Ornis Fennica 69:92–96. 1992

The vertical use of a city park by urban birds in Poland

Eero Antikainen

Antikainen, E., Department of Mathematics and Science, University of Eastern Africa Baraton, P. O. Box 2500 Eldoret, Kenya, East Africa

Received 5 February 1991, accepted 9 April 1991

The exploitation of a city park (total 20.5 ha) surrounding the Old city of Cracow in Poland was analyzed by dividing the vertical dimension of the park into six different zones and observing the activity of urban birds at separate stations. The data were obtained from five censuses and additional checks in the prenesting period, mainly March–April 1980 and 1986. The ground and lower height zones were chiefly used by granivorous and omnivorous Feral Pigeons *Columba livia domestica* and Rooks *Corvus frugilegus*, fed by humans, and by House Sparrows *Passer domesticus*. The higher zones were used by insectivorous species. No difference was found in the density of birds between the early and late prenesting periods (March–early May).

1. Introduction

In city centres parks and green zones benefit the urban bird community. The parks can be used not only as feeding and breeding sites, but also as sites of intensive interaction between species, and as places for resting, sunbathing, preening, hiding and roosting (Emlen 1974, Pettingil 1979). In prenesting periods in particular, exploitation increases with the activities of the birds, all of which contributes to the structure and success of the whole bird community in a city (Lancaster & Rees 1979).

The aim of this study is to examine the vertical use of the green zone by the birds in the park of Planty in Cracow, Poland (cf. e.g. Hogstad 1971 and Alerstam & Ulfstrand 1977). Hitherto the avifauna of Planty has been studied mainly on the horizontal plane and by combining it with the birds of other parks in Cracow (e.g. Tomek 1969, Śmiałowska 1970 and Brozek 1978), or elucidating the overwintering (Harmata 1961) and roosting of some species (Groziński 1971, cf. Strawiński 1970). Attention to the vertical use and distribution of the bird species, may allow a more holistic view of the role of parks in the life of the urban bird community (cf. Suhonen & Jokimäki 1988).

2. Material and methods

Planty, a 4 km long (20.5 ha) park, encircles the Old City (or Stare Miasto, see Ludwikovski 1979) of Cracow. The circular green zone varies from 80 to 200 m in breadth. This zone chiefly consists of deciduous woodland (plantings), in which the main species of trees and shrubs are: *Acer platanoides*, *A. campestris*, *Tilia cordata*, *Ulmus laevis*, *Larix decidua*, *Robinia* sp., *Picea* sp., *Fraxinus excelsior*, *Betula verrucosa*, *Aesculum hippocastaneum*, *Lonicera* sp., *Sambucus nigra*, *Vi-*

burnum opulus, *Corylus avellanus*, *Cornus mas*, *Symphoricarpos* sp., *Syringa vulgaris*, *Caragana* sp., and *Philadelphus* sp. (P. Profus, in litt.).

A section of 100 x 25 m contained 80–120 trees, which were mostly 30–80 cm in diameter. The canopy, approximately 15 m in height, covers 60–70% of the park, while shrubs and lawn cover 10% and 10–30% respectively. Several streets and pedestrian paths that cross the park lower the untarmacked green park area to 20.5 hectares.

During the springs of 1980 and 1986, I collected data on the stratification of urban bird species in Planty. My intention was to count all individuals by the "strip" method (Emlen 1974). During each of the five main censuses, on 16 and 23 March, 1 April, 8 May 1980 and 15 April 1986, from 5.30 to 11.30 a.m., I walked back and forth along the whole length of Planty at a leisurely pace. During the observation periods before foliation, the height zones of the feeding stations and other occurrences were quite easy to determine by eye or with binoculars. The park was divided into the following six vertical zones:

1) the ground,
2) the top of the bushes and the lowest branches of trees up to about 3 m,
3) halfway up the trees, i.e. approximately 8 m,
4) the top of the trees, i.e. 15 m,
5) the height of the roof of 5-storey houses, or 25 meters, and high top brances and
6) the air space above the roofs.

The position and activity of each bird was estimated to the nearest height zone, using symbols in the records. Hogstad (1971) divided trees into four equal vertical zones when determining the position of woodpeckers (cf. Alerstam & Ulfstrand 1977). Additional data were obtained almost daily during the periods 6 March–3 April and 7–15 May 1980, and 9–16 April 1986. Observations were also made from Mariacki Church Tower on 31 March 1980 at 8.30–10.30 a.m.

3. Results

Altogether 21 species were observed in the park. The vertical distribution of the seven most numerous species is seen in Table 1.

Evidently, I did not observe late breeders, but on the other hand, the data include four species that are visitors (cf. Tomek 1969, Śmiałowska 1970). As the results of the censuses of 1980 and 1986 were similar, I conclude that they show the main characteristics of the avifauna, particularly in the pre-nesting periods. Seven of the species are mainly granivorous, six omnivorous and eight insectivorous. As many as 10 species are hole-nesters. Altogether 12 species are non-migratory. The list of the species is almost identical with those presented by Tomek (1969), Śmiałowska (1970) and Brozek (1978).

The four most abundant species, the Feral Pigeon *Columba livia*, Rook *Corvus frugilegus*, House Sparrow *Passer domesticus* and Collared Turtle Dove *Streptopelia decaocto*, comprised 88.6% of the individuals. The total densities, 1013 and 1382 pairs/10 ha, did not vary significantly during the season (censuses of March and early May, $t = 0.26$).

The herb layer (ground) and the two following vertical zones were exploited by the granivorous/omnivorous Feral Pigeon, House Sparrow and Rook, which availed themselves of the year-round feeding in the park and market place. The upper height zones (4–5) were used by granivorous species and Rooks and Jackdaws, which perch and roost in canopy. The Swift *Apus apus* utilized the aerial plankton (zone 6).

4. Discussion

Most woodland birds exploit definite vertical strata of the vegetation (e. g. Colquhoun & Morley 1943, Pielowski 1961, Hogstad 1971). This also seems to apply to many urban species. The need to carry out the vital functions of feeding, roosting, nesting and singing in city conditions seems to lead to even more efficient vertical use of park zones (Erz 1966, see Tomiałojć & Profus 1976, Suhonen & Jokimäki 1988). All these functional patterns are strongly modified, however, by the availability or abundance of food, which in Cracow is distributed by humans feeding the birds round the year.

Most of the food consists of grains and pieces of bread, which are pecked up by the granivorous/omnivorous Feral Pigeon, House Sparrow, Rook,

Jackdaw and even Blackbirds. Thus all these species exploit the ground intensively, also seeking additional food, such as insects, worms and particles of plants. In the prenesting periods, particularly during a cold spell in spring, the park attracts birds from outside the community of Planty, which results in high densities (about 6910 pairs/km^2) in the first vertical zone (in natural habitats only some hundreds of pairs/km^2, e.g. Straviński 1963). Straviński reports values as high as 4600–8500 pairs/km^2 in the breeding season from similar urban territories, which differ strikingly from the values for rural and undisturbed natural surroundings (cf. Tomek 1969, Śmiałowska 1970). During the whole prenesting period, the barren ground in Planty, besides providing nest material and hiding places, chiefly for small birds, offers camouflage for urban species with increased industrial melanism (see Van Tyne & Berger 1976, cf. Straviński 1970, Pozas & Balat 1981). In the breeding period, which begins on an average in the latter half of April (Bozek 1978 and my personal observations), the green lawn of the park with natural food sources replaces the benefits of the barren ground. So, as noted by Lancaster & Rees (1979), the natural and unintentionally discarded food in parks is important to birds in urban sites, maintaining the quantity of birds at approximately the same level through the pre-nesting periods.

The quantitative data of my study reveal high frequencies for three species: the Feral Pigeon, Rook and House Sparrow (frequencies over 5%). All these are granivorous/omnivorous. The most numerous species is the Feral Pigeon, which in winter roosts massively on the ornamental facades of the buildings round the market place (Rynek) and Planty. This leads to a preference of resting places on the same level in Planty, which explains the second highest density of Pigeons in the fourth vertical zone. Emlen (1974) has shown in Tucson, Arizona, that the quantity of food provided by humans may even exceed the energy requirements of some urban bird communities. Though Pigeons breed outside Planty in the attics of houses, they exploit the ground of the park throughout the year (cf. Groziński 1971:735). In many Polish cities the Feral Pigeon is less numerous than in Cracow. (e.g. Luniak 1964, Straviński 1970, Tomiałojć & Profus 1977 and my personal observations).

According to my observations, the most numerous species are fairly evenly distributed round the whole of Planty, using height zones 2–5. Particularly after foliation, which in Cracow occurs in the first half of April (Groziński 1971), insectivorous birds, e. g. the Lesser Whitethroat, Wood Warbler and Tits, exploit mainly zones 3

Table 1. The vertical distribution of the seven most numerous species (percentage/individuals per 10 ha) in the height zones, which are explained in the text CL = *Columbia livia*, PD = *Passer domesticus*, TM = *Turdus merula*, SD = *Streptopelia decaocto*, CC = *Carduelis cloris*, CF = *Corvus frugilecus*, CM = *Corvus monedula*. In addition, the following species were observed (the average height zones indicated in parentheses): *Pica pica** (2), *Sitta europaea* (2), *Certhia familiaris** (2), *Ficedula hypoleuca* (2), *Passer montanus** (2), *Carduelis cannabina* (2), *Parus major* (3), *P. coeruleus* (3), *Sylvia curruca* (3), *Sturnus vulgaris* (3), *Phylloscopus sibilatrix** (4), *Carduelis carduelis* (4), *Fringilla coelebs* (4) and *Apus apus* (6). Visiting species are marked with an asterisk. The total number of individuals of all species is 2808.

Species	Height zones						Total individuals	Mean height (m)
	1	2	3	4	5	6		
CL	87.7/622	3.0/ 22	1.5/ 11	6.3/ 46	1.2/ 9	0.3/ 2	1452	1.5
PD	56.2/ 93	24.1/ 40	13.8/ 23	4.7/ 8	1.2/ 2	0.0/ 0	340	2.8
TM	57.4/ 13	21.3/ 5	14.9/ 3	6.4/ 1	0.0/ 0	0.0/ 0	47	2.8
SD	32.7/ 16	28.7/ 14	15.8/ 8	18.8/ 9	4.0/ 2	0.0/ 0	101	5.9
CC	0.0/ 0	50.0/ 5	45.0/ 4	5.0/ 0	0.0/ 0	0.0/ 0	20	5.9
CF	54.0/163	1.4/ 42	25.6/ 77	0.3/ 5	18.3/ 55	0.4/ 10	718	6.8
CM	17.3/ 7	34.6/ 4	12.3/ 5	27.2/ 11	8.6 / 3	0.0/ 0	81	8.3
Total	69.8/940	7.7/103	10.7/144	5.6 / 76	5.9/ 80	0.3/ 3	2759	7.0

and 4, which are composed of the foliage (canopy and thick branches, see Alerstam & Ulfstrand 1977, Lancaster & Rees 1979, Cody 1981, Oksanen 1987).

Groziński (1971) reports Planty as one of the three rallying sites for Jackdaws and Rooks in Cracow. The birds gather here for roosting flights (zones 4–5) in the evenings outside the breeding period. Zones 3–5 are also used as pre-roosting sites by these species, before they move to their favourite roosting sites in Planty (see Groziński 1971).

The elevation of the nests above the ground has influenced the vertical distribution of the species. In Rooks the gathering of nest material and the defense of colonies at their limits explain the location of the modal value in zone 3. The House Sparrow, nesting in the lowest holes in trees and houses, only seldom exploits the upper zones 3–5 in flight. According to my data, Blackbirds and Greenfinches use unexpectedly high zones, because the singing males come to claim their territories in the pre-nesting periods, while the Collared Turtle Dove exploits the whole vertical dimension quite evenly, except the highest zone 6 (see Śmiałowska 1970, Straviński 1970, Brozek 1978).

My study on the vertical exploitation of city parks by the urban bird community shows that many species are apparently highly dependent on a certain green zone, which they can also frequent outside the breeding season (cf. Straviński 1970, Suhonen & Jokimäki 1988).

Acknowledgements. I am grateful to Olli Järvinen, Jukka Suhonen, Ossi V. Lindqvist, an anonymous referee and Juhani Koivusaari for valuable criticism. I also wish to thank the following scientists of the Polish Academy of Sciences: Zbigniew Jacubiec for valuable discussions, Piotr Profus for botanical data on Planty and Anna Dyduch-Falniowska for helping to organize the observations. I am grateful to the Polish Academy of Sciences and the Finnish Academy for financial support for my studies, and to my wife, Ritva Antikainen, for checking my English.

Selostus: **Kaupungin sisäisen puistovyöhykkeen linnuston vertikaalijakautuma pesintäkautta edeltävänä aikana Puolassa**

Analysoin, kuinka kaupunkilinnusto hyödyntää keskikaupungilla sijaitsevan puistovyöhykkeen eri vertikaalitasoja ja jakautuu eri korkeustasoille pesimäkautta edeltävänä aikana. Tutkimuskohteena oli Puolassa Krakovan vanhaa kaupunkia kiertävä puistovyöhyke Planty. Pinta-alaa puistolla, jota luonnehtivat Keski-Euroopan jalopuut ja -pensaat, on 20.5 ha ja pituutta 4 km. Jaoin puiston kuuteen vertikaalitasoon: 1) pohjakerros (maa), 2) pensastaso keskimäärin 3 m:n korkeudelle asti, 3) puitten puoliväli noin 8 m:iin saakka, 4) puitten latvustaso 8–15 m, 5) 5-kerroksisten rakennusten kattotaso n. 25 m (sekä korkeimmat erilliset latvaoksat) ja 6) ilmatila puiston yläpuolella (yli 25 m). Keräsin aineiston viitenä aamuna maalis-toukokuussa 1980 ja 1986 sekä useilla lisähavainnoinneilla.

Kenttäkerrosta ja kahta muuta alinta tasoa käyttivät hyväkseen siemensyöjä/kaikkiruokainen kesykyyhky, varpunen ja mustavaris, jotka hyödynsivät ympärivuotista ruokintaa puistossa ja torilla. Ylimmillä vyöhykkeillä (4–5) viihtyivät siemensyöjälajit sekä puiden latvustoja seurusteluja yöpymistarkoituksessa hyödyntävät mustavaris ja naakka (Taulukko 1). Ylintä vyöhykettä hyödynsi ilmaplanktonin hyväksikäyttäjä tervapääsky. Lintutiheys ei eronnut pesimäkautta edeltävien jaksojen välillä. Korkeimmat lajikohtaiset ja kokonaistiheydet olivat ensimmäisellä, kolmannella ja toisella vyöhykkeellä. Plantyn vertikaalitasoja hyödynsi kaikkiaan 21 lajia.

References

Alerstam, T. & Ulfstrand, S. 1977: Niches of Tits Parus ssp. in two types of African woodland. — Ibis 119:521–524.

Brozek, C. 1978: Ptaki cmetarza rakowickiego w Krakowie. — Przeglad Zool. 22:63–64.

Cody, M. L. 1981: Habitat selection in birds: the roles of vegetation structure, competitors, and productivity. — BioScience 31:107–113.

Colquhoun, M. K. & Morley, A. 1943: Vertical zonation in woodland bird communities. — J. Anim. Ecol. 12:75–81.

Emlen, J. T. 1974: An urban bird community in Tucson, Arizona: derivation, structure, regulation. — Condor 76:184–197.

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

Groziński, Z. 1971: Daily flights of Rooks Corvus frugilegus Linnaeus, 1758 and Jackdaws Corvus monedula Linnaeus, 1758 wintering in Cracow. — Acta Zool. Cracoviensia 16:735–772.

Harmata, W. 1961: Obserwajce nad aktywnoścta i wystepowaniem niektorych ptakow drapieznych na terenie Krakowa w latach 1944–60. — Przeglad Zool. 5:249–254.

— 1969: Zimowanie szpaków, Sturnus vulgaris L. w zimie 1967/68 w Krakowie. — Przeglad Zool. 13:102–103.

Hogstad, O. 1971: Stratification in winter feeding of the Great Spotted Woodpecker Dendrocopus major and the Three-toed Woodpecker Picoides tridactylus. — Ornis Scand. 2:143–146.

Lancaster, R. K. & Rees, W. E. 1979: Bird communities and the structure of urban habitats. — Can. J. Zool. 57:2358–2368.

Ludwikowski, L. 1979: A guide to Cracow and environs. — Wydawnictwo Sport i Turistyka, Warszawa.

Luniak, L. 1987: Interspecific competition and structure of bird guilds in boreal Europe: the importance of doing fieldwork in the right season. — Trends Ecol. Evol. 2:376–379.

Pettingil, O. S. 1970: Ornithology in laboratory and field. —Burgess Publishing Company, Minneapolis. 524 pp.

Pielowski, Z. 1961: Über die Vertikalverteilung in einem Pineto-Quercetum Biotop. — Ekol. Polska Ser. A, 9:1–23.

Pozas, G. & Balat, F. 1981: Quantitative and qualitative composition of the bird community in a garden suburb of Habana (Cuba). — Folia Zool. 30:155–164.

Śmiałowska, M. 1970: Awifauna ogrodu Botanicznego Jagiellońskiego w Krakowie. — Not. Ornitol. 11:30–34.

Strawiński, S. 1963: Problematyka urbanizacji ptaków w świetle badań awifauny Torunia i okolicy. — Przeglad Zool. 7:254–259.

— 1970: Problematyka badań awifauna miast. — Przeglad Zool. 14: 125–130.

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

Tomek, T. 1969: Ptaki Parku im. Dra Jordana w Krakowie w latach 1964–67. — Przeglad Zool. 13:334–346.

Tomiałojć, L. & Profus, P. 1977: Comparative analysis of breeding bird communities in two parks of Wroclaw and in adjacent Querco-Carpinetum forest. — Acta Ornitol. Warszawa 16:117–177.

Van Tyne, J. & Berger, A. J. 1976: Fundamentals of ornithology. — John Wiley & Sons, Inc. New York. 624 pp.