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Long-term changes in the bird community of farmland in Åland, SW Finland

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The bird community breeding on farmlands in Åland (about 60°N, 20°E), SW Finland, was studied semiquantitatively in the 1920s and 1930s, and quantitatively (by line transect censuses) in 1975—77. Owing to the low accuracy of the older data, only striking changes could be detected; the relative densities of most species had not changed greatly since the 1920s. *Emberiza hortulana* had decreased catastrophically: the former index figure was 5, but the present one only 0.1. A similar decrease has been observed in Sweden, but not on the mainland of Finland. The data also indicate considerable decreases in *Oenanthe oenanthe* and *Carduelis cannabina*. The relation between the population changes observed and changes in agricultural practices is discussed; changes in the tropical winter quarters may be a more important cause of the decrease in *E. hortulana* (and possibly *O. oenanthe*). *Sturnus vulgaris* has increased considerably from the 1920s to the 1970s, in keeping with the general expansion of the species in Finland.

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1. Introduction

The avifauna of the mainland of Åland ("Fasta Åland", about 60°N, 20°E) was studied intensively by Palmgren (e.g. 1930, 1935), but since his classic studies the area has been *terra incognita*, as noted by Tenovuo (1966). Therefore, extensive line transect censuses were made on Åland in 1975—77. In this paper, we compare our data on the bird community of open farmlands with those presented by Palmgren (1935). Our results refer only to the abundant species; for data on other species of open habitats, see Haila *et al.* (1979).

2. Material and methods

Palmgren (1935) did not make quantitative censuses in open farmlands, but he indicated the relative abundance of many species on the basis of his records made during excursions to different parts of the Åland archipelago in 1921—27 and 1930—32, particularly in 1926—27. The index figures given below are based on counts made in 1926—27 (Palmgren, pers. comm.). Palmgren (1935) emphasizes that his data possess a certain "*Gelegenheitscharakter*", which certainly prevents us from detecting moderate or slight population changes.

Our data are based on line transect censuses (for details, see Haila *et al.* 1979). Altogether 213.7 km of transects were censused, 172.9 km in 1975 and the rest in 1976—77. About 6/7 of the data are from the mainland of Åland and about 1/7 from Föglö (2 km from Kökar); Föglö and Kökar are small groups of islands east and south-east of the mainland of Åland.

The results of the excursions (Palmgren) and censuses (our data) are expressed as index figures, the index for *Alauda arvensis* being defined as 10. If a species had an index value of, say, 2, the records made on that species amounted to about 20 % of those made on *A. arvensis*. As we used the total numbers of records made in transect censuses (primary data in Haila *et al.* 1979), both Palmgren's indices and ours were affected by the variable "lateral detectability" (Järvinen & Väisänen 1975, Järvinen 1978) of different species. Palmgren (pers. comm.) made 62 and we made 520 observations of the index species *A. arvensis*. As all sources of error could not be eliminated (see below), results of statistical tests should be treated with the greatest caution. Therefore, we have neglected all species for which χ^2 was not highly significant ($P < 0.001$). Further, as it is possible that *A. arvensis* has increased considerably, we also required that another null hypothesis, based on the

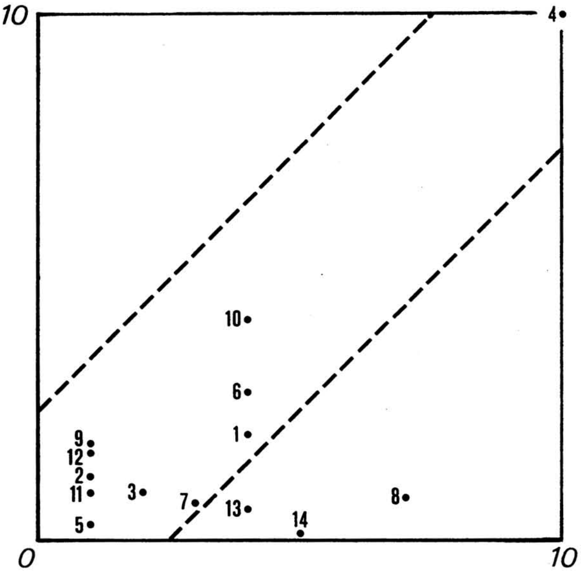

Fig. 1. Index figures showing the relative abundance of different farmland bird species according to the data of Palmgren (1935; abscissa) and Haila et al. (1979; ordinate). The species are: 1 = *Vanellus vanellus*, 2 = *Gallinago gallinago*, 3 = *Numenius arquata*, 4 = *Alauda arvensis*, 5 = *Anthus pratensis*, 6 = *Motacilla alba*, 7 = *Saxicola rubetra*, 8 = *Oenanthe oenanthe*, 9 = *Sylvia curruca*, 10 = *S. communis*, 11 = *Lanius collurio*, 12 = *Carduelis chloris*, 13 = *C. cannabina*, 14 = *Emberiza hortulana*. The index for *Alauda arvensis* was by definition 10, and the values for the other species denote the counts of these species in relation to the counts of *A. arvensis*.

assumption that *A. arvensis* has actually doubled, could be rejected highly significantly. The data used by us included all habitats, but our conclusions agree with unpublished data for the main belt covering 1.86 km^2 of farmland (66 observations on *A. arvensis*).

The data for *Phylloscopus trochilus* and *Emberiza citrinella* were omitted, because forest habitats are more important for these species than agricultural areas (based on 208 and 139 main belt observations, respectively). *Crex crex* was also excluded, as the hours of the line transect census were unsuitable for this nocturnal species. However, the species has certainly decreased greatly, as judged from numerous excursions we made in addition to the censuses (see also von Haartman 1958, Tenovuo 1966).

3. Results and discussion

Our results are shown in Fig. 1. As detailed statistical comparisons are not warranted, the "confidence limits" drawn in the figure were not based on statistical calculations, but are arbitrary and indicate a diagonal zone of relative stability (from lower left to upper right). As many as 10 out of 13 species (and *Alauda arvensis* by definition) fell within the limits drawn, their index values thus differing by less than 2.5 units from those given by Palmgren (1935). Thus, the relative densities have remained fairly stable during the last 50 years, although, of course, this conclusion is not necessarily valid for absolute densities. It is true that in Fig. 1 the scatter of points is relatively wide even within the zone of relative stability, but there are five major reasons why the index values might be different:

1. The density of *A. arvensis* may have changed. In fact, a fair increase seems probable during recent decades (Järvinen & Väisänen 1979). Moderate decreases in the index values of other species thus suggest, but do not prove, population stability.

2. Some of our observations were made in habitats other than farmlands, owing to the method used. As judged from the main belt data, this source of error may have led to index figures that are too high for a few species, in particular *Motacilla alba*, *Sylvia curruca*, *Lanius collurio* and *Carduelis chloris*.

3. Our censuses were made in the early morning, but Palmgren's data seem to refer to all times of day. As species vary in daily activity patterns, this difference might have led to apparent changes in index values. According to an experiment made in Åland (Järvinen *et al.* 1977), the detectability of *A. arvensis* was fairly high from early morning to afternoon, but poor in the evening. Seasonal activity patterns among species also differ.

4. Minor differences may arise by chance.

5. Population changes may really have occurred. They may have been due to changed densities within the habitats occupied or to changed coverage of suitable habitats. The changes in the coverage of different kinds of farmland habitats from 1929 to 1969 are shown in Table 1. As the wooded pastures mostly support forest bird populations (Palmgren 1935), the major habitat change affecting populations of farmland birds is that now (1969) about 15 km^2 less was under grass, and about 16 km^2 more was cultivated than in 1929. As shown by the high densities of *A. arvensis* in Central Europe and southern Scandinavia (e.g. Sharrock 1976, Ulfstrand & Högstedt 1976), this index species, used by Palmgren and ourselves, is well adapted to intensive farming. In consequence, moderate decreases in index values are to be

expected in many other species, even if their densities in the preferred habitats remain stable. However, no great population changes should follow from the habitat changes displayed in Table 1.

A reasonable hypothesis seems to be that "agricultural modernization" is an important cause of population changes in farmland birds. On Åland, modernization implies that the coverage of meadows has decreased, while that of ploughed land has increased; but a more important phenomenon is connected with the stony hillocks commonly surrounding fields in Åland: they are now probably less open than before, owing to changes in grazing practices (e.g. cessation of forest grazing). Many small trees have thus been able to invade these hillocks and the land between them and the fields. In general, there is little difference in agricultural practices between Åland and the other parts of SW Finland (see Varjo 1977); these areas of Finland are characterized by intensive farming.

The following conclusions emerge from the data (Fig. 1):

Alauda arvensis was top dominant among the 14 species of Fig. 1 both in 1926—27 and in 1975—77. Six species had intermediate values (3 to 7) in the 1920s (Palmgren 1935), but only one species (*Sylvia communis*) reached this level in 1975—77. Hence, *A. arvensis* is even more characteristic than before on farmlands in Åland.

Most species had index values fairly similar to those seen in Palmgren's time. This means that the structure of the community in the two study periods was broadly the same, except that *A. arvensis* is now even more dominant than before. The index values of three species have decreased so greatly that a real decrease seems clear ($P < 0.001$ in the two χ^2 tests described in Sect. 2): *Oenanthe oenanthe*, *Carduelis cannabina* and *Emberiza hortulana*. (A fourth case worthy of attention is *Saxicola rubetra*: the index decreased from 3 to 0.7, but the accuracy of the comparison is not sufficient to evaluate the reality of the change.)

Table 1. Changes in coverage of different kinds of farmland on Åland from 1929 to 1969 (data from Suomen tilastollinen vuosikirja 1932, 1975).

	Area (km²)	
	1929	1969
Gardens	1	2
Fields	117	133
Meadows	25	10
Pastures	76	52
Total	219	197

Oenanthe oenanthe. The index decreased from 7 to 0.8, and it is incredible that this trend could be due wholly to the sources of error listed above, especially because about 1/3 of our observations on *O. oenanthe* came from non-agricultural habitats (clear-cuttings, rocky hills etc.). As the detectability of this species increases towards the end of June (Järvinen and Väisänen, unpubl. line transect data from the whole of Finland), the decrease might partly be accounted for by a greater proportion of late observations in Palmgren's data. Even by conservative standards, however, a real decrease of at least 50 % seems to have occurred. The increased coverage afforded by bushes and small trees on the stony hillocks near fields (above) may be very unfavourable for the species, and the beneficial effect of the clear-cuttings (von Haartman *et al.* 1963—72) does not seem to provide sufficient compensation in Åland (clear-cuttings, etc., covered 50 km² on Åland in 1971—72, Kuusela & Salovaara 1974). The species has decreased greatly in Western Europe in recent years (e.g. Dybbro 1976, Sharrock 1976). The British data in particular (Sharrock 1976) suggest that cessation of grazing has been an important factor in decreasing the population, but changes in the tropical winter quarters of the species may also contribute significantly in this case.

Carduelis cannabina. Tast (1968) predicted that the population of *C. cannabina* on the Åland Islands will decrease as agriculture is modernized. The decrease in the index value from 4 to 0.6 may be interpreted as supporting this prediction. *C. chloris* is now certainly more abundant than *C. cannabina* (in Palmgren's time the ratio between the species was 1:4), but this change may be explained by an increase in *C. chloris* (e.g. von Haartman *et al.* 1963—72).

Emberiza hortulana. As the index decreased from 5 to 0.1, the population has no doubt decreased drastically during the study period. This conclusion is further supported by the few occasions on which the species was seen during our additional excursions. No general decreases seem to have occurred on the Finnish mainland (von Haartman *et al.* 1963—72, Järvinen and

Väisänen, unpubl.), but a decrease has been reported from neighbouring areas in Sweden (Stolt 1974; see also Engström 1952). As the species was typical of fields in Palmgren's time, agricultural modernization is not likely to have caused the decrease (another possibility would be agricultural chemicals, but the decrease in Sweden seems to have started earlier than the intensive application of chemicals). Changes in the winter quarters of this tropical migrant thus seem the most plausible explanation for the decrease observed in Sweden and Åland.

Both the main belt data from farmlands and the data used here indicate that *Sturnus vulgaris* should now have an index value of at least 3. As the starling was not included in Palmgren's (1935) statistics, a considerable increase has certainly occurred in this species. The forest populations of *S. vulgaris* have increased only a little in Åland; our main belt data suggest that of the present population about 50 % breeds in forest habitats. In consequence, the population of this species seems to have increased less in Åland than elsewhere in Finland (cf. Järvinen & Väisänen 1978).

We conclude that there have been at least three decreases and one increase, and other sources (e.g. von Haartman *et al.* 1963—72, Haila *et al.* 1979 and unpubl., Tenovuo 1966) suggest several other changes. For example, Tenovuo's (1966) data from Kökar show clear increases in *Vanellus vanellus*, *Sylvia curruca* and *Carduelis chloris* and a decrease in *Anthus pratensis*. As our data show similar trends (see Fig. 1), our "confidence limits" may be too broad; the only exception is *Vanellus vanellus*, which may have expanded to Kökar later than to other parts of the Åland Archipelago owing to differences in agricultural history (Palmgren 1935, Tenovuo 1966). Among the changes reported here special interest attaches to the catastrophic decrease in *Emberiza hortulana*. The reason for this decrease is enigmatic, but even earlier the farmlands of Åland provided puzzles for students of bird populations: for example, why is *Motacilla flava*, a common passerine of shore meadows, absent from Åland (see e.g. Palmgren 1935)?

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