Limicola falcinellus	4.223	7/	35	4.410	10/	48	A	0/	0	4.223	7/	35	4.671
Philomachus pugnax	5.131	55/	227	5.262	59/	238	A	2/	18	5.387	53/	209	5.584
Lymnocryptes minimus	0.415 B	1/	49	0.338	1/	60	B	0/	0	B	1/	49	0.383
Gallinago gallinago	2.418	92/	781	2.347	105/	918	2.815	44/	324	2.138	48/	457	2.458
Scolopax rusticola	16.906	36/	54	17.301	40/	59	15.683	29/	46	A	7/	8	15.083
Limosa limosa	2.000 *	0/	1	2.000 *	0/	1	A	0/	1	A	0/	0	A
Limosa lapponica	2.000 *	3/	5	2.000 *	3/	5	A	0/	0	A	3/	5	A
Numenius phaeopus	1.532	24/	320	1.487	32/	439	4.918	6/	26	1.246	18/	294	1.765
Numenius arquata	1.060	29/	555	1.039	37/	721	0.803	16/	403	1.749	13/	152	1.050
Tringa erythropus	4.223	19/	95	3.302	22/	139	A	0/	3	4.369	19/	92	4.738
Tringa totanus	2.363	25/	218	2.438	26/	220	2.383	20/	173	2.288	5/	45	2.064
Tringa nebularia	1.555	22/	289	1.147	27/	478	2.212	5/	47	1.431	17/	242	1.730
Tringa ochropus	3.727	39/	220	3.436	43/	262	3.745	34/	191	3.611	5/	29	3.661
Tringa glareola	3.553	182/	1072	3.158	211/	1391	2.691	15/	112	3.655	168/	961	3.992
Actitis hypoleucos	4.769	37/	165	4.605	46/	212	5.056	27/	114	4.135	10/	51	4.465
Arenaria interpres	6.534	3/	10	6.534	3/	10	A	0/	0	6.534	3/	10	7.525
Phalaropus lobatus	3.245	13/	84	3.300	14/	89	A	0/	1	3.287	13/	83	3.617
Stercorarius longicaudus	1.749	7/	76	1.784	8/	86	A	0/	0	1.749	7/	76	2.097
Columba livia	7.340	23/	69	5.746	24/	90	7.340	23/	69	A	0/	0	3.634
Columba oenas	1.013	6/	120	0.956	6/	127	1.013	6/	120	A	0/	0	0.778
Columba palumbus	1.564	128/	1663	1.540	143/	1887	1.556	117/	1527	1.652	11/	136	1.400
Streptopelia decaocto	8.000 *	0/	1	8.000 *	0/	1	A	0/	0	A	0/	1	A
Streptopelia turtur	4.000 *	0/	11	4.000 *	0/	11	A	0/	11	A	0/	0	A
Cuculus canorus	0.764	70/	1850	0.639	78/	2463	0.698	37/	1069	0.855	33/	781	0.780
Bubo bubo	8.000 *	2/	6	8.000 *	2/	6	A	2/	4	A	0/	2	A
Nyctea scandiaca	1.000 *	0/	1	1.000 *	0/	1	A	0/	0	A	0/	1	A
Surnia ulula	- B	3/	9	6.718	4/	13	B	0/	0	A	3/	9	8.171
Glaucidium passerinum	16.000 *	0/	1	16.000 *	0/	1	A	0/	1	A	0/	0	A
Strix aluco	8.000 *	2/	6	8.000 *	2/	6	A	2/	6	A	0/	0	A
Strix uralensis	- B	2/	8	6.534	3/	10	B	1/	5	B	1/	3	6.621
Strix nebulosa	8.000 *	0/	1	8.000 *	0/	1	A	0/	0	A	0/	1	A
Asio otus	8.000 *	1/	4	8.000 *	1/	6	A	1/	4	A	0/	0	A
Asio flammeus	3.368 B	5/	31	3.122	6/	40	A	0/	6	4.223	5/	25	3.572
Aegolius funereus	8.000 *	0/	0	8.000 *	1/	1	A	0/	0	A	0/	0	A
Caprimulgus europaeus	- B	2/	5	9.763	3/	7	B	2/	5	B	0/	0	8.949
Apus apus	0.875	28/	647	0.985	36/	740	0.892	25/	567	0.757	3/	80	0.782
Alcedo atthis	16.000 *	0/	1	16.000 *	0/	1	A	0/	1	A	0/	0	A
Jynx torquilla	2.400	22/	189	2.254	23/	210	2.943	18/	127	1.312	4/	62	2.336

	A			B			C			D			E
	Total 1973-83			Total 1941-83			South 1973-83			North 1973-83			Standard
	K	MB	SB	K	MB	SB	K	MB	SB	K	MB	SB	K(10 p/km)
Picus canus	9.321	7/	17	9.321	7/	17	9.321	7/	17	A	0/	0	6.878
Dryocopus martius	0.933	5/	109	1.010	9/	181	1.160	5/	88	A	0/	21	0.898
Dendrocopos major	5.059	109/	460	4.668	129/	587	5.049	79/	334	5.085	30/	126	4.933
Dendrocopos leucotos	8.000 *	0/	0	8.000 *	1/	1	A	0/	0	A	0/	0	A
Dendrocopos minor	7.929 B	5/	14	6.393	5/	17	B	4/	10	B	1/	4	5.337
Picoides tridactylus	13.333 B	10/	18	7.526	15/	44	B	1/	3	B	9/	15	8.912
Lullula arborea	3.082	4/	27	3.082	4/	27	3.082	4/	27	A	0/	0	2.901
Alauda arvensis	3.551	398/	2346	3.492	435/	2605	3.516	373/	2219	4.153	25/	127	3.333
Eremophila alpestris	5.888 B	3/	11	4.223	6/	30	B	0/	0	B	3/	11	5.135
Riparia riparia	2.737	23/	174	1.423	32/	458	3.526	15/	89	1.929	8/	85	2.788
Hirundo rustica	2.980	103/	718	3.253	147/	942	3.073	91/	616	2.427	12/	102	2.797
Delichon urbica	4.368	99/	480	4.338	116/	565	4.666	97/	442	1.067	2/	38	3.960
Anthus trivialis	4.025	1165/	6096	3.808	1434/	7908	4.482	890/	4207	3.026	275/	1889	4.012
Anthus pratensis	5.390	495/	1970	5.310	537/	2167	7.751	70/	200	5.133	425/	1770	6.204
Anthus cervinus	9.865	24/	56	9.865	24/	56	A	0/	0	9.865	24/	56	11.543
Anthus spinoletta	8.000 *	0/	1	8.000 *	0/	1	A	0/	0	A	0/	1	A
Motacilla flava	8.395	509/	1354	7.735	568/	1625	7.964	100/	278	8.507	409/	1076	9.129
Motacilla alba	8.354	412/	1100	8.035	475/	1313	8.712	358/	921	6.574	54/	179	7.681
Bombycilla garrulus	4.223 B	3/	15	3.122	3/	20	B	0/	1	B	3/	14	3.625
Cinclus cinclus	4.000 *	0/	1	4.000 *	0/	1	A	0/	0	A	0/	1	A
Troglodytes troglodytes	5.556	38/	147	5.006	42/	179	5.647	37/	141	A	1/	6	5.130
Prunella modularis	4.138	180/	918	4.104	186/	956	4.384	153/	739	3.140	27/	179	3.933
Erithacus rubecula	6.381	726/	2471	6.199	790/	2761	6.687	659/	2149	4.404	67/	322	6.021
Luscinia luscinia	2.545	17/	138	2.435	17/	144	2.545	17/	138	A	0/	0	2.090
Luscinia svecica	5.235	97/	397	5.193	105/	433	A	0/	0	5.235	97/	397	6.129
Phoenicurus phoenicurus	3.193	232/	1514	2.855	335/	2436	3.582	74/	433	3.039	158/	1081	3.538
Saxicola rubetra	7.248	249/	756	6.442	296/	1000	8.962	188/	473	4.572	61/	283	7.392
Oenanthe oenanthe	7.677	224/	646	7.729	262/	751	10.133	100/	226	6.428	124/	420	8.372
Turdus torquatus	2.125	3/	29	2.125	3/	29	A	0/	0	2.125	3/	29	2.600
Turdus merula	5.104	305/	1275	5.065	309/	1301	5.136	302/	1255	3.122	3/	20	4.254
Turdus pilaris	5.905	753/	2752	5.736	858/	3221	6.179	645/	2263	4.664	108/	490	5.405
Turdus philomelos	3.692	502/	2848	3.596	590/	3433	4.322	439/	2145	1.834	63/	703	3.557
Turdus iliacus	4.902	1437/	6246	4.699	1555/	7032	5.566	903/	3486	4.081	535/	2760	4.913
Turdus viscivorus	3.125	30/	197	3.143	51/	335	3.329	21/	129	2.741	9/	68	3.242
Locustella naevia	3.205 B	2/	13	4.544	3/	14	B	2/	13	B	0/	0	4.051
Locustella fluviatilis	8.000 *	1/	2	8.000 *	1/	2	A	1/	2	A	0/	0	A
Acrocephalus schoenobaenus	5.592	110/	423	5.424	112/	443	6.107	88/	312	4.183	22/	111	5.120
Acrocephalus dumetorum	7.340 B	6/	18	6.913	6/	19	B	6/	18	B	0/	0	5.853
Acrocephalus palustris	14.045	11/	19	14.045	11/	19	14.045	11/	19	A	0/	0	10.661
Acrocephalus scirpaceus	4.875	38/	166	4.875	38/	166	4.875	38/	166	A	0/	0	3.688
Acrocephalus arundinaceus	4.000 *	0/	2	4.000 *	0/	2	A	0/	2	A	0/	0	A
Hippolais icterina	9.374	36/	87	8.909	38/	96	9.500	36/	86	A	0/	1	6.650
Sylvia nisoria	10.528	16/	35	10.528	16/	35	10.528	16/	35	A	0/	0	9.293
Sylvia curruca	5.637	167/	636	5.325	193/	775	6.003	145/	521	4.029	22/	115	5.247
Sylvia communis	6.225	248/	864	6.210	297/	1037	6.281	248/	857	A	0/	7	5.382
Sylvia borin	4.246	570/	2833	4.242	683/	3398	4.408	544/	2610	2.404	26/	223	3.719
Sylvia atricapilla	5.523	100/	389	5.516	104/	405	5.509	99/	386	A	1/	3	4.309
Phylloscopus trochiloides	8.448	17/	45	7.854	17/	48	9.139	17/	42	A	0/	3	7.912
Phylloscopus borealis	4.000 *	0/	4	4.000 *	0/	5	A	0/	0	A	0/	4	A
Phylloscopus sibilatrix	4.784	205/	912	4.774	223/	994	4.840	202/	889	2.700	3/	23	4.290
Phylloscopus collybita	3.305	221/	1392	3.206	267/	1732	3.413	206/	1258	2.305	15/	134	3.076
Phylloscopus trochilus	3.934	4084/	21839	3.815	4869/	26805	4.547	2683/	12510	3.127	1402/	9329	3.970
Regulus regulus	8.514	621/	1633	8.366	674/	1800	8.650	551/	1429	7.581	70/	204	7.917
Muscicapa striata	9.923	913/	2100	9.084	1056/	2622	10.834	596/	1272	8.576	317/	828	9.709
Ficedula parva	7.340	8/	24	7.015	8/	25	7.697	8/	23	A	0/	1	6.612
Ficedula hypoleuca	5.858	290/	1067	5.585	364/	1400	6.606	217/	715	4.388	73/	352	5.580
Aegithalos caudatus	10.896 B	8/	17	13.032	12/	22	B	8/	17	B	0/	0	9.828
Parus montanus	8.543	508/	1332	7.850	688/	1944	8.932	366/	923	7.681	142/	409	8.390
Parus cinctus	11.050	20/	42	10.439	59/	130	A	0/	0	11.050	20/	42	12.714
Parus cristatus	10.241	230/	514	8.825	291/	740	10.251	215/	480	10.098	15/	34	9.703
Parus ater	8.876	116/	294	8.602	119/	310	8.614	108/	281	A	8/	13	7.506
Parus caeruleus	12.176	80/	155	12.176	80/	155	12.176	80/	155	A	0/	0	8.060
Parus major	6.809	572/	1837	6.573	624/	2069	7.060	528/	1641	4.775	44/	196	6.013
Sitta europaea	8.000 *	1/	1	8.000 *	1/	1	A	1/	1	A	0/	0	A
Certhia familiaris	9.604	105/	249	9.496	109/	261	9.533	93/	222	10.186	12/	27	8.559
Oriolus oriolus	2.008	7/	72	1.363	7/	105	2.038	7/	71	A	0/	1	1.726
Lanius collurio	11.346	111/	228	10.803	114/	244	11.197	104/	216	A	7/	12	10.310
Lanius excubitor	4.838	5/	22	4.223	5/	25	A	0/	6	A	5/	16	5.358
Garrulus glandarius	7.306	79/	237	6.888	102/	323	7.340	71/	212	7.015	8/	25	6.792
Perisoreus infaustus	10.965	44/	93	9.348	71/	172	A	0/	1	11.107	44/	92	12.875
Pica pica	2.501	71/	586	2.239	84/	772	2.355	56/	490	3.258	15/	96	2.304
Nucifraga caryocatactes	8.091	4/	11	8.091	4/	11	8.091	4/	11	A	0/	0	6.595
Corvus monedula	1.098	13/	240	1.118	14/	254	1.103	13/	239	A	0/	1	1.030
Corvus frugilegus	1.067	1/	19	1.067	1/	19	A	1/	17	A	0/	2	0.835
Corvus corone	1.518	139/	1867	1.433	162/	2303	1.602	118/	1503	1.173	21/	364	1.414
Corvus corax	0.543	5/	186	0.458	5/	220	0.437	1/	46	0.578	4/	140	0.608
Sturnus vulgaris	4.297	282/	1387	4.483	340/	1607	4.386	274/	1322	2.542	8/	65	3.725
Passer domesticus	7.949	247/	690	7.933	283/	792	8.034	245/	678	A	2/	12	6.823
Passer montanus	18.227	19/	27	18.227	19/	27	18.227	19/	27	A	0/	0	8.355
Fringilla coelebs	4.952	4494/	19350	4.655	5236/	23887	5.222	4032/	16522	3.413	462/	2828	4.613

	A			B			C			D			E
	Total 1973-83			Total 1941-83			South 1973-83			North 1973-83			Standard
	K	MB	SB	K	MB	SB	K	MB	SB	K	MB	SB	K(10 p/km)
Fringilla montifringilla	3.340	860/	5372	3.160	970/	6388	4.419	31/	149	3.309	829/	5223	3.859
Carduelis chloris	4.018	52/	273	4.120	55/	282	4.015	51/	268	A	1/	5	3.314
Carduelis carduelis	8.000 *	2/	7	8.000 *	2/	7	A	2/	7	A	0/	0	A
Carduelis spinus	3.606	441/	2559	3.436	530/	3221	4.133	361/	1840	2.291	80/	719	3.549
Carduelis cannabina	8.260	30/	81	8.196	32/	87	8.260	30/	81	A	0/	0	7.347
Carduelis flavirostris	8.000 *	0/	1	8.000 *	0/	1	A	0/	0	A	0/	1	A
Carduelis flammea	2.779	314/	2338	2.356	379/	3311	2.491	14/	116	2.794	300/	2222	3.183
Loxia leucoptera	4.000 *	1/	2	4.000 *	1/	4	A	0/	0	A	1/	2	A
Loxia curvirostra	1.678	72/	871	1.680	146/	1770	1.900	46/	491	1.393	26/	380	1.751
Loxia pytyopsittacus	2.608	7/	56	2.190	9/	85	3.644	6/	35	A	1/	21	2.541
Carpodacus erythrinus	4.430	168/	803	4.361	174/	844	4.656	155/	707	2.807	13/	96	3.894
Pinicola enucleator	9.016	14/	35	7.340	17/	51	A	0/	1	9.321	14/	34	10.653
Pyrrhula pyrrhula	4.603	113/	521	4.100	127/	653	5.311	90/	363	3.026	23/	158	4.474
Coccothraustes coccothraustes	16.000 *	2/	2	16.000 *	2/	2	A	2/	2	A	0/	0	A
Calcarius lapponicus	6.548	178/	591	6.444	187/	630	A	0/	0	6.548	178/	591	7.493
Plectrophenax nivalis	6.638	49/	161	6.231	52/	181	A	0/	0	6.638	49/	161	7.758
Emberiza citrinella	5.348	676/	2709	5.180	770/	3179	5.538	635/	2464	3.500	41/	245	4.814
Emberiza hortulana	5.690	125/	473	5.113	140/	585	5.867	109/	401	4.723	16/	72	5.446
Emberiza rustica	10.397	237/	524	8.591	301/	785	9.678	57/	134	10.648	180/	390	11.530
Emberiza pusilla	8.000 *	1/	1	8.000 *	1/	3	A	0/	0	A	1/	1	A
Emberiza aureola	8.000 *	0/	1	8.000 *	0/	1	A	0/	1	A	0/	0	A
Emberiza schoeniclus	6.402	228/	773	6.152	240/	844	6.084	86/	306	6.613	142/	467	6.309

PÄÄSIÄISRETKI PORTUGALIIN

Suomen Lintutieteellinen Yhdistys (SLY) järjestää ensi keväänä jäsenilleen (ja näiden perheenjäsenille) linturetken Portugaliin. Retkeen voivat osallistua myös Lintutieteellisten Yhdistysten Liiton muiden jäsenjärjestöjen jäsenet. Matka alkaa Helsingistä 18.4.1984 ja paluu Helsinkiin tapahtuu 26.4.1984. Osanottomaksu on mk 3400:— hengeltä. Hintaan sisältyvät kuljetukset, majoitukset ja SLY:n matkanjohtajan palvelut.

Retkeilykohteet Portugalissa sijaitsevat Faron (etelärannikko), Evoran (keskiylänkö) ja Setubalin— Lissabonin (länsirannikko) ympäristössä. Useimmat paikalliset lajit ovat tähän aikaan jo pesimäpuuhissa ja kevätmuutto Afrikasta Eurooppaan on käynnissä.

Sitovat ennakkoilmoittautumiset tehtävä **helmikuun 1. päivään 1984 mennessä.** Tämä tapahtuu maksamalla ennakkomaksu mk 500:— SLY:n retkitilille, ps-tili 159372-3, c/o Kalevi K. Malmström (SLY:n retkisihteeri), Loosarintie 9, 00910 Helsinki 91. Osanottomaksun loppuerä on maksettava maaliskuun 16. päivään mennessä. Jos ilmoittautuminen peruutetaan ennen loppuerän maksamista, peruutukseen sovelletaan matkatoimiston peruutusehtoja. Jos retkelle ilmoittautuu enemmän ihmisiä kuin ryhmälle varattu 40 hengen kiintiö sallii, osanottajat valitaan ennakkomaksun maksamisjärjestyksessä.