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Food resource partitioning between two Dendrocopos species during the breeding season

By

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Abstract. Diet niche relationship of *Dendrocopos medius* and *D. major* was studied in the parental care period. Food samples were obtained by placing neck-collars on the nestlings. Caterpillars, dipterans and aphids predominated in the food of the middle spotted woodpeckers; caterpillars, coleopterans, dipterans, spiders and hemipterans in the food of the great spotted woodpeckers. The larger great spotted woodpecker utilized a wider spectrum of prey sizes. The greatest degree of segregation between the two bark-foraging bird species was found in prey composition.

The resource partitionong in avian communities has been intensively studied in the last ten years (CODY, 1974; ULFSTRAND, 1976; WIENS & ROTENBERRY, 1979; ALATALO, 1978). Primary aims of these studies have been to obtain information on the mechanisms regulating the structures of these communities.

Dendrocopos species *(major, medius, minor, syriacus)* use a clearly defined resource while feeding, the bark of trees. Hence recently the spatial distribution of this resource has been intensively studied for these species (WINKLER, 1973; ALATALO, 1978; HOGSTAD, 1978; JENNI, 1983). Almost all of these studies have been restricted to the winter season when the observation not too difficulte even in a forest with dense vegetation. Unfortunately, there are very few data on the diet relationships between bark-foraging species in the breeding season.

In this study I have examined the food resource partitioning (food composition and prey-size dimensions) of two species of birds that feed on tree trunks *(Dendrocopos major* and *D. medius)* in the nestling period.

Study area and methods

The study was carried out in a medium-age turkey-oak forest (Quercetum petraeae cerris) near Budapest. The predominant tree species of the 12 ha study area are *Quercus cerris* and *Q. petraea*. Shrubs occurring in appreciable numbers are *Ligustrum vulgare, Sambucus nigra, Cornus mas* and *Rosa* and *Crataegus* species.

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Food samples were collected from nestlings 2 – 15 days old using the neck-collar method (KLUIJVER, 1933; TÖRÖK, 1981). Length of the prey items was measured to the nearest mm and their dry weight taken after drying at 104 C for 4 hrs.

Food niche analysis was made on two dimensions (food composition and prey size). In the food composition dimensions categories of food items identified to familial level, rarely because of identification problems to the ordinal level, are presented. Categories were distinguished in 1 mm intervals for the prey size dimension.

The level of prey identification greatly influences niche metrics (GREENE & JAKSIC, 1983), therefore the niche breadth values obtained from figures of ordinal level of identification are underestimates, the values of niche overlap are overestimates of values of generic or species levels. In this report most of the identification are to the family level, hence they are of an intermediate state as compared to the levels examined by GREENE & JAKSIC (1983). The results presented are a better estimates of the true niche dimensions than those obtained from calculations made at ordinal level.

Niche breadth (diversity) was computed using the Shannon formula (SHANNON & WEAVER, 1949):

$$H = - \sum p_i \log_2 p_i,$$

where p_i is the relative abundance of category i (family or size interval) as compared to total number. Evenness was computed using the formula $J = \frac{H}{H_{max}}$ (PIELOU, 1966), where $H_{max} = \log_2 S$, S being the total number of categories.

Niche overlap (similarity) was calculated using RENKONEN'S (1938) proportional similarity index:

$$S_{1-2} = \sum_{i=1}^{i=S} \min (p_{1,i}, p_{2,i}),$$

where $p_{1,i}$ is the relative proportion of category i in bird species 1 and $p_{2,i}$ is the proportion of category i relative to the total number of categories in bird species 2.

Results

As regards the number of prey categories, the diet of the middle spotted woodpecker was more diverse than that of the great spotted woodpecker (Table 1). The middle spotted woodpecker fed on lepidopterans, while the great spotted

Table 1. Food composition diversity and evenness of the two woodpecker species (based on number of individuals)

	Dendrocopos medius 1981	*Dendrocopos major*	
		1981	1982
Diversity	3.26	2.47	1.89
Evenness	0.65	0.52	0.46

woodpecker mainly consumed aphids and hemipterans. The prey items which are obtained in the characteristic "woodpecker way" (e.g. coleopteran larvae living in the wood) were absent in the food of both species of woodpeckers in the nestling period.

Of the dipterans both species fed mainly on the larger *Limonia* and *Tipula* species. The prey item of greatest size was the maybeetle, which was found only in the food of great spotted woodpecker nestlings. Both woodpecker species consumed considerable quantities of harvestmen, the great spotted woodpecker specializing on larger ones.

As based on dry weight, the predominant food of the middle spotted woodpeckers were caterpillars, those of the great spotted woodpeckers were coleopterans. Among the groups representing abundant yet small-sized species only the proportion of mirid larvae was significant in the food of the great spotted woodpeckers.

Food composition diversity based on number of items higher in the middle spotted woodpecker than in the great spotted woodpecker (Table 1). Evenness was also greater in the middle spotted woodpecker.

The food composition overlap was 0.50 between the two species based on number of prey items (Table 2).

Table 2. Prey size similarities in five food categories relative to the total number of prey between two woodpecker species (NI – based on number of individuals, DW – based on dry weight)

	Similarity	
	NI	DW
Aphidoidea	0.71	0.60
Heteroptera	0.55	0.50
Diptera	0.50	0.49
Lepidoptera larva	0.79	0.75
Arachnoidae	0.44	0.38
Total	0.51	0.52

In the two *Dendrocopos* species body size was inversely proportional to mean prey size calculated from the number of individuals (Table 3). Carrying out the computations separately for the various prey groups, woodpecker species were segregated mainly as regards sizes of spiders and dipterans (Table 2).

The hemipterans had a bimodal size distribution, the peak around 4 mm representing larvae, the one at 7 mm standing for imagos. The middle spotted woodpecker took few hemipterans and those were mainly imagos, the great spotted woodpecker fed on many hemipterans but those were larvae.

Taking into consideration the number of different sized prey items, the greates similarity was observed between the two species in Aphidoidea and Lepidoptera larvae (Table 2). Tendencies similar to the above were observed in the segregation as calculated from the dry weights of the various food categories (Table 2).

Mean prey size (calculated from dry weight) and the size range of preys increased with increase in body size of bird species (Table 3). Prey size niche breadth calculated from number of individuals was greater in the middle

spotted woodpecker than that of the great spotted woodpecker. Calculated from dry weight the greatest niche breadth was observed for the great spotted woodpecker (Table 3).

Table 3. Body size, prey size (mean, $\bar{x}$ and standard deviation, SD), prey size diversity (H) and evenness (J) in the two woodpecker species (sample size in parentheses)

	Dendrocopos medius	*Dendrocopos major*
Body size of adult birds		
mean mass (g)	59.5 (3)	79.2 (14)
mean bill length (mm)	24.6 (3)	27.7 (14)
Prey size		
based on number of individuals		
$\bar{x}$	9.0	5.6
SD	5.4	4.2
H	4.14	3,25
J	0.88	0.65
based on dry weight		
$\bar{x}$	14.0	18.3
SD	4.8	11.7
H	4.12	4.59
J	0.88	0.92

Discussion

The literature on the resource partitioning of the bark-foraging guild of birds is scantly (WILLIAMS BATZLI, 1979). There are, however, data on the food composition of *Dendrocopos* species, but those were obtained from various geographical localities, habitats and seasons (CSIKI, 1905; PYNNÖNEN, 1943; BLUME, 1968; LÖHRL, 1972; GNIELKA, 1978; JENNI, 1983; PETTERSON, 1983).

The results suggest that the most important prey groups of *Dendrocopos medius* were caterpillars and aphids (numerically) and dipterans (in dry weight). In the food samples collected from nestlings in Switzerland (JENNI, 1983) also caterpillars were the predominant prey and the proportion of Tipulidae, Formicidae, Cantharidae and Panorpidae were also in accordance with my findings. PETTERSON (1983) studied the food of nestlings of middle spotted woodpecker in oakwoods in Sweden, where Coccidea, Hymenoptera and Lepidoptera larvae, as well as insects from the surrounding littoral habitat occured frequently in the samples. Since with his method nearly 50% of the prey taken to the nestlings could not be identified, the importance of the various prey groups is only approximative. CSIKI (1905) and BLUME (1968) found ants, coleopterans and hemipterans in the stomach contents of this bird species. Since these data were obtained from various habitats and seasons, and because of the method of study the less cutinized prey items could be identified only with difficulty, any discussion of the relative proportion of the various prey categories would be misleading.

Consumption of aphids, harvestmen and caterpillars by great spotted woodpeckers in this study was similar to that reported by JENNI (1983). In this woodland in the outskirts of Budapest the parents fed more Heteroptera and *Tipula* and less Hymenoptera to the nestlings than in the Swiss habitats. According to stomach content analyses the proportion of Lepidoptera was 5.6%, that of Coleoptera 18.5% in Finland, 22.2% and 57.1% in Germany, respectively (PYNNÖNEN, 1943). The studies of CSIKI (1905) show that this species feeds mainly on coleopterans, and to a lesser extent on ants.

It is a fundamental feature of resource partitioning of competitive communities that there is a positive correlation between body size and prey size in the species of similar feeding strategies (HESPENHEIDE, 1971; SCHOENER, 1974). My results suggest that the species with greater body mass and longer bill utilized a wider spectrum of prey sizes. Since large prey are scarcer than smaller ones (SCHOENER, 1974), the bird species of larger body size also frequently take small prey (like great spotted woodpecker). Mean prey size calculated from dry weight was related to the mean body mass and bill length of the adult birds. WILLIAMS & BATZLI (1979) also found positive correlation between prey size and bill length, and prey size and body mass in the winter food of bark-foraging birds.

The results presented here suggest that the greatest degree of segregation in the studied niche dimensions of two woodpecker species was found in prey composition. This dimension is also an important factor in other avian communities (TÖRÖK, 1986).

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