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Short research contribution

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DOES THE GREAT SPOTTED WOODPECKER *DENDROCOPOS MAJOR* SELECT HOLES FOR ROOSTING?

ABSTRACT: Characteristics of Great Spotted Woodpecker roosting holes are compared with those used for breeding. Neither postbreeding nor winter roosting holes differed from woodpecker nests with respect to tree species, condition, girth at breast height, cavity height or cavity direction. However, behavioural observations suggested that particular holes might be selected, probably in connection with microclimate condition and predator avoidance.

KEY WORDS: *Dendrocopos major*, primary cavity nesters, roosting

Studies examining roosting birds using tree holes are not numerous and concentrate mainly on two aspects: communal roosting and energy benefits (e.g. Frazier and Nolan 1959, Kendeigh 1961, Du Plessis *et al.* 1994). Few studies have examined the manner in which roosting holes are selected (e.g. Pitts 1976), and usually only described based on a single site (Knorr 1957, Kilham 1971), or from information gathered on birds sleeping in nest-boxes (Busse and Olech 1968, Winkler and Hudde 1988).

Woodpeckers (Picidae) excavate their own holes for nesting and roosting (Short 1982, Cramp 1985). Because woodpeckers use cavities for different purposes, the characteristics of such holes might be different. However, only breeding sites of various species of woodpeckers have been investigated (e.g. Jackson 1976, Wesołowski and Tomiałojć 1986, Kerpez and Smith 1990, Stenberg 1996). Roosting holes are generally not studied in any great detail, but are very important for these birds. Lack of suitable roosting sites may affect woodpecker populations, especially in winter, when trees are more susceptible to damage, or at the borders of their range (Short and Horne 1990).

It seems that roost cavities should be similar to nesting ones because many species may later utilize roosting holes for breeding and *vice versa* (Short 1982). However, most woodpeckers roost in holes all year round and, thus, different environmental conditions during breeding and postbreeding/winter seasons might cause the birds to select different cavities depending upon the time of year. Such patterns have already been observed in Pileated Woodpeckers *Dryocopus pileatus* and White-backed Woodpeckers *Dendrocopos leucotos*: both species choose different holes for roosting and nesting (Bull *et al.* 1992, Hogstad and Stenberg 1994).

The Great Spotted Woodpecker *Dendrocopos major* is the most common woodpecker species in Europe (Hagemeijer and Blair 1997). It roosts solitarily in old nesting holes of both conspecific individuals and

other Picinae, in holes excavated for roosting, or in nestboxes (Cramp 1985). Breeding holes of Great Spotted Woodpeckers are described in various parts of its range (e.g. Blagosklonov 1968, Wesołowski and Tomiałojć 1986, Hagvar *et al.* 1990, Mazgajski 1998) but data concerning roosting holes and behaviour are very rare (Blume 1961, Nyholm 1968). It seems that roosting holes of Great Spotted Woodpecker may be divided into two groups with respect to environmental conditions and intrapopulation factors. After breeding adults and recently fledged young have weakly pronounced territorial behaviours (Rychlik 1979). Thus many of the available holes should be used during the postbreeding time for roosting. In addition, environmental factors (e.g. temperature, winds etc.) do not force birds to select specific holes that may provide thermoregulatory benefits. During winter, when individual territories are established and maintained, severe environmental conditions may force woodpeckers to select and use specific holes for roosting.

In this short contribution I describe roosting holes of Great Spotted Woodpeckers and compare them with nesting ones. Some other aspects of roosting behaviour are also mentioned.

This study was carried out from October 1995 to April 1997, in a large nature reserve (ca 980 ha) composed of deciduous and mixed forests, near Warsaw (Kabacki Forest 52° 07' N, 21° 03' E). A detailed description of the study area and nest holes of the Great Spotted Woodpecker can be found elsewhere (Mazgajski 1998).

The location of roost sites was determined by flushing woodpeckers from their holes by striking the tree trunk. Most of the disturbed woodpeckers were caught using a net similar to a hand fishing net, and later ringed. Searches were started just before dusk because woodpeckers enter roosts prior to sunset (Blume 1961), enabling released birds to fly away and find a roost site before darkness fell. During the breeding season birds were not trapped, and capture was resumed once the young had fledged. Various holes (i.e. nests of Great Spotted Woodpeckers from previous seasons, cavities excavated by Middle Spotted Woodpeckers *Dendrocopos medius* and cavities of unknown origin) were monitored. I also monitored holes that were excavated outside of the breeding season.

For both roosting and nesting holes the following parameters were recorded: tree species, cavity height above the ground, girth of tree at breast height (GBH), presence of other holes, tree condition, and cavity direction.

I have categorized non-breeding cavities into postbreeding roosting holes (pRH used June–September) and winter roosting holes (wRH – used October–March) and compared them with breeding ones (BH). For data analysis, roost hole characteristics were only considered once (or twice – separately for pRH and wRH), even when several individuals were found to use the same cavity over time.

Disadvantage of the capture method used in this study is that only holes up to 7 m were checked (i.e. the net was only 7 m high). Therefore, in the comparison of nesting and roosting holes, only holes found below 7 m were used (breeding cavities found during 1993–1996). However, in Kabacki Forest, Great Spotted Woodpeckers breed very low – 80% of nests were found below 10 m (Mazgajski 1998), and thus this height limitation should have little influence on the results.

During this study I found only one hole excavated by woodpeckers for roosting purposes. A cavity in a birch was excavated by a first-year male during the winter. All other birds used existing cavities. Those holes used for roosting were mainly old breeding holes excavated by Great Spotted Woodpeckers, two holes of Middle Spotted Woodpeckers, and several of unknown origin. One young Great Spotted Woodpecker was observed roosting in a cavity that had been enlarged by a Black Woodpecker *Dryocopus martius*.

I found roosting holes of the Great Spotted Woodpecker in 7 tree species. Most holes were situated in oaks (*Quercus* sp.) and aspen (*Populus tremula*) and few were found in beech (*Fagus silvatica*), pine (*Pinus silvestris*), birch (*Betula verrucosa*), grey alder (*Alnus incana*) and linden (*Tilia cordata*). The same tree species were used for excavating nesting holes (Table 1). Therefore, there were no differences in tree species selection for breeding and roosting holes (pRH *vs.* BH $\chi^2 = 3.66$, df = 2, NS; wRH *vs.* BH $\chi^2 = 2.42$, df = 2, NS). Also girth at breast height (GBH) was similar for trees containing breeding and roosting holes (pRH *vs.* BH $\chi^2 = 0.49$, df = 2, NS, wRH *vs.* BH $\chi^2 = 1.54$, df = 2, NS) (Table 1).

Table 1. Characteristics (in %) of breeding (BH), postbreeding (pRH) and winter (wRH) roosting holes of the Great Spotted Woodpecker *Dendrocopos major* in mixed deciduous forest. N = number of holes (χ^2 test analysis – BH *vs.* pRH, BH *vs.* wRH, pRH *vs.* wRH – all cases NS)

Characteristics		BH (N = 49)	pRH (N = 28)	wRH (N = 18)
Tree species	*Quercus* sp.	49	28	28
	Populus tremula	39	61	55
	others	12	11	17
GBH (m)	0.5–1.0	55	61	44
	1.0–1.5	29	28	44
	> 1.5	16	11	12
Cavity height (m)	< 2.5	24	7	11
	2.5–5.0	45	71	50
	5.0–7.5	31	22	39
Tree condition	live	88	93	78
	dead	12	7	22
Entrance direction	N	27	37	30
	E	37	30	42
	S	18	9	11
	W	18	24	17

Almost 90% of roosting holes were found above 2.5 m, and 24% of breeding holes were situated below 2.5 m (Table 1). The lowest roosting holes (pRH – 1.60, wRH – 1.95 m) were twofold higher then breeding ones (0.70 m). Percentage distributions of hole height were rather similar for roosting and breeding holes (pRH *vs.* BH $\chi^2 = 5.80$, df = 2, NS; wRH *vs.* BH $\chi^2 = 1.48$, df = 2, NS). However, average height of observed winter roosting holes was almost significantly differ from breeding ones (wRH – 4.46 m, BH – 3.62; Kruskal-Wallis ANOVA H = 3.4, p = 0.066).

All roosting holes of the Great Spotted Woodpecker were found on the bole of the tree. Most of them were situated in living trees (Table 1). There were no differences between roosting and breeding holes in relation to tree condition (pRH *vs.* BH $\chi^2 = 0.50$, df = 1, NS; wRH *vs.* BH $\chi^2 = 1.03$, df = 1, NS). However, winter roosting holes were twice as like to occur in dead trees than breeding holes (Table 1).

Almost half of trees contained roost hole and one or more other holes situated near-by (pRH – 54 %, wRH – 50%). Breeding holes were constructed in trees with no other holes (67%), but those proportions were not significant (pRH *vs.* BH $\chi^2 = 2.67$ df = 1, NS; wRH *vs.* BH $\chi^2 = 1.69$, df = 1, NS).

There were no preferences in cavity direction of roosting holes (pRH $\chi^2 = 2.99$, df = 3, NS; wRH $\chi^2 = 2.11$, df = 3, NS). Holes facing both south and west were rarely used (Table 1), but those directions were also biased against by birds excavating breeding holes. Therefore, there were no differences between roosting holes and breeding holes in relation to entrance direction (pRH *vs.* BH$\chi^2 = 2.18$, df = 3, NS; wRH *vs.* BH $\chi^2 = 0.60$, df = 3, NS).

I found no differences in macrohabitat parameters measured for breeding and roosting holes. However it might be assumed that specific roosting holes were selected by woodpeckers because many of them were used by several birds. In 33% of roosting holes more then two individuals were caught over time (never together). Such frequently used holes were those preferred during the winter season. For example, one hole in particular, located in an aspen, housed 5 different individuals (four Great and one Middle Spotted Woodpeckers) between 4 January and 23 December 1996. Such turnover could not be explained by human disturbance. Frightened or caught birds always came back to the same hole. In fact, in a few holes the

same bird was caught during postbreeding and winter seasons or *vice versa*, and sometimes after one year.

The Great Spotted Woodpecker uses various places for roosting (Cramp 1985). For that purpose it uses mainly previously existing holes and excavation of roosting holes rarely occurs (Short 1982). Similar findings were observed during this study. Therefore some selection of existing holes for roosting should be observed. However, I did not find significant differences between roosting and nesting holes (Table 1). Thus, Great Spotted Woodpeckers differ from other woodpecker species in that they do not discriminate between roosting and nesting cavities. Breeding and roosting holes of White-backed and Pileated Woodpeckers are different in tree species selection, condition, DBH, etc. (Bull *et al.* 1992, Hogstad and Stenberg 1994). However, I think that this species somehow selects holes for roosting. Especially in winter, roosting holes (wRH) during this study were utilized by many different individuals although other holes were available. Such holes probably maintain a specific microclimate that aids birds in thermoregulatory demands because other measured characteristics did not differ.

One of the main requirements for an optimal roost site is protection from predators (Campbell and Lack 1985). Few ways in which woodpeckers could employ antipredator tactics in roosting hole selection could be considered. There was a certain tendency for woodpeckers to choose roost holes situated higher than nest holes (especially during winter). Also, more frequent use of holes in dying and decaying trees might lower predation pressure, because predator penetration of trees that are prone to fall down makes it more difficult for the predator to successfully climb the tree, as suggested by studies of White-backed Woodpeckers where roosting holes in mainly dying/dead trees is prevalent (Hogstad and Stenberg 1994). In Kabacki Forest, however, silvicultural management has eliminated dead trees and, thus, only a small proportion of roosting holes was found in such trees.

The other strategy of predator avoidance is to choose trees with many holes. As a potential predator Pine Martens *Martes martes* have been shown to search for holes and revisit them from year-to-year (Sonerud 1985). Therefore, nest holes are excavated mainly in trees without old holes (61–86 % – Hagvar *et al.* 1990, Hogstad and Stenberg 1994, Mazgajski 1998). On the other hand, roosting holes situated in trees with many holes might be more safe because the probability of predator penetration during the night becomes smaller as the predator needs to check many more cavities and frequency of finding holes with woodpecker decrease. Results obtained for Great Spotted (46–50% of roosts and 67% of nests occurred in trees with a single hole), and White-backed Woodpeckers (56% roosts and 86% nests – Hogstad and Stenberg 1994) support the hypothesis that woodpeckers build nest cavities away from other cavities and roosts in places with few cavities to avoid predators finding them. Similar behaviour was observed for Pileated Woodpeckers (Bull *et al.* 1992).

Similar to other authors (e.g. Blume 1961, Nyholm 1968) this study found that Great Spotted Woodpeckers show great fidelity to their roosting sites. Even after being frightened away or captured, the woodpeckers returned to the same hole. The opposite trend was observed with Pileated Woodpeckers – after disturbance or capture birds rarely reused such roosts (Bull *et al.* 1992). Similar to other authors (e.g. Blume 1961, Nyholm 1968), I observed that few individuals roosted in one tree when more than one cavity was available (in summer: two males in an aspen and a male and juvenile in an oak; in winter: a male and female in an oak and two males, and a Middle Spotted Woodpecker in a birch). Of interest is the fact that woodpeckers are strongly territorial yet allow other individuals to use tree holes situated within their individual territories. It appears that roost trees may not be as strongly defended as food resources.

Breeding holes were rarely utilized for roosting soon after the young had fledged. I monitored many such cavities (ca. 30), yet caught only 6 birds – 2 males and 4 juveniles. This finding appears to be novel and counter to Short (1982) who stated that only nesting adult males of Great Spotted Woodpecker will roost in the former nest cavity once the young have fledged.

Data concerning roost site selection or roosting behaviour of hole nesters are rare even though roost sites are important to the life history of the birds using tree holes (Short and Horne 1990). Therefore, any information that can be gathered with respect to roost sites is a valuable contribution to the

protection of woodpecker species and might be applied to forest management in order to protect the roost sites.

It seems that for description of roosting holes selection not only macrohabitat variables like tree species, holes' height etc. should be used, but also microclimate measurements inside the holes and other (behavioural) data have to be considered.

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