Factors Affecting the Occurrence of Middle Spotted Woodpeckers as Revealed by Forest Inventory Data

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Abstract

We examined the habitat selection of the Middle Spotted Woodpecker in the approximate home range scale, using a range of environmental predictors based on a forest inventory database. Our goal was to assess usefulness of the quantitative inventory data in modelling of species' distribution for conservation and management purposes. We used 128 woodpecker location points found in pre-breeding season and the same number of randomly selected absence points to describe habitat preferences. For each natural and random location we obtained several environmental characteristics, including forest type, stand age, share of individual tree species in the canopy layer and the complexity of stand structure. The redundancy analysis revealed significant differences between occupied and random locations, with just five variables explaining 89% of total variance in the dataset. The share of oak was the most important predictor of the presence of Middle Spotted Woodpeckers. Areas occupied by birds were characterized by the presence of mature, unevenly structured stands, with trees of different ages present in canopy layer. Moreover, riparian woodland and stands dominated by elms were also preferred. These results confirm the general pattern of habitat selection by Middle Spotted Woodpeckers. Our results provide the evidence that databases designed for the management of timber production can serve as a useful source of ecologically-oriented habitat characteristics for habitat modelling of specialized and demanding forest dwelling species.

Key words: habitat selection, forest management, riverine forests, Middle Spotted Woodpecker

Introduction

Determining structure and composition of an area that fulfils critical life history requirements for threatened species is an important step to develop conservation strategies (Pasinelli et al. 2001). In most studies on forest dwelling birds, such as woodpeckers Picidae, environmental variables used to explain their habitat selection include the diameter at breast height and condition of nesting trees as well as the density of trees potentially used for nesting and foraging (e.g. Pasinelli 2000, Kosiński and Winiecki 2004, Kosiński and Kempa 2007, Rehnus et al. 2011, but see Garmendia et al. 2006). Data are often collected in the field for the purpose of the particular study, making the process time-consuming. On the other hand, forest managers maintain their own inventory databases, which contain data almost ready to use, compatible with all commonly used GIS (Geographic Information Systems) environments. Moreover, communication between conservation biologists and forest managers would be alleviated if factors affecting persistence of species and crucial in the protection of birds were expressed in terms of forest inventory data.

The Middle Spotted Woodpecker *Dendrocopos medius* is a specialised, resident bird species of the Western Palearctic, inhabiting mature deciduous forests, in particular oak-dominated (Pasinelli 2003, Kosiński 2006). Habitat requirements of Middle Spotted Woodpeckers have been widely investigated. However, most of these studies refer to small spatial scales, i.e. nest-site selection (Kosiński and Winiecki 2004, Kosiński et al. 2006, Pasinelli 2007), trees used for foraging (Pasinelli and Hegelbach 1997, Robles et al. 2007), or general features affecting the occurrence of Middle Spotted Woodpecker (Delahaye et al. 2010). Several studies in larger, macrohabitat or landscape scales describe habitat use or population density in relation to, e.g., the type of forest, stand age, forest patch size, the density and diameter of potential nesting and foraging trees (Müller 1982, Kosiński and Winiecki 2005) as well as the management regime (Robles et al. 2007). Exceptionally, the variation in home range size has been analysed with regard to specific factors, such as the amount of oaks, snags and the canopy closure (Pasinelli 2000). According to the theoretical model by Pavlík (1994), the habitat selection of Middle Spotted Woodpecker might be influenced

by the density of canopies, the number of tree species in the canopy layer and stand vertical diversity. These results have been partially confirmed as potentially important for Middle Spotted Woodpeckers in landscape scale (Roberge et al. 2008) and microhabitat scale (Delahaye et al. 2010). However, to our knowledge no study has investigated the role of stand structure and composition, as described in the forest inventory, in the habitat selection with regard to the home range scale. Earlier studies of occurrence of Middle Spotted Woodpeckers based on forest inventory data tested the suitability of permanent forest inventory plots (0.05 ha in size) for modelling its distribution and to derive habitat threshold values (Müller et al. 2008).

One should expect that the Middle Spotted Woodpecker prefers more complex environment with multistorey profile of stands and high tree species diversity, supporting more diverse bird communities (Wiens 1989, Mikusiński et al. 2001). However, some studies show that Middle Spotted Woodpecker also inhabits homogenous, monocultural commercial oak stands (e.g. Müller 1982, Kosiński et al. 2006). Understanding various patterns of Middle Spotted Woodpecker's habitat selection is important due to the fact that the species is considered as one of the best indicators of forest bird diversity within its distribution range (Roberge and Angelstam 2006) and natural forest dynamics (Roberge et al. 2008).

Forest inventory database has proved to be useful in several studies dealing with the habitat selection of specialized species (i.e. Pakkala et al. 2002, Müller et al. 2008, Treinys et al. 2009, Treinys and Mozgeris 2010), and the evaluation of forest biological value (Kurlavicius et al. 2004). However, except for a few countries such studies are not very common across Europe due to the limited access to forest inventory data, which are often not publicly available. Some of these studies are based on data extrapolated from small sample plots (Müller et al. 2008, Delahaye et al. 2010) or use advanced indicators of habitat suitability (Pakkala et al. 2002).

In this study, we attempt to describe the habitat selection of the Middle Spotted Woodpecker on the home range scale in pre-breeding period, using a range of environmental predictors based on a forest inventory database. Specifically, we ask the following questions: 1) What are the habitat characteristics of nesting areas with regard to stand attributes?; 2) Do Middle Spotted Woodpeckers select habitats with certain physical atrributes related to the complexity of within-stand age and vertical structure?

We use the total area of forest fulfilling specific criteria, based on stand age and structure extracted directly from a forest inventory database as model predictors. Therefore we attempt to examine whether this format of environmental data can provide reliable results in predictive habitat modelling.

Materials and methods

Study area

The study area (7,370 ha) is located along the Warta River Valley in central Wielkopolska (western Poland, 52°05-52°11' N, 17°23-17°35' E), covering the western part of the „Middle Warta River Valley", designated as an Important Bird Area (PL076) and NATURA 2000 Special Protection Area (PLB 300002) (Wilk et al. 2010). Approximately 56% (4,136 ha) of the study area is covered by forests. The diversity of forest types, age, species composition and spatial structure results from the previous and current management impact. Deciduous stands make approximately 46% of all forests. Lower, temporarily flooded parts are dominated by hardwood alluvial *Quercus-Fraxinus-Ulmus* (*Fraxino-Ulmetum*) and ash-alder (*Fraxino-Alnetum*) woodland, changing into oak-hornbeam and *Quercus-Carpinus* (*Stellario-Carpinetum*) stands in the higher, drier parts. In total, wet and temporarily flooded stands make up about 23% of all forests within study area. Stands older than 120 years make about 10% of total forest cover (cf. the average for Poland, 2.5%; Anon. 2011), while stands between 81-120 years constitute further 25%. The oldest stands (over 170 years), rich in decaying snags, are protected inside the "Czeszewski Las" reserve (222.6 ha), as remnants of an ancient European floodplain forest (Kosiński and Winiecki 2004, Kosiński et al. 2006).

The occurrence of Middle Spotted Woodpeckers was recorded during 2010-2011. In 2010, inventories were conducted over the entire study area, in all types of mixed and deciduous forest stands, including also not obvious locations such as generally conifer-dominated stands with a substantial admixture of old deciduous trees. Since this inventory confirmed the preference of Middle Spotted Woodpeckers to deciduous stands older than 60 years old (Pasinelli 2003, Kosiński 2006), in 2011 only potential habitats were checked. In both years two censuses were carried out, with 1-2 additional visits to the most densely occupied area ("Czeszewski Las" reserve – Kosiński and Winiecki 2004, Kosiński et al. 2006) where a long-term monitoring scheme of Middle Spotted Woodpeckers based on at least three visits was established in 2000. The number of territories was estimated at 132 in 2010 and 128 in 2011. Since the species distribution was almost the same during both years, to avoid pseudoreplication (Hurlbert 1984), only data from 2011 was included in further analysis.

Woodpecker surveys were performed during the pre-breeding period, from the second half of March until the end of April (23 days, 147 hours in total in 2011). The survey was based on the well described and recommended audio stimulation (playback) method, as a way of overcoming difficulties in detection and mapping (Kosiński et al. 2004). To provoke responses of territorial birds, taped calls (rattle- and advertising-calls of males) were used. To reduce the probability of some individuals being attracted away from their territories through use of the playback technique, the minimum distance between points of stimulation was ca 150-200 m and maximum time of stimulation in one bout was 30–40 seconds followed by 1-2 minutes of listening. The second bout of playback was rarely performed. Territorial pairs or individuals were mapped. The woodpecker's position, behaviour, type of call and movements were recorded. Special attention was paid to register simultaneously active birds (Tomiałojć 1980). In this way the number of birds holding territory on study area could be assessed. It was assumed that a minimum of two registrations are required to accept a territory (Kosiński et al. 2004). Considering the experience from previous studies, we can assume that up to 80% of all territories can be found during one visit (Kosiński et al. 2004), and two visits allow an experienced observer to find almost 100% of territories (Z. Kosiński, unpubl. data). All surveys were performed in good weather conditions without rainfall and strong wind. All locations with any signs of woodpecker presence (observed individuals, spontaneous or stimulated vocal response) were GPS-marked and located on forest maps. The approximate centre of each territory was identified on the basis of all collected observations for each individual/breeding pair. Previous studies show that the distribution of Middle Spotted Woodpecker nest-sites corresponds with clusters delineated in pre-breeding season (Kosiński and Winiecki 2003, Kosiński et al. 2004, Kosiński and Ksit 2006).

In order to test habitat preferences, we created randomly 128 absence points, enforcing a minimum distance of 388 m between them, equal to the average distance of each territory location point (where woodpeckers were actually detected) to three nearest neighbours. For all natural and random locations we created buffers with 152 m radius, corresponding to the average required area of a breeding pair (7.2 ha) in early spring (Pasinelli et al. 2001). Within each buffer we calculated the share (%) of total forest area for every variable described below.

Environmental predictors

We used the forest inventory database maintained by State Forests National Forest Holding, to obtain habitat characteristics for locations occupied by the Middle Spotted Woodpecker. It consists of tabular data of various type combined with stand-level numeric maps, fully compatible with GIS environment. An individual stand is considered uniform, thus environmental characteristics of the stand are applied to its every fragment. In the field, stands might present some level of inner heterogeneity; therefore forest inventory data are an approximation. In our study the area of stands ranged between 0.01 and 23.55 ha (mean area: 2.84±0.07 ha). Stand characteristics used include: forest type, stand age (the age of dominant species), individual tree species in the canopy layer and their share in the total stand area. The database was updated in 2010, therefore environmental data can be mostly assumed as compatible with the bird data obtained in 2011.

We divided all stands into 4 age classes: AGE1 – 1-40 years (young and pole stands); AGE2 – 41-80 years (premature forests); AGE3 – 81-120 years (mature forests); AGE4 – over 120 years (cutting age and general old-growth). For each stand, we extracted the total number of tree species in the dominant+canopy layer and classified them into 3 categories: NSPE1 – 1-3 species; NSPE2 – 4-6 species; NSPE3 – more than 6 species. We also added 2 more criteria to describe the complexity of within-stand age and vertical structure: STR1 – uneven age structure: stands at least 80 years old with at least 30 years of difference in the age of trees in the canopy layer; STR2 – stands with very old veteran trees (at least 20 years over the cutting age for particular species). We adopted the last two criteria from the methodology of Biologically Important Forest Mapping Project (BIFM), aimed at identifying forests with well developed natural characteristics (Kurlavicius et al. 2004, Stachura-Skierczyńska et al. 2009).

We combined forest site categories from the inventory database into 4 main classes: coniferous (CON) - dry, fresh and wet coniferous stands (mainly pine monocultures); mixed coniferous (CONM) - fresh and wet conifer-dominated stands with the addition of deciduous species (mainly pine with oak and sometimes spruce); deciduous (DEC) - fresh deciduous and mixed stands (mainly oak-hornbeam forests); riparian (RIP) - wet forest (mainly ash-elm riparian forests). For each stand, we calculated proportional area covered by 10 most abundant tree species: PIN – Scots pine *Pinus sylvestris,* OAK – oak *Quercus* spp. (native species only), BIR – birch *Betula pendula*, HB – hornbeam *Carpinus betulus*, ASH – ash *Fraxinus excelsior*, ALD – black alder *Alnus glutinosa*, SPR – Norway spruce *Picea abies*, LIM – lime *Tilia* spp, ELM – elm *Ulnus* spp., MAP – maple *Acer pseudoplatanus*.

Data analysis

In order to identify differences between environmental characteristics of habitats of natural and random locations, we used a constrained ordination method (Lepš and Šmilauer 2003). The longest gradient in Detrended Canonical Correspondence Analysis (DCA) was estimated at 3.0, making it possible to use Redundancy Analysis, which is applicable for largest gradient values not exceeding 4.0 (Lepš and Šmilauer 2003). The overall significance of the multivariate analysis was tested with Monte Carlo permutation test (499 permutations). All analyses were performed in CANOCO 4.5. The importance of individual environmental predictors was tested using a forward selection approach, with automatic selection. Random and natural locations were also tested for differences in their environmental characteristics using a two-sample Mann-Whitney U test (99% confidence interval) in SPSS 18.0.

Results

Natural and random locations differed significantly in the majority of environmental predictors (Table 1). Territories inhabited by Middle Spotted Woodpeckers had significantly older stands (≥81-year-old – AGE3 and AGE4) and stands with a more complex structure (STR1, STR2) and more than six tree species (NSPE3), and a lower proportion of stands with 4–6 tree species (NSPE2). Coniferous stands (CON, CONM) were almost absent in the Middle Spotted Woodpecker territories but the share of riparian and other wet stands (RIP) were higher at occupied sites. Similarly, the share of tree species connected with fresh deciduous and mixed stands (DEC) as well as riparian and other wet stands (RIP) was higher in occupied than in randomly selected stands. Oaks (OAK) dominated in occupied sites and pines (PIN) prevailed in random locations.

Being aware of potential linkages existing between environmental variables, we checked the Spearman's rank correlation coefficients between pairs. The strongest (positive) correlations were found between structural variables (STR1, STR2) and age-related (AGE3, AGE4) meaning that older stands tend to have more complex structure; nevertheless the correlation coefficients did not exceed 0.516, indicating at least moderate correlation. Relationship between predictors was taken into account in the course of further analysis.

The Redundancy Analysis effectively distinguished between natural and random locations, with just five environmental variables explaining 89% of total variance in the dataset. In the final model OAK, PIN, ELM, STR1 and RIP were included as significant

	Predictor	Present		Absent		Z	*P* value
		Mean	SE	Mean	SE		
Age and structure	Uneven age structure	49.6	31.8	12.1	21.4	-9.251	**<0.001**
	Presence of veteran trees	44.6	34.8	13.2	23.4	-7.262	**<0.001**
	Age 1-40 years	9.5	14.0	23.0	26.3	-4.116	**<0.001**
	Age 41-80 years	18.7	24.1	36.6	31.2	-4.840	**<0.001**
	Age 81-120 years	24.3	28.5	16.6	24.2	-2.413	**0.016**
	Age > 120 years	33.4	33.6	2.1	8.7	-9.088	**<0.001**
Forest type	1-3 species in the canopy	14.3	22.9	13.8	21.2	-0.836	0.403
	4-6 species in the canopy	24.6	25.4	40.2	31.4	-3.886	**<0.001**
	> 7 species in the canopy	47.1	31.5	24.4	31.1	-5.839	**<0.001**
	Coniferous	0.0	0.0	1.3	8.2	-2.474	**0.013**
	Mixed coniferous	0.5	2.5	28.4	34.8	-8.577	**<0.001**
	Deciduous	39.4	42.5	43.9	40.1	-1.847	0.065
	Riparian	46.1	36.8	5.8	17.3	-9.301	**<0.001**
Share of tree species	Pine	10.6	14.7	53.6	31.7	-10.101	**<0.001**
	Oak	48.4	20.6	13.4	13.7	-11.606	**<0.001**
	Birch	3.8	6.9	7.5	8.3	-6.380	**<0.001**
	Hornbeam	13.7	16.7	3.7	7.7	-7.003	**<0.001**
	Ash	12.1	16.0	2.7	8.6	-8.433	**<0.001**
	Alder	4.6	10.7	4.4	9.1	-0.271	0.787
	Spruce	1.7	3.1	3.4	5.0	-3.796	**<0.001**
	Lime	6.3	9.5	1.7	4.3	-7.585	**<0.001**
	Elm	2.5	2.8	0.3	0.8	-8.245	**<0.001**
	Maple	0.4	1.4	1.0	2.6	-1.697	0.090

Table 1. Comparison of environmental predictors between territories (N=128) and random it would (N=128) locations of Middle Spotted Woodpecker (Mann-Whitney U, p<0.001). Significant values are marked in bold

variables (Monte Carlo permutation test, $p < 0.05$) (Table 2, Figure 1).

Table 2. Monte Carlo tests for the significance of environmental predictors in explaining variation among natural and random locations of Middle Spotted Woodpecker. Permutations were run using the automatic forward selection of individual variables (OAK – oak *Quercus* spp.; PIN – Scots pine *Pinus sylvestris*; ELM – elm *Ulnus* spp.; STR1 – stands at least 80 years old with at least 30 years of difference in the age of trees in the canopy layer; RIP – riparian forest)

Predictor	% variation	*F*	*p*
OAK	62.5	110.2	0.002
PIN	16.7	30.0	0.002
ELM	6.3	13.2	0.002
STR1	2.1	6.3	0.008
RIP	2.1	4.5	0.018

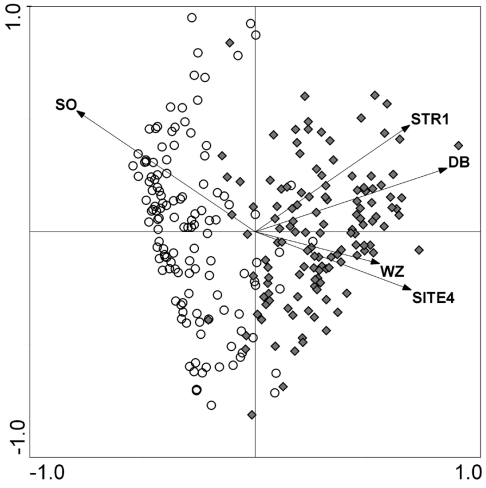

Figure 1. Scatter plot of occupied (diamonds) and random locations (circles) along gradients of environmental variables

Discussion and conclusions

Our results, based on forest inventory data, confirm the general patterns of habitat selection by Middle Spotted Woodpeckers (Pasinelli 2003): a preference for stands with a high share of oak, significantly different from pine-dominated forests common in the study area. However, to our knowledge, this study is the first one, which demonstrates an important role of mature unevenly structured stands, with trees of different ages present in the canopy layer on the home range scale. Moreover, our study indicates that riparian woodland, and stands dominated by elms were also selected.

The presence of oak was the most important factor determining the habitat selection. This result is in line with previous studies demonstrating that oak-dominated stands are crucial for the Middle Spotted Woodpecker all through the year on various spatial scales (Müller 1982, Pasinelli 2000, Kosiński and Winiecki 2005, Kosiński 2006, Müller et al. 2008, Delahaye et al. 2010). The availability of old oaks with fissured bark rich in arthropods creates an important foraging substrate for the Middle Spotted Woodpecker (Nicolai 1986, Török 1990, Pasinelli and Hegelbach 1997, Winter et al. 2005). Recent studies, involving radiotracking of twenty Middle Spotted Woodpeckers in the „Czeszewski Las" reserve, have revealed that during the nestling period adult birds most frequently use oaks for food collecting (66% of all observations; Leniowski 2012). During earlier studies we have found that old oaks are also preferred for hole excavation both in near-natural riverine forests and in managed stands (Kosiński and Winiecki 2004, Kosiński et al. 2006). The density of Middle Spotted Woodpeckers was positively correlated with the percentage of the oldest deciduous stands, mainly oak-dominated, also on the macrohabitat scale (Kosiński and Winiecki 2005).

The second most important predictor of the presence of the Middle Spotted Woodpecker was the share of elm, which is probably the consequence of the fact that ash-elm riparian stands with a substantial share of oak cover the oldest and the most natural part of the study area, making it particularly attractive for woodpeckers (Kosiński and Winiecki 2004, Kosiński et al. 2006). Moreover, the share of elm was significantly correlated with the presence of riparian stands (although the correlation was weak, $r < 0.30$); therefore its influence might be interpreted as a surrogate of the presence of floodplain forests. Floodplain oak-elm forests were also identified as the preferred habitat of the Middle Spotted Woodpecker in the Rhine Valley (Spitznagel 1990). However, this study was simply based on comparison between numbers of records of woodpeckers in different forest types vs. their total area (Spitznagel 1990).

The woodpecker's inhabitation preference for the mature unevenly structured stands with trees of different ages present in canopy layer corresponds to earlier findings that it prefers forests characterized by a higher tree species and vertical diversity of forest stand (Spitznagel 1990, Kosiński and Winiecki 2004, Delahaye et al. 2010). It should be noted that in our study the STR1 variable only included unevenly structured stands that were also at least 80 years old; thus our results complement those from previous studies where preferences towards mature forests (at least 80 years old) were recorded (Kosiński and Winiecki 2005). Unevenly structured stands with rough-barked tree species other than oaks present, e.g. ash, elm and al-

der, may offer additional feeding opportunities for Middle Spotted Woodpeckers (Pavlík 1994, Delahaye et al. 2010); however, other studies do not confirm this hypothesis (Pasinelli 2003). It is worth noting that food limitation seems to be one of the most important agents affecting breeding density of birds (Newton 1994). The presence of unevenly structured deciduous stands may increase winter survival rates of Middle Spotted Woodpeckers and stabilize their population size (Z. Kosiński unpubl. data). It is also noticeable that the woodpecker nesting sites often had a very rich tree species composition (NSPE3), although this variable did not appear in the reduced habitat model. Tree species diversity, along with the uneven vertical stand structure, often indicates high degree of forest naturalness (Bobiec 1998, Hanski 2005, Bartha et al. 2006, Clark and Covey 2012). It can be concluded that occurrence of Middle Spotted Woodpeckers might be related to some extent with the naturalness of forest, as was earlier reported by Roberge et al. (2008).

Considering the fact that Middle Spotted Woodpecker is usually described as a deciduous forest specialist, it is interesting to note that its territories did not differ from random sites by the share of fresh deciduous forest (DEC), while riparian and wet types (RIP), dominated by ash-elm communities but also with a high share of oak, were preferred as the primary nesting habitat. It should be noted, however, that the forest type, as described in forest inventory database, is not always in accordance with the actual species composition, since it mostly reflects soil conditions and primary vegetation type. For example, many sites primarily covered by deciduous oak-hornbeam communities (DEC), have been transformed into artificially planted pine stands due to improper management decisions made in the past. In our study area, approximately 440 stands (1,424 ha) described as deciduous or deciduous-mixed forest type, had pine as dominant tree species. Therefore, since woodpeckers definitely avoid forests with high share of pine, mainly due to the food scarcity (Lõhmus et al. 2010), such stands, described in the database as deciduous "by type" (DEC), but pine-dominated, also would not be preferred. Such misclassifications do not occur in case of riparian habitats due to their specific and unique water conditions. Therefore while using forestry database, one should refer to the actual species composition. It is worth noting that the percentage of coniferous stands was the single most important factor decreasing the crude density of the Middle Spotted Woodpecker in macrohabitat scale (Kosiński and Winiecki 2005).

To our knowledge, this study is the first one, which uses the data expressed as the total area of forest fulfilling specific criteria and extracted directly from a forest inventory database to study Middle Spotted Woodpecker's habitat selection. The inventory database had been designed primarily for commercial purposes; as such, it does not provide detailed information, such as the quantity and quality of decaying wood, which is essential for many studies concerning forest specialist species. However, it contains detailed information about age, stand structure and composition fully compatible with accurate digital maps. Moreover, some additional characteristics describing complexity of within-stand age and vertical structure can be simply obtained directly from basic data (Kurlavicius et al. 2004, Stachura-Skierczyńska et al. 2009). The characteristics of individual stand are an approximation, and stand might present some level of inner heterogeneity. This nonuniformity, however, can be accepted for the purpose of habitat modelling in spatial scales larger than microhabitat level. It should be stressed that State Forests National Forest Holding *established standard methods* for *sampling* forest stands. In consequence data obtained in different sites are fully comparable. Therefore, forest inventory database can still serve as a useful source of ecologically-oriented habitat characteristics for habitat modelling of specialized and more demanding forest dwelling species.

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ФАКТОРЫ, ВЛИЯЮЩИЕ НА ОБИТАНИЕ СРЕДНИХ ДЯТЛОВ, СОГЛАСНО ДАННЫМ О ЛЕСНЫХ РЕСУРСАХ

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Резюме

Предмет исследования - выбор гнездования средним пестрым дятлом на уровне ориентировочно определенного ареала вида. В исследовании был использован ряд экологических факторов, определенных на основании базы данных о лесных ресурсах. Цель исследования - оценка пригодности количественных данных об упомянутых факторах при моделировании обитания видов, проводимого с целью их охраны и контроля. Исследовано 128 пунктов, заселенных дятлами в период до высадки яиц и такое же количество случайно выбранных пунктов без птиц, с целью описания их предпочтений при гнездовании. Каждое природное и случайное место было описано с точки зрения характеристики среды, включая следующие элементы: тип леса, возраст древостоя, доля отдельных видов деревьев в древесном ярусе и сложность структуры древостоя. Анализ редудантности показал существенную разницу между заселенными и случайными местами при использовании всего пяти переменных, объясняющими 89% общей дисперсии в масссиве данных. Доля дуба явилась важнейшим прогнозным фактором присутствия среднего дятла. Территории, занимаемые птицами, характеризуются наличием зрелого древостоя с неравномерной структурой и деревьями различного возраста в древесном ярусе. Кроме того, предпочтение отдавалось также прибрежным лесам и древостою с доминированием вяза. Эти результаты подтверждают общий стереотип выбора места гнездования средними дятлами. Результаты проведенных исследований показывают, что базы данных, предназначенные для управления воспроизводством леса, могут служить полезным источником экологической характеристики обитания при создании мест для гнездования отдельных и редких видов лесных птиц.

Ключевые слова: выбор места гнездования, лесное хозяйство, токование, средний пёстрый дятел