Changes in land bird populations on the Krunnit Islands in the Bothnian Bay, 1939—77

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A survey is presented of the structure and dynamics in the land bird populations on the forested main islands of the Krunnit group in the northern Bothnian Bay (65°N, 24°E) during the period 1939—77. The study is based on quantitative censuses made (mainly by the line transect method) in 1939, 1949, 1972, 1973, 1975 and 1977, and semi-quantitative or qualitative ones from five additional years.

During the study period the number of nesting land birds declined from over 1100 pairs to about 700, but the number of species and the species diversity (Shannon function) increased. The ratio of the northern to southern elements in the avifauna varied markedly without any clear trend. The greatest increases occurred in *Fringilla coelebs* and *Acrocephalus schoenobaenus,* and the main decreases in *Phylloscopus trochilus, Riparia riparia, Anthus trivialis, Oenanthe oenanthe, Motacilla alba, Muscicapa striata* and *Phoenicurus phoenicurus.* Major fluctuations were found in the populations of *Turdus iliacus, Fringilla montifringilla* and *Ficedula hypoleuca.* Of the total of 55 species, 12 were observed only once or twice in the 11 censuses.

Several long-term changes may be explained by changes in the nesting and feeding conditions caused by the spread and increase in density of the forest. Since the area became protected in 1936, all human activity, including silviculture, has ceased. The short-term fluctuations in the numbers of the species and proportions of different elements correlated with the temperature during the nesting season. Other causes of changes in the numbers of individual species are also discussed.

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Introduction

The Krunnit islands in the northern Gulf of Bothnia are a good locality for studying long-term changes in nesting bird populations, as the avifauna has been censused several times since the first survey in 1939 (Merikallio 1950). However, although several studies have been published on the sea birds of the area (Grenquist 1965, Väisänen 1972, 1973, 1974, Väisänen & Järvinen 1977), the only subsequent paper dealing with land birds is that of Salkio (1952). Changes in land bird populations have been treated in studies made in other archipelagos of the northern Baltic, e.g. those by Tenovuo (1966) and Hildén (1966).

The purpose of this paper is to describe the structure and dynamics of the land bird populations on the forested main islands of the Krunnit

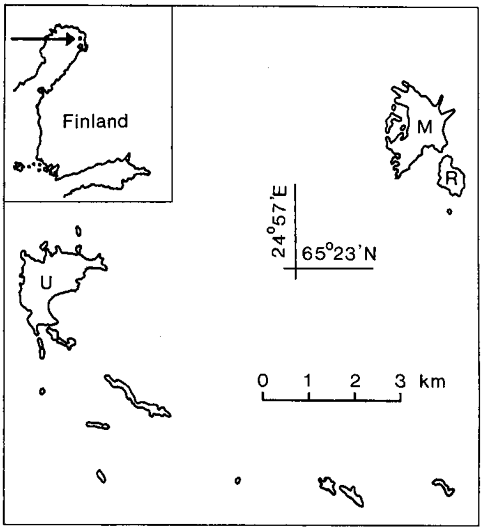

FIG. 1. Study area. M = Maakrunni, R = Ristikari, U = Ulkokrunni.

group during the period 1939—77, and to search for reasons for the changes which have taken place.

The term "land birds" refers here to the orders Falconiformes, Cuculiformes, Strigiformes, Apodiformes, Piciformes and Passeriformes.

Study area

The islands of Krunnit lie some 11—21 km off the Finnish mainland (65°25′N, 25°00′E). There are altogether over 30 islands, three of which are considerably larger and older than the others (Fig. 1). These main islands have reached a maximum height of 6.4—7.0 m above sea level (Vartiainen 1967), which with the local rate of land uplift of ca. 80 cm per 100 years (Hela 1953) implies an age of 850—930 years.

The distribution of the three main islands into open and forested lands is presented in Table 1. The relief of the islands is mainly rather slight, the greater part of their area lying 1—3 m above sea level. Most of the forests are of the deciduous *Cornus-Deschampsia* type, the most common trees being *Betula pubescens, Prunus padus, Sorbus aucuparia* and *Alnus incana.* The field layer is characterized by *Avenella flexuosa, Cornus suecica, Deschampsia caespitosa, Silene dioica* and *Milium effusum.* There is a small *Pinus silvestris* forest on Maakrunni, and all three islands have some *Populus tremula.*

The vegetation has developed slowly on the Krunnit islands. Thus, ground that is 100—300 years old still bears only deciduous forest, which is clearly older than the corresponding successional stage in adjacent mainland forest. Because of this, the avifauna of the archipelago shows some features characterizing the bird populations of climax forests, although *Picea abies,* the dominant tree in the climax stage, is still almost absent.

The open ground, located partly in the immediate vicinity of the shore and partly on the higher areas, bears heath vegetation consisting typically of *Juniperus communis, Empetrum nigrum* and *Vaccinium vitis-idaea,* with scattered *Sorbus aucuparia.* The more protected coves support extensive stands of *Phragmites australis.* For a more detailed account of the vegetation of the islands, see Vartiainen (1967).

The decrease of human activity on Krunnit has allowed the natural succession to proceed unchecked. The grazing of cattle, once so common on the islands, has not been practised for several decades, and the reed beds and shore meadows are no longer cut for cattle fodder. All silvicultural activity has also ceased since the islands became protected in 1936. The forest is thus closing up and encroaching on the shores and ridges. Since 1936, the only measures taken to improve nesting conditions for birds on the islands have been slight control of crows and foxes.

TABLE 1. Length of transects and areas of forested and open ground on the main islands of the Krunnit group in the 1970s.

	Length of transects (m)	Area (ha) Forest	Open ground
Maakrunni	5520	84.5	49.8
Ristikari	3245	30.6	5.0
Ulkokrunni	4050	89.4	90.2
Total	12815	204.5	145.0

Material and methods

The first census on the Krunnit islands was carried out in 1939 by E. Merikallio, who estimated the numbers of land birds on the main islands by means of line transects (Merikallio 1950). These same census routes were used in the subsequent surveys in 1949 (Salkio 1952), 1972 (E. Helle), 1973 (E. & P. Helle), 1975 (P. Helle) and 1977 (E. & P. Helle). In addition, supplementary observations are available from several years (R. Tenovuo 1950, 1952, 1954 and 1955; E. & P. Helle 1974). The surveys were carried out on fine days with little wind and clear or partially clear skies, between 03.00 and 08.00 on the following dates: 12—19 June 1939, June 1949, 6 June — 8 July 1972, 15—18 June 1973, 13—16 June 1975 and 16—19 June 1977.

The line transect censuses of the forest birds were carried out by all the workers in the same way, with a main belt of 50 m (see Merikallio 1946, V. Salkio in litt.). The supplementary belt was used only for scarce and more audible species, which were counted as in the mapping method, as the supplementary belt cannot be surveyed satisfactorily in regard to the most common species (see Järvinen & Väisänen 1976).

All patches of open ground were surveyed thoroughly one to five times in censusing the open-ground species (*Apus apus, Alauda arvensis, Hirundo rustica, Delichon urbica, Riparia riparia, Oenanthe oenanthe, Saxicola rubetra, Acrocephalus schoenobaenus, Anthus pratensis* and *Motacilla alba)*.

The densities for the populations of forest birds were calculated per unit area of forest, and those for the open-ground species per unit area of open land.

The line transect method has been criticized because of the numerous sources of error involved, compounded here by the number of different observers. Nevertheless we believe that the results obtained in this study may be regarded as fairly reliable, at least with respect to the most common species and the main changes in the populations. The densities must be considered relative, and the real figures may differ greatly from them, e.g. because of the edge effect.

In the present paper the land bird fauna is divided into the following groups: (1) increasing and (2) decreasing species (Student's t-test gives a significant difference between the average densities in 1939—49 and those in 1972—77), (3) markedly fluctuating species (no difference in the t-test, but densities differ significantly in the χ^2-test), (4) constant species (no difference in either test), and (5) rare or occasional species (observed only once or twice in 11 years of qualitative surveys).

One inaccuracy, kindly brought to our attention by Dr. Risto A. Väisänen, has been corrected in comparing the new census results with those of 1939, namely that the densities presented by Merikallio (1950) are considerably higher than his primary census data would warrant (Merikallio records in University of Oulu).

The census results were compared with the temperatures for May-June in Oulu. Although the temperatures in 1939 and 1949 were close to the average values, in both cases the preceding 5 years had been particularly warm (see Fig. 2). Similarly, the surveys in the 1970s were made in years that were warmer than average. Hence, the results from these three periods are comparable with regard to the temperature, but may give too southerly an impression of the land bird population of

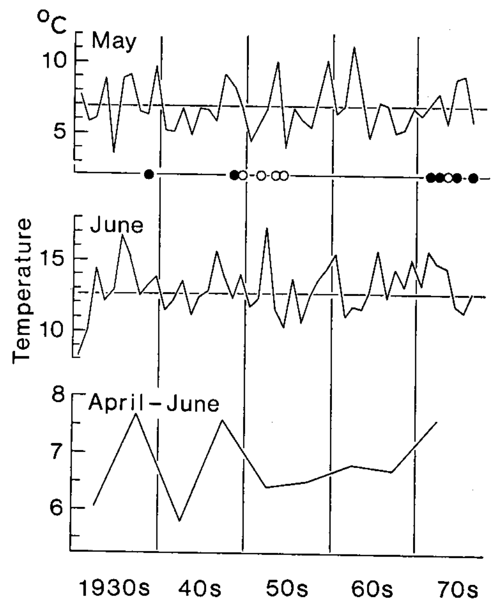

FIG. 2. Mean temperatures for May and June in the different years and mean temperatures for April-June in 5-year periods at the Oulu Meteorological Station during the study period (Anon. 1931—77). Times of censuses shown by black dots (quantitative censuses) and open circles (semi-quantitative and qualitative censuses).

TABLE 2. Densities of forest and open-ground species (pairs/km²) on the Krunnit islands.

	1939	1949	1972	1973	1975	1977
Maakrunni						
Forest	495.6	475.6	369.1	294.6	262.6	307.6
Open-ground	147.6	133.9	44.2	46.2	52.2	..
Ristikari						
Forest	607.0	508.8	339.9	287.6	313.7	274.5
Open-ground	115.0	105.0	220.0	320.0	300.0	..
Ulkokrunni						
Forest	438.5	472.8	439.8	268.6	415.1	362.6
Open-ground	154.8	136.9	68.8	28.8	57.7	..
Total						
Forest	487.0	480.3	396.4	282.7	336.6	321.4
Open-ground	168.9	151.1	65.7	44.9	64.3	..

the islands. The qualitative material from the 1950s, on the other hand, originates from the coldest period included here.

Results

Number of nesting pairs. The decline of the numbers of nesting land birds from over 1100 pairs in 1939—49 to about 700 pairs in 1973—75 is due to reductions in both the forest and open-ground species (Table 2). Though a high density of forest birds was still recorded in 1972, this was followed by the lowest records of the whole period in 1973. The numbers decreased even more markedly in the open-ground than in the forest species.

Numbers of species. A total of 55 species belonging to the orders listed in the introduction were observed on the main islands, the numbers being greater in the censuses carried out in the 1970s than in the earlier ones (Table 3).

Densities of individual species. The most important species are included in Table 4. The only species which have occurred in the Krunnit area regularly since 1939 and have increased are *Fringilla coelebs* and *Acrocephalus schoenobaenus;* several species have established themselves on the islands after 1949.

The greatest decrease in numbers was found in *Riparia riparia* and *Phylloscopus trochilus,* the most pronounced change having taken place between 1949 and 1972. Marked declines were also noted in several other species (Table 4).

TABLE 3. Numbers of land bird species on the Krunnit islands in 1939—77.

	1939	—49	—72	—73	—74	—75	—77	Total
Maakrunni	26	25	23	25	20	22	25	45
Ristikari	18	14	23	27	19	19	18	41
Ulkokrunni	24	18	34	29	22	28	27	46
Total	29	25	39	37	27	32	34	55

TABLE 4. Densities (pairs/km²) of species which changed markedly in numbers on the Krunnit islands in 1939—77 (+ = no accurate estimate).

	1939	1949	1972	1973	1975	1977
A. Increased						
a. Observed continuously						
Acrocephalus schoenobaenus	2.2	3.0	13.3	9.0	22.1	+
Fringilla coelebs	34.2	35.2	67.6	36.8	44.1	51.9
b. Started breeding after 1949						
Delichon urbica	0	0	12.4	13.1	13.1	+
Parus major	0	0	1.0	2.9	2.0	+
Turdus pilaris	0	0	5.4	5.9	7.8	2.9
T. merula	0	0	1.5	4.4	2.5	1.5
Erithacus rubecula	0	0	2.0	3.4	2.9	2.9
B. Decreased						
Riparia riparia	70.4	55.6	17.2	1.4	6.9	+
Oenanthe oenanthe	23.7	25.9	4.1	6.2	4.1	+
Phoenicurus phoenicurus	16.6	19.7	13.2	3.9	3.4	2.9
Sylvia borin	20.7	20.2	20.6	13.8	17.2	10.8
Phylloscopus trochilus	243.0	212.4	114.2	88.7	119.6	117.1
Muscicapa striata	33.2	31.6	21.6	11.3	10.3	18.1
Anthus trivialis	35.2	46.6	6.9	10.6	18.1	22.1
Motacilla alba	26.2	25.7	10.3	5.4	4.6	+
C. Fluctuated						
Turdus philomelos	1.0	0.5	7.8	4.4	1.5	6.9
T. iliacus	4.7	35.2	23.0	11.3	18.6	25.0
Ficedula hypoleuca	1.0	2.1	13.7	1.5	3.4	1.5
Acanthis flammea	1.6	7.3	4.9	2.9	4.9	3.9
Fringilla montifringilla	39.9	4.1	38.8	32.8	42.6	18.1
Emberiza schoeniclus	40.9	59.6	31.9	35.8	39.3	+

The most typical of the fluctuating species with no clear overall trend were *Turdus iliacus, Fringilla montifringilla* and *Ficedula hypoleuca.*

In addition, 22 species were observed more or less regularly (in at least 3 years), but in densities that were too low to permit any conclusions on possible changes. The mean yearly densities were less than 1 pair/km² in *Falco tinnunculus, Apus apus, Dendrocopus major, D. minor, Alauda arvensis, Corvus corax, Parus montanus, Certhia familiaris, Troglodytes troglodytes, Saxicola rubetra, Lanius collurio, Sturnus vulgaris, Loxia curvirostra/pytyopsittacus* (not breeding?), *Emberiza citrinella* and *E. rustica,* and 1—3 pairs/km² in *Cuculus canorus, Iynx torquilla, Hirundo rustica, Corvus corone, Sylvia curruca, Anthus pratensis* and *Carduelis spinus* (not breeding?).

The following rare or occasional species are worth mentioning:

Surnia ulula. Nesting pair on Ulkokrunni in 1977.

Asio flammeus. Nesting pair on Ulkokrunni in 1977.

Picoides tridactylus. Male giving alarm cries on Ulkokrunni 10 June 1972.

Sylvia atricapilla. Singing male on Ristikari 4 July 1954 and on Ulkokrunni 6 July 1972.

Phylloscopus trochiloides. Nest find on Ristikari in June-July 1973 (26 June 6 eggs, 18 July empty nest).

Ph. sibilatrix. Singing male on Ristikari 26 June 1973.

Ph. borealis. Nest find on Ristikari 18 July 1973 (5 nestlings).

Prunella modularis. Singing male on Maakrunni 25 June 1973.

Pyrrhula pyrrhula. 1 ex. on Ulkokrunni 11 July 1950 and on Maakrunni 1 July 1974.

Emberiza hortulana. Singing male on Maakrunni 21 June 1972.

E. pusilla. Pair giving loud alarm cries on

Ulkokrunni several times 10 June — 7 July 1972.

Passer montanus. 1 ex. on Ulkokrunni June 1939.

Species diversity. The species diversity, as measured by Shannon's function, increased over the period in question on all three islands (Table 5).

Northern and southern species. The division into northern and southern species used here follows that of Merikallio (1946), with certain additional species allocated on the basis of data from v. Haartman et al. (1963—72); this division leaves about 45 % of the avifauna outside the two categories.

The proportion of northern birds in the total number of species was clearly highest in 1950—55 and lowest in 1973 (Table 6). The percentage of northern birds in the total number of pairs ranged from 30.7 (1972) to 38.3 (1975).

In both the southern and northern species the highest density was observed in 1972. The general reduction in the density of land birds between 1949 and 1972 is entirely due to the decline in the indifferent group from 850 pairs to 450.

Discussion

It is a general rule that the species diversity, number of species and density of avifauna will increase as the vegetation succession advances (e.g. Johnston & Odum 1956, Glowaciński 1975), and the first two changes were in fact found on the Krunnit islands. The increase in the number of species may be also at least partly due to the temperatures during the nesting season. Although no correlation could be found, the highest figures were reached in years with the highest nesting season temperatures (1972, 1973; Table 3, Fig. 2). The density of avifauna, on the other hand, seems to have run counter to the general rule. But the decrease in numbers is due chiefly to the decline of *Phylloscopus trochilus* and *Riparia riparia;* if the former species is excluded, the density of forest species appears to have remained more or less constant over the period in question.

Northern and southern species. Long-term climatic changes are decisive in determining the composition of the avifauna, and southerly species are known to have spread to North Europe in the early part of this century (see e.g. Siivonen & Kalela 1937, Kalela 1946, 1949).

TABLE 5. Species diversity (Shannon's function) on the main islands of the Krunnit group in 1939—77.

	1939	1949	1972	1973	1975	Total
Maakrunni	2.21	2.28	2.48	2.45	2.38	2.48
Ristikari	1.94	2.12	2.51	2.82	2.51	2.52
Ulkokrunni	2.18	2.19	2.70	2.34	2.52	2.53
Total	2.22	2.26	2.68	2.52	2.54	2.54

TABLE 6. Percentage of northern species in the total number of land bird species (A) and in the total number of pairs (B) on the Krunnit islands in 1939—77.

	1939	—49	—50	—52	—54	—55	—72	—73	—74	—75	—77
A	28.6	33.3	40.0	44.4	33.3	50.0	30.4	18.2	18.8	23.5	30.5
B	33.1	36.1	..	..	..	..	30.7	33.5	..	38.3	..

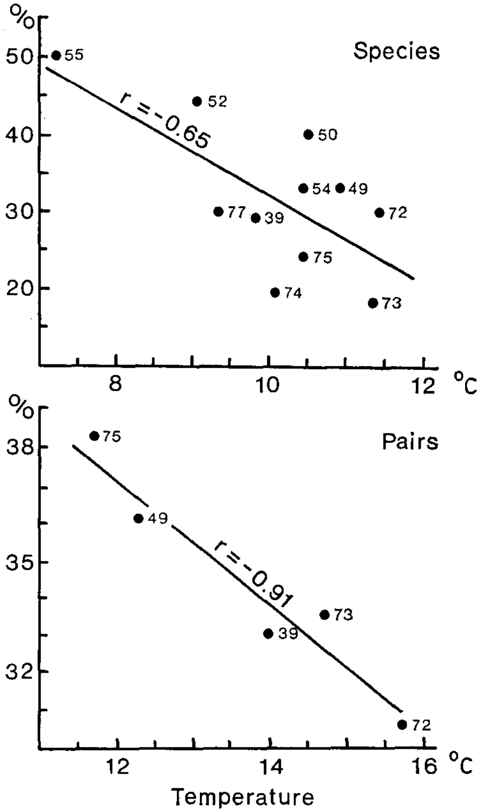

FIG. 3. Correlations of the proportion of northern species in the total number of species and in the total number of pairs with the mean temperatures in, respectively, May-June and June on the Krunnit islands in the different census years.

Calculated from the numbers of pairs, the northern:southern ratio does not indicate any change in the composition of the land birds of the Krunnit islands since 1939, but the ratio of the species numbers shows that southern species had clearly increased by the 1970s. This is due to the northward expansion of several species (see also Järvinen 1978), at least partly as a consequence of the favourable climatic conditions. These species include *Turdus merula, Acrocephalus schoenobaenus, Phylloscopus trochiloides* and *Ph. sibilatrix.*

The considerable annual variation in the proportions of northern and southern species may be explained on the basis of temperature, for a negative correlation exists between temperatures during the migration and nesting season and the proportion of northern species in terms of both numbers of species and numbers of pairs (Fig. 3).

An interesting approach to this question is afforded by pairs of related species in which one has a southern and the other a northern distribution, e.g. *Fringilla coelebs* — *F. montifringilla* (see Merikallio 1951). The percentage of the latter species in the total *Fringilla* population varied in the following manner:

1939	—49	—50	—52	—54	—55
53.8	10.4	18.9	10.0	21.3	16.7

—72	—73	—74	—75	—77
36.1	47.1	26.7	49.1	25.9

A significant increase in the proportion of *F. montifringilla* is seen between the years 1949—55 (mean 15.5) and 1972—77 (mean 37.0) (t = 4.0, $P < 0.01$). These findings agree with earlier reports of a decline in the numbers of this species during the 1940s (see Merikallio 1951) and a strengthening of the population in the 1950s and 1960s (v. Haartman et al. 1963—72).

According to Kalela (1938), there is a clear connection between high densities of *F. montifringilla* and low mean temperatures for April-June, but outstanding exceptions to this have been pointed out by both Hildén (1966) and v. Haartman et al. (1963—72). In the present material, no such correlation is found; on the other hand the proportion of this species shows a high negative correlation with the percentage of northern species in the land avifauna as a whole, excluding the *Fringilla* species (r = —0.927, $P < 0.05$). There may be two reasons for this: (1) The most suitable nesting environment for a northern species in a warm year is an area that is cooler than its surroundings, in the present instance a group of off-shore islands, where conditions during the nesting season correspond to those encountered in much more northerly regions (Fig. 4). (2) The Krunnit islands no longer lie on the extreme southern margin of the distribution of *F. montifringilla;* hence, a cold spring will not lead to an increase in its numbers here but rather further south and in warmer habitats within the same major region (see also Siivonen 1952).

On the whole, the most marked quantitative changes taking place in the land bird populations on the Krunnit group during the study period can mostly be attributed to other factors than long-term changes in temperature (see also v. Haartman 1978).

Influence of vegetational changes on the avifauna. Hole-nesting species accounted for 6.1 % (4.0—9.6 % in different years) of the avifauna of the Krunnit islands in 1939—77, or only about a half of the corresponding figure for deciduous forests in the southernmost parts of the country (see Haapanen 1965). As the vegetation develops, the forests grow denser and the field layer becomes correspondingly impoverished, affording fewer sites that are suitable for ground-nesting birds (Haapanen 1965). This may, at least partly, be a reason for the decline in the proportion of species nesting on the ground, from 66 % in 1939—49 to 49 % in the 1970s. The greatest decreases occurred in the numbers of *Phylloscopus trochilus* and *Anthus*

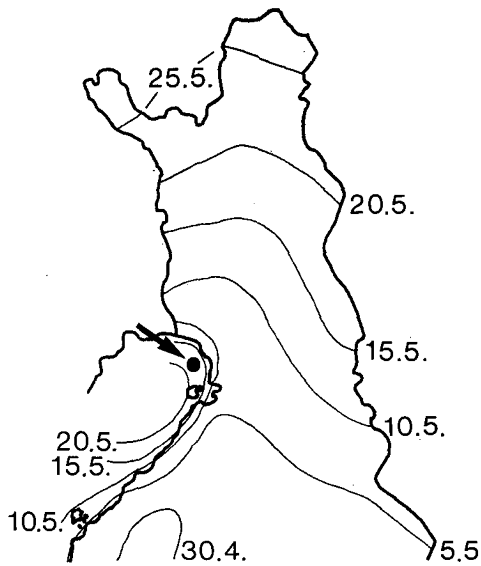

FIG. 4. The dates of the +5°C isotherms in central and northern Finland (Kolkki 1960). The arrow shows the position of the Krunnit islands.

trivialis. During the same time, the species nesting in trees and bushes increased from 34 % to 51 %.

From the nutritional point of view those species profit most from the growth of the forests which obtain their food from the foliage or trunks of the trees, and those suffer most which forage on the ground or catch their food in the air (Haapanen 1965). The transformation of the low, open deciduous shrub of the 1930s into the denser and more mature forest of the 1970s has thus created more favourable nesting and/or feeding conditions for species such as *Certhia familiaris, Troglodytes troglodytes, Erithacus rubecula* and *Fringilla coelebs,* and led to a decline in *Phoenicurus phoenicurus, Sylvia borin, Phylloscopus trochilus, Muscicapa striata* and *Anthus* *trivialis*. These changes agree with previous reports on the nesting habitat requirements of these species (e.g. v. Haartman et al. 1963—72).

As regards the species of open ground, the encroachment of shrub vegetation on the heath-covered ridges and shore meadows has made conditions much less favourable for *Oenanthe oenanthe* and *Motacilla alba*, which is probably one reason for the strong decrease in their numbers in the study area.

Other reasons for changes in populations. Recent general expansions of certain species in Finland are reflected in the populations on the Krunnit islands, e.g. that of *Prunella modularis* (see Järvinen & Väisänen 1977) and *Acrocephalus schoenobaenus* (v. Haartman 1978). The decisive drop in the numbers of *Riparia riparia* prior to the 1970s was presumably due to foxes, which spent several summers on the islands and caused considerable destruction to the colonies nesting in the low sand banks. *Surnia ulula* and *Asio flammeus* were attracted to the islands in summer 1977 by the peak population of the Water Vole *Arvicola terrestris* (see Pulliainen 1978); no other small mammals are known to exist on the islands. An exceptionally cold period with heavy snowfall in late May 1968 led to the exhaustion of large numbers of insectivorous birds on the Finnish coast of the northern Bothnian Bay. Among the birds found dead, *Oenanthe oenanthe* was the second most numerous (Ojanen 1979), and its low density on the remote Krunnit islands in the 1970s may still be partly due to this catastrophe.

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Selostus: Maalinnuston kehitys Krunnien saaristossa Perämerellä 1939—77

Kirjoituksessa käsitellään maalinnuston kehitystä Iin Krunnien kolmella metsäisellä pääsaarella (pinta-alat taulukossa 1) vuosina 1939 —77. Saaristo on ollut rauhoitettu v:sta 1936, joten kasvillisuuden ja eläimistön luontaiseen kehitykseen ei ole juuri puututtu tutkimuskaudella ihmisen toimesta.

Kirjoitus perustuu kuuteen kvantitatiiviseen ja viiteen kvalitatiiviseen laskentaan. Metsälinnusto on laskettu perinteisen linjalaskentamenetelmän mukaisesti (pääsaran leveys 50 m); ulkopuolista apusarkaa on käytetty vain laskettaessa harvalukuisia lajeja kartoitusmenetelmän tapaan. Laskentalinjat ovat olleet samat ensimmäisestä laskennasta (1939) lähtien. Avomaalinnut on laskettu käymällä läpi saarten kaikki avomaat 1—5 kertaa.

Krunnien pääsaarten pesivän maalinnuston parimäärä laski yli 1100 parista vuosina 1939 ja 1949 noin 700 pariin 1970-luvun laskennoissa (taul. 2); avomaalintujen väheneminen oli jyrkempää kuin metsälintujen. Laskennoissa tavattiin kaikkiaan 55 lajia, yhtenä vuonna (1972) enimmillään 39 (taul. 3). Lajiston moninaisuus (lajidiversiteetti, Shannonin indeksi) nousi vuosien 1939 ja 1949 laskennoista 1970-luvulle (taul. 5). Lajiston pohjoisuus: eteläisyys-rakenne ei muuttunut selvästi mihinkään suuntaan tutkimusjaksolla, mutta vaihteli suuresti vuodesta toiseen (taul. 6).

Tärkeimmät lajikohtaiset tulokset esitetään taulukossa 4. Selvimmin yleistyivät peippo ja ruokokerttunen sekä vuoden 1949 jälkeen uusina tulokkaina räystäspääsky ja räkättirastas. Eniten taantuivat uunilintu, törmäpääsky, metsäkirvinen, kivitasku, västäräkki, harmaasieppo ja leppälintu. Urpiaisen, pajusirkun, punakylkirastaan ja järripeipon kannat vaihtelivat huomattavasti ilman selvää suuntaa.

Krunnien pääsaarten puusto on ikääntynyt ja käynyt sulkeutuneemmaksi sukkession myötä. Saman suuntaisesti ovat vaikuttaneet laidunnuksen, heinänniittämisen ja metsänhoidon loppuminen rauhoituksen alkaessa. Yleensä tällaisessa tilanteessa maassa pesivien lajien pesimismahdollisuudet huonontuvat ja puissa sekä pensaissa pesivien paranevat; samoin ilmasta ravintonsa pyydystävien lajien saalistusmahdollisuudet heikentyvät, rungoilla ja lehvistössä ruokailevien taas vastaavasti paranevat. Nämä muutokset selittänevät useimmat yllä mainituista linnuston pitkäaikaismuutoksista Krunneillakin.

Suuretkin lyhytaikaiset vuosien väliset muutokset johtunevat paljolti pesintäkauden lämpötiloista. Lajimäärä on suuri lämpiminä kesinä, ja pohjoisten lajien osuus koko lajistosta on negatiivisessa korrelaatiossa pesintäkauden lämpötilaan (kuva 4). Lämpiminä vuosina lajistoa rikastuttavat yksilömääräisesti vähäiset eteläis-itäiset vierailijat.

Pesivän järripeippokannan vahvuus ei vaihtele Krunneilla tyypillisesti pohjoisen lajin tapaan vaan päinvastoin: kanta on vahva lämpiminä ja niukka kylminä kesinä. Tähän on ainakin kaksi syytä. (1) Lämpiminä vuosina järrit siirtyvät pesimään keskimääräistä pohjoisemmaksi ja toisaalta tietyn alueen puitteissa kylmimpiin biotooppeihin, esim. meren ulkosaaristoon (ks. kuva 4). (2) Kylminä vuosina järripeippokannan pesiminen keskimääräistä etelämpänä näkynee nykyisin selvemmin lähempänä lajin levinneisyyden etelärajaa eikä niinkään enää esim. Krunneilla.

Monet muutkin tekijät ovat vaikuttaneet Krunnien maalinnuston koostumukseen. Niinpä esim. västäräkki- ja kivitaskukannat ovat ainakin osittain heikentyneet rantaniittyjen umpeenkasvun seurauksena, matalissa törmissä pesivät törmäpääskyt ovat kärsineet kettujen oleskelusta saarilla ja ajoittain runsas vesimyyräkanta on tehnyt mahdolliseksi hiiri- ja suopöllön pesimisen.

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