ACTA ORNITHOLOGICA
Vol. 32 (1997) No. 1

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Magpie *Pica pica* nest sites in urban habitats in Poland

Jerzak L. Magpie *Pica pica* nest sites in urban habitats in Poland. Acta orn. 32: 69–76.

Abstract. Magpie nest sites in the Polish urban environment were described from data gatheredon 1838 nests. Tree rows, hedges, and groups of trees and bushes were more frequently used as nest sites (58%). Poplar (*Populus spp.*) was the most commonly used species for magpie nest sites (31%). Other tree species were *Tilia sp.* and *Betula sp.* Most nests were located between 14–20m with mean value 14.98m (SD = 5.533) above ground level. Nests were located higher in the city centre than in suburbs. Magpies, preferred 6 tree species (*Populus sp., Tilia sp., Aesculus hippocastanum, Alnum sp., Platanus x acerifolia* and *Larix decidua*) as nest sites in Zielona Góra (with $W > 1$). There was a strong positive correlation between nests and preferred trees species distribution ($r = 0.767$ $p < 0.001$) and all trees distribution ($r = 0.497$ $p < 0.05$). Magpies build nests higher than the average height of all trees recorded in researched plot.

Key words: Magpie *Pica pica*, nest sites, urban environment, Poland

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Received — Aug. 1996, accepted — Oct. 1996

INTRODUCTION

Magpies have been colonising Eurasian towns rapidly for last 50 years (Birkhead 1991, Jerzak 1994). One of main questions is what is the mechanism involved. Is it changes in Magpie biology or favourable conditions in the urban environment for magpie life. There are some papers concerning the breeding success of the urban Magpie (e.g. Tatner 1982, Kuranov 1984, Kavanagh *et al.* 1991, Jerzak 1995). One of main factors responsible for birds' breeding success are good nest sites. There are very few papers concerning this aspect of Magpie ecology (Tatner 1982a, Birkhead 1991). In this paper a large number of nest sites in Polish towns have been chosen to try, and find any preferences of Magpies in choosing nest sites in the urban habitat in Poland.

METHODS

In this paper I collected data from 1838 Magpie nests both from Polish Nest Record Scheme — PNRS (671 nest cards collected in 1969–1995) and from direct studies in 12 towns in West Poland (1167 nests). The latter data was partly presented in an earlier paper (Jerzak 1992) but are combined together with PNRS data for a better description of nest sites across Poland. Data from 60 Polish towns like including microhabitats, vertical distribution, tree species and location within tree, are presented.

A detailed study on nest-site selection in Zielona Góra (20km^2) involved counting of all trees higher than 5 meters. In the central plot (1km^2) trees were counted and height measured. For the analysis of nest sites selection by Magpie it was assumed that: expected frequency of Magpie nests (S) was $S = D \times N/100$ where S is expected number of nests for one tree species, D = observed frequency of each tree species in

the study area relative to other species, N = total number of nests. This is similar to the method used by Tatner in Manchester (1982a). The choice index (W) is expected frequency/observed frequency indicates the frequency with which tree species are chosen by the Magpie as nest site compared to the abundance of that tree species.

MICROHABITATS

In Polish towns the Magpie build nests more frequently in rows of trees and hedges (32.8%) and groups of trees and bushes. There was no difference between nest sites in city and suburb (Tab. 1). Magpies prefer parks, copses, groves and cemeteries as a next nest site in the city (city — 23%, suburb — 10%). In suburban areas gardens (city — 4%, suburb — 16%) were selected more often than parks. This is probably an impact of microhabitat distribution in these two environments, since in the city there are more parks, copses and old cemeteries than in the suburbs. Gardens are more common in the suburbs. Surprisingly there were few nests in gardens and orchards. Observations indicated that nests were destroyed by people in these areas. Forest edges were avoided in all environments.

Table 1. Nest site characteristics of Magpies in the urban environment, Poland (microhabitat structure).

[Tabela 1. Charakterystyka miejsc lęgowych sroki w środowisku miejskim Polski (struktury mikrosiedliskowe).]

Nest site	City		Suburb		Total	
	n	(%)	n	(%)	N	(%)
Rows of trees and hedges	218	(31)	274	(35)	492	(33)
Groups of trees and bushes	203	(29)	176	(22)	379	(25)
Parks, copses, groves, cemetries	162	(23)	75	(10)	237	(16)
Single trees and bushes	82	(11)	104	(13)	186	(12)
Gardens	29	(4)	123	(15)	152	(10)
Forest edges	13	(2)	40	(5)	53	(4)
Total	707	(100)	792	(100)	1499	(100)

In the rural Polish environment (Jerzak 1988) Magpie nests were found primarily in groups of trees and bushes, and in rows of tree and hedges surrounded by grassland (about 68%). This is a typical "wild" microhabitat for Magpie in farmland (Goodwin 1987, Birkhead 1991). In towns, about 58% of nests were located in rows and groups of trees, in microhabitats created by man. Bossema *et al.* (1986) proposed that since the Magpie is a bad flyer, it prefers to forage in areas close to trees where it can retreat quickly and conceal its nests. Man has created many kinds of this microhabitat in towns which explains its success in these habitats.

TREES AND BUSHES USED AS NEST SITES

In the urban environment Magpies use fewer species of trees as nests sites compared to the rural environment, where more species are selected (Jerzak 1988). This way be influenced by the impact of human activity. In towns, people very commonly sow visually attractive fast growing species of plants. A high number of nests in Polish towns were located on: *Populus sp.* (31%), *Tilia sp.* (15%), and *Betula sp.* (9%) (Tab. 2). This is possibly the result of the planting programme adopted in towns. The above species are known to be fast growing. Visually attractive and inexpensive poplars *Populus sp.* were commonly sown in the fifties and sixties (Tatner 1982a, Clarkson *et al.* 1987). These trees are now used as nest sites by Magpies in most Eurasian towns (Tab. 3). In Zielona Góra about 44% of nests was located on poplar (Jerzak 1992) compared to 38% in Manchester (Tatner 1982a). In Asia Doo Pyo & Tae Hoe (1986) recorded in Seoul that Magpie prefer Poplar, also. It is possible that the great number of tree and bush species used as nest sites may depend on accessibility of those species.

There were some nests in Polish towns located on unusual places like a crane, electricity pylon (pole) and even on the ground. Outside of towns species like *Tilia sp.*, *Acer sp.*, *Crataegus sp.* are very common along roads

and are more often used by Magpie here than in towns. A clear preference for human settlements in non-urban areas may explain the high number of nests on fruit trees (very common around houses in farmland).

Polish towns. There are isolated and safe from people at this altitude, which is similar to the height of nest sites recorded by other authors from Eurasian towns (Tab. 5). In Polish towns nests are located higher in the

Table 2. Tree and bush species used as Magpie nest sites in the urban environment in Poland.

[Tabela 2. Gatunki drzew i krzewów na których sroka budowała gniazda w środowisku miejskim Polski.]

Species	City		Suburb		Total	
	n	(%)	n	(%)	N	(%)
Populus sp.	285	(35)	288	(30)	573	(31)
Tilia sp.	149	(19)	125	(13)	274	(15)
Betula sp.	69	(9)	95	(10)	164	(9)
Quercus sp.	56	(7)	51	(5)	107	(6)
Fruit trees	21	(3)	81	(9)	102	(6)
Acer sp.	45	(6)	41	(4)	86	(5)
Alnus sp.	18	(2)	67	(7)	85	(5)
Aesculus hippocastanum	38	(5)	23	(2)	61	(3)
Robinia sp.	28	(4)	26	(3)	54	(3)
Salix sp.	12	(2)	38	(4)	50	(3)
Crataegus sp.	2	(0.3)	30	(3)	32	(2)
Pinus sp.	7	(0.9)	22	(2)	29	(2)
Fraxinus sp.	5	(0.6)	15	(2)	20	(1)
Platanus x acerifolia	19	(2)	1	(0.1)	20	(1)
Fagus silvatica	17	(2)	2	(0.2)	19	(1)
Picea sp.	10	(1)	9	(0.9)	19	(1)
Carpinus betulus	11	(1)	2	(0.2)	13	(0.7)
Prunus spinosa	1	(0.1)	8	(0.8)	9	(0.5)
Larix sp.	3	(0.4)	4	(0.4)	7	(0.4)
Juglans regis	2	(0.3)	3	(0.3)	5	(0.3)
Pseudotsuga taxifolia	4	(0.5)	2	(0.2)	6	(0.3)
Ulmus sp.	-	(-)	6	(0.6)	6	(0.3)
Thuja sp.	3	(0.4)	-	(-)	3	0.20)
Corylus sp.	-	(-)	3	(0.3)	3	0.2)
Rosa sp.	-	(-)	2	(0.2)	2	(0.1)
Morus alba	-	(-)	2	(0.2)	2	(0.1)
Castanea sativa	1	(0.1)	1	(0.1)	2	(0.1)
Prunus sp.	1	(0.1)	-	(-)	1	(0.1)
Rhamnus frangila	-	(-)	1	(0.1)	1	(0.1)
Hippophae rhamnoides	-	(-)	1	(0.1)	1	(0.1)
Abies sp.	-	(-)	1	(0.1)	1	(0.1)
Syringa sp.	-	(-)	1	(0.1)	1	(0.1)
Jasminum nudiflorum	-	(-)	1	(0.1)	1	(0.1)
Elaeagnus sp.	-	(-)	1	(0.1)	1	(0.1)
Crane, pylon, ground	1	(0.1)	2	(0.2)	3	(0.2)
Not determined	33	(4)	42	(4)	76	(4)
Total	808	(100)	954	(100)	1838	(100)

Most of nests were located in the top of tree (73% of nests), especially in the fork at the top where the nests were probably safer (Tab. 4).

VERTICAL DISTRIBUTION OF NESTS

Magpies located nests between 14–20m above ground level ($\bar{x}$ = 14.98m; SD = 5.533; n = 1691) in city centre ($\bar{x}$ = 16.3m; SD = 4.767) compared to suburban areas ($\bar{x}$ = 13.9m; SD = 5.906) (Fig.1). Magpie located nests lower ($\bar{x}$ = 7.3m) in Polish rural environment (Jerzak 1988). The mean height in areas without farm buildings was 4.1m and in villages was 12.3m. Disturbance is low in non-urban environments (e.g. Abdreimov 1981, Prinzinger and Hund 1981). Other authors have shown that Magpies located nests higher in human settlements like towns and villages.

The pressure of man and other mammals may influence this fact. Knight and Fitzner (1985) described how disturbed Magpie populations located nests those lower down (Jerzak 1995). This fact supports Knight and Fitzner (1985) observations and explains why Magpies prefer higher nest sites in towns.

Table 3. Tree and bush species most frequently used as Magpie nest sites in various Eurasian towns.

[Tabela 3. Gatunki drzew i krzewów, na których sroka najczęściej umieszczała gniazda w wybranych miastach Eurazji.]

Town	Tree and bush species	Author
Manchester	*Populus nigra, Crataegus monogyna, Platanus hispanica*	Tatner 1982
Sheffield	*Platanus sp., Acer sp., Fagus sp.*	Eden 1985
Cuxhaven	*Ulmus sp., Populus sp., Betula sp.*	Lemke 1977
Oldenburg	*Quercus sp., Betula sp., Pinus sp.*	Barkmeyer *et al.* 1977
Bonn	*Populus sp., Aesculus hippocastanum, Quercus sp.*	Wink 1967
Oberhausen	*Platanus acerifolia, Populus sp., Robinia sp.*	Hyla 1975
Berlin E.	*Populus sp., Platanus acerifolia, Aesculus hippocastanum, Tilia sp.*	Lehmann *et al.* 1986
Berlin W.	*Populus nigra pyramidalis, Betula sp.*	Witt 1985
Poznań	*Populus sp., Acer sp., Tilia sp., Aesculus hippocastanum*	Klejnotowski 1972
Cracow	*Populus sp.*	Harmata 1985
S Slovakian towns	*Populus sp., Betula sp., Prunus spinosa, Pirus sativa*	Salaj 1991
Saratov	*Ulmus sp., Populus sp., Acer sp.*	Tuczin *et al.* 1984
Voronezh	*Populus sp., Ulmus sp., Acer sp., Fraxinus sp.*	Sarychev *et al.* 1984
Bukhara	*Robinia sp., Fraxinus sp., Salix sp., Pinus sp.*	Bakaiev 1984
Seoul	*Robinia pseudoacacia, Quercus acutissima, Populus euroamericana*	Doo-Pyo *et al.* 1986

Table 4. The location of nests within trees in the urban environment, Poland.

[Tabela 4. Miejsca umieszczania gniazd na drzewach w środowisku miejskim w Polsce.]

Location of nest	City		Suburb		Total	
	n	(%)	n	(%)	n	(%)
Top, fork of top	55	(61)	163	(77)	218	(73)
Near the trunk	19	(21)	27	(13)	46	(15)
Forked tree/bush branches	2	(2)	12	(6)	14	(5)
Forked horizontal branch	14	(16)	8	(4)	22	(7)
Total	90	(100)	210	(100)	300	(100)

Table 5. Height [m] of Magpie nest sites in various Eurasian towns.

[Tabela 5. Wysokość [m] umieszczenia gniazd sroki w wybranych miastach Eurazji.]

Town	Average	Min–Max	Author
Manchester	13.7	–	Tatner 1982
Oldenburg	70% > 10m	–	Barkemeyer *et al.* 1977
Oberhausen	52% 10–15m	6.0–25.0	Hyla 1975
Berlin E.	16–18	10.0–24.0	Lehman *et al.* 1986
Berlin W.	12–16	–28.0	Witt 1985
Poznań	–	4.0–22.0	Klejnotowski 1972
Pomeranian towns	13.2	–	Górski *et al.* 1996
Cracow	–	2.5–35.0	Harmata 1985
S. Slovakia	7.8	–15.0	Salaj 1991
Voronezh	–	–	Sarychev *et al.* 1984
Tomsk	9.8	–	Kuranov 1984

higher year by year. They suggest that nest site distribution is correlated with the distribution of tall trees. It is interesting that in Zielona Góra a greater percentage of higher nests had breeding success than

There is a strong positive correlation between Choice index (W) and the average height of trees in the centre of Zielona Góra. But there is no correlation between W and the average height of nest sites for each

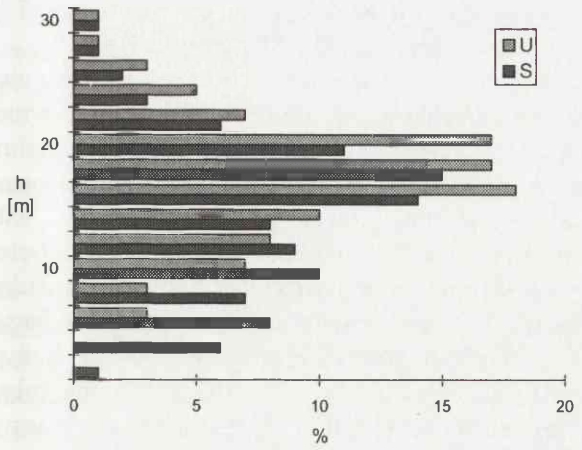

Fig. 1. Vertical distribution of Magpie nests in urban (U) and suburban (S) environments in Poland.

[Ryc. 1. Wysokość umieszczenia gniazd sroki w śródmieściu (U) i na peryferiach (S) miast Polski.]

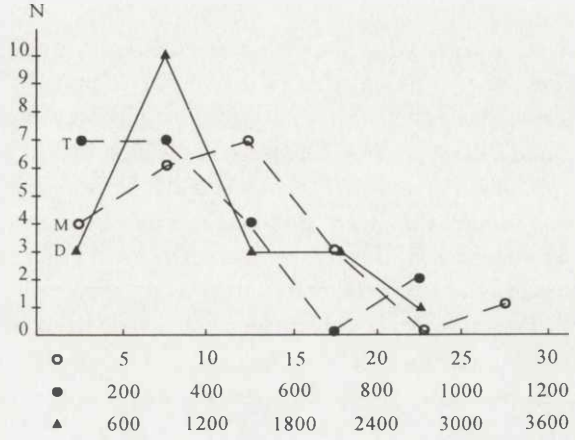

Fig. 2. The density of trees (per 1km^2) — D, prefered tree species — T and Magpie breeding pairs — M in Zielona Góra in 1987. N — number of plots (1km^2).

[Ryc. 2. Zagęszczenie drzew (na 1km^2) — D, najczęściej wybieranych gatunków drzew — T oraz par lęgowych sroki — M w Zielonej Górze w 1987 roku. N — liczba powierzchni (1km^2).]

Table 6. Species of tree selected as Magpie nest sites in Zielona Góra in 1987; T — tree crown type: I — column, O — round; L — development of leaf cover in spring: 1 — early, 2 — later; S — expected frequency of nests in town; W — choice index (observed frequency/expected frequency).

[Tabela 6. Gatunki drzew, na których najczęściej sroka budowała gniazda w Zielonej Górze w 1987 roku; T — typ korony drzewa: I — kolumna, O — okrągła; L — pojawienie się liści wiosną: 1 — wcześnie, 2 — później; S — oczekiwana częstotliwość występowania gniazd na danym gatunku drzewa w mieście; W — współczynnik wybiórczości (obserwowana częstotliwość/oczekiwana częstotliwość).]

Tree species	T	L	Trees number in town		Observed frequency		S	W
			N	(%)	N	(%)		
Populus sp.	I	1	3207	(13)	92	(44)	27.0	3.4
Aesculus hippocastanum	O	1	482	(2)	7	(3)	4.0	1.8
Tilia sp.	I	–	2443	(10)	30	(14)	20.6	1.5
Quercus sp.	I	2	1223	(5)	11	(5)	10.2	1.1
Betula sp.	I	1	2022	(8)	17	(8)	17.1	1.0
Acer sp.	I	–	1820	(7)	12	(6)	15.5	0.8
Robinia pseudoacacia	O	2	2045	(8)	8	(4)	17.3	0.5
Pinus sp.	O	–	1951	(8)	7	(3)	16.4	0.4
Fruit trees	O	–	5733	(23)	8	(4)	48.3	0.2
Alnus sp., Platanus x acerifolia, Larix decidua, Fagus silvatica, Salix sp., Carpinus betulus, Picea sp.	–	–	2294	(9)	16	(8)	19.3	0.8
Others	–	–	1601	(7)	–	–	–	–
Total	–	–	24821	(100)	208	(100)	–	–

tree species in spite of differences between the mean high of all trees and mean high of nest sites in this plot ($\chi^2 = 49.91$; $p<0.001$). This suggest that the height of the tree is not the only factor influencing the choice of tree species. An other factor may be the thickness of the branches on top of the tree (Jerzak 1988) which may provide a column of cover for the nest in the crown. *Populus sp., Tilia sp., Quercus sp.* are more often chosen by Magpies in Zielona Góra. The timing of leaf development in spring varies between species of trees (*Populus sp., Aesculus hippocastanum* break early) and helping to hide the nest. This factors has been also discussed by Baeyens (1981).

NEST SITES IN URBAN ENVIRONMENT

The choice (W) index shows a very strong preference of three species in urban environments in Zielona Góra *Populus sp.* (3.4), *Aesculus hippocastanum* (1.8) and *Tilia sp.* (1.5). There was also a high index for species like: *Alnus sp.*, *Platanus* × *acerifolia* and *Larix decidua* though they were grouped together because of the low number of those trees species in town (Tab. 6). As much as 44% of nests were situated on *Populus sp.* in 1987. This very high percentage may result from the very high number of this species in Zielona Góra. Poplar was also commonly chosen in other towns (Tab. 3).

There was a high positive correlation between the distribution of nests and preferred species of trees (*Populus sp.*, *Tilia sp.*, *Aesculus hippocastanum*, *Alnum sp.*, *Platanus* × *acerifolia* and *Larix decidua*) in town ($r = +0.767$; $p < 0.001$). There was also a strong correlation between distribution of nests and all trees counted in town ($r = +0.497$; $p < 0.05$) (Fig. 2). Similar correlations were recorded by Tatner (1982a) in Manchester. Magpies did not select species like: fruit trees, *Picea sp.* and *Pinus sp.*

It is very possible that Magpies preferred some species of trees so as to build a nest higher in town. This is suggested by the correlation observed between high proportion of tree species with strong Choice index (W) and mean height of nest sites in each square of the town ($r = 0.519$; $p < 0.02$) (Fig. 2).

The highest count of all trees which may be used as a nest site by the Magpie was found (N = 2236) in the central square (1km^2) of the study area. This was also the square with the highest nest density of the Magpie. In this square some species were more often chosen by Magpie like: *Populus sp.* and *Quercus sp.* Nests here were much higher ($\bar{x}$ = 16m) than the mean height of all trees ($\bar{x}$ = 12.3m). The nests were located mainly in the range of between 12–20m.

All nests in this plot were located on the top of trees similar to data for all Polish nests. The correlation between tree height and nest height was very strong ($r = +0.952$; $p < 0.001$). This suggest that tree height is one of the main factors influencing the choice of nest site by Magpies. Knight and Fitzner (1985) observed that in plots with increasing numbers of people, Magpies built their nests higher each year. So, the distribution of high tree species in towns may influence the distribution of Magpie breeding pairs. In Zielona Góra tall species like: *Populus sp.*, *Quercus sp.* and *Tilia sp.* were most often used by Magpie as nest site.

On the basis of this research it is quite clear that man has created good conditions for Magpie which help it colonise in urban environments. Expanding towns and increasing human density has changed towns: providing, more trees and bushes with grasslands, parks without bushes, cemeteries, grasslands around industrial buildings etc. In earlier research in a few towns of Western Poland Jerzak (1992) found a positive correlation between human density and Magpie breeding density in the urban environment. Kot (1988) in his research in the Warsaw suburbs found positive correlation between magpie density and building density. He suggested that older parts of the town (with higher magpie density) have more areas covered by hard cover (concrete, asphalt) and here is many more tall trees compared to modern parts of the town. All those observations confirm the trend for colonisation of urban environment.

CONCLUSIONS

Magpies in towns use very similar microhabitats for nesting as in rural environments of Poland. These include rows of trees, hedges (33%) and groups of trees and bushes (25%). Most nests were build in Polish towns in poplar trees (31%), the species which were planted very commonly in towns after Second World War. The next species chosen were *Tilia sp.* and *Betula sp.* Magpie located nests very high in the urban environment. The average high in Poland was 14.98m (SD = 5.533). It is very possible that the activity of people force Magpies to select a higher nest location.

The number of possible nest sites is great in towns. Magpies select the best places for better breeding success. The choice index suggests that Magpies prefer six tree species in the urban environment of Zielona Góra: *Populus sp.*, *Aesculus hippocastanum*, *Tilia sp.*, *Alnus sp.*, *Platanus x acerifolia* and *Larix decidua*. Because the average nest height ($\bar{x}$ = 16m) was higher than the average tree height ($\bar{x}$ = 12m), it suggests that birds prefer higher trees in the centre of Zielona Góra. Nest density also correlated with tree height density.

All this suggested that man planting tall trees (like Poplar) in towns, in rows and groups create good

potential nest sites. But tree height is not the only factor in the urban environment which may impact on the breeding pairs distribution. The distribution of tree species also plays an important role.

ACKNOWLEDGEMENTS

Author thanks: to all people who collected data for the Polish Nest Record Scheme (PNRS) about magpie nests, to Prof. T. Wesołowski for help in using a PNRS and to Prof. J. Pinowski and Prof. W. Górski for comments during the research and special thank to dr. B. Kavanagh for English corrections with comments.

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STRESZCZENIE

[Miejsca lęgowe sroki *Pica pica* w środowisku zurbanizowanym Polski]

Miejsca lęgowe sroki gniazdującej w środowisku zurbanizowanym Polski zbadano na podstawie 671 kart lęgowych Kartoteki Gniazd i Lęgów (Uniwersytet Wrocławski) zebranych w 60 miastach w okresie od 1969 do 1995 roku oraz danych własnych autora zebranych w 12 miastach zachodniej Polski (1167 gniazd) w latach 80-tych (razem 1838 gniazd). Aby stwierdzić czy sroka częściej wybiera określone miejsca lęgowe w środowisku zurbanizowanym, policzono drzewa wyższe niż 5m na całej badanej powierzchni Zielonej Góry (20km^2). Porównując stwierdzone wykorzystanie poszczególnych gatunków drzew z oczekiwanym wykorzystaniem wyliczono wskaźnik wybiórczości (W) określający stopień preferowania danego gatunku drzewa przez srokę jako miejsca lęgowego.

W miastach sroki umieszczały gniazda głównie w szpalerach drzew i krzewów (33%) oraz w ich grupach (25%) (tab. 1). Podobne miejsca lęgowe sroki wybierały również w krajobrazie pozamiejskim Polski (Jerzak 1988). Poza tym w śródmieściu miast sroki gnieździły się w parkach i cmentarzach, a na peryferiach w ogrodach.

Prawie jedna trzecia badanych gniazd była umiejscowiona na topoli (31%) (tab. 2). Drzewo to jest też wymieniane jako najczęściej wykorzystywane przez srokę w wielu badanych miastach Eurazji (tab. 3). Z pośród innych gatunków wymieniane były lipa (15%), brzoza (9%), dąb (6%) oraz drzewa owocowe (6%). Pozostałe gatunki były wykorzystywane do umieszczania gniazd rzadziej (poniżej 5%). Różnorodność gatunkowa wykorzystywanych drzew i krzewów jest znacznie większa w miastach niż w środowiskach pozamiejskich.

Większość badanych gniazd sroki była umieszczona w przedziale wysokości od 14 do 20 metrów. Średnia wysokość położenia gniazda wyniosła 15,0m i była wyższa w śródmieściu (16,3m) niż na peryferiach (13,9m) (ryc. 1). Tak wysokie umieszczanie gniazd wydaje się być powodowane obawą przed ludźmi.

Typowe miejsce lęgowe sroki w środowisku miejskim to szpaler lub grupka topoli otoczonych trawnikiem, a gniazdo umieszczone jest dość wysoko w rozwidleniu gałęzi części szczytowej drzewa (tab. 4).

W mieście sroki znajdują obfitość miejsc lęgowych pozwalających na odniesienie sukcesu lęgowego. Przeprowadzona analiza wskazuje, że sroka wybierała częściej jako miejsce lęgowe sześć gatunków drzew: topola, kasztanowiec, lipa oraz olsza, platan i świerk (tab. 6). Rozmieszczenie gniazd wyraźnie korelowało z rozmieszczeniem tych gatunków drzew (ale także wszystkich drzew) w mieście (ryc. 2). Częstsze wybieranie tych gatunków wydaje się być związane z wczesnym pojawianiem się na nich ulistnienia oraz z możliwością wysokiego umieszczania gniazd co jest wymuszane na sroce przez ludzką aktywność. Oczywiście jest to tylko jeden z czynników mogących wpływać na rozmieszczenie terytoriów sroki w środowisku zurbanizowanym.