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NEST SITE SELECTION OF THE GREAT SPOTTED WOODPECKER (*DENDROCOPOS MAJOR*) IN SAAREMAA.

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Abstract. The objective of the present study was to find out weather and to what extent Great Spotted Woodpeckers exhibit a preference for nest site. Data on 21 nests from 17 nesting territories in western Saaremaa were used. It appeared that Great Spotted Woodpeckers preferred deciduous and mixed forests over coniferous stands. Within the nesting sites the proportion of aspen, oak and elm was higher than of pine and birch. Canopy closure varied greatly. Proportion of dead trees and snags within a stand was probably not relevant in terms of nest site selection since no dead wood was found in more than a quarter of all nest sites. Altogether six different tree species were used for nesting whereby aspen was the most numerous one. The majority of the nests were excavated into live trees while the proportion of dead trees and snags as nest trees was 31%. Mean diameter of a nest tree was 37 cm, and mean height 21 m. Mean height of the cavity above ground was 6.3 m. Mean diameter of the cavity entrance was 5.0 cm horizontally and 5.3 cm vertically. In trees of larger diameter woodpeckers excavate nests higher than the average. Data of the current study confirms that the Great Spotted Woodpecker is a common and numerous species in any kind of stands and has wide ecological amplitude, therefore, is probably not demanding in terms of nest site woodland. However, the fact that Great Spotted Woodpeckers have a clear preference when it comes to nest tree selection and important nest parameters was partially proven.

Introduction

In Estonia, the only animals excavating larger cavities into trees are eight different species of woodpeckers. These cavities are for secondary cavity users, as different species of birds, mammals, and insects that use them for nesting, wintering but also for resting. Therefore, woodpeckers have a major ecological impact on forest ecosystems.

In general, the Great Spotted Woodpecker uses a nest cavity only during one breeding season. Yet, 15-30% cavities are being used more than once. The average number of fledglings in one brood is 3.4 (Pasinelli 2006). In Estonia, first nestlings have been reported on May 3rd, however, the exact number remains unknown.

Woodpeckers are keystone species that provide cavities for secondary cavity users. Of all the woodpecker species in Estonia, Great Spotted Woodpecker is the only omnivorous species and is much more numerous when compared to insectivorous woodpecker species (Lõhmus *et al*. 2000). Population density of the Great Spotted Woodpecker has been estimated up to 50 000-100 000 breeding pairs (Elts *et al*. 2009). Thus, it is the most numerous woodpecker species in Estonia. This species is also common in Saaremaa and nests are easy to detect. The Great Spotted Woodpecker does not have a clear preference neither for nesting site nor for nest tree (largely depending on geographical location). However, most of the research on nest site selection has left out potential nest trees so the information concerning nest tree species remains poor (BWP*i* 2008). In Estonia, nest site selection of the Great Spotted Woodpeckers has been studied poorly, which is why this species was chosen to be the research subject of the current study.

Nest sites of the Great Spotted Woodpeckers were described by the properties of (1) forest stand and (2) nest tree and nest hole. The main hypothesis to be tested in this study is that Great Spotted Woodpeckers have a clear preference for nest tree characteristics as well as for nest characteristics (no random selection occurs among woodpeckers). Nest hole excavation expends a lot of energy, therefore, woodpeckers need to pass the most economical decisions possible. A nest needs to have low predation risk and suitable microclimate. At the same time building a nest needs to have low energy expenditure.

Material and methods

Figure 1. Nests locations of Great Spotted Woodpeckers.
Joonis 1. *Suur-kirjurähni pesade paiknemine.*

The study was conducted in western Saaremaa. The majority of nests were detected in June when nestlings had grown already rather old. Most of the nests were detected owing to begging sounds of nestlings that in windless conditions are audible for up to 100 m. Great Spotted Woodpecker nestlings more than 10 days old are particularly loud (Lõhmus 2000). Most of the nests were located on monitoring areas on Viidu and Lagenõmme (Nellis 2008). In recording the exact nest co-ordinates, GPS receiver was used which enables

to easily locate the nests afterwards. In order to cause any disturbance to the woodpeckers, nest measures were taken and nest sites were characterized in autumn and winter. Data on 21 nests from 17 nesting territories were used. Nest locations of the Great Spotted Woodpeckers are shown in Figure 1. The sample of nests, however, is not completely random since almost half of them have been detected during other activities and are probably located in fairly more accessible locations (close to paths) than woodpecker nests in general. Sixteen different parameters were used in describing nests, nest trees and nest sites. The immediate surroundings of the nest tree was characterised by 5 parameters: forest type (deciduous, mixed or coniferous stand), canopy closure (%), species composition (%), basal area of living and dead trees (m^2/ha), the girth of 10 trees surrounding the nest tree (cm) - basis for calculating the basal area of a tree. In order to estimate species composition and basal area a relascope was used. Deciduous and coniferous stands were defined as stands where 75% consisted of either deciduous or coniferous trees. In order to avoid pseudoreplications, the occasion where two nests were located on one and the same nesting territory, the stand was described only once, with the nest that was found first. Entrance hole and cavity characteristics were described similar to Remm (2004). Calliper (to the nearest mm) was used in: measuring the cavity entrance horizontally and vertically, distance to back wall and thickness of front wall. Additionally, the trunk diameters at nest height, height of cavity above ground were measured (see Fig. Remm 2004) and facing compass direction of the entrance was determined. In order to measure height of the nest tree and of some cavities a klinometer and a 50-meter tape measure were used. A relascope was used in taking measurements at one measuring point, mostly 5 to 10 meters from a nest. Methods of operating with a relascope can be found in forestry textbooks (*e.g.* Vaus 2004) or in handbooks (Jänes 2006). In describing the characteristics, minimum and maximum values as well as the arithmetic mean were taken into account. Correlations between different characteristics were tested by linear regression analysis. Compass direction of the entrance and habitat preference was tested using χ^2-tests.

Results

Habitat characteristics. The majority of Great Spotted Woodpecker nests were located in deciduous (50.0%), to a lesser extent in mixed (37.5%) and least of all in coniferous stands (12.5%). No significant habitat preference was detected probably due to a small sample size (χ^2=3.50, df=2, p=0.17). The highest proportion of nests was reported in stands where the

dominating species were aspen (*Populus tremula*) and oak (*Qercus robur*; Fig. 2). Proportion of pine (*Pinus sylvestris*) and birch (*Betula sp.*) in woodpecker nest sites remained below average.

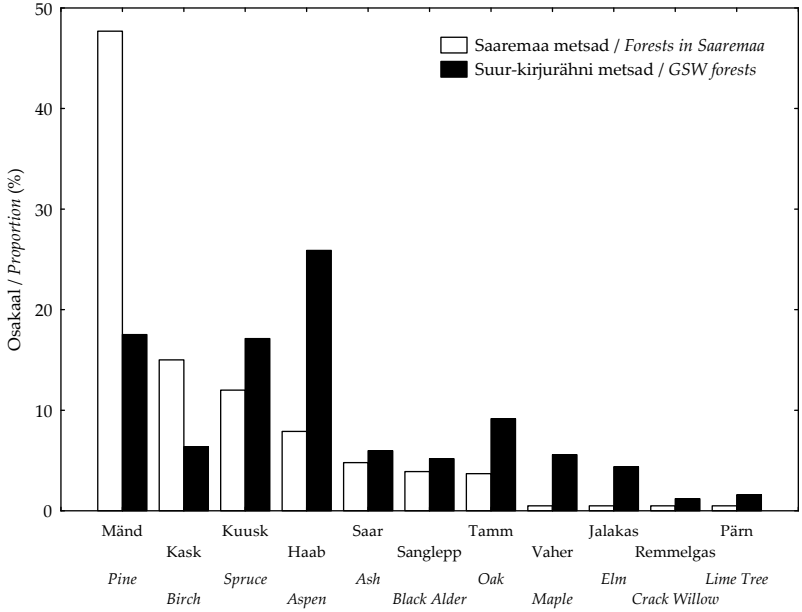


Figure 2. Frequency of different tree species in Great Spotted Woodpecker habitat and in Saaremaa overall.
Joonis 2. *Puuliikide esinemissagedus suur-kirjurähni pesapaikades (n=16) ja kõigis Saaremaa metsades.*

It appeared that canopy closure was not a relevant factor for Great Spotted Woodpeckers. Even though the majority of nests (8) were located in forest stands (canopy closure 0.7–0.9), some were located in areas with a lower canopy closure, *e.g*. parks and wooded meadows (canopy closure 0.2–0.6). Within nest sites the mean basal area of all trees was 33.5 m^2/ha. The basal area of dead trees and snags was 2.4 m^2/ha. Mean percentage of dead trees in woodpecker habitats was 7.2.

Nest tree. Main cavity tree of the Great Spotted Woodpecker was aspen, followed by pine and willow (*Salix sp.*). Comparing woodpecker nest trees with the overall species composition of the forests in Saaremaa, it appeared that the Great Spotted Woodpecker prefers to breed in aspen and other trees with soft wood (Fig. 3). Pine as a nest tree was uncommon considering its overall prevalence. Moreover, without any exception, all nest cavities in pines were excavated into dead trees. As it takes significantly more effort to excavate a nest into a viable pine tree, they make generally uncommon nest trees.

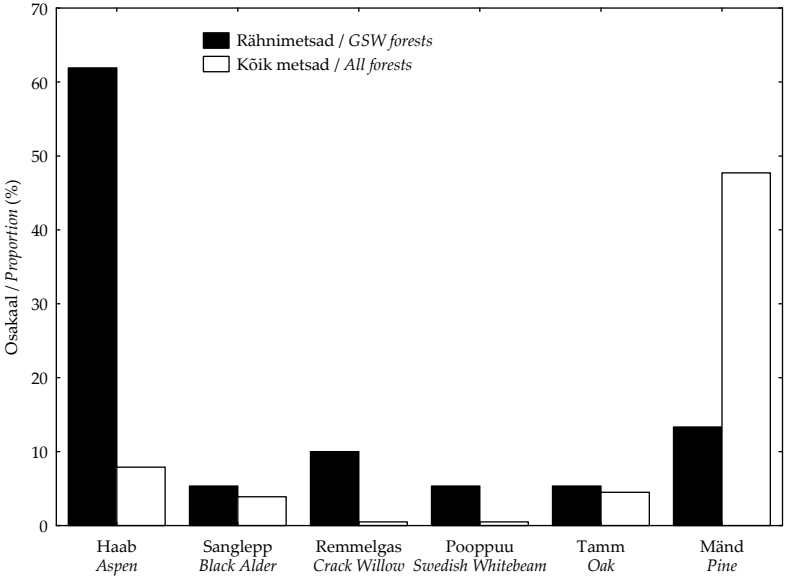
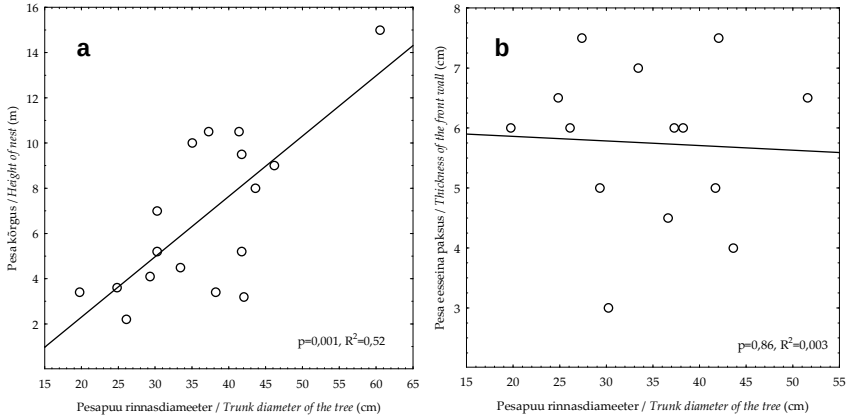


Figure 3. The proportion of different tree species as Great Spotted Woodpecker nest trees and in Saaremaa overall.

Joonis 3*. Puuliikide osakaal suur-kirjurähni pesapuudena ja Saaremaa metsade koosseisus*.

The majority of woodpecker nests were located in live trees (71%), 19% in dead trees and 14% in snags (n=21). Mean height of the nest tree was 20.7 m (12–26, n=18), however, snags were not included since the original height of the tree could not be estimated. Basal area of the nest tree was 37.4 cm (19.7–60.5).

Nest cavities. The mean height of a nest cavity was 6.3 m above ground (2.2–15.0 m). There may probably be an error in these results as it is relatively easier to detect nests that are excavated lower. Nevertheless, a correlation between nest height above ground and basal area of nest tree was detected (Fig. 4a).



Joonis 4. Suur-kirjurähni pesaava kõrguse ja pesapuu rinnasdiameetri seos (a) ning pesa eesseina paksuse ja pesapuu rinnasdiameetri seos (b).
Figure 4. *Relation between nest height and trunk diameter of the tree (a) and between the front wall thickness and trunk diameter of the tree (b) in the Great Spotted Woodpecker.*

Distribution of the compass direction of the entrance hole was tested using a method similar to Remm *et al*. (2006). However, there was no clear preference to any compass direction detected (Fig. 5). Mean facing of a nest hole entrance was east or south-east direction (azimuth 111°). The number of nests facing the same compass direction (±90°) as the azimuth of the average nest hole entrance, was compared to the number of entrance holes facing the opposite direction. The result did not significantly differ from a random distribution (χ^2-test, n=20, p=0.18, deviation was 29%). The reason may lie in a too small sample size since nest entrances facing north-east, south-east and south-west were rather numerous (Fig. 5). West and north-west directions were mostly avoided.

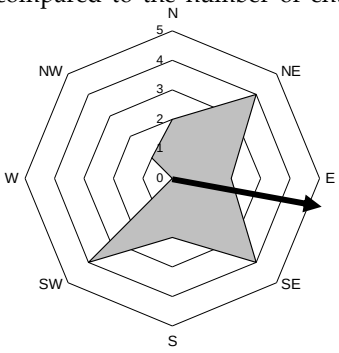


Figure 5. Compass direction of the entrance. Arrow represents average azimuth.
Joonis 5. *Puuõõnsuste ava suundade jaotus. Nool on keskmine asimuut.*

Diameters of the cavity entrance horizontally and vertically were characteristics that varied the least (Table 1). Mean horizontal diameter of the entrance was approximately 5

cm, whereby the vertical diameter was somewhat wider.

Hypothesis of the current study was that in order to excavate nest holes into larger trees in the middle of the tree, where the wood is softer woodpeckers need to leave the front wall of the nest thicker. This hypothesis is based on the presumption that, if possible, woodpeckers aim to excavate nests in the middle of a tree trunk. Latter refers to a relation between tree trunk diameter and thickness of the front wall (Fig. 4b).

The expected correlation did not appear and the front wall of the nest was not thicker among larger trees as suggested. A correlation did neither appear with the removal of all tree species except aspen nor with replacing the original measure of diameter – the basal area - with diameter above the entrance hole.

Table 1. Cavity measurements (cm).
Tabel 1. *Pesaõõnsuse mõõtmed (cm).*

	Average (min-max) ***Keskmine (min-max)***
Horizontal diameter of the entrance *Pesaava horisontaalne läbimõõt*	5.0 (4.0–6.1)
Vertical diameter of the entrance *Pesaava vertikaalne läbimõõt*	5.3 (4.0–6.5)
Distance to the back wall *Pesakoopa tagaseinast pesaava esiseinani*	17.0 (12.0–25.0)
Thickness of the front wall *Õõnsuse esiseina paksus*	5.8 (3.0–7.5)

Discussion

Forest type. In order to understand the preferences of a woodpecker, data obtained within the study area was compared to an overall classification of the Estonian woodland into coniferous, mixed and deciduous stands (Adermann 2007). Unfortunately, data on forests of Saaremaa were not available. The population density of the Great Spotted Woodpecker in broad-leaved deciduous woodland was 5 breeding pairs/km^2, 2–9 breeding pairs/km^2 in forests with birch as the dominating tree species and in coniferous forests 2–3 breeding pairs/km^2 (Leibak *et al*. 1994). Data on population density suggests that the number of woodpeckers remains lower in coniferous forests. Data based on nesting cards shows that Great Spotted Woodpeckers above all preferred to inhabit mixed woodland (36% of total number of occasions), less deciduous (23%) and the least of all coniferous woodland (20%) (Elts 2000). An even clearer preference for mixed woodland can be seen in Great Spotted Woodpeckers in

Norway where 75% of birds breed in mixed stands while 14% in deciduous and 11% in coniferous woodlands (Hagvar *et al.* 1990).

In consideration of the species composition of nesting habitat, the preference for oaks results from the fact that on the main study area in Viidumäe there are large wooded meadows with oak trees. Every single nest on these meadows was located in a forested area. Wooded meadows overgrow with aspen, spruce (*Picea abies*) and ash (*Fraxinus excelsior*). In woodpecker habitats also the percentage of ash and spruce was rather high (preferred by 1.4% and 1.1%, respectively). The remarkable preference for aspen woods probably results from the fact that for Great Spotted Woodpeckers aspen is the most suitable nest tree. Latter also finds support by data obtained from areas near Estonia. Aspen is the most preferred nest tree in Scandinavia and central and north-western part of Russia, whereas, in central Europe beech (*Fagus sylvatica*) and oak are more prevalent (BWP*i* 2008). Data obtained from nesting cards showed that inhabited woodlands with one dominating deciduous tree species were predominantly (60%) aspen forests (Elts 2000).

The fact that canopy closure is not a relevant factor among Great Spotted Woodpeckers also finds support by scientific literature. According to Angelstam & Mikusinski (1994), Great Spotted Woodpeckers inhabit all forest types and also agricultural landscapes with only a few trees along paths or fields.

Proportion of dead trees within a stand was 7.2% what is slightly higher compared to the mean percentage in forests within Saare County (5.6%) (Adermann 2006). In the current study there were woodpecker nests encountered in forests with no dead trees whatsoever, with one exceptional case where dead trees made up 8 m^2/ha of the forested area.

Nest tree. According to Lõhmus (1998), in north-western Estonia, Great Spotted Woodpeckers clearly prefer to nest in aspen trees, moreover, the occupancy of deciduous tree species is proportional to the hardness of their wood. Preference for aspen may also be due to the fact that this species extremely often suffers from heartrot. Preferences of the Great Spotted Woodpeckers vary geographically. For instance, within oak forests in Poland, Great Spotted Woodpeckers preferred to nest in oak (86%) (Kosiński *et al.* 2006). Therefore, in Norway, the preferred nest tree was aspen (78%; Hagvar *et al.* 1990). Latter study also showed that 14% of woodpeckers were breeding in snags and the mean height of a nest tree was 13.6 m while the diameter of the tree was 34 cm measured 0.5 m above ground (Hagvar *et al.* 1990).

In order to test the hypothesis that excavating a nest into a tree with a certain diameter brings about advantages for the woodpecker, it was presumed, that as the basal area of a tree grows, woodpeckers build their nests higher

(smaller trunk diameter). A relation was confirmed and Fig. 5 demonstrates how among trees with a wider trunk diameter compared to trees with a smaller trunk diameter woodpecker nests were excavated significantly higher above ground. It is more advantageous to excavate a nest into the heartwood, which contains soft dead tissue. However, among woodpecker nests in willows, this relation did not find proof. In case of willows, even in stouter trees, nest holes were excavated lower. A similar study in Norway showed a mean height of a nest being 5.2 m (Hagvar *et al.* 1990).

In his study, Remm (2004) showed that the mean compass direction of the entrance hole was facing east and north-east. Moreover, the compass direction of an entrance hole was considered to be a factor affecting the microclimate of the nest.

In terms of nest predation, measurements of the entrance hole play a rather significant role. It cannot be too large; otherwise the risk of nest predation increases. Also, excavating a larger hole is more energy consuming for the woodpecker. Moreover, the size of an entrance hole probably has a significant effect on the microclimate of the nest.

Based on literature, it may assumed, that the most influential factor affecting size of the entrance hole is predation, which in all terms needs to be avoided. According to Sonerud (1985), Pine Martens (*Martes martes*) search for woodpecker nests with a larger entrance hole and even memorize their location in order to revisit them yearly. Latter may be the reason why woodpeckers prefer to excavate a new nest hole every year (Hagvar *et al.* 1990). Size of the entrance hole also is an important factor for the secondary cavity nesting bird species. Nest cavities of the Great Spotted Woodpeckers are suitable for cavity nesting passerines (Great Tit *Parus major*, Pied Flycatcher *Ficedula hypoleuca*) and the Eurasian Pygmy Owl *Glaucidium passerinum*.

Suur-kirjurähni (*Dendrocopos major*) pesapaiga- ja pesapuuvalikust Saaremaal

Töö eesmärgiks oli selgitada, kas ja kuivõrd on suur-kirjurähn elupaiga suhtes valiv. Töös kasutati andmeid 21 pesa ja pesapuu kohta 17 suurkirjurähni pesitsusterritooriumilt Saaremaa lääneosas. Ilmnes, et pesametsana eelistas suur-kirjurähn leht- ja segametsi okasmetsade ees, keskmisest kõrgem oli haava, tamme ja saare osakaal, väiksem kase ja männi oma. Metsa liituvus varieerus väga suurtes piirides. Surnult seisvate puude tagavara metsas ei ole tõenäoliselt määrav tegur pesapaiga valikul, sest rohkem kui veerandis pesapaikades surnud puid ei olnud. Pesapuuna oli esindatud kuus puuliiki, kõige sagedamini

haab. Suurem osa pesi paiknes elavates puudes, surnult seisvate puude ja tüügaste osakaal oli 31%. Pesapuu keskmine diameeter oli 37 cm ja keskmine kõrgus 21 m. Pesaõõnsus asus keskmiselt 6,3 m kõrgusel, pesaava läbimõõt oli horisontaalsuunas keskmiselt 5,0 cm ja vertikaalsuunas 5,3 cm. Jämedamate pesapuude puhul rajavad rähnid pesaõõnsuse keskmiselt kõrgemale. Leidis kinnitust varasem teadmine, et suur-kirjurähn on igasugustes puistutes levinud, arvukas ja laia ökoloogilise amplituudiga liik ja seega pole ilmselt valiv pesapaiga metsa suhtes. Et pesapuu valikul ja pesa iseloomustavate oluliste parameetrite puhul on suur-kirjurähnil selged eelistused, leidis osaliselt kinnitust.

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