The bird community of reserved fields in central Finland

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The bird fauna was censused in 24 reserved (uncultivated) fields (0.3—6.0 ha) in central Finland, using the study area method; the reliability of the method was tested and found good. The fields, except for four which had been recultivated, were recensused five and six years later.

At the first census, the fields had lain uncultivated for one to six years. The most dominant species were *Saxicola rubetra* (34 %), *Alauda arvensis* (28 %), *Emberiza citrinella* (12 %) and *Motacilla flava* (10 %). After five years' secondary succession, *Alauda arvensis* had disappeared from the fields; the dominant species in 1979 and 1980 were *Saxicola rubetra* (37 and 29 %), *Phylloscopus trochilus* (14 and 21 %), *Emberiza citrinella* (12 and 8 %) and *Sylvia borin* (8 and 11 %). The number of species (10, 12 and 12), Shannon diversity and its evenness component increased slightly, while the total density remained almost stable (75, 63 and 68 pairs/km^2).

The occurrence of birds was examined in relation to the successional stage of the field and the size of the cleared area. *Alauda arvensis* was most common in recently abandoned fields in large clearings. *Saxicola rubetra* was the typical species of reserved fields and had a wide habitat range. *Carpodacus erythrinus, Phylloscopus trochilus* and *Sylvia borin* were most common in older reserved fields in smaller clearings.

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Introduction

The amount of natural meadows is quite small in Finland. Clearing of forests and draining of peatlands for agricultural purposes created open habitats, which nowadays cover 8.6 % of the land area.

Abandoned fields increased rapidly in Finland with the Field Reservation Act of 1969. By the end of 1974 about 8 % of the cultivated land was reserved. In contrast to agricultural fields, reserved fields are subject to at least seminatural succession (Hokkanen & Raatikainen 1977a, b).

Only a few Finnish studies deal with the bird communities of cultivated fields or natural meadows (Palmgren 1935, Soikkeli 1965, Haila et al. 1979, 1980, Soikkeli & Salo 1979). The present paper reports on the composition of the bird communities of reserved fields during the ten first years of secondary succession. It is partly based on two earlier papers in Finnish (Törmälä & Hokkanen 1976, 1979).

Study areas and methods

The fields of the reserved farms in central Fin-

TABLE 1. Number of bird pairs in two 6-ha reserved fields obtained by (a) the study area method and (b) extensive observation and searching for nests.

Species	Field 1 a	Field 1 b	Field 2 a	Field 2 b
Gallinago gallinago	1	1	0	0
Saxicola rubetra	2	2	4	5
Acroceph. schoenobaenus	1	1	0	0
Anthus trivialis	0	0	2	2
Motacilla flava	1	0	0	0
Carpodacus erythrinus	1	1	2	2
Emberiza schoeniclus	2	2	0	0
Total	8	7	8	9

land are usually small (mean total area 6.0 ha), open-ditched (88 %), and situated in separate clearings (for detailed information, see Hokkanen 1979).

During the first five years of secondary succession the vegetation of reserved fields becomes meadow-like. Moist fields on organic soils are mostly dominated by *Deschampsia caespitosa,* while *Agrostis tenuis, Achillea ptarmica* and *Taraxacum* spp. are characteristic of fields on mineral soils (Hokkanen & Raatikainen 1977a). Potential food for insectivorous birds is abundant in both the field and ground layers during the summer (Törmälä & Raatikainen 1976, Hokkanen & Raatikainen 1977b, Törmälä 1979).

The material discussed here was obtained from three sets of censuses:

1) In 1974 twenty reserved farms were selected at random in the town of Jyväskylä (1), Jyväskylä rural commune (8), Petäjävesi commune (7), and Uurainen commune (4). Altogether 24 separate fields (range 0.3 to 6.0 ha) with a total area of 69.4 ha were surveyed. By 1974 the fields had laid uncultivated for one to six years.

The observer walked up and down in the fields and marked the pairs on 1:3000 maps. On average about 6 ha was censused per hour. In line-transect counts one kilometre is censused in 45—60 minutes, which for the main belt (25 m on both sides of the transect) corresponds to 5—6.5 ha per hour. The observations were interpreted as pairs, as in line-transect censuses (cf. Järvinen & Väisänen 1977). Obvious visitors (e.g. *Corvus corone, Turdus* spp.) were disregarded. The censuses were performed on 4—11 June from 08.00 to 14.00 (cf. Järvinen et al. 1977).

2) New censuses were made in same fields by the same observer on 5—16 June 1979 and 9—13 June 1980 at the same time of day as in 1974. The total area censused was now 55.7 ha each year, as four recultivated fields were excluded.

3) Two 6-ha fields were first censused on 19 June 1979 using the same method as above. Then on two consecutive days the birds were observed carefully with binoculars and telescopes and their nests sought systematically by about ten persons, to discover the absolute numbers of birds nesting in the fields. Although the sample was small (Table 1), it indicates that efficiency of the study area method used is fairly good in reserved fields. Several factors probably contributed to this. First, the habitat structure was very simple, especially in younger reserved fields, which enabled the observer to concentrate on a single vertical layer. Second, the birds could be detected at some distance because of the relatively open view. Third, the bird densities were low, and, fourth the census work was facilitated by the small well-delimited areas. On the other hand, it was sometimes difficult to judge whether a bird (pair) belonged to the community of the reserved field or to the adjoining forest or garden.

One of these fields was also censused in 1980 using the study area method.

Results and discussion

Densities. The density of birds in the field studied ranged from 0 to 400 pairs/km², averaging 77 pairs/km². These figures are very low compared with densities in forests (Järvinen & Väisänen 1976) or in urban environments (Huhtalo & Järvinen 1977) obviously due to the simple habitat structure. The largest field without birds was 3.3 ha.

Haila et al. (1980) censused cereal fields in Åland using the line transect method, and obtained a total density of 128 pairs/km². Due to the method, their data includes species that probably did not breed in the fields (e.g. *Turdus pilaris, Muscicapa striata, Fringilla coelebs),* but even if these are excluded the density remains higher than the mean for my study area. In coastal meadows near Pori the abundance of

TABLE 2. Bird densities and dominance values (%) in 20 reserved fields in 1974, 1979 and 1980 (55.7 ha), and in the whole material (194.3 ha).

Species	1974 p/km²	%	1979 p/km²	%	1980 p/km²	%	Total p/km²	%	*N*
Vanellus vanellus	1.8	2.4	—	—	—	—	0.5	0.7	1
Gallinago gallinago	1.8	2.4	1.8	2.9	1.8	2.6	2.1	2.7	4
Numenius arquata	3.6	4.8	1.8	2.9	—	—	1.5	2.0	3
Alauda arvensis	18.0	23.9	—	—	—	—	7.7	10.0	15
Oenanthe oenanthe	1.8	2.4	—	—	—	—	0.5	0.7	1
Saxicola rubetra	28.7	38.1	23.3	37.1	19.7	28.9	26.2	34.0	51
Lanius collurio	—	—	—	—	1.8	2.6	0.5	0.7	1
Acroc. schoenobaenus	—	—	—	—	1.8	2.6	1.5	2.0	3
Sylvia borin	—	—	5.4	8.6	7.2	10.6	3.6	4.7	7
S. communis	—	—	1.8	2.9	1.8	2.6	1.5	2.0	3
Phylloscopus trochilus	1.8	2.4	9.0	14.3	14.4	21.1	7.7	10.0	15
Prunella modularis	—	—	—	—	—	—	0.5	0.7	1
Anthus trivialis	—	—	1.8	2.1	3.6	5.3	2.6	3.3	5
A. pratensis	1.8	2.4	—	—	—	—	0.5	0.7	1
Motacilla alba	—	—	1.8	2.9	—	—	0.5	0.7	1
M. flava	7.2	9.5	1.8	2.9	5.4	7.9	5.7	7.3	11
Carpodacus erythrinus	—	—	5.4	8.6	3.6	5.3	4.6	6.0	9
Emberiza citrinella	9.0	11.9	7.2	11.5	5.4	7.9	6.2	8.0	12
E. schoeniclus	—	—	—	—	—	—	2.1	2.7	4
E. hortulana	—	—	1.8	2.9	1.8	2.6	1.0	1.3	2
Pairs/km²	75.4		62.8		62.8		77.2		150
No. of species	10		12		12		20		
Diversity (H')	1.78		2.03		2.11		2.33		
Evenness (J')	0.77		0.82		0.85		0.78		

birds was generally higher (Soikkeli & Salo 1979) than in reserved fields in central Finland, but if ducks and waders are excluded from the comparison the results are fairly similar. Wiens (1973) reported densities of 10 to 140 pairs/km² from ungrazed American grassland.

Succession. The composition of the bird communities of the 20 reconsused fields changed clearly from 1974 to 1979—80 (Table 2). *Alauda arvensis,* second in abundance in 1974 had disappeared by 1979; the single pairs of *Anthus pratensis, Vanellus vanellus* and *Oenanthe oenanthe* had also disappeared. The densities of *Saxicola rubetra, Emberiza citrinella* and *Motacilla flava* decreased also. The abundance of *Phylloscopus trochilus* increased, and the following species were observed only in 1979—80: *Sylvia borin, S. communis, Carpodacus erythrinus, Emberiza hortulana, Anthus trivialis, Motacilla alba, Lanius collurio* and *Acrocephalus schoenobaenus.* The total density remained roughly the same. Slight increases in the number of species, in Shannon diversity ($H' = -\Sigma p_i \ln p_i$; p_i = proportion of i^{th} species) and in evenness ($J' = \frac{H'obs}{\ln S}$, S = number of species) indicate that the bird fauna had become more diversified in five to six years.

Niche relations. It was not possible

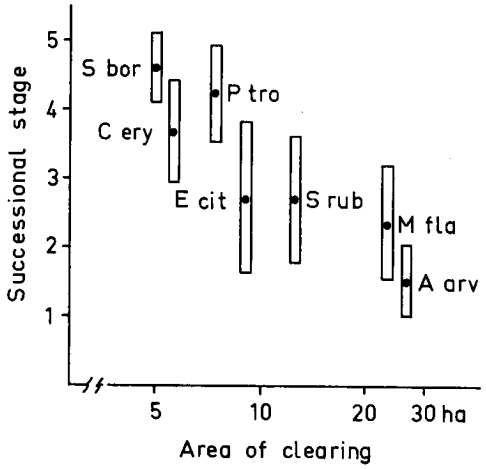

FIG. 1. Means of the occurrence of the most common species in relation to the successional stage of the field and the size of the cleared area. The vertical bar is a relative measure of niche breadth (Shannon index) along the successional axis. S bor = *Sylvia borin*, C ery = *Carpodacus erythrinus*, P tro = *Phylloscopus trochilus*, S rub = *Saxicola rubetra*, M fla = *Motacilla flava* and A arv = *Alauda arvensis*.

to consider the bird communities in relation to the time during which the fields had laid uncultivated; the normal succession of the vegetation may have been delayed by mowing or some other kind of management, or the change in the vegetation may have been accelerated by afforestration. The fields were therefore classified into five successional stages on the basis of the vegetation: (1) fields resembling cultivated fields, without bushes; (2) fields resembling natural meadows, with bushes (*Salix* spp., *Betula* spp. and *Alnus* spp.) in the ditches; (3) small bushes growing elsewhere in the fields as well; (4) dense bushes in the ditches and fairly abundant bushes elsewhere; and (5) quite dense scrub, about 2 m high, or afforested field with a least 2-m-high trees. The last category corresponds to about ten years of uninterrupted succession.

Graphic representation of the niche relations of the most common species ($\geq$ 7 pairs in my data) in respect to the successional stage and the area of the clearing revealed a clear species sequence (Fig. 1). *Alauda arvensis* was a species of early successional stages in big clearings. Soikkeli & Salo (1979) found that *Alauda arvensis* remained fairly abundant on shore meadows partly invaded by bushes, but the species was totally absent from bushy reserved fields. The shore meadows of Soikkeli & Salo (1979) were mostly larger than the clearings in my study areas. In addition in the older fields studied, the surface of the ground was covered by a thick layer of dead plant material, 200—400 g dry weight/m², during breeding season (Törmälä & Raatikainen 1976, Hokkanen & Raatikainen 1977a) which probably made moving and feeding probably difficult for *Alauda*.

Motacilla flava preferred somewhat older fields than *Alauda arvensis*. *Emberiza citrinella* occurred on fields of various successional stages. It seemed to frequent small groups of trees or bushes around heaps of stones or barns, etc. *Saxicola rubetra* was the typical species of reserved fields. It favoured relatively open fields with scattered bushes and was most abundant on fields of successional stage 2 and 3. *Carpodacus erythrinus*, *Phylloscopus trochilus* and *Sylvia borin* preferred later successional stages and smaller clearings.

The occurrence of the most common species along the successional axis was analysed using the Shannon index as a measure of niche breadth (Colwell & Futuyma 1971). *Emberiza citrinella* and *Saxicola rubetra* had the broadest niches, while *Sylvia borin* and *Alauda arvensis* had the narrowest (Fig. 1). Niche overlap, measured by the per-

centage similarity method (Colwell & Futuyma 1971), was greatest between *Motacilla alba, Saxicola rubetra* and *Emberiza citrinella* (0.68—0.80), and between *Sylvia borin, Phylloscopus trochilus* and *Carpodacus erythrinus* (0.77—0.78). *Alauda arvensis* (stages 1—2) had no overlap with *Sylvia borin* (4—5) or *Carpodacus erythrinus* (3—5).

The species that first colonized the reserved fields are mainly inhabitants of cultivated fields (e.g. *Alauda arvensis, Vanellus vanellus)* or open natural habitats (e.g. *Numenius arquata, Motacilla flava, Anthus pratensis).* The birds occupying the fields in the later successional stages come from semi-open habitats *(Saxicola rubetra, Emberiza schoeniclus, Sylvia communis)* or even from more or less wooded habitats *(Anthus trivialis, Phylloscopus trochilus, Sylvia borin, Carpodacus erythrinus).* It seems that the species of the last group first occupy the edges of the field and that their territories also include habitats outside the fields.

Reserved fields in central Finland are generally like small islands surrounded by forest. Often the amount of birds in the field is so small that it is questionable whether they form a functional community. The number of species increased slightly with the area of the field ($r = 0.30$*). The richest censused had seven species (x = 2.3 species for fields with at least one pair of birds). The low number of species is typical of temperate grassland (e.g. Wiens 1973).

Cody (1966, 1968) suggested that American grassland bird communities are saturated. This implies that the species co-occurring in an area are adapted to exploit resources in different ways, to permit stable co-existence. American grasslands are old, large and stable compared with the reserved fields, where the succession is fairly rapid. Because of the low number of species (habitat segregation, small areas) and low densities in the reserved fields competition was not probably very keen. The fact that even in the larger reserved fields which were intensively observed there were large areas evidently not belonging to any bird's feeding or nesting area also indicates that the communities were not fully saturated. Swallows (aerial feeders), thrushes (ground feeders) and owls (vole predators), which frequently utilize the food resources of reserved fields, have different foraging techniques from those of the birds nesting there.

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Selostus: **Keskisuomalaisten pakettipeltojen lintuyhteisöstä**

Jyväskylän lähiympäristössä laskettiin näytealamenetelmällä 24 pakettipellon linnusto kesäkuun alussa 1974. Laskenta uusittiin 5 ja 6 vuotta myöhemmin, paitsi neljällä pellolla, jotka oli otettu uudelleen viljelyyn.

Käytetyn näytealamenetelmän tehokkuutta tutkittiin 1979 kahdella 6 hehtaarin pakettipellolla. Laskennan jälkeen lintuja tarkkailtiin kahtena päivänä intensiivisesti ja niiden pesät pyrittiin löytämään todellisen parimäärän selvittämiseksi. Menetelmä vaikutti varsin luotettayalta (taul. 1).

Vuoteen 1974 mennessä tutkittavat pellot olivat olleet viljelemättä 1—6 vuotta. Seuraavien g—6 vuoden sekundaarisukkession jälkeen linnusto oli muuttunut selvästi (taul. 2). Kiuru, 1974 toiseksi runsain laji, oli kadonnut tyystin, ja yleensäkin avomaiden lajit (keltavästäräkki, kuovi ym.) olivat taantuneet. Mm. pajulintu, punavarpunen, lehto- ja pensaskerttu olivat runsastuneet. Lajiluku, diversiteetti ja sen tasaisuuskomponentti olivat hieman suurempia 1979 ja

1980 kuin 1974. Kokonaisparimäärä pysyi suurin piirtein tasaisena.

Lintujen esiintymisen suhdetta kasvillisuuden sukkession vaiheeseen tutkittiin koko aineiston pohjalta. Pellot jaettiin kasvillisuuden mukaan viiteen sukkessiovaiheeseen. Runsaista lajeista pensastasku ja keltasirkku esiintyivät tasaisimmin eri vaiheessa olevilla pelloilla (kuva 1). Kiurun esiintyminen keskittyi suurilla aukeilla sijaitseville, äskettäin paketoiduille pelloille. Pajulintu, lehtokerttu ja punavarpunen olivat myöhäisempien sukkessiovaiheiden (pensoittuneet pellot) lajeja.

Keskisuomalaiset pakettipellot ovat tavallisesti pieniä metsien ympäröimiä saaria, joiden yksilö- ja lajimäärät (keskimäärin 2.3/pelto) ovat hyvin pieniä. Tutkimuksessa päädytään siihen, että lajien välinen kilpailu ei liene kovin voimakasta. Osaltaan tähän vaikuttaa lajiston nopea muuttuminen pensoittumisen myötä.

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