A biogeographical comparison of the breeding bird species assemblages in twenty Finnish urban parks

Jukka Suhonen & Jukka Jokimäki

Suhonen, J. & Jokimäki, J. 1988: A biogeographical comparison of the breeding bird species assemblages in twenty Finnish urban parks. — Ornis Fennica 65:76–83.

Census data on urban parks and cemeteries in three ornithogeographical zones in Finland were extracted from the literature. The breeding birds were censused using the territory mapping or study plot method.

Southern parks had more similar bird assemblages than northern ones. Bird density depended more on park area than on its geographical location; density correlated positively with edge length. *Fringilla coelebs, Phylloscopus trochilus, Muscicapa striata* and *Parus major* were the dominant species in parks of all sizes, whereas *Anthus trivialis* and *Sylvia* spp. avoided small parks. The number of species increased with park area and was not dependent on geographical location.

Ph. trochilus and *F. coelebs* had similar relative abundances in parks as they had regionally. The relative abundance of *T. pilaris* was greater in the northern parks than it was regionally, whereas *M. striata* had greater relative abundance in southern parks than regionally. Hole-nesting and deciduous forest species favour parks but coniferous forest species avoid them.

Jukka Suhonen and Jukka Jokimäki, Konnevesi Research Station, University of Jyväskylä, SF-44300 Konnevesi, Finland.

Introduction

Cities represent the extreme of human-modified environments, with only remnants of the original habitats existing. With the urbanization of birds going on all over the world, we are able to witness an "ecological experiment" on a large scale. It reveals many problems of adaptation in birds, the forming of new population structures, and interspecific interactions among birds colonizing a habitat with new ecological opportunities (Erz 1966, Tomialojc & Profus 1977, Tomialojc 1985).

The breeding bird community structure in urban parks, cemeteries and woodlands has been studied, for example, in Poland (Tomialojc & Profus 1977, Luniak 1974, 1981), in the Federal Republic of Germany (Bezzel 1982 and references therein), England (Taylor et al. 1987), Canada (Gotfryd & Hansell 1986) and in the U.S.A. (Gavareski 1976, Lussenhop 1977). In Finland, Kajoste (1961) has censused bird communities of parks and cemeteries in Helsinki, and Huhtalo & Järvinen (1977) give data on the urban birds of Tornio.

Our main purpose is to examine the structure of breeding bird assemblages of urban parks in different geographical regions in Finland (see Järvinen & Väisänen 1973, 1980). We also examine edge effect and compare the abundances of park birds with their regional abundances. This makes it possible to examine how biogeographical regionality is reflected in local assemblages of urban bird species (for a similar approach based on old-forest birds, see Virkkala 1987).

Material and methods

The material includes twenty parks and cemeteries in Finland, and the data cover three ornithogeographical zones of Järvinen & Väisänen (1980): Helsinki is in the hemiboreal, Karkkila, Heinola and Kuopio in the south-boreal and Rovaniemi in the mid-boreal zone.

Table 1. The material of this study. The territory mapping method was used in Karkkila and Rovaniemi, whereas the other areas were censused using the study plot method.

Location	Parks	Total area ha	(Range)	Years	Visits	Source
Hemiboreal						
Helsinki (60°10'N, 24°55'E)	9	110.3	(0.5–50)	1956	4	Kajoste (1961)
South-boreal						
Karkkila (60°32'N, 24°12'E)	1	13.2		1979	5	Luoto (1981)
Kuopio (62°52'N, 27°40'E)	3	6.4	(1.8–2.6)	1972–74	3	Hohtola (1984)
Heinola (61°10'N, 26°02'E)	1	60.0		1971	2	Hietanen (1975)
Mid-boreal						
Rovaniemi (66°30'N, 25°42'E)	6	12.0	(0.5–4.0)	1983	5	Jokimäki (1987)

All data were extracted from the literature (Table 1). The breeding birds were censused using the territory mapping or study plot method. Differences between the two methods are fairly small in urban habitats (Hohtola 1978). The size distribution of parks was as follows:

	≤2.0 ha	2.1–10.0 ha	>10.0 ha	Total
Number of parks	9	7	4	20
Total area	12.0	34.7	155.2	201.9

The similarities between different breeding bird assemblages were compared using Renkonen's (1938) index of percentage similarity, $PS = \Sigma\min(p_{1i}, p_{2i})$, where p_{1i} and p_{2i} are the percentages of the ith species in samples 1 and 2. The dendrogram based on the pairwise similarities of the assemblages was constructed according to Cody (1974). The effect of the differences in sample size on species number was eliminated by the method of rarefaction (see Heck et al. 1975).

Relative constancy (B_i) for species i was measured with Simpson's index $B_i = 1/\Sigma f_{ij}^2$, where f_{ij} is the frequency of species i in park j.

The regional relative abundances of birds were based on extensive line transects (O. Järvinen & R. A. Väisänen unpubl.). The regional data were matched to the urban censuses as closely as possible with respect to both area and time. For the hemiboreal zone, 43.4 km censused in zone 67 of the Finnish uniform grid (see Järvinen & Väisänen 1980: Fig. 1) in 1952–63 were used. For the south-boreal zone, 897.4 km censused in this zone (see Järvinen & Väisänen 1980) in 1973–77 were used. For the mid-boreal zone, 130.7 km of transects censused in zone 73 of the Finnish uniform grid in 1973–77 were used.

Results

Structure of bird assemblages

A dendrogram (based on percentage similarities) shows that geographical location affects structure of the bird assemblages more than the park area does (Fig. 1), as parks from the same region tend to form clusters, but similar-sized parks do not. A 1.0 ha park in Rovaniemi with many typical park species, for example, *Muscicapa striata, Fringilla coelebs* and *Carduelis chloris*, is surprisingly similar to hemiboreal parks, however. Southern parks are more similar to each other than the northern ones.

Bird density and edge effect

Bird density seems to depend more on park area than on the geographical position, as area is highly significantly correlated with density, but there is no distinct relationship between ornithogeographic region and bird density (Fig. 2). Bird density in 10-hectare parks (about 2.9 pairs/ha) was less than half of that in the one hectare parks (about 6.8 pairs/ha). The result may be related to edge length. We estimated relative edge length (supposing that parks are squares): $REL = 400\sqrt{A}/A$ (m/ha), where A is the park area in hectares. Density was positively correlated with

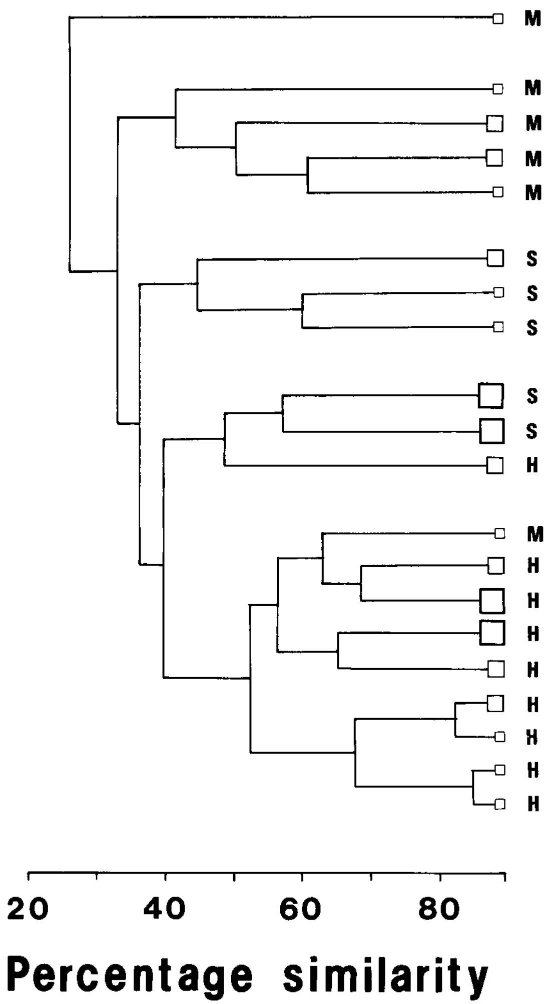

Fig. 1. Dendrogram based on the percentage similarities of 20 park-breeding bird assemblages in different ornithogeographical zones in Finland. The letters in the figure refer to ornithogeographical zones; H = hemiboreal, S = south-boreal and M = mid-boreal zone. Size of squares indicate park area. Small = at most 2.0 ha, medium = 2.1 – 10.0 ha and large = > 10.0 ha.

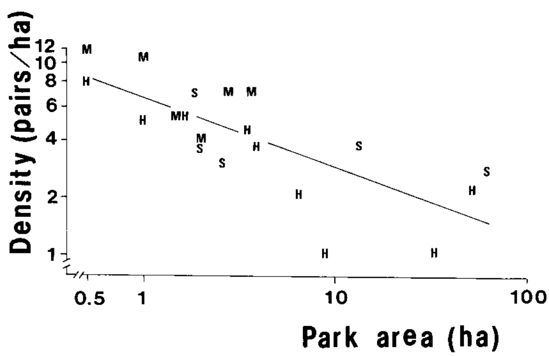

Fig. 2. Bird density (D) (territories/ha) of 20 parks in Finland in relation to park area (A) (ha). $D = 6.75A^{-0.36}$, $r = 0.75$, $P < 0.001$. The symbols as in Fig. 1.

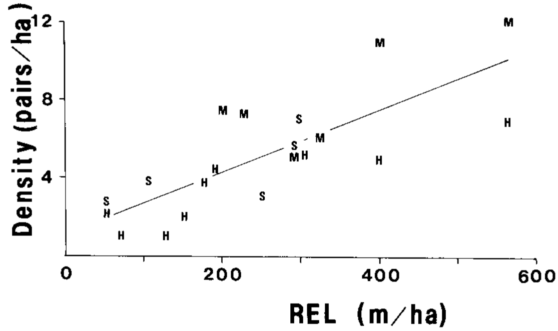

Fig. 3. Bird density (D) (territories/ha) of 20 parks in Finland in relation to relative edge length (REL) (m/ha). $D = 1.11 + 0.0159$ REL, $r = 0.79$, $P < 0.001$. For symbols see Fig. 1.

relative edge length (Fig. 3). Our formula underestimates the perimeter, in large parks in particular (see Gotfryd & Hansell 1986), and in reality therefore the slope may be even steeper than in Fig. 3.

The population densities (pairs/10 ha) of those bird species that occurred in at least three parks were calculated for the following park size classes: ≤ 2.0, 2.1 – 10.0, and > 10.0 hectares (Table 2). Most bird species reach their maximum density in small parks, whereas *Anthus trivialis* and *Sylvia* spp. were absent.

The dominant species in parks of all sizes were *F. coelebs*, *Phylloscopus trochilus*, *M. striata* and *Parus major*.

Number of species

The number of species increases when park area increases but is apparently not strongly dependent on geographical location (Fig. 4). The logarithmic function explains slightly more of the variance (69 %) than the power function (65 %).

The expected number of species in similar-sized samples (60 pairs), estimated using rarefaction (all parks were pooled in different zones), is greater in the south-boreal zone than in the hemi- and mid-boreal zones, but the curves did not differ statistically from

Table 2. Breeding bird densities (pairs/10 ha) of the most abundant species (seen in at least three parks) in three different ornithological zones and three different size classes of parks (n = number of total pairs, P = number of parks (total 20) where species occur, B = relative constancy and abbreviations for the species occurring in Figs. 6–7).

	Hemiboreal	Southboreal	Midboreal	≤2.0	2.1–10.0	>10.0	n	P	B
Hirundo rustica (Hrus)	0.5	0.4	–	–	1.2	0.3	9	3	2.8
Anthus trivialis (Atri)	–	0.3	0.8	–	0.3	0.1	3	3	3.0
Motacilla alba (Malb)	0.1	1.9	1.7	0.8	1.2	0.8	18	6	2.1
Sturnus vulgaris (Svul)	0.2	2.1	–	–	–	1.2	19	3	1.2
Pica pica (Ppic)	0.1	0.5	0.8	2.5	0.3	0.1	6	6	6.0
Corvus corone cornix (Ccor)	0.1	0.3	0.8	0.8	0.3	0.1	4	4	4.0
Hippolais icterina (Hict)	0.7	–	–	0.8	0.9	0.3	8	6	4.6
Sylvia borin (Sbor)	0.5	0.5	0.8	–	0.9	0.5	11	6	4.5
S. communis (Scom)	0.4	0.3	–	–	0.6	0.3	6	4	3.6
S. curruca (Scur)	0.5	0.1	–	–	0.6	0.3	7	5	3.8
Phylloscopus trochilus (Ptro)	1.4	2.9	15.8	5.8	5.5	2.0	57	15	7.3
Ficedula hypoleuca (Fhyp)	1.2	2.5	4.2	6.7	1.4	1.7	40	12	4.5
Muscicapa striata (Mstr)	2.9	2.6	3.3	6.7	4.0	2.3	57	15	7.6
Phoenicurus phoenicurus (Ppho)	0.2	0.8	0.8	0.8	0.3	0.5	9	5	4.3
Turdus iliacus (Tili)	0.6	0.3	1.7	1.7	1.2	0.3	11	8	6.4
T. pilaris (Tpil)	0.3	1.3	13.3	4.2	3.2	0.8	29	8	5.2
Parus caeruleus (Pcae)	1.1	0.8	–	–	0.9	1.0	18	7	3.6
P. major (Pmaj)	4.0	2.1	5.0	10.0	3.2	2.8	67	17	7.0
Passer domesticus (Pdom)	–	2.4	–	2.5	–	1.0	19	4	2.0
Fringilla coelebs (Fcoe)	4.5	4.3	11.7	14.2	6.1	3.9	98	19	7.4
Carduelis chloris (Cchl)	1.0	0.4	3.3	3.3	1.2	0.6	18	11	7.4
Other species (19 spp.)	0.7	3.9	6.8	0.9	2.4	2.7	50	..	..
Total number of pairs	232	244	85	74	124	366	564		
Total number of species	25	32	19	15	26	34	40		
Total density	21.0	30.7	70.8	61.7	35.7	23.6	27.9		

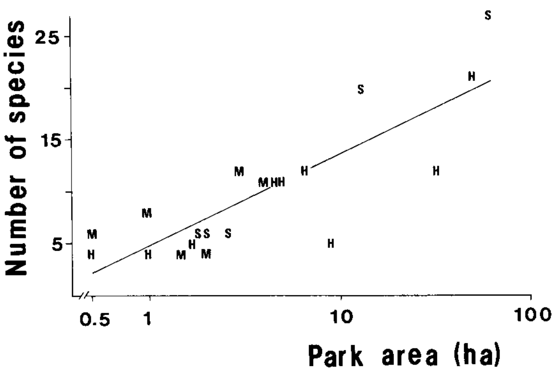

Fig. 4. Number of bird species (S) in relation to area (A) in 20 Finnish parks. S = 3.85 ln(A) + 4.70, r = 0.83, P < 0.001. For symbols see Fig. 1.

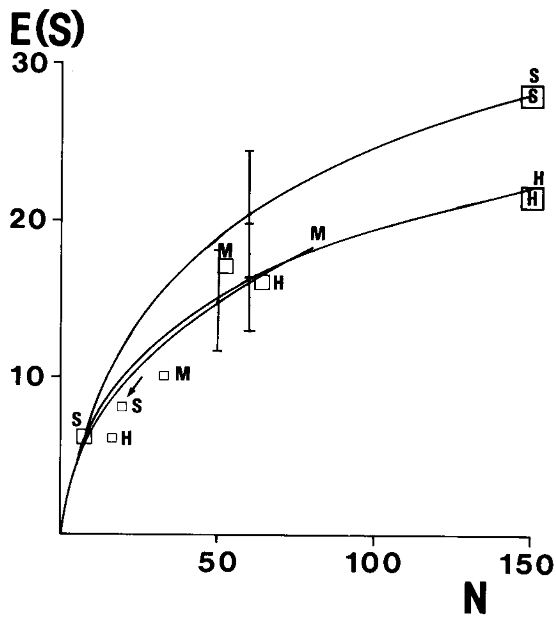

Fig. 5. Estimated species number E(S) in samples of different sizes (N) in parks. The rarefaction curves are based on the total data in different ornithogeographical zones. Bars indicate ± SD. The letters and squares as in Fig. 1. The small park with a significant difference (south-boreal zone) is indicated by an arrow.

each other. In small parks (≤ 2.0 ha) of all zones the number of species was lower than expected (Fig. 5). Only the smallest parks in the south-boreal zone differed significantly from the pooled data ($t = 2.49$, $df = 19$, $P < 0.05$, tested at the end point of curves).

Similarity of park bird assemblages to regional land bird assemblages

In general, the most abundant bird species have the broadest habitat amplitude (e.g. Haila et al. 1980, Alatalo 1981, Helle 1985). We expected that regionally abundant species are also abundant in the parks. We studied the ten most abundant bird species in the parks and regionally the ten most abundant land birds in different ornithogeographical zones.

Hole-nesting and deciduous forest species (e.g. *P. major*, *F. hypoleuca* and *C. chloris*) have greater relative abundance in the parks than in the forest, whereas the abundance of the coniferous forest species (e.g. *Anthus trivialis, Erithacus rubecula* and *Regulus regulus*) was very low or the species did not occur in the parks at all.

In all ornithogeographical zones *Ph. trochilus* and *F. coelebs* had nearly the same relative abundance in the parks as they had regionally (Fig. 6). This is also the case for *T. pilaris* in the southern zones, but in the mid-boreal zone relative abundance was higher in the parks. On the contrary, *M. striata* has a higher relative abundance in the parks of the southern zone than it has regionally, but in the mid-boreal zone the relative abundance in the parks is the same as it is regionally.

Relative constancy of species

We estimated the relative constancy of the species over all the parks in this study (see Material and methods). The most abundant bird species occurred in most of the parks ($r = 0.77$, $P < 0.001$; see Fig. 7, Table 2). We divided the bird species represented (at least three pairs) into two groups: species which breed in holes or buildings (ten species above and one species below the regression line describing total abundance against constancies) or in other places (5 above and 11 below). Hole-nesting bird species thus have high numbers of pairs but a low relative constancy (Fisher's test, $P = 0.003$). The species deviating below the regression line frequently nest in trees (e.g. *Pica pica*). The shrub and ground nesters deviate less from the regression line than species nesting in holes/buildings and trees.

Discussion

Usually both the number of bird species and the density of birds is lower in the north (for some ex-

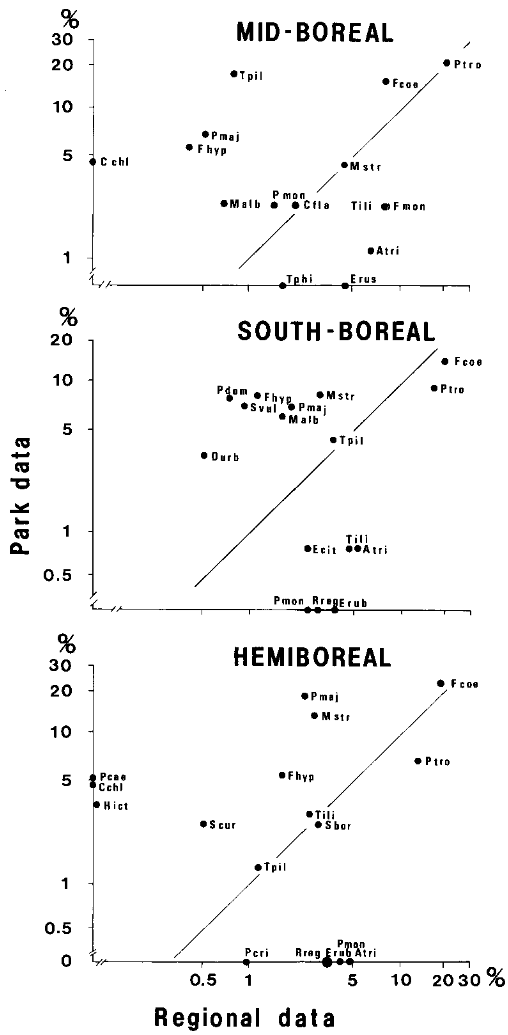

Fig. 6. Representation (%) of the ten most abundant bird species in the parks and regionally the ten most abundant land birds in the different ornithogeographical zones in Finland. The continuous line indicates that relative abundances were the same both in the park and regionally. Species abbreviations: *Carduelis flammea* (Cfla), *Delichon urbica* (Durb), *Erithacus rubecula* (Erub), *Emberiza citrinella* (Ecit), *E. rustica* (Erus), *Fringilla montifringilla* (Fmon), *Parus cristatus* (Pcri), *P. montanus* (Pmon), *Regulus regulus* (Rreg) and *Turdus philomelos* (Tphi). For other species see Table 2.

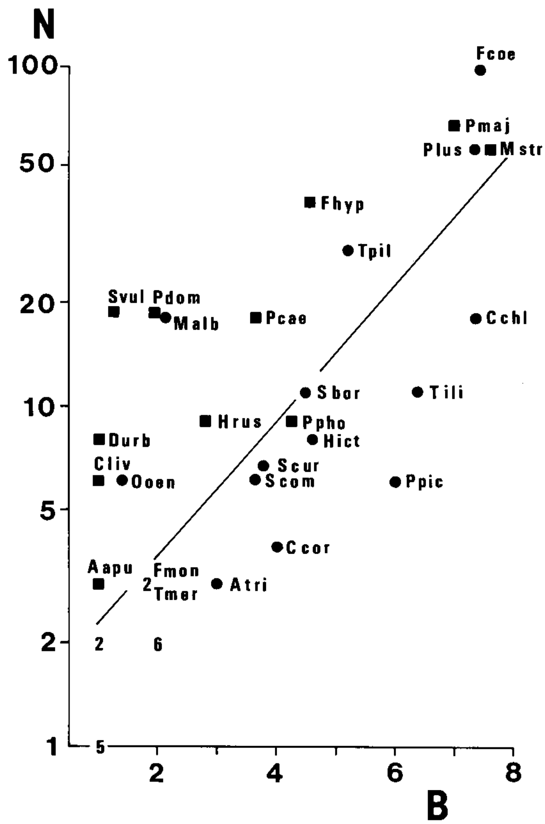

Fig. 7. Relative constancy of species (B) in relation to the number of pairs (N) ($r = 0.77$, $df = 38$, $P < 0.001$). The numbers in the figure indicate the number of species overlapping at that point. The species that had at least three pairs have been indicated using abbreviations. The symbols indicate nesting habits: in buildings and nest-boxes (square) or elsewhere (dot). Species abbreviations are: *Apus apus* (Aapu), *Columba livia* (Cliv), *Delichon urbica* (Durb), *Fringilla montifringilla* (Fmon), *Oenanthe oenanthe* (Ooen) and *Turdus merula* (Tmer). For other species, see Table 2.

ceptions, see Järvinen & Sammalisto 1976, Järvinen et al. 1987). However, in our study, the bird density and the number of species seem to be more dependent on park area than geographical location. Of course, the possibility remains that similar-sized parks would show a geographical trend in bird density or species number, although this is not evident from our data (Figs. 2 and 4).

We found a negative correlation between bird density and park area. Similar results have been obtained in many studies, for example, in parks (Luniak 1981) and forest habitat islands (e.g. Helle 1984, Taylor et al. 1987). In Seattle, U.S.A., Gavareski (1976) found only a marginal correlation between park area and the total abundance of birds. Relative edge length may explain the high bird density in small parks (Fig. 3). Gotfryd & Hansell (1986) found that the perimeter length of the woodlot and the woodlot area were the only habitat variables that had significant correlations with either bird abundance or species richness. Species favouring edges and small forest fragments (e.g. *Ph. trochilus* and *F. coelebs*) increase the bird densities of forests edges (Helle & Helle 1982, Helle 1983, 1984, Fuller & Whittington 1987, Haila et al. 1987). Also in our study the densities of these species were highest in small parks.

The availability of a good food supply throughout the year for some species is one of the most significant features in the urban system (Erz 1966, Nuorteva 1971). This makes it possible for *C. chloris* and *P. major* to winter in high numbers in urban parks. This may explain why their proportion in the breeding season is greater in the parks than on average in the region.

As in our study, species number generally increases with habitat area (urban habitats) (Luniak 1974, 1981, Gavareski 1976, Lussenhop 1977). A low species number in relation to the rarefaction curve in the smallest parks agrees well with the results from small forest fragments in Finland (Haila et al. 1987). This may be caused by the simple structure of vegetation (see Gavareski 1976, Hohtola 1978, Luniak 1981, Gotfryd & Hansell 1986), small variation in the types of surrounding habitats (low edge heterogeneity; see Hohtola 1978, Gotfryd & Hansell 1986) or the isolated position of small parks (Opdam et al. 1984).

Acknowledgements. We thank R. Alatalo, E. Bezzel, P. Helle, A. Järvinen, O. Järvinen, M. Kuitunen, K. Vepsäläinen and an anonymous referee for comments on this paper.

Selostus: **Maantieteellisen sijainnin vaikutus kaupunkien puistojen pesimälintuyhteisön rakenteeseen Suomessa**

Tutkimus käsittää kaksikymmentä puistoa ja hautausmaata kolmelta lintumaantieteelliseltä vyöhykkeeltä: Helsinki (9 puistoa) hemiboreaaliselta, Karkkila (1) ja Heinola (1) sekä Kuopio (3) eteläboreaaliselta ja Rovaniemi (6) keskiboreaaliselta vyöhykkeeltä. Aineisto on kerätty suomalaisesta lintukirjallisuudesta (taulukko 1). Alueet on laskettu joko kartoitus- tai koealamenetelmällä.

Lintuyhteisöt olivat samankaltaisempia eteläisissä vyöhykkeissä kuin pohjoisissa (kuva 1). Linnuston tiheys laski puiston koon kasvaessa, eli kääntäen: mitä enemmän reunaa pinta-alayksikköä kohti, sitä suurempi lintutiheys. Eri vyöhykkeiden välillä ei ollut eroja (kuvat 2–3). Kaikissa puistokokoluokissa peippo, pajulintu, harmaasieppo ja talitiainen olivat dominantteja. Pienimmistä kokoluokista puuttuivat metsäkirvinen ja *Sylvia*-lajit (taulukko 2). Lajimäärä kasvoi luonnollisesti pinta-alan kasvaessa, mutta pienissä puistoissa lajimäärä oli odotettua pienempi (kuvat 4–5).

Kaikilla lintumaantieteellisillä vyöhykkeillä pajulinnun ja peipon osuus oli likimain sama sekä puistoissa että alueen faunassa yleensä. Kolopesijöitä oli suhteellisesti ottaen enemmän puistoissa kuin alueella yleensä, mutta havumetsien lajit selvästi välttivät kaupunkien puistoja. Räkättirastas suosi pohjoisessa enemmän kaupunkien puistoja kuin Etelä-Suomessa, kun taas harmaasieppo suosi kaupunkien puistoja eteläisillä vyöhykkeillä, mutta ei pohjoisessa (kuva 6). Mitä runsaampi laji on, sitä lukuisammissa puistoissa se esiintyy. Kololintujen esiintyminen on laikuttaisempaa kuin avopesijöiden (kuva 7). Tämä saattaa johtua kolojen tarjonnan laikuttaisuudesta.

References

Alatalo, R. V. 1981: Habitat selection of forest birds in the seasonal environment of Finland. — Ann. Zool. Fennici 18:103–114.

Bezzel, E. 1982: Vögel in der Kulturlandschaft. — Stuttgart.

Cody, M. L. 1974: Competition and the structure of bird communities. — Princeton Univ. Press, Princeton.

Erz, W. 1966: Ecological principles in the urbanization of birds. — Ostrich sup. 6:357–363.

Fuller, R. J. & Whittington, P. A. 1987: Breeding bird distribution within Lincolnshire ash-line woodlands: the influence of rides and the woodland edge. — Acta Oecol., Oecol. Gener. 8:259–268.

Gavareski, C. A. 1976: Relation of park size and vegetation to urban bird populations in Seattle Washington. — Condor 78:375–382.

Gotfryd, A. & Hansell, R. I. C. 1986: Prediction of bird-community metrics in urban woodlots. — In: Verner, J., Morrison, M. L. & Ralph, C. J. (eds.), Wildlife 2000. Modeling habitat relationships of terrestrial vertebrates, pp. 321–326. Univ. Wisconsin Press.

Haila, Y., Hanski, I. K. & Raivio, S. 1987: Breeding bird distribution in fragmented coniferous taiga in southern Finland. — Ornis Fennica 64:90–106.

Haila, Y., Järvinen, O. & Väisänen, R. A. 1980: Habitat distribution and species associations of land bird populations on the Åland Islands, SW Finland. — Ann. Zool. Fennici 17:87–106.

Heck, K. L., van Belle, G. & Simberloff, D. 1975: Explicit calculation of the rarefaction diversity measurement and the determination of sufficient sample size. — Ecology 56: 1459–1461.

Helle, E. & Helle, P. 1982: Edge effect on forest bird densities on offshore islands in the northern Gulf of Bothnia. — Ann. Zool. Fennici 19:165–169.

Helle, P. 1983: Bird communities in open ground-climax forest edges in northeastern Finland. — Oulanka Reports 3:39–46.

Helle, P. 1984: Effects of habitat area on breeding bird communities in Northeastern Finland. — Ann. Zool. Fennici 21:421–425.

Helle, P. 1985: Habitat selection of breeding birds in relation to forest succession in Northeastern Finland. — Ornis Fennica 62:113–123.

Hietanen, E. 1975: Heinolan kaupunkialueen pesimälinnusto. — Päijät-Hämeen Linnut 6:4–25.

Hohtola, E. 1978: Differential changes in bird community structure with urbanisation: a study in Central Finland. — Ornis Scand. 9:94–100.

Hohtola, E. 1984: Kulttuuribiotooppien linnustosta Kuopion kaupungin alueella. — Siivekäs 5:1–7.

Huhtalo, H. & Järvinen, O. 1977: Quantitative composition of the urban bird community in Tornio, Northern Finland. — Bird Study 24:179–185.

Jokimäki, J. 1987: Rovaniemen kaupungin puistolinnustosta. — Kokko 10:6–9.

Järvinen, O., Kouki, J. & Häyrinen, U. 1987: Reversed latitudinal gradients in total density and species richness of birds breeding on Finnish mires. — Ornis Fennica 64:67–73.

Järvinen, O. & Sammalisto, L. 1976: Regional trends in the avifauna of Finnish peatland bogs. — Ann. Zool. Fennici 13:31–43.

Järvinen, O. & Väisänen, R. A. 1973: Species diversity of Finnish birds, I: Zoogeographical zonation based on land birds. — Ornis Fennica 50:93–125.

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.

Kajoste, E. 1961: Helsingin keskikaupungin pesimälinnustosta. (Zusammenfassung: Über die Nistvogelfauna der Innenstad von Helsinki). — Ornis Fennica 38:45–61.

Luniak, M. 1974: Ptaki biotopow parkowych w malych miastach srodkowo-wshodniej Polski. (Summary: The birds of park biotopes in small towns of central-eastern Poland). — Acta Ornithol. 14:99–143.

Luniak, M. 1981: The birds of park habitats in Warsaw. — Acta Ornithol. 18:335–374.

Luoto, H. 1981: Karkkilan kaupunkilinnusto. — Tringa 8:57–60.

Lussenhop, J. 1977: Urban cemeteries as bird refuges. — Condor 79:456–461.

Nuorteva, P. 1971: The synanthropy of birds as an expression of ecological cycle disorder caused by urbanization. — Ann. Zool. Fennici 8:547–553.

Opdam, P., van Dorp, D. & ter Braak, C. J. F. 1984: The effect of isolation on the number of woodland birds in small woods in the Netherlands. — J. Biogeogr. 11:473–478.

Renkonen, O. 1938: Statistisch-ökologische Untersuchungen

über die terrestrische Käferwelt der finnischen Bruchmoore. — Ann. Zool. Soc. 'Vanamo' 6(1):1–226.
Taylor, K., Marchant, J. H. & Morgan, R. A. 1987: The breeding bird communities of woodlands in a new city. — Acta Oecol., Oecol. Gener. 8:293–299.
Tomialojc, L. 1985: Urbanization. — In: Campbell, B. & Lack, E. (eds.), A dictionary of birds, pp. 616–617. Poyser, Calton.
Tomialojc, L. & Profus, P. 1977: Comparative analysis of breeding bird communities in two parks of Wroclaw and in an adjacent Querco-Carpinetum forest. — Acta Ornithol. 16:117–177.
Virkkala, R. 1987: Geographical variation in bird communities of old, intact forest in northern Finland. — Ornis Fennica 64:107–118.

Received 6 May 1987, revised 22 February 1988, accepted 24 February 1988

The Deutsche Ornithologen-Gesellschaft will hold its 100th annual meeting as the "International 100th Annual Meeting" September 24 through October 1, 1988 at the Museum Alexander Koenig in Bonn, West Germany. The two key themes will be Zoogeography & Systematics and Behavioral Ecology. All interested in participating should contact:

Dr. K.-L. Schuchmann
Museum Alexander Koenig
Adenauerallee 150–164
D–5300 Bonn
Federal Republic of Germany