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# Study on the intersexual differentiation of foraging niche in relation to abundance of winter food in Great Spotted Woodpecker *Dendrocopos major*

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**Abstract.** Intersexual differences in foraging patterns during three winters with different availability of Scots Pine *Pinus sylvestris* cones were studied. Decreased cone availability was associated with changes in foraging behaviour: (1) both sexes used less cones and exploited more bark/wood; (2) both sexes increased their foraging diversity as they were forced to exploit other food sources; (3) intersexual niche overlap decreased significantly. Males were significantly more aggressive and territorial in cone poor winters than in winters with rich cone crops. Conclusions: territoriality in Great Spotted Woodpecker reduced intraspecific competition for food in winter. Territoriality, in the case studied, was a behavioural adaptation which is plastic and depends on food availability.

**Key words:** foraging behaviour, Great Spotted Woodpecker *Dendrocopos major*, intraspecific competition, food availability changes.

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## INTRODUCTION

Resource discrimination between sexes has been found in many bird species, but it is especially pronounced in woodpeckers (e.g. Selander 1966, Hogstad 1976, 1978, Peters & Grubb 1983, Aulén & Lundberg 1991, Osiejuk 1994). Sex-specific foraging niches have often been attributed to size dimorphism (Selander 1966, Storer 1966, Wallace 1974). For example, among North American *Dendrocopos* (= *Picoides*) woodpeckers it is sometimes accompanied by sexual dimorphism in bill size (Kilham 1965, Ligon 1968, Kisiel 1972, Austin 1976, Gamboa & Brown 1976). In Europe, similar sexual differences in bill size and niche utilization during winter have been established for the Three-toed Woodpecker *Picoides tridactylus* (Hogstad 1976) and White-backed Woodpecker *D. leucotos* (Aulén & Lundberg 1991).

In the case of the Great Spotted Woodpecker the pattern of foraging niche differenation is not so clear. Hogstad (1978) stated that sexes of this species are similar in size and generally utilise the same foraging pattern. He suggested that *Dendrocopos* species might reduce intersexual competition by having mutually exclusive winter feeding territories and called this phenomenon "microgeographic allopatry". However, in circumstances of high food availability in winter (rich crop of pine cones) males and females could not establish exclusive territories (Osiejuk 1994). In such case, competition for food is expressed only rarely as aggressive chasing of females by males. In most cases, both sexes fed simultaneously in very close proximity. The result was that foraging behaviour of males and females was similar. However, the socially dominant sex (males) spent more time feeding on the most available food (pine cones).

In this paper are presented data on the sexual divergence in foraging behaviour of Great Spotted Woodpecker during winters (1990–1993) with different Scots Pine *Pinus sylvestris* cone availability.

## STUDY AREA

The study was conducted in the most natural part of Wielkopolski National Park (WNP), i.e. Grabina reserve and its vicinity, Western Poland (52°15'N, 16°50'E). The study site was ca 30 ha of an oak-hornbeam forest, partly mixed with pine. The dominant tree species were *Quercus robur* and *Pinus sylvestris* mixed with less numerous *Carpinus betulus*, *Betula* spp. and *Acer* spp. The fraction of dead trees in the study area varied from 5.4% to 14.9% — mean 12.7%, based on several samples from 1 ha square plots (Osiejuk 1993). The cone crops were estimated by counting them through binoculars. Each winter in early December were selected randomly ten points on the study area. Then were counted cones on the nearest pine tree to each of these points. Although this method probably caused overestimation of cone numbers, it sufficient to demonstrate relative abundance changes of cones (Białobok *et al.* 1993). During two winters (1990/91 and 1991/92), the Scots Pine had a very rich cone crop, 810 (SD ± 105) and 785 (± 130) cones per tree, respectively, while during the next winter (1992/93) the cone crop was relatively sparse — 450 (± 174). The differences between first two winters were insignificant (U-test, $U = 45.5$, $N = 20$, $p > 0.7$), while winter 1992/93 differed significantly from the two earlier ($U = 3.0$, $N = 20$, $p < 0.001$ and $U = 5.5$, $N = 20$, $p < 0.001$, respectively).

## METHODS

The foraging behaviour of birds was observed between 08h and 12h, from 1 December to 28 February during each winter. To minimize the effect of weather, observations were made only in days with temperature over –5°C, wind below 4° (Beaufort scale), no rain or snow. The one-tree-one-record (1T1R) method was used (Matsuoka 1977, Ishida 1990). Eight to twelve individuals were followed each year, and foraging variables were dictated into a hand-held tape-recorder. Data for the first two winters were pooled. The following ten foraging variables were recorded:

1) tree species used for foraging

2) tree height (< 10, 10–20, > 20 m)

3) tree diameter at breast height (DBH, cm)

4) tree condition (dead or alive)

5) part of tree used — trunk, branch diameter (< 1, 1–3, 3–5, 5–10, > 10 cm)

6) height of foraging above the ground (< 5, 5–10, 10–15, 15–20, > 20 m)

7) condition of foraging place (dead or alive)

8) foraging technique: gleaning — picking invertebrates from the surface, probing — peering and poking for arthropods on the surface, scaling — scaling the bark of branches or trunk for food, excavating — subcambial excavation, picking up cones and husking, and earth gleaning — picking invertebrates from the ground

8) foraging pattern: stationary — foraging without movements within a tree or dynamic — movements within a tree

9) body position: horizontal with head up, horizontal with head down, horizontal with head up and down alternately, vertical with back up, vertical with back down, vertical with back up and down alternately

10) direction of movements: up, down, up and down alternately, horizontal.

Aggressive interactions between individuals were also noted. The total observation times were: 177 min. and 120 min. for males and females, respectively, in the two winters with rich crops (169 and 114 1T1R observations), and 260 min. and 365 min. in the winter with a poor crop (202 and 157 1T1R observations). Foraging diversity was calculated using the Shannon-Wiener index: $H' = -\Sigma p_i \ln p_i$, where H' is the diversity value for the particular observation category (i.e. tree species, tree condition, etc., $p_i$ is the proportion of time spent by bird within the sub-division of each category i, i = 1, 2, ..., n. All values are expressed as the ratio $J' = H'/H'_{MAX}$, where $H'_{MAX}$ is the maximum possible diversity, representing equal utilization of all sub-divisions of the categories used by the species (Pielou 1966, Krebs 1989). The degree of intersexual overlap in niche utilization was quantitatively determined using Horns's (1966) equation:

$$R_0 = \frac{\sum (x_i + y_i) \log(x_i + y_i) - \sum x_i \log x_i - \sum y_i \log y_i}{(X + Y) \log(X + Y) - X \log Y - Y \log Y}$$

in which X and Y represent the total number of obser-

vations (total time) for males and females, respectively, in particular category; $x_i$ and $y_i$ represent the number of occurences (fraction of the observation time) made in the ith sub-division within each category for X and Y, respectively. The contingency table method (Rosner 1986) was used to analyze the original numerical data concerning preferences in foraging behaviour, Wilcoxon matched-pairs rank-sum test and nonparametric two-factor analysis of variance (Zar 1984) to two-sample problems related to indexes (J' and H').

## RESULTS

### Foraging behaviour in winters with rich cone crops

The microhabitat utilization pattern was similar in males and females, but some significant differences were found. Males foraged on dead trees more than females did ($\chi^2 = 13.56$, df = 1, $p < 0.001$). Females spent more time foraging in the lower part of trees ($\chi^2 = 29.93$, df = 2, $p < 0.001$). Both sexes most often foraged on trunks, but males used thicker branches more frequently than females ($\chi^2 = 20.96$, df = 5, $p < 0.001$). Other aspects of microhabitat utilization did not differ between the sexes (Tab. 1).

Table 1. Sexual dimorphism (M — male, F — female) in microhabitat utilization during winters with rich and poor crops of Scots Pine (in brackets data for animal food only).

[Tabela 1. Dymorfizm płciowy (M — samiec, F — samica) w wykorzystywaniu (% czasu żerownia) mikrohabitatów w czasie zim o zróżnicowanym urodzaju szyszek sosny zwyczajnej (w nawiasach dane dla żerowania na pokarmie zwierzęcym).]

| Tree characteristic | Percentage of feeding time | | | |
|---|---|---|---|---|
| | Rich crops | | Poor crops | |
| | M | F | M | F |
| Tree species | | | | |
| *Quercus robur* | 4 (8) | 12 (29) | 11 (25) | 46 (53) |
| *Pinus sylvestris* | 95 (92) | 88 (69) | 57 (0) | 43 (24) |
| Other | 1 (0) | 0 (2) | 32 (75) | 10 (23) |
| Tree height (m) | | | | |
| < 10 | 0 (0) | 0 (0) | 0 (9) | 1 (2) |
| 10–20 | 59 (43) | 46 (55) | 43 (72) | 52 (82) |
| > 20 | 40 (57) | 54 (45) | 57 (19) | 47 (16) |
| Tree diameter — DBH (cm) | | | | |
| < 20 | 5 (0) | 9 (24) | 9 (22) | 2 (6) |
| 20–40 | 76 (97) | 78 (26) | 15 (29) | 53 (41) |
| > 40 | 18 (3) | 13 (50) | 76 (49) | 45 (53) |
| Trees alive | 21 (41) | 48 (90) | 66 (98) | 79 (89) |
| Trees dead | 79 (59) | 52 (10) | 34 (2) | 21 (11) |

There were fewer differences in foraging behaviour of males and females than in microhabitat utilization (Tab. 2 and Tab. 3). A significant difference was found in foraging techniques used ($\chi^2 = 15.16$, df = 4, $p = 0.004$). Males spent more time feeding on cones (males, 87.9% of feeding time, husking and picking up cones; females, 80.1%). However, cones were the main source of food for both sexes. Females were possibly more mobile than males, spending twice as much time feeding with a dynamic pattern. This difference, however, was not statistically significant at 0.05 level.

Table 2. Sexual dimorphism (M — male, F — female) in selection of place of foraging during winters with rich and poor crops of cones (in brackets data for animal food only).

[Tabela 2. Dymorfizm płciowy w wybiórczości (% czasu żerowania) miejsc żerowania w czasie zim bogatych i ubogich w szyszki sosnowe (M — samce, F — samice; w nawiasach dane dla żerowania na pokarmie zwierzęcym).]

| Place of foraging | Percentage of feeding time | | | |
|---|---|---|---|---|
| | Rich crops | | Poor crops | |
| | M | F | M | F |
| Trunk | 37 (63) | 32 (8) | 24 (32) | 34 (38) |
| Branches Ø > 10 cm | 13 (15) | 24 (39) | 31 (26) | 17 (6) |
| Branches Ø 5–10 | 31 (12) | 8 (34) | 20 (12) | 36 (40) |
| Branches Ø 3–5 | 1 (5) | 1 (8) | 5 (1) | 3 (5) |
| Branches Ø 1–3 | 13 (5) | 26 (10) | 12 (27) | 1 (1) |
| Branches Ø < 1 | 5 (0) | 5 (0) | 7 (2) | 9 (10) |
| Trees alive | 20 (31) | 36 (33) | 91 (70) | 8 (59) |
| Trees dead | 80 (69) | 64 (67) | 9 (30) | 92 (41) |
| Height [m] | | | | |
| < 5 | 0 (0) | 0 (0) | 16 (33) | 4 (6) |
| 5–10 | 0 (0) | 2 (0) | 13 (37) | 2 (6) |
| 10–15 | 1 (10) | 14 (70) | 10 (25) | 29 (41) |
| 15–20 | 72 (65) | 61 (25) | 51 (3) | 63 (44) |
| > 20 | 26 (25) | 23 (5) | 10 (2) | 2 (2) |

### Foraging behaviour in winters with poor crops

During the winter with poor cone crops, the sexes differed significantly in most of the foraging behaviour aspects (Tabs. 1–4). Males foraged significantly more on pines and deciduous trees — excluding oak — ($\chi^2 = 59.66$, df = 2, $p < 0.001$) and preferred higher and thicker trees ($\chi^2 = 8.41$, df = 2, $p = -0.015$ and $\chi^2 = 36.98$, df = 2, $p < 0.001$). There were also significant intersexual differences in foraging location ($\chi^2 = 22.17$, df = 5, $p < 0.001$), foraging height ($\chi^2 = 78.81$, df = 4, $p < 0.001$) and foraging technique ($\chi^2 = 21.84$, df = 4, $p < 0.001$). A conspicuous decrease in Scots Pine usage was found in comparison to the previous two winters (males, $\chi^2 = 135.30$, df = 1, $p < 0.001$; females, $\chi^2 = 36.14$, df = 1, $p < 0.001$, Tab. 1). However, both sexes still

spent nearly 60% of feeding time husking and picking up cones. Stationary and dynamic foraging patterns were used with equal frequency in males and females (Tab. 3).

Table 3. Sexual differences (M — male, F — female) in foraging behaviour. In brackets data for animal food only.

[Tabela 3. Międzypłciowe różnice w zachowaniu żerowiskowym (M — samiec, F — samica), w nawiasach dane dotyczące żerowania wyłącznie na pokarmie zwierzęcym.]

| Foraging behaviour | Percentage of feeding time | | | |
|---|---|---|---|---|
| | Rich crops | | Poor crops | |
| | M | F | M | F |
| Foraging pattern | | | | |
| Stationary | 97 (26) | 93 (67) | 90 (80) | 92 (86) |
| Dynamic | 3 (74) | 7 (33) | 10 (20) | 8 (14) |
| Movement direction | | | | |
| Up | 89 (89) | 73 (73) | 64 (62) | 84 (87) |
| Down | 0 (0) | 0 (0) | 0 (0) | 10 (5) |
| Up & down | 11 (11) | 27 (27) | 33 (35) | 0 (0) |
| Horizontal | – | – | 3 (3) | 6 (8) |
| Body position | | | | |
| Vertical | 93 (100) | 93 (100) | 86 (85) | 86 (86) |
| Horizontal | 7 (0) | 7 (100) | 14 (15) | 14 (14) |
| Foraging technique | | | | |
| Gleaning | 4 (39) | 2 (11) | 25 (58) | 9 (19) |
| Probing | 0 (0) | 0 (0) | 1 (2) | 1 (3) |
| Scaling | 0 (0) | 5 (25) | 6 (15) | 23 (56) |
| Excavating | 8 (61) | 13 (64) | 2 (5) | 9 (22) |
| Husking | 82 | 68 | 51 | 53 |
| Picking up cones | 6 | 12 | 6 | 5 |
| Earth gleaning | 0 (0) | 0 (0) | 8 (20) | 0 (0) |

Table 4. Foraging behaviour — significances of contingency tables between and within sexes (M — male, F — female) and pine crops (R — rich, P — poor), ns — insignificant, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$).

[Tabela 4. Zachowanie żerowiskowe — istotność różnic (tablice kontyngencji) między płciami (M — samiec, F — samica) i między zimami o różnym urodzaju szyszek sosnowych (R — wysoki, P — niski), ns — różnica nieistotna, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.]

| Variable tested | Cones crop | | Sex | |
|---|---|---|---|---|
| | Rich | Poor | Males | Females |
| | M:F | M:F | R:P | R:P |
| $\chi^2$ contingency table | | | | |
| Tree species | ns | *** | *** | *** |
| Tree height | ns | * | ns | * |
| Tree diameter | ns | *** | *** | *** |
| Tree condition | *** | ns | *** | *** |
| Place of foraging | *** | *** | *** | ** |
| Place condition | ns | ns | *** | *** |
| Height of place | *** | *** | *** | ** |
| Foraging pattern | ns | ns | ns | ns |
| Movement direction | ns | ns | ns | ns |
| Body position | ns | ns | ** | ns |
| Foraging technique | ** | *** | *** | ** |

## Changes in foraging diversity and intersexual niche overlap

Changes observed in foraging diversity were related to the cone crop (Tab. 5 and Tab. 6). In winters with a rich crop of pine cones, males showed more uniform foraging behaviour than females (Wilcoxon matched-pairs signed-ranks test, $z = -2.7118$, $p = 0.007$, Tab. 5). In the winter with lower cone availability, males were not significantly different than females in their foraging pattern ($z = -1.7838$, $p = 0.074$, Tab. 5). Overlap in foraging niche utilization between the sexes was significantly lower in the winter with a poor cone crop ($z = -2.10$, $p = 0.036$, Tab. 7). Females changed their foraging behaviour less than males in response to different cone crops ($z = -2.52$, $p = 0.012$, Tab. 7). Male behaviour changed as measured by tree diameter selected, location on the tree, foraging technique, and tree species. Females changed foraging height and foraging technique (Tab. 7).

Table 5. Indices of foraging diversity J' of males (M) and females (F).

[Tabela 5. Wskaźnik różnorodności żerowania J' samców (M) i samic (F) podczas zim o bogatym i słabym urodzaju szyszek.]

| Variable | Rich crop | | Poor crop | |
|---|---|---|---|---|
| | M | F | M | F |
| Tree species | 0.20 | 0.35 | 0.84 | 0.87 |
| Tree height | 0.62 | 0.63 | 0.64 | 0.67 |
| Tree diameter | 0.61 | 0.60 | 0.64 | 0.71 |
| Tree condition | 0.74 | 1.00 | 0.92 | 0.73 |
| Place of foraging | 0.81 | 0.82 | 0.91 | 0.77 |
| Place condition | 0.72 | 0.94 | 0.74 | 0.66 |
| Height of place | 0.41 | 0.53 | 0.85 | 0.58 |
| Foraging pattern | 0.20 | 0.35 | 0.45 | 0.40 |
| Movement direction | 0.26 | 0.43 | 0.55 | 0.40 |
| Body position | 0.35 | 0.36 | 0.58 | 0.58 |
| Foraging technique | 0.35 | 0.39 | 0.70 | 0.68 |
| Mean | 0.48 | 0.58 | 0.71 | 0.64 |

Table 6. Dependence of foraging diversity on woodpecker sex and Scotch Pine crop (nonparametric two-factor analysis of variance).

[Tabela 6. Zależność różnorodności żerowania od płci dzięciołów i dostępności szyszek sosny (nieparametryczna, dwuczynnikowa analiza wariancji).]

| Source of variation | SS | DF | H | P |
|---|---|---|---|---|
| Cells | 999.04 | 3 | 6.06 | 0.109 |
| Factor A (crop) | 820.45 | 1 | 4.98 | 0.026 |
| Factor B (sex) | 6.57 | 1 | 0.04 | 0.842 |
| Interaction A x B | 172.02 | 1 | 1.04 | 0.307 |

Table 7. Indices of intersexual and seasonal overlap (R — rich crop, P — poor crop) in foraging behaviour of male (M) and female (F).

[Tabela 7. Wskaźniki międzypłciowego (M — samiec, F — samica) i międzysezonowego (R — zima bogata w szyszki, P — uboga) pokrywania się niz zerowiskowych.]

| Variable tested | Cones crop | | Sex | |
|---|---|---|---|---|
| | Rich | Poor | Males | Females |
| | M:F | M:F | R:P | R:P |
| Tree species | 0.98 | 0.87 | 0.82 | 0.82 |
| Tree height | 0.99 | 0.99 | 0.98 | 0.99 |
| Tree diameter | 0.98 | 0.87 | 0.69 | 0.90 |
| Tree condition | 0.94 | 0.98 | 0.84 | 0.92 |
| Place of foraging | 0.91 | 0.91 | 0.94 | 0.99 |
| Place condition | 0.98 | 0.43 | 0.59 | 0.91 |
| Height of place | 0.94 | 0.87 | 0.79 | 0.88 |
| Foraging pattern | 0.99 | 0.99 | 0.99 | 0.99 |
| Movement direction | 0.97 | 0.94 | 0.92 | 0.93 |
| Body position | 1.00 | 0.99 | 0.99 | 0.99 |
| Foraging technique | 0.96 | 0.88 | 0.82 | 0.91 |
| Mean | 0.97 | 0.88 | 0.85 | 0.93 |

**Aggressive and territorial behaviour**

In winters with rich cone crops, aggressive behaviour was observed only 4 times during 297 min. of total observation time (one observation per 74 min.). All of these observations were of a male attacking a female. Aggressive behaviour was initiated when females fed very close to males (0.5–2 m). Many times a few individuals feeding were observed within 10–30 m of each other without any aggressive behaviour (Osiejuk 1994). In the winter with poor crops aggressive behaviour was observed 15 times during 625. min of total observation time (one observation per 42 min.). The difference in aggressive behaviour frequency was significant ($\chi^2 = 3.98$, df = 1, p = 0.046). All of these observations were of a male attacking a female or a male attacking a male (two observations). However chasing was initiated when the distance between individuals was 10–15 m. Thus, in the winter with lesser cone crops woodpeckers apparently were more territorial.

## DISCUSSION

Great Spotted Woodpecker belongs to the bark-foraging guild, but it is not trunk-specialists (as for example treecreepers). Great Spotted Woodpeckers use several techniques to obtain arthropods from bark, wood, and ground (Vanicsek 1988, Török 1990). This species is also able to take cones of pine or spruce, passerine nestlings and even nectar (Hogstad 1971, Cramp 1985, Lester 1992, Osiejuk 1994 and other author's data). It has been also found that foraging behaviour differentiation in this species is both spatial and temporal (Hogstad 1971, Ishida 1990). All these facts are indicative for great plasticity of Great Spotted Woodpecker foraging behaviour.

In all seasons compared in this study, seeds of Scots Pine were still the predominant food of woodpeckers. There was found that intersexual foraging niche differentation and probably also territorial behaviour in Great Spotted Woodpeckers was associated with cone availability. In winters with higher cone availability, both sexes showed an uniform foraging pattern, feeding mainly on seeds. In the winter with lower cone availability, both sexes changed their behaviour significantly. Seeds husked from cones were still the main element in their diets, but they were probably an insufficient source of food as woodpeckers exploited other sources in over 40% of feeding time. As a consequence, foraging patterns of males and females became more diverse. Intersexual niche overlap was significantly lower in the winter with poorer cone crops. This was caused by the fact that after exploiting cones in similar proportions, the sexes used different bark and wood exploitation techniques.

A remarkable change in aggressive behaviour was found between winters with different cone availability. Because the observed individuals were not marked, it is hard to know if exclusive territories existed or where territorial boundaries were. However, woodpeckers certainly were more aggressive in the winter with lower cone availability. The fact that the minimum observed distance between foraging individuals was longer in the poor crop winter is also consistent with increased territoriality.

Based upon these results, the territorial allopatry observed by Hogstad (1978) is probably not a permanent territorial system of Great Spotted Woodpeckers, but instead is one state of possible territorial patterns. In most cases, wintering woodpeckers are forced to use poor quality bark/wood food resource as arthropod food is also not renewable during winter (Dziabaszewski 1976, Török 1990). Thus, territorial allopatry could easily evolve as an adaptation to mitigate intraspecific competition for food during periods of food shortage (Selander 1966, Wallace 1974, Hogstad 1978).

On the other hand, costs of territory defense may be in some circumstances higher than benefits of owning a territory (Gill & Wolf 1975, Pyke 1979, Carpenter *et al.* 1983). The very similar foraging behaviour of males and females and less pronounced aggressive behaviour in winters with rich cone crops suggest that such circumstances occurred in the 1990/91 and 1991/92 winters. One year later woodpeckers had to exploit arthropods more, but seeds were still the main source of food (see proportions of techniques used in Tab. 3). Intersexual dimorphism in foraging niche utilization during this winter and more pronounced aggressive behaviour of males were more territorial than in two earlier winter. So, the results obtained confirm the hypothesis that the function of territoriality in Great Spotted Woodpecker is reduction of intersexual competition for food (Hogstad 1976).

The territorial behaviour of Great Spotted Woodpecker which was described in this study might be rather uncommon and temporary. First, bumper crops of Scots Pine and other coniferous trees are rare events which almost never occur in series (Białobok *et al.* 1993). For example Scots pine rich crops occur every 10–15 years in Finland but every 3–4 year in Poland (Białobok *et al.* 1993). Second, there are other factors which possibly could modify territorial patterns, as for example population density, atmospheric conditions, patchines of forest stands (patches with rich and poor crops), and interspecific competition. However, the results obtained indicated that level of intersexual foraging niche overlapping might significantly vary from year to year in relation food availability, and that these changes are not indifferent to territorial system. In the face of such potential plasticity there is a need for experimental investigation of social systems in relation to food resources in this species.

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## STRESZCZENIE

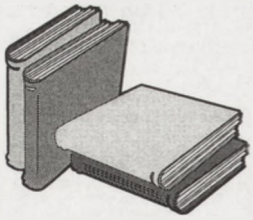
**[Badania nad międzypłciowym zróżnicowaniem niszy żerowiskowej dzięcioła dużego w zależności od obfitości pokarmu w zimie]**

Badano różnice w behawiorze żerowiskowym samców i samic dzięcioła dużego podczas dwóch zim (1991–1992) o bardzo dużej, a następnie w zimie (1992/93) relatywnie o ok. połowę mniejszej obfitości szyszek sosny. Badania prowadzono w Wielkopolskim Parku Narodowym na ok. 30 ha powierzchni grądu z domieszką starego drzewostanu sosnowego, w trakcie trzech zim w latach 1990–1993. Każdego roku obserwowano od ośmiu do dwunastu osobników i notowano szereg parametrów opisujących ich zachowanie żerowiskowe (tab. 1–3). Notowano również przypadki agresji między osobnikami. Analiza danych miała na celu stwierdzenie, czy międzypłciowe różnice w behawiorze żerowiskowym są stałe, czy też zależą od zmian dostępności szyszek sosny, które są ważnym pokarmem zimowym dzięcioła dużego.

W czasie zim z urodzajem szyszek zachowanie żerowiskowe samców i samic było dość podobne, choć pewne istotne statystycznie różnice były stwierdzone (tab. 4). Samce żerowały więcej na martwych drzewach, zaś samice w niższych partiach drzew (tab. 1). Były również nieco bardziej ruchliwe niż samce (tab. 3). Głównym pokarmem ptaków obu płci były szyszki, chociaż samce korzystały z nich w większym stopniu (tab. 3). Przypadki agresywnych kontaktów między ptakami różnej płci były rzadkie i prawdopodobnie nie istniały ścisłe terytoria osobnicze.

W sezonie z mniejszą dostępnością szyszek osobniki obu płci różniły się istotnie pod względem większości cech behawioru żerowiskowego (tab. 1–4). Nastąpił istotny spadek użytkowania szyszek a ptaki eksploatowały w większym stopniu bezkręgowce ukryte na powierzchni i pod korą drzew, i znacznie zwiększyły różnorodność stosowanych technik (tab. 3). Eksploatowały środowisko bardziej równomiernie niż w zimach, gdy szyszki były bardziej dostępne (tab. 5 i 6). Samce były wtedy również stosunkowo bardziej agresywne i terytorialne.

Wyniki badań potwierdzają teorię, iż terytorializm u dzięcioła dużego jest adaptacją, której funkcją jest obniżanie konkurencji wewnątrzgatunkowej o pokarm w okresie zimowym. Wskazują jednak również, iż w warunkach dużej dostępności pokarmu w zimie (np. szyszek sosny) dzięcioły duże mogą znacznie obniżać swoją terytorialność. Jest to cecha behawioralna o dużej plastyczności. Terytorializm u badanego gatunku był zależny od warunków pokarmowych.



# *BOOKS RECEIVED*

**THE BIRDS OF SAXONY**
[PTAKI SAKSONII]

**Steffens R., Saemann D., Groessler K. (eds.). 1998. Die Vogelwet Sachsens. Gustav Fischer Verlag, Jena, 530 pp.**

This is the third handbook, after "Birds of Meklenburgia" (1977) and "Birds of Thuringia" (1986), on the avifauna of regions-lands of the East Germany. And this is the first avifaunistic synthesis of the Saxony since the work of R. Heyder (1952), which was the pioneer one in this topic. "Birds of Saxony" is the collective effort of more than 700 ornithologists-contributors. The book was written in cooperation with G. Erdmann, H. Holupirek, P. Hummitzsch and S. Rau. The working group "Birds of Saxony" was founded in 1978 by D. Saemann.

After the introduction by R.Steffens, there is the the chapter devoted to history of avifaunistic investigations in Saxony since XVI century to 1990s. Following chapters give general information on the avifauna (367 bird sp. recorded up to 1989, 179 breeding ones), describe the region under study — its physiography and landscapes, as a background for avifauna. The next chapter characterises Saxony as an area of bird migrations and winterquartes. Then changes in avifauna as a result of habitat transformations, various topics of bird endangering/conservation (the Red List with 16 lost and 60 endangered breeding sp.), and conservation respect of avifaunistic research — are presented. The general part of the book ends with an extensive review of more than 160 census studies carried out in 27 habitat types. Ornithological characteristics (18 tables of census results) of habitats are given.

Species review is the most extensive (pp. 123–453) part of the book. It presents data on occurrence of all species of the avifauna of Saxony — their status and distribution in the region area and in habitats as well, their population number and changes, data on breeding biology and migrations.

The references list of the book consists of about 4199 positions (the earliest from the year 1552) used as sources of data, and about other 300 positions.

The index refers to German and English names of bird species or taxonomic groups.

The matter and the editorial shape qualifies "Birds of Saxony" as one of the best books of the recent ornithological literature, and one of the most important for the region of Central Europe.

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