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NEST-SITE CHARACTERISTIC OF GREAT SPOTTED WOODPECKER *DENDROCOPOS MAJOR* IN CENTRAL POLAND

ABSTRACT: The study was carried out in two nature reserves in Warsaw (central Poland) in 1992–1995. Following aspects of *Dendrocopos major* nest hole's localisation are describing: tree species, height above the ground, tree trunk girth, condition of tree, tree fragment (in which nest was located) and entrance's exposure. Near all nest's parameters were different between two study areas what suggest that Great Spotted Woodpecker is quite indiscriminate in nest site selection.

KEYWORDS: Great Spotted Woodpecker, *Dendrocopos major*, nest-site, breeding, primary cavity nesters

1. INTRODUCTION

For woodpeckers (*Picidae*) probably most important environmental factor is proper place for hole's excavation (Short and Horne 1990), especially because those birds use holes all year round for breeding and roosting. Lack of suitable sites for such activity could limit woodpecker's population.

Some aspects of woodpecker's requirement about breeding sites are quite well known. Most commonly used parameters for describing nest's selection are: tree species, hole's height above the ground, whether the tree is living or dead, stem girth or diameter at breast height, orientation of nest entrance and others (Inouye 1976, Jackson 1976, Wesołowski and Tomiałojć 1986, Aulen 1988, Wesołowski 1989, Hagvar et al. 1990). However, many studies describe woodpeckers nests sites collect from quite large area (Blagosklonow 1968, Aulen 1988, Hagvar et al 1990, Glue and Boswell 1994) therefore it's difficult to compare its results.

The most numerous woodpeckers' species in Europe is Great Spotted Woodpecker *Dendrocopos major*. Its population is rather stable or even increases. One of the reasons of such situation is

that this species is feeding generalist and can change diet seasonally from insect to conifer seeds (Skoczylas 1961, Hogstad 1971, Torok 1990). Also this species probably has not specific preferences in nest sites' selection.

In boreal zone, where there is lack of many species deciduous trees, Great Spotted Woodpecker preferred Aspen *Populus tremula* for nest's excavation (Angelstam and Mikusiński 1994). In temperate zone apart this also excavates holes in greater extends in other tree species (Wesołowski and Tomiałojć 1986). Forest management eliminates trees that are dead, rotten or infected by fungi probably could not strongly influence Great Spotted Woodpecker population, because this species can excavate holes in living trees (Wesołowski 1989, Hagvar et al. 1990). Breeding in suburban areas Great Spotted Woodpecker can change its nesting behaviour: breeding lower than in close forest, more frequently excavate nests in trees contained other, old holes and more frequently use the same nest holes in consecutive years (Hansson 1992).

Most studies of *Dendrocopos major* nest sites originated from Scandinavia (Aulen 1988, Hagvar et al. 1990, Hansson 1992, Stenberg 1996). In Poland breeding holes were described only in Białowieża Primaeval Forest (Wesołowski and Tomiałojć 1986, Wesołowski 1989).

Aim of this study was to describe and compare nest site's characteristic of Great Spotted Woodpecker from two different, semi-natural forests stands.

2. STUDY AREAS

Study was carried out in two nature reserves in Warsaw (Central Poland 52° N, 21° E). These are: Bielański Forest and Kabacki Forest refer further in the text as Forest I (Bielański) and Forest II (Kabacki). Both are quite large, dense forest areas, situated on the outskirts of town. Both forests consist of old, mainly oak – hornbeam *Tilio-Carpinetum* stands, composed of oaks *Quercus robur* and *Q. sessilis*, hornbeam *Carpinus betulus* with addition of birch *Betula verrucosa*, lime *Tilia cordata* and aspen *Populus tremula*. Everywhere occur pine *Pinus silvestris* – either naturally or man-planted, which forms fragments of mixed coniferous stands. In Forest I also ash-alder *Ficario-Ulmetum campestris* stands can be found composed mainly of alder *Alnus glutinosa* and ash *Fraxinus excelsior* and oaks.

Detailed description of study areas contais Table 1.

Forest management activities such as pine cultivation, logging of dead trees and occurrence of alien tree species as ash-leaved maple *Acer negundo* or black locust *Robinia pseudoacacia* were also noted.

There is a grid of touring routes in both study areas. The influence of tourism is greatest in spring and summer, during birds' breeding season.

3. METHODS

Studies were started in 1992 in Forest I and 1993 in Forest II and ended in 1995. Search for woodpecker nests began at from the end of April (time of nest hole

Table 1. Characteristic of study areas

	Forest I (Bielański Forest)	Forest II (Kabacki Forest)
Area (ha)	ca 145	ca 980
Number of tree species	34	20
Dominated tree species (%)		
Quercus sp.	50	19
Populus tremula	*	3
Alnus glutinosa	17	*
Carpinus betulus	10	3
Pinus silvestris	3	66
Robinia pseudoacacia	5	*
Betula sp.	*	7
others	15	2
Tree stand age (%) (data from 1970s)		
1–40	36	54
41–80	*	25
81–120	20	21
121<	44	*

* – < 0.1%.

excavation) and was carried out until about 20 of June (fledging time of young birds). Only few holes were found during excavation phase. Main part of nests was found guided by begging calls of young. In that way nests of Great Spotted Woodpecker *Dendrocopos major*, Middle Spotted Woodpecker *D. medius* and Lesser Spotted Woodpecker *D. minor* were found, but for two last species sample sizes were too small for any comparison.

After the breeding season the following parameters were recorded for each woodpeckers' nest:

– tree species

– tree trunk girth at breast height (GBH)

– "degree of decay " in following scale (Hagvar et al. 1990 – modified): 1) living tree in good health (no dead branches), 2) living tree with one or more dead larger branches (or sighs of broken branches), 3) tree still alive but only one or a few living branches, 4) recently dead trees, 5) tree dead from many years with soft wood.

– condition of tree fragment containing hole – live vs. dead

– tree fragment – trunk vs. limb and branch

– occurrence of old woodpeckers' nesting (or roosting) holes in the same tree up to 5 meters from nest

– estimated height above the ground

– entrance exposure

Comparing estimated densities of breeding pairs of *Dendrocopos major* on study areas (Luniak et al. 1990) with the number of found nests, it could be calculated that probably 90–100% of all nests were found in Forest I on every year and only 30% in Forest II. However, in Forest II nests were carefully searched only in part of area.

4. RESULTS

On study areas *Dendrocopos major* bred in 9 tree species (Table 2). There were significant differences between study areas ($\chi^2 = 40.69$; $p < 0.001$; df = 8), connected with presence of ash-alder stand in Forest I and higher presence of aspen in Forest II.

Comparing availability of tree species on study areas (Table 1) and use of tree species for nest holes' excavation (Table 2) it's possible to find that Great Spotted Woodpecker show preferences for alder in Forest I, and oaks and aspen in Forest II.

Woodpecker's nests were found from 1 to about 30 m above the ground. The lowest holes occured in similar height on both areas (Forest I – 1.2 m, Forest II – 0,95 m). There were significant differences in percentage distribution of nests' height between study areas ($\chi^2 = 34.8$; $p < 0.001$; df = 4) (Fig. 1). Nest's height was not related to human pressure and possibility of disturbance. Many holes in Forest II were located very low (1–2 m) near tourist route.

Percentage distribution of nest trees' girth at breast height (GBH) (Fig. 2) was different in two areas ($\chi^2 = 44.2$; $p < 0.001$; df = 7) what is connected with difference of nest trees' species (see Table 2) and their girth (Table 3). In Forest II woodpeckers bred in thicker trees then in Forest I. However the thinnest trees contained woodpecker holes in both areas had similar girth (Forest I – 0.75 m, Forest II – 0.7 m).

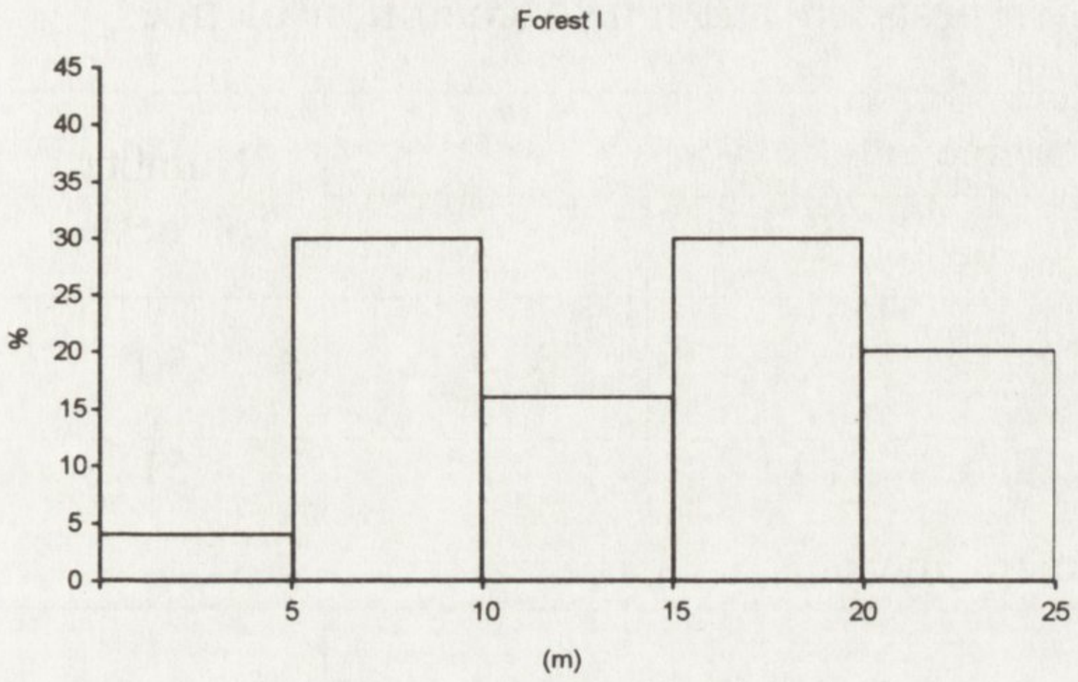
Great Spotted Woodpecker bred either in living or dead trees. Nests were excavated in live and dead tree fragments (Table 4). Between both study areas there were no differences either in vitality of tree or state of fragments that contained holes (tree condition $\chi^2 = 5.11$; $p > 0.05$; df = 4, tree fragment condition $\chi^2 = 2.4$; $p > 0.05$; df = 1).

Preferences to excavation nests in living trees or live fragment could be apparent – dead trees in both areas are very rare because they are removed by forest management service, sometimes even dead limbs are cut, especially when they

Table 2. Tree species used for nesting by *Dendrocopos major*

Tree species	Forest I[1]		Forest II[1]		Total	
	N	%	N	%	N	%
Quercus sp.	28	54	23	45	51	50
Populus tremula	1	2	23	45	24	23
Alnus glutinosa	15	28	–	–	15	
Carpinus betulus	2	4	1	2	3	3
Pinus silvestris	4	8	2	4	6	6
Robinia pseudoacacia	–	–	1	2	1	1
Betula sp.	–	–	1	2	1	1
Acer negundo	1	2	–	–	1	1
Populus nigra	1	2	–	–	1	1
	52	100	51	100	103	100

1 see Table 1.



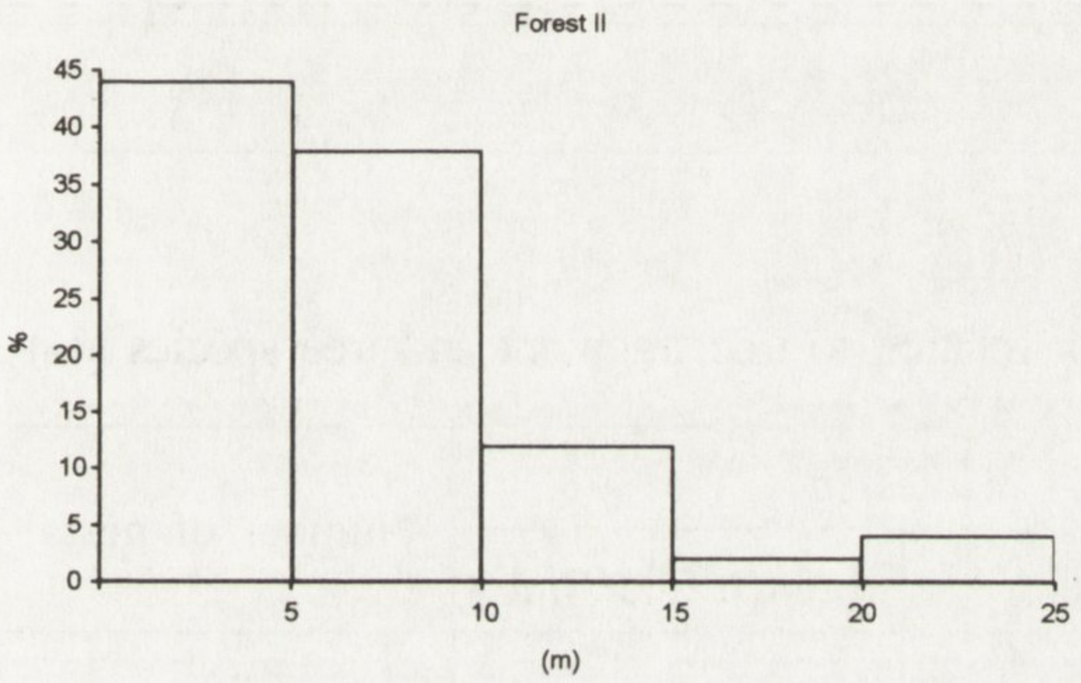
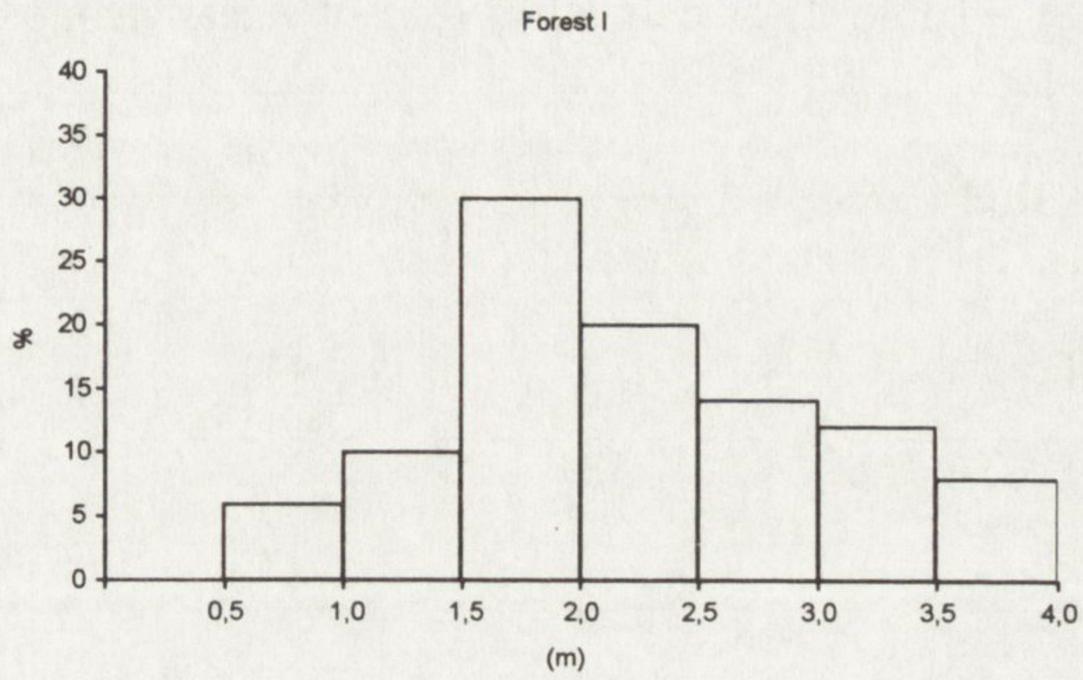


Fig. 1. Percentage distribution of *Dendrocopos major* nest's height. (Forest I[1], N = 50; Forest II[1], N =5 0). [1] see Table 1



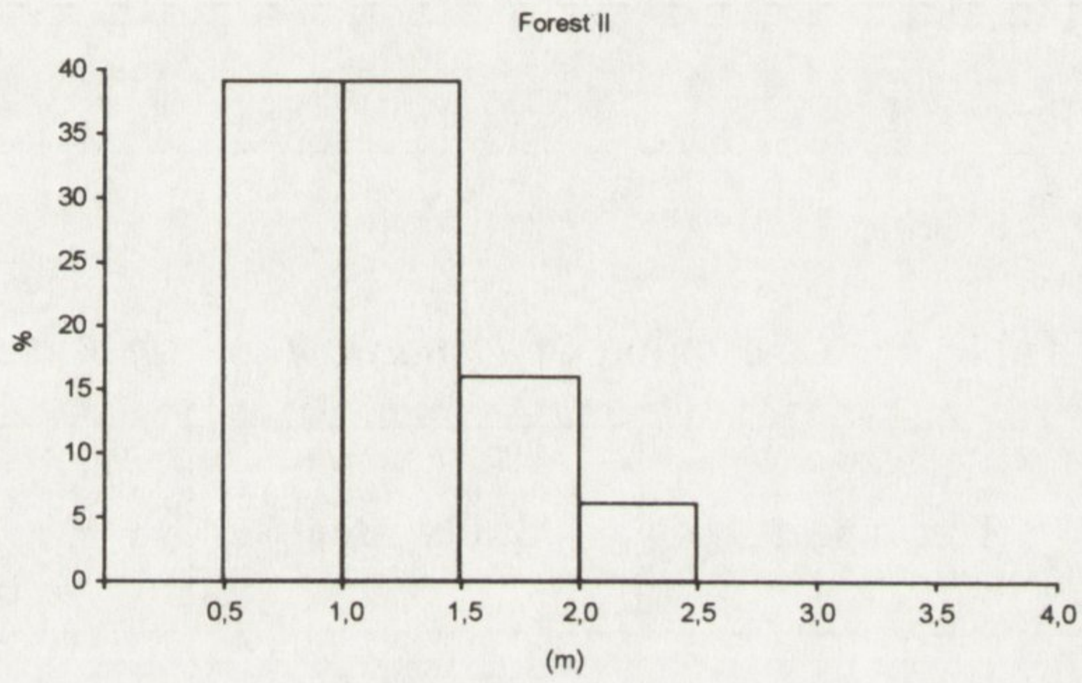


Fig. 2. Percentage distribution of girth at breast height of trees with *Dendrocopos major* nests (Forest I[1], N = 50, Forest II[1], N = 50).
[1] see Table 1

Table 3. Mean values ± s.d. of girth at breast height (GBH) of nest trees utilized by *Dendrocopos major*

Tree species	Study area[1]	Mean GBH ± s.d. (m)	Number of nests
Quercus sp.	Forest I	2.61 ± 0.95	27
	Forest II	1.37 ± 0.49	23
Populus tremula	Forest II	1.04 ± 0.23	22
Alnus glutinosa	Forest I	1.99 ± 0.38	14
All trees	Forest I	2.29 ± 0.95	50
	Forest II	1.19 ± 0.41	51

[1] see Table 1.

could be dangerous for walking people (more often in Forest I). Trees classified in "degree of decay" as 1 or 2 (this means healthy) were frequently infected by fungi and in those cases holes were located near polypores.

Most of Great Spotted Woodpecker's nests were located in trunks (Table 5). Differences between study areas (χ^2 = 21.08; $p < 0.001$; df = 1) are connected with age of tree stands and nest tree species (Table 1, 2) – in aspen holes were found only in trunks, in old oaks in Forest I main part of holes were located in limbs or branches.

Most of woodpecker's nests were excavated in places that are located away from old woodpeckers' holes (Forest I –

Table 4. Localization (%) of *Dendrocopos major* nests' in relation to condition of trees

Study area[1]	Condition of tree – degree of decay					Number of nests
	1	2	3	4	5	
Forest I	38	44	12	6	–	50
Forest II	53	27	8	10	2	51

	Condition of tree fragments		
	live	dead	
Forest I	76	24	51
Forest II	88	12	51

[1] see Table 1.

Table 5. Localization of *Dendrocopos major* nests in relation to tree fragment and tree species (%)

Tree species	Study area[1]	Holes in		Number of nests
		trunk	branch and limb	
Quercus sp.	Forest I	32	68	28
	Forest II	87	13	23
Populus tremula	Forest II	96	4	23
Alnus glutinosa	Forest I	73	27	15
All trees	Forest I	52	48	52
	Forest II	92	8	52

[1] see Table 1.

Table 6. Distribution (%) of entrance exposure of *Dendrocopos major* nests

Study area[1]	Hole entrance direction								Number of nests
	N	NE	E	ES	S	SW	W	NW	
Forest I	18	7	13	12	11	15	13	11	50
Forest II	9	17	21	10	13	6	8	16	50

[1] see Table 1.

64% nests and Forest II – 61% nests in such places).

There were no preferences in entrance exposure neither between areas nor within one area (Table 6) (between areas $\chi^2 = 7.68$; $p > 0.05$; $df = 7$, Forest I $\chi^2 = 3.21$; $p > 0.05$; $df = 7$, Forest II $= 7.41$; $p > 0.05$; $df = 7$). There were significant differences in entrance exposure between tree species (Table 7). Comparison of holes' entrances orientation excavated in aspen and oaks in Forest II show significant differences ($\chi^2 = 11.24$; $p < 0.02$; $df = 3$). Distribution of entrances orientation for holes excavated in aspen was significantly different from uniform ($\chi^2 = 9.57$; $p < 0.05$; $df = 3$), woodpeckers excavated more holes turned north and east. In oaks no directions were preferred, similar as in oaks in Forest I.

Table 7. Distribution (%) of entrance exposure of *Dendrocopos major* nests in relation to tree species

Hole entrance direction	Forest I[1]		Forest II[1]	
	Alnus	*Quercus*	*Quecus*	*Populus*
N	32	21	11	38
E	32	24	24	45
S	32	22	26	10
W	4	33	39	7
Number of nests	14	27	23	21

[1] see Table 1.

5. DISCUSSION

Obtained results suggested that *Dendrocopos major* is very adaptable or indiscriminate in nest site selection. Particular nest site parameters were different between two study areas. Great Spotted Woodpecker probably isn't strongly related to specific tree species during nest site selection, and can excavate it's holes in many tree species (Blagosklonov 1968, Wesołowski and Tomiałojć 1986). Only one study describes significant preference for aspen and alder comparing nest site with availability of possibly nests' trees (Aulen 1988). Few others studies describe overutilization of aspen and oaks for excavation nest holes (Blagosklonoy 1968, Wesołowski and Tomiałojć 1986, Hagvar et al 1990), but such results were not compare with tree species availability. In this study aspen, oaks and alder were also overutilized. Breeding in *Acer negundo* and *Robinia pseudoacacia* indicate that Great Spotted Woodpecker is able to excavate holes in those, originally North American tree species. Those tree species are commonly planted in parks and other areas (e.g. squares, cemeteries) what allow to assume that this species could breed in such places.

Nest's height found in this study is similar for those from other study. Results from Forest I are similar to Białowieża Primaeval Forest (Wesołowski and Tomiałojć 1986). Over 90% nest located below 10 m in Forest II is very similar for results from Scandinavia (Aulen 1988, Hagvar et al 1990). Low localisation of holes was rather connected with age of tree, in old trees in Forest I holes were excavated much higher (cf. Fig. 1 and Fig. 2).

Low localisation of nest's holes is not avoided by Great Spotted Woodpecker in Forest II, even such holes were use by them in consecutive breeding season (Mazgajski 1994).

Frequency of localisation of nests in tree without old woodpeckers' holes (61–64%) was similar for that found in forest (67–69% – Hagvar et al. 1990, Stenberg 1996) and higher than in suburban areas (52% – Hansson 1992).

Differences found in nest entrance's exposure between tree species are very interesting, but lack of similar elaborated data in results found by other authors make comparisons imposible. Some authors found no significant preferences in nest entrance's exposure (but southwest was overutilized – Hagvar and Hagvar 1989), others found that Great Spotted Woodpecker prefer entrances turn to north – like in this study for holes

in aspen (Wesołowski and Tomiałojć 1986, Tracy 1938 after Hagvar and Hagvar 1989) and south (Wesołowski and Tomiałojć 1986), but none compare distribution of nest entrance exposure between different tree species.

The possible reasons for preferences of nest entrance exposure towards north or east in Forest II are wind directions. In that area more winds blows from west and fewer from north or north-east (Dmowska 1979). However, if avoidance of wind would be main reason of nest hole exposure preference there will be no differences between tree species.

Preferences for excavation holes in aspen turn to east and north are need to confirm on greater sample size, and in other areas, however Hagvar and Hagvar (1989) found more holes turns to south-west, and their sample was contain mainly nest from aspen (Hagvar et al. 1990). Also Inouye (1976) found nonrandom orientation of entrances to woodpecker's nests excavated in aspen: *Sphyriapicus varius* and *Colaptes auratus* excavate his holes directed to south.

It's possible that woodpeckers during nest site selection are followed by other features than were measured. However, in all papers those parameters are describe, and others, for instance hardness of substrates are difficult to estimate, besides obtained results are unclear (Conner 1977).

Great Spotted Woodpecker besides its foraging advantages (wide variety of food and changing diet) is also adaptable in nest's site selection, those would be reason for its evolutionary success.

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6. SUMMARY

Following aspects of Great Spotted Woodpecker *Dendrocopos major* nests were described: tree species, nests' height, tree girth, condition of tree, tree fragment and it's vitality, entrance exposure. Studies were carried out in two nature reserves in outskirts of Warsaw (Central Poland). There were: Bielański Forest (Forest I) and Kabacki Forest (Forest II). Both areas were composed by mainly deciduous trees (Table 1). Nests were found guided by begging calls of young. Great Spotted Woodpecker nest sites were different between study areas in relation to tree species (Table 2) and distribution of its girth (Fig. 2), distribution of nest's height (Fig. 1) and frequency of excavation of holes in trunks (Table 5). There were no differences between areas in vitality of nest' trees and condition of fragment contained nest holes (Table 4). Also there were no differences in nest entrances exposure neither between areas nor within one area. (Table 6). Interesting differences appeared when nest entrance exposures were compared from different tree species. In aspen *Populus tremula* Great Spotted Woodpecker excavated more holes turned to north and east (Table 7). Variability of nest sites' parameters indicates that Great Spotted Woodpecker is adaptable in nest site selection to environmental conditions.

8. REFERENCES

1. Angelstam P., Mikusiński G. 1994 – Woodpecker assemblages in natural and managed boreal and hemiboreal forest – a review – Ann. Zool. Fenn. 31: 157–172.

2. Aulen G. 1988 – Nest site selection of the White Backed Woodpecker *Dendrocopos leucotos* and Great Spotted Woodpecker *D. major* in central Sweden (In: Ecology and Distribution History of the White-Backed Woodpecker *Dendrocopos leucotos* in Sweden) – S.L.U. Uppsala. Report 14: 197–220.
3. Blagosklonov K. N. 1968 – [The nesting trees of woodpeckers in the various types of forests] – Ornitologiya 9: 95–102.
4. Conner R. 1977 – The effect of tree hardness on woodpecker nest entrance orientation – Auk 94: 369–370.
5. Dmowska H. 1979. Flora zachodniej części Lasu Kabackiego. [Flora of west part of Kabacki Forest] – MS Thesis. Warsaw University.
6. Glue E. D., Boswell T. 1994 – Comparative nesting ecology of the three British breeding woodpeckers – Br. Birds 87: 253–269.
7. Hagvar S., Hagvar G. 1989 – The direction of the hole in norwegian woodpecker nests – Fauna norv. Ser. C.12: 106–107.
8. Hagvar S., Hagvar G., Monness E. 1990 – Nest site selection in Norwegian woodpeckers – Holarct. Ecol. 13: 156–165.
9. Hansson L. 1992 – Requirements by the Great Spotted Woodpecker *Dendrocopos major* for a suburban life – Ornis Svecica 2: 1–6.
10. Hogstad O. 1971 – [Notes on the winter food of the Great Spotted Woodpecker *Dendrocopos major*] – Sterna 10: 233–241.
11. Inouye D. W. 1976 – Nonrandom orientation of entrance holes to woodpecker nests in aspen trees – Condor 78: 101–102.
12. Jackson J. A. 1976 – A comparison of some aspects of the breeding ecology of Red-Headed and Red-Bellied Woodpeckers in Kansas – Condor 78: 67–76
13. Luniak M., Jędraszko-Dąbrowska D., Kozłowski P., Nowicki W. 1990 – Stan awifauny rezerwatów przyrody w Warszawie oraz wskazania dla jej kształtowania [Avifauna of Warsaw nature reserves and instructionsfor it's managenent] (In: Wykorzystanie układów ekologicznych w systemie zieleni miejskiej [utilization of ecological comunity in urban green areas] Ed. H. Zimny) – 64: 127–149.
14. Mazgajski T. D. 1994 – Dziuple wykute przez dzięcioły jako miejsca gnieżdżenia się dziuplaków wtórnych [Woodpeckers' holes as nest site of secondary cavity nesters] – Ms. Thesis. Warsaw University.
15. Short L. L., Horne J. F. M. 1990 – Woodpeckers – a world perspective and conservation concerns (In: Conservation and management of woodpecker populations, Eds. Carlson A., Aulen G.) -S.L.U. Uppsala. Report 17: 5–12 .
16. Skoczylas R. 1961 – Dynamika liczebności, rozmieszczenie pionowe i zachowanie terytorialne dzięcioła pstrego dużego (*Dryobates major*) w borze sosnowym [Number changes, vertical distribution and teritorial behaviour of Great Spotted Woodpecker (*Dryobates major*) in pine forest] – Ekol. pol. 9: 229–243.
17. Stenberg I. 1996 – Nest site selection in six woodpecker species – Fauna norv. Ser. C. 19: 21–38.
18. Torok J. 1990 – Resource partitioning among three woodpecker species *Dendrocopos* spp. during breeding season – Holarct. Ecol. 13: 257–264.
19. Wesołowski T. 1989 – Nest-sites of hole-nesters in a primaeval temperate forest (Białowieża National Park, Poland) – Acta orn. 25: 321–351.
20. Wesołowski T. 1995 – Ecology and behaviour of the White Backed Woodpecker (*Dendrocopos leucotos*) in a primaeval temperate forest (Białowieża National Park, Poland) – Vogelwarte 38: 61–75.
21. Wesołowski T., Tomiałojć L. 1986 – The breeding ecology of woodpeckers in a temperate primaeval forest – preliminary data – Acta orn. 22: 1–21.

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