Bird census results in different years, stages of the breeding season and times of the day

Olli Järvinen, Risto A. Väisänen & Yrjö Haila

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The same 18 km of line transects in S Finland (60°N, 20°E) were censused repeatedly at different times of the day and stages of the breeding season in 1975 (partly 1976). In mid-June, the estimates of the density were highest in the censuses made early in the morning (index 100), the index falling to 87 in the late morning, 51 in the afternoon and 62 in the evening. The morning density decreased by about 20 % from mid- to late June. Species diversity tended to decrease as the day progressed, but remained constant from early to late June. The composition of the bird community, as judged from the censuses, was similar at all times of the day, except the evening, and throughout the breeding season. Thus, censusing in the afternoon may be expected greatly to decrease census efficiency, while censusing in the evening also causes a considerable change in the proportions of the species. These conclusions apply to most census methods (e.g. mapping), and an international standardization of the census hours is thus urgent. Abundant species were considered from the same points of view as the whole community, but the conclusions were less definite.

Olli Järvinen & Risto A. Väisänen, Department of Genetics, University of Helsinki, P. Rautatiekatu 13, SF-00100 Helsinki 10, Finland
Yrjö Haila, Fredrikinkatu 39 G 35, SF-00120 Helsinki 12, Finland

Introduction

There are two approaches to bird census methodology. On the one hand, many ornithologists (e.g. Berthold 1976) emphasize the pitfalls in different census methods and advocate the so-called absolute methods. On the other hand, many others believe that the scope of bird census work would be unnecessarily restricted if relative methods were excluded. We ourselves belong to the latter school (e.g. Järvinen 1976, Järvinen & Väisänen 1977). Oversimplifying, we may say that the first school focuses on the question, "Which method is the most accurate one?", while the latter school enquires, "Which method is the best one for the present purpose (the purpose being accurately defined first)?"

The results of a line transect experiment made in 1975 are presented here in the hope that they may serve to improve the interpretation of line transect censuses. The experiment was designed to yield information on the breeding season. As part of it was repeated in 1976, the effect of annual fluctuations could also be studied.

The author Haila made all the censuses and wrote a preliminary analysis of the 1975 data (Haila 1976); Järvinen and Väisänen planned the experiment and made the greater part of the final analysis.

Materials and methods

Censuses. The method has already been described in detail (JÄRVINEN & VÄISÄNEN 1976) and brief comments are sufficient here. The census-maker follows a transect planned beforehand and writes down his observations made within 25 m of the transect, about one-fifth of the total; the survey belt (*SB*) list contains all the observations. The experiment has been partly described in an earlier study (JÄRVINEN et al. 1976) of another aspect of the present data. Four transects were censused repeatedly during the summer of 1975 on the island of Ahvenanmaa (60° N, 20° E) in the commune of Finström, near the village of Bjärström (27° E Grid: 669:10). Five censuses were performed on transect IV (4.8 km), which covered mainly fields and meadows (= 'field censuses'), and eight censuses were made on each of the forest transects I—III (13.1 km, 'forest censuses'):

	Breeding season		
	Early (26 May— 4 June)	Middle (8—18 June)	Late (24—30 June)
Early morning (04—08)	I—IV	I—IV	I—IV
Late morning (08—12)	I—IV	I—IV	I—III
Afternoon (12—16)	—	I—III	—
Evening (18—22)	—	I—III	—

In 1976, the forest censuses were repeated on 14—16 June in the early morning. As we wished to eliminate interobserver variation, all the censuses were made by the same ornithologist.

The exact routes of the transects (see HAILA 1976) were marked out with crêpe paper streamers (50 m apart). These proved to be reliable in the field work, and enough of them were found in 1976 to ensure that the transects censused in 1976 were identical with those of 1975. The main belt of the forest censuses covered 65.5 ha, 62 % of which consisted of forest of different kinds, 25 % of fields and coastal meadows and 13 % of other habitats. The main belt of the field census comprised fields (56 %) and coastal meadows (44 %). The forest of the experimental censuses is a typical sample of natural habitats in SW Finland.

Analysis methods. Densities were estimated using the linear model of JÄRVINEN & VÄISÄNEN (1975) and JÄRVINEN (1976). The correction procedure of JÄRVINEN & VÄISÄNEN (1976c) was applied. It should be noted that the methods are strictly valid for early morning only (JÄRVINEN et al. 1976). Thus a comparison of the survey belt and the main belt may be misleading for other times of the day. For the estimation of various bird community parameters, see VÄISÄNEN & JÄRVINEN (1977). All H' (diversity, Shannon function) values are corrected for sample size. The H' values were compared with a t test. The necessary formulae are given by HUTCHESON (1970). All the logarithms are natural.

TABLE 1. Density (pairs/km²) of birds in the experimental censuses: A. main belt data, B. survey belt data. Number of observations in parentheses.

		Breeding season		
		Early	Middle	Late
Forest censuses				
Early morning	A.	256 (168)	278 (182)	224 (147)
	B.	270 (692)	293 (769)	231 (573)
—„—, 1976	A.	—	290 (190)	—
	B.	—	283 (751)	—
Late morning	A.	208 (136)	261 (171)	234 (153)
	B.	185 (420)	254 (532)	234 (516)
Afternoon	A.	—	160 (105)	—
	B.	—	148 (387)	—
Evening	A.	—	157 (103)	—
	B.	—	181 (469)	—
Field censuses				
Early morning	A.	117 (28)	104 (25)	104 (25)
	B.	108 (127)	106 (159)	102 (119)
Late morning	A.	96 (23)	75 (18)	—
	B.	97 (117)	73 (113)	—

Results and discussion

The results are presented and discussed (1) at the level of the land bird community and (2) at the level of single species.

Community parameters

Density. Density was estimated for the

TABLE 2. Number of species of birds observed in the survey belt in the experimental censuses.

	Breeding season Early	Middle	Late
Forest censuses			
Early morning	62	64	63
—„—, 1976	—	63	—
Late morning	54	66	57
Afternoon	—	55	—
Evening	—	57	—
Field censuses			
Early morning	27	30	27
Late morning	29	22	—

main belt and the survey belt (Table 1). Several points emerge:

(1) Early morning gives the highest densities. The following index values are derived from the densities estimated in the middle period of the breeding season in 1975 (in both cases, early morning = 100):

	Main belt	Survey belt
Early morning	100	100
Late morning	94	87
Afternoon	58	51
Evening	57	62

(2) The difference between the density estimates for the two belts is slight. For early morning, the survey belt gives 3—5 % higher density estimates than the main belt, which is theoretically expected (JÄRVINEN & VÄISÄNEN 1975). The estimates for other times of the day also agree quite well, although the correction coefficients applied to the data were derived from early morning censuses.

(3) The stage of the breeding season affects the estimates. The difference is not significant in the field censuses, but in the forests the density in the late stage is about 20 % lower than in the middle stage. This result is no doubt largely due to the species composition of the community studied.

(4) The annual differences were surprisingly slight, but only two seasons were studied.

Number of species. As this parameter is strongly dependent on sample size, the similarity of the results from different censuses, particularly in early morning, is remarkable (Table 2). Apparently fewer species are observed in the afternoon and in the evening than in the morning; even certain relatively numerous species were missed in the evening (see below). The main belt (data not given) shows greater variation than the survey belt. For example, the range observed in the forest censuses made in early morning in 1975 was 35 to 40 species.

Diversity. *H'* is similar in all the early morning censuses, about 3.5 in the forests and 2.7 in the field (Table 3), but tends to decrease as the day progresses. The similarity of the diversity estimates from different years confirms the results of JÄRVINEN & VÄISÄNEN (1976a), who showed that, for a variety of Fennoscandian bird

TABLE 3. Diversity (*H'* ± *S. D.*) of birds in the survey belt in the experimental censuses.

	Breeding season Early	Middle	Late
Forest censuses			
Early morning	3.48 ± 0.04	3.51 ± 0.04	3.48 ± 0.05
—„—, 1976	—	3.53 ± 0.04	—
Late morning	3.43 ± 0.05	3.45 ± 0.05	3.36 ± 0.05
Afternoon	—	3.41 ± 0.06	—
Evening	—	3.30 ± 0.06	—
Field censuses			
Early morning	2.61 ± 0.12	2.75 ± 0.12	2.74 ± 0.12
Late morning	2.89 ± 0.12	2.50 ± 0.14	—

communities, diversity fluctuates relatively little from year to year.

The diversity index for the main belt ranges from 3.13 to 3.33 in the forest censuses, but none of the pairwise comparisons shows a statistically significant difference. The samples in the field censuses are too small for such comparisons. In all the censuses, diversity is lower in the main than in the survey belt, presumably because the main belt is less heterogeneous than the survey belt.

Evenness. The evenness component of diversity (*H'* divided by the logarithm of the number of species) is very similar in most censuses (Table 4), because both diversity and the logarithmic number of species are relatively constant.

The main belt data (not shown) are fairly constant in the forest censuses (0.84 to 0.89), but the field censuses give variable results (0.68 to 0.89) because of small samples.

Composition of the community. The composition of the bird community is an important ecological indicator. In earlier studies (Järvinen & Väisänen 1973, 1976b, Haila 1976), we have considered that *rD* (or *DIUdiff*) values of about 10 (0.1) indicate a biologically meaningful difference. (Far smaller *rD* values often indicate statistically significant differences.) Two examples may illustrate the properties of the index *rD*. Palmgren's (1930) habitats *Laubhaine* and *Hage* on Åland differ by 4.8 *rD* units, while his *Mischwaldhaine* and *Laubhaine* differ by 10.7 *rD* units (our unpubl. data). We have compared the censuses pairwise and used the results to draw two dendrograms, one for the main belt and the other for the survey belt (Fig. 1).

The dendrograms are similar, but that based on the survey belt is more compact. The fact that the main branches of the dendrograms meet at a lower *rD* level in the survey belt dendrogram is due to the inclusion of forest birds in the survey belt of the field censuses. Other changes towards a more compact dendrogram are predictable from theoretical considerations — Järvinen (1976) showed that the variances of density estimates should decrease when the survey belt is used instead of the main belt. In both dendrograms, the evening census differs most from the other forest censuses. There are presumably two reasons for this result: the relative proportions are estimated differently in the evening than at other times of the day, and, owing to the changes in the activity pattern of many species towards the evening, the correction coefficients are misleading for these data (see below). As the evening census deviates most from the others (even more than the census made in 1976) in the main belt dendrogram as well, we can be sure that the difference is due to both reasons. The relative similarity of the 1976 census to those made in 1975 is remarkable, since the territories of the birds certainly differed greatly between the two years.

Table 4. Evenness component of diversity in the survey belt in the experimental censuses.

	Breeding season		
	Early	Middle	Late
Forest censuses			
Early morning	0.83	0.83	0.82
—„—, 1976	—	0.84	—
Late morning	0.84	0.81	0.81
Afternoon	—	0.82	—
Evening	—	0.79	—
Field censuses			
Early morning	0.74	0.76	0.78
Late morning	0.80	0.75	—

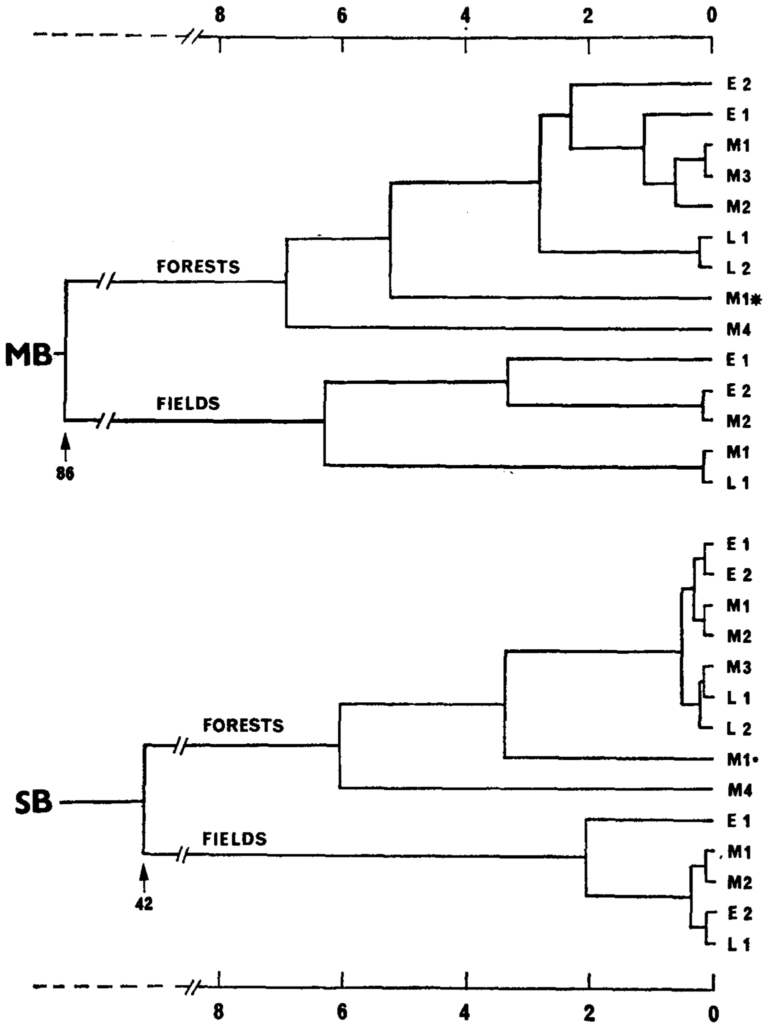

FIG. 1. Similarity of the censuses in the main belt (*MB*, upper) and survey belt (*SB*, lower) data. Similarity is measured with the index *rD*, which may range from 0 to 100 (scales below and above the dendrograms). The letters denote the three periods of the breeding season (*E* = early, *M* = middle, *L* = late) and the figures the time of day (*1* = early morning, *2* = late morning, *3* = afternoon, *4* = evening). The census made in 1976 is labelled with an asterisk. Note that the evening census (*M4*) is that which deviates most greatly among the forest censuses, and that the dendrogram based on *SB* is consistently more compact than that based on *MB*.

Single species

As the number of main belt observations is too low to permit a reliable analysis of single species, the following analysis is mainly based on the survey belt.

Annual differences. Annual monitoring of bird population changes has not been attempted previously with the modern version of the line transect method. The data presented in Table 5 can thus be viewed as the first step towards such a monitoring system. If the amount of work is considered (about 12 hours in the field per year), the body of data obtained is very large. Furthermore, the results can be analysed by standard techniques so that, e.g., diversity estimates can be computed without the laborious evaluation of the results required in the mapping method.

The data given in Table 5 are not intended to represent a larger area; our experiment was not planned for such a purpose. Of the nine species that changed most from 1975 to 1976, four are known for their tendency to fluctuate — *Parus ater, Regulus regulus, Carduelis spinus* and *Loxia curvirostra.* The five others are *Lyrurus tetrix, Parus major, Erithacus rubecula, Motacilla alba* and *Sturnus vulgaris.* The changes observed in *L. curvirostra* and *S. vulgaris* should be treated with caution, since these species breed so early that mainly flocks were observed. Furthermore, the flocks of *S. vulgaris* partly form during the census period, which causes additional variation in the censuses made at different stages of the breeding season in the same summer and in different years.

Season. We have examined all the species which had at least 10 pairs in at least one of the early morning censuses in 1975 (Table 6).

In fairly many species the numbers decrease towards the end of the breeding season. Such species include *Parus major, Turdus iliacus, T. philomelos, Sylvia communis, Phylloscopus trochilus* and *Anthus trivialis*. The numbers increase towards the end of the season in *Phylloscopus collybita* and *Prunella modularis*. Certain species have peak numbers in the middle period: *Columba palumbus, Alauda arvensis, Corvus corone, Parus ater, Erithacus*

TABLE 5. Annual differences in the forest censuses. The species included were observed at least 10 times in the early morning censuses of the middle period in 1975 or 1976. The figures are absolute numbers observed in the survey belt. Results of X^2 tests are also shown (*=$P<0.05$, **=$P<0.01$, ***=$P<0.001$).

Species	1975	1976
Lyrurus tetrix	11	5
Columba palumbus	24	25
Cuculus canorus	11	9
Alauda arvensis	33	40
Corvus corone	17	17
C. monedula	10	13
Parus major	12	21
** *P. ater*	21	7
P. montanus	10	9
Erithacus rubecula	21	11
Turdus merula	23	19
T. pilaris	23	15
T. iliacus	28	34
T. philomelos	27	25
Acrocephalus schoenobaenus	10	10
Sylvia borin	25	29
S. communis	20	24
Phylloscopus trochilus	51	52
Ph. collybita	19	19
Regulus regulus	19	9
Prunella modularis	11	8
Anthus trivialis	33	26
* *Motacilla alba*	4	12
*** *Sturnus vulgaris*	7	31
Carduelis spinus	4	10
*** *Loxia curvirostra*	7	33
Fringilla coelebs	131	119
Emberiza citrinella	40	51

TABLE 6. Change in the detectability of the most abundant species during the breeding season in 1975. Data from survey belts in the early morning censuses. The three columns give index numbers *(middle period=100;* the numbers of observations made in the middle period are shown in parentheses after the species name). Results of X^2 tests are shown before the species (Tests were made only if the conditions for X^2 were fulfilled).

Species	Breeding season Early	Middle	Late
Forest censuses			
Lyrurus tetrix (11)	0	100	0
** *Columba palumbus* (24)	29	100	42
Cuculus canorus (11)	64	100	64
Alauda arvensis (33)	79	100	82
* *Corvus corone* (17)	24	100	59
C. monedula (10)	40	100	30
** *Parus major* (12)	258	100	100
* *P. ater* (21)	62	100	29
P. montanus (10)	110	100	110
Erithacus rubecula (21)	62	100	67
Turdus merula (23)	83	100	61
T. pilaris (23)	78	100	83
T. iliacus (28)	125	100	71
T. philomelos (27)	89	100	52
Acroc. schoenobaenus (10)	90	100	60
Sylvia borin (25)	88	100	64
S. communis (20)	120	100	50
*** *Phyll. trochilus* (51)	165	100	80
Ph. collybita (19)	79	100	111
Regulus regulus (19)	58	100	58
Prunella modularis (11)	55	100	127
Anthus trivialis (33)	112	100	82
Fringilla coelebs (131)	79	100	85
Emberiza citrinella (40)	95	100	98
Field censuses			
Alauda arvensis (57)	96	100	82
** *Corvus corone* (15)	20	100	33
* *Sturnus vulgaris* (11)	9	100	55

rubecula, Turdus merula, T. pilaris, Sylvia borin, Regulus regulus and *Fringilla coelebs.*

These results naturally require confirmation by similar investigations in other areas, but, although the ratio of the lowest to the highest estimate in the breeding season seldom approaches or exceeds 1:2, seasonal differences do seem to exist in the density estimates of many species. Thus, when the densities of a certain species are compared between two regions, the censuses should cover similar parts of the breeding season.

We feel that a comparison of our results with those of other ornithologists (e.g. NILSSON 1974; for other references, see BERTHOLD 1976: 13—14) would be premature; ideally, a series of carefully planned field experiments should be available. TOMIAŁOJĆ's (1974) observation that censuses are affected by breeding losses indicates that comparative studies must take account of the nesting habits (e.g. length of breeding season) of birds in different regions.

Time of the day. As the censuses from other periods do not cover all the times of the day, only the middle period is used in this analysis. The species included in Table 7 all had at least 10 pairs in at least one of the censuses.

It is clear that the numbers of pairs observed in the main belt are decisive in the estimation of densities. (This point may be obscured by the fact that all the observations are used here. However, all the data are corrected with species-specific coefficients that depend crucially on the percentage of main belt registrations.) As Table 7 gives data for the survey belt only, the conclusions drawn must be checked against the main belt data. This point may be illustrated by one extreme example. The numbers of *Scolopax rusticola* are very high in the evening census, because a great number of individuals were observed in display flight. All these birds belong to the supplementary belt (that part of the survey belt which lies more than 25 m from the transect). In fact, detectability in the main belt is similar in all censuses; this implies that similar estimates of density would be derived at all times of the day, if proper correction coefficients were used. Similar, but less extreme cases are the other "evening species", *Erithacus rubecula* (main belt numbers equal in the early morning and in the evening) and *Turdus philomelos* (main belt numbers highest in the early morning). The densities of these species are thus *not* underestimated in early morning censuses, compared with the evening.

A great number of species should clearly be censused early in the morning (index value below 75 for other times of the day; species in parenthesis, if number of observations close to 10): *(Lyrurus tetrix), Columba palumbus, (Cuculus canorus), Corvus corone, (C. monedula), Parus ater, (P. montanus), Turdus pilaris, (Acrocephalus schoenobaenus), Phylloscopus collybita, Regulus regulus* and *Anthus trivialis.* The following species can be censused almost equally well in the late as in the early morning: *Alauda arvensis, (Parus major), Sylvia borin, S. communis, Phylloscopus trochilus, Fringilla coelebs* and *Emberiza citrinella.* The following species can be censused best early in the morning or in the evening: *Erithacus rubecula, Turdus merula* and *(Prunella modularis);* all censuses except the afternoon give relatively good results for *Turdus iliacus.* In two species, *Scolopax rusticola* and *Turdus philomelos,* the highest numbers of observations were made in the evening (see above).

Two of the most dominant species in Finland, *Phylloscopus trochilus* and *Fringilla coelebs,* belong to the group which give good census results in both the early and late morning. Several other species in this group are also among the ten most frequent species

TABLE 7. Change in the detectability of the most abundant species during the day (1975). The table has been constructed in the same way as Table 6, except that the data come from the censuses made at different times of the day in the middle period of the breeding season (*early morning = 100;* i.e., the same number of observations of a species gives the same index figure in Tables 6 and 7).

Species	Late morning	After-noon	Even-ing
Forest censuses			
Lyrurus tetrix (11)	9	0	9
Scolopax rusticola (1)	200	100	1100
*** *Columba palumbus* (24)	29	0	58
Cuculus canorus (11)	27	45	45
** *Alauda arvensis* (33)	82	70	30
** *Corvus corone* (17)	29	29	41
C. monedula (10)	50	30	40
Parus major (12)	100	50	50
*** *P. ater* (21)	29	29	19
P. montanus (10)	70	20	0
* *Erithacus rubecula* (21)	62	43	119
* *Turdus merula* (23)	70	35	104
T. pilaris (23)	65	61	65
T. iliacus (28)	96	43	100
*** *T. philomelos* (27)	59	33	178
Acroc. schoenobaenus (10)	30	30	20
** *Sylvia borin* (25)	80	52	24
* *S. communis* (20)	75	55	25
* *Phyll. trochilus* (51)	80	53	59
Ph. collybita (19)	53	63	58
** *Regulus regulus* (19)	68	16	32
** *Prunella modularis* (11)	27	0	82
* *Anthus trivialis* (33)	55	70	36
* *Sturnus vulgaris* (7)	86	157	14
** *Fringilla coelebs* (131)	80	62	67
Emberiza citrinella (40)	92	72	70
Field censuses (early and late morning only)			
Alauda arvensis (57)	84	—	—
Corvus corone (15)	53	—	—
Sturnus vulgaris (11)	36	—	—

in Finland. This fact has an interesting consequence when the censuses made in the early and late morning are compared: the relative frequencies of the most abundant species are higher in the latter censuses. Thus species diversity can be expected to decrease from early to late morning, and this is confirmed by the data in Table 3 (with one exception in the field censuses).

Other workers (for references, see BERTHOLD 1976:16—17) have also reported differences in the results of censuses conducted at different times of the day, and they belong to the everyday experience of field ornithologists. A systematic and quantitative examination of these phenomena appears to be needed. For example, a geographical comparison of the daily activity patterns of different populations of a species is impossible without detailed quantitative data. Indices of general activity (derived, e.g., from survey belt results) would also be useful in ornithological handbooks.

Concluding remarks

The experimental design proved successful, for the results could be used to elucidate the problems chosen for study (this paper and JÄRVINEN et al. 1976). During the planning of the experiment, the number of observations that might be expected per set of censuses was estimated from census data available from other parts of SW Finland, in order to ensure that sufficient data were gathered. As has been regretfully concluded by several ornithologists studying bird census methodology, without careful planning the data collected are often insufficient.

The results have certain implications for other studies made with the line transect method. In studies focusing on community structure, it is evidently possible to use data from several years (for further details, see JÄRVINEN & VÄISÄNEN 1976a). In comparisons of two or more areas a certain bias may be introduced into the results unless similar parts of the breeding season are used. Both community parameters (e.g. density) and single-species densities may be affected by changes in detectability during the season. Further, the results of a census are strongly affected by the times of the day. Censuses made in the afternoon and evening should not be combined with morning censuses. We have found earlier (JÄRVINEN et al. 1976) that the correction coefficients used in the analysis of densities are most suitable for early morning data, since the detectability of birds changes from early to late morning. As seen in the present study, the practical significance of the difference is not very great. The density estimates are slightly affected (a decrease of 10 % from early to late morning is probably representative), but the other community parameters are fairly similar in all the morning censuses. When speed is important, it thus seems permissible to accept late morning censuses, but care should be taken to avoid the biases possibly introduced in this way.

The extent of the variation in census efficiency at different times of the day can be approximated with the indices derived for the main belt density in different censuses (see above). We conclude with a hypothetical example illustrating the significance of the census hours for the results obtained in a mapping census performed according to the international standard (ANON. 1970).

Assume that (1) eight statistically independent censuses are made and that (2) census efficiency is 0.6 in the morning (e.g. ENEMAR 1959), and 0.35 in the afternoon (our results, above). Then the number of registrations of a pair in a series of eight censuses can be predicted from the binomial distribution (the figures are probabilities):

Registrations	All censuses made in early morning	afternoon
0	0.0007	0.0317
1	0.0079	0.1373
2	0.0413	0.2587
3	0.1239	0.2786
4	0.2322	0.1875
5	0.2787	0.0808
6	0.2090	0.0217
7	0.0896	0.0033
8	0.0168	0.0002
Total	1.0001	1.0000

As the international standard (ANON. 1970) recommends that a pair should not be accepted if less than 3 registrations have been made in a mapping study involving eight censuses, about 5 % of the pairs are missed in a study based on early morning censuses, but as many as 43 % if the censuses are made in the afternoon! Accordingly, the results obtained in our experimental line transect census show that it is important to standardize the census hours as soon as possible.

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Selostus: **Pesimälinnuston laskentatuloksen vaihtelu eri vuosina ja eri vuorokauden ja pesimäkauden aikoina**

Samat 18 km arviointilinjaa laskettiin 5—8 kertaan eri vuorokauden ja pesimäkauden aikoina Ahvenanmaalla kesällä 1975. Pesimäkauden keskivaiheen aamulaskenta toistettiin kesällä 1976. Tiheysarviot (taul. 1) ovat korkeimmillaan aamulla: jos pariheyttä merkitään 100:lla, indeksi on aamupäivällä 87, iltapäivällä 51 ja illalla 62 (pesimäkauden keskivaiheen tuloksia tutkimussaralta). Lajimäärä (taul. 2) pysyy samana läpi pesimäkauden, mutta näyttää laskevan aamusta iltaan. Lajidiversiteetti (taul. 3) ja sen "tasaisuus" (taul. 4) ovat suhteellisen vakioita aamulla ja aamupäivällä koko pesimäkauden ajan. Iltalaskennassa todettu linnuston koostumus poikkeaa eniten muiden vuorokauden aikojen tuloksista; edes vuonna 1976 tehdyn aamulaskennan tulos ei eronnut yhtä voimakkaasti muiden laskentojen tuloksista (kuva 1). Iltalaskentoja ei siis tule yhdistää muina vuorokauden aikoina tehtyihin laskentoihin. Myöskään iltapäivälaskentojen yhdistäminen muuhun aineistoon ei ole suotavaa, koska tiheydet jäävät kovin alhaisiksi.

Taulukossa 5 on esitetty runsaimpien lajien parimäärät toisiaan vastaavissa laskennoissa tutkimusvuosina. Suurimmat, ilmeisesti todelliset muutokset havaittiin kuusitiaisen ja pikkukäpylinnun kannoissa (kottaraisella parveutuminen laskentakauden kestäessä aiheuttaa suurta vaihtelua tuloksiin). Taulukossa 6 on indeksiluvuin (pesimäkauden keskiosa = 100) esitetty havaittavuuden muutos toukokuun lopusta kesäkuun loppuun. Useilla lajeilla (esim. talitiainen) havaittavuuden huippu sattuu laskentakauden alkuun, monilla (esim. punarinta) keskivaiheille ja muutamilla loppuun (tiltaltti). Havaittavuus muuttuu myös aamusta (indeksi = 100) iltaan (taul. 7). Useimmiten parhaan tuloksen antaa aamulaskenta. Eräiden lajien (lehtokurppa, laulurastas) huimat indeksiluvut iltalaskennassa johtuvat pääsaran ulkopuolisten havaintojen kasvusta eikä siitä, että havaittavuudessa pääsaralla olisi olennaista eroa illan ja aamun välillä.

Samankaltaisten laskentakokeiden toistaminen maamme muissa osissa antaisi työmäärään nähden runsaasti uutta tietoa, joka tekisi linjalaskenta-aineistojen tulkinnan entistä luotettavammaksi. Samalla olisi mahdollista selvitellä lintujen vuorokautisen ja pesimäkautisen lauluaktiivisuuden maantieteellistä vaihtelua.

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