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Accuracy and efficiency of different techniques for censusing territorial Middle Spotted Woodpeckers *Dendrocopos medius*

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Abstract. The aim of the study was to test whether the methods using the playback technique produce accurate data of population size when compared to the standard mapping and nest-searching methods. The three-visit method with audio-stimulation was found to produce data of the same accuracy (100%, n = 11 territories) as the standard mapping method, but the nest-searching method and single-visit with audio-stimulation yielded slightly lower estimates, 91% and 82% respectively, in comparison to the previously mentioned methods. However, the three-visit method with audio-stimulation was 2.2 times less time consuming than the five visits which used the standard mapping method (9h vs 20h). The three-visit method with audio stimulation could be appropriate for assessing distribution and abundance, and also for monitoring purposes.

Keywords: Middle Spotted Woodpecker, *Dendrocopos medius*, territory mapping method, playback technique, nest-searching, inter-methods differences

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INTRODUCTION

The estimation and long-term surveillance study of population size is an important aspect in the conservation of endangered species making it possible to identify population changes. The Middle Spotted Woodpecker shows evidence of a rapid decline and local extinction in many parts of Europe resulting from changes in forestry management, although, in the northern part of central Europe it is expanding and increasing in number (Mikusiński & Angelstam 1997, del Hoyo et al. 2002, Pasinelli 2003). As a habitat specialist the Middle Spotted Woodpecker might be useful as an indicator of the management of mature oak-dominated forest (Müller 1982, Günther 1992, Bühlmann & Pasinelli 1996, Pasinelli 2000). Moreover, it is considered to be a subset of "focal species", whose spatial, compositional, and functional requirements encompass those of all other species in the landscape (Lambeck 1997, Angelstam et al. 2004). Thus, in agreement with the World Conservation Union (IUCN) criteria for classifying threatened species, an important step in developing conservation strategies for this species and landscape biodiversity consists in identifying the distribution, size and population trends of populations (Gärdenfors 2001). However, the long-term monitoring programme of breeding birds such as the Common Breeding Bird Survey is inappropriate for surveillance study of the Middle Spotted Woodpecker because individuals are established in a few survey plots only (e.g. Chylarecki et al. 2001).

The playback technique has been recommended for Middle Spotted Woodpecker censuses as a way of overcoming difficulties in detection and mapping (Spitznagel 1993, Südbeck & Gall 1993, Pasinelli 2003, but see Müller 1982). This method makes it possible to assess the population size over large areas (e.g. Becker & Heyne 1994, Noah 2000, Randler 2000), and with high efficiency (Conrads & Conrads 1992, Günther 1992, Kosiński & Winiecki 2003). However, the method using

audio-stimulation has not yet been independently compared to the standard or combined version of the mapping method, which has supplied us with the most accurate data (Pinowski & Wiliamson 1974, Tomiałojć 1980, but see Nowakowski 1994). The high survival rates of woodpecker nests (e.g. Glue & Boswell 1994, Mazgajski 2002) and noisy begging-calls of the young should produce an estimation of the breeding population close to absolute. However, it has been found that the nest–searching method gives lower than expected results and is also rather time-consuming (Günther 1992, Kosiński & Winiecki 2003).

Therefore, the aim of this study was to test whether the methods using the playback technique produce accurate data of population size when compared to the standard mapping and nest-searching methods.

MATERIALS AND METHODS

The 78.2 ha study plot was located in the Smoszew Forest in the vicinity of Smoszew village (51°40'N, 17°30'E) near Krotoszyn, central Poland. About 64% (50.0 ha) of the study area consists of oak-dominated stands, mainly *Galio sylvatici-Carpinetum* and *Calamagrostio arundinaceae-Quercetum petraeae* association, older than 120 years (up to 159 years old), 10% (7.9 ha) between 81–120 years old, 5% (4.0 ha) between 41–80 years old and 7% (5.3 ha) between 0–40 years old; 11% (8.7 ha) is dominated by the Scots Pine *Pinus sylvestris* and 3.0% (2.3 ha) is covered by division lines and roads. Approximately 17% (13.46 ha) of the forest area has been protected within the "Dąbrowa Smoszew" reserve. The study plot was partly isolated from other mature oak-dominated stands, which could be inhabited by the Middle Spotted Woodpecker; only 20% of boundary length (0.7 km) adjoins similar stands. Moreover, 38% (1.4 km) of the boundary was surrounded by pine forest, 29% (1.1 km) by agricultural areas and 12% (0.5 km) by Beech *Fagus sylvatica* stands.

Three methods, which differed according to the number of visits and the use of playbacks, were adopted to assess the number of territories of the Middle Spotted Woodpecker: single-visit with audio-stimulation (29 March, R. Hybsz), three-visits with audio-stimulation (22 March, 3, 17 April, M. Kempa) and standard mapping method (25 March, 1, 11, 15, 24 April, Z. Kosiński) to control the efficiency of the two previously mentioned bird census techniques. All methods were based on the territory mapping technique, where all contacts with birds, either by sight or sound, are plotted on large-scale maps (Tomiałojć 1980, Bibby et al. 2000). In this way the number of birds holding territory on plot can be assessed. It is known that some territories could be occupied by unpaired or "floater" birds (Schmitz 1993, Pasinelli 2001, Robles & Olea 2003). Therefore, the nest–searching method was used to control the presence and location of breeding pairs (Bibby et al. 2000). All censuses were conducted in early spring, when aggressive interactions between individuals are most common (Pasinelli et al. 2001) and a high detectability of birds is found (Kosiński & Winiecki 2003). Each of the nine censuses was carried out on different days. The observations began in the morning at 7 a.m. and continued until midday. The surveys were conducted in good weather without rainfall or strong wind. All observers were familiar with the study area. Before the study period all the observers were furnished with detailed information about the field procedure. To increase the accuracy of all the methods, special attention was paid to register simultaneously active birds, in particular the advertising call of males (Tomiałojć 1980). Contrary to earlier suggestions that an advertising call is given by both males and females (Pasinelli 2003) we assumed, that the male gives the "kweek-call" only. No females were found to emit such vocal activity (pers. obs.). 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 (ca 150 m) and maximum time of stimulation (30–40 seconds in one bout) were defined. Because observers moved along approximately parallel lines (150–200 m), the same bird could have been recorded more than once. The woodpecker's movements were also recorded. It was assumed that a minimum of two registrations are required to accept a territory. To meet this requirement during the standard mapping method five valid visits were carried out (Pinowski & Williamson 1974, Bibby et al. 2000). In fact, most territories were delineated on the basis of three or more registrations (three territories on the basis of five registrations, six territories on the basis of four registrations and one territory on the basis of three registrations). Only one territory was delineated on the basis of two registrations. In the case of the single visit the number of territories was based on the distribution of records and on the register of simultaneously active birds. The delineated territories were checked between 20 April and 2 May, during the four days, to find excavated or occupied breeding holes. Territories where no nests

were found or nests were abandoned were revisited during the three days at the beginning of June (3, 5, 10 June) for the detection of calling nestlings.

To determine the effectiveness of different methods the chi-square test for homogeneity was used.

RESULTS

It was found that all the methods produced data of similar accuracy (Table 1, Fig. 1). There were no differences between the three-visit method with audio stimulation and the standard mapping method. The two other methods gave a slightly lower estimation. The single-visit with audio stimulation resulted in 82% accuracy while the accuracy of the nest–searching method was 91%. However, the differences between the number of territories and nests obtained by the different methods were not statistically significant ($\chi^2 = 0.27$, df = 3, p = 0.97). In spite of producing the same degree of accuracy, the three-visit method with audio stimulation was 2.2 less time-consuming than the standard mapping method. This method was also conducive to increasing the speed of performing the survey compared to the standard mapping method (Table 1). The nest-searching method was the most time consuming technique (Table 1). The average amount of time spent in finding the nest hole in the territory during the excavation period was 2 h 27′ (n = 10 holes; total time — 24 h and 30′). However, three of them were abandoned and one was lost as an effect of the competition for nest sites with the Great Spotted Woodpecker *Dendrocopos major*. The new ones were found based on nestling voices and the time needed for the location of each nest was 1 h 45′ (n = 4 holes; total time — 7 h). All of them were old holes. In spite of intensive searching (four hours) during the nestling period, in one territory the nest was not found. This territory was probably abandoned at the end of April. In total an average of 3 h and 33′ were needed to find the nesting hole in each territory.

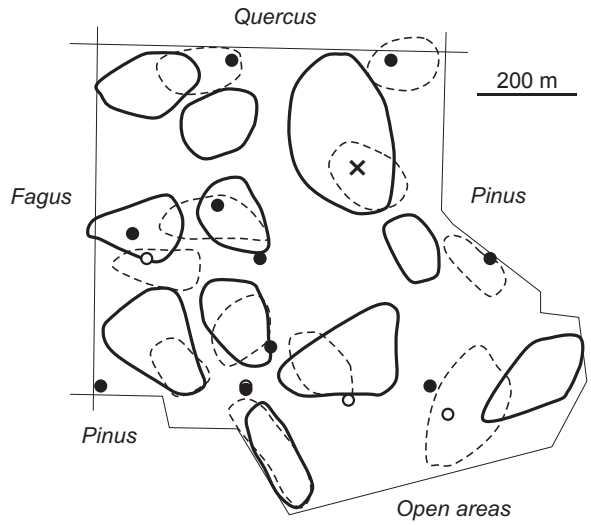

Fig. 1. Distribution of the territories obtained by the standard mapping method (continuous lines) and three-visit method with playbacks (dotted lines). Nest-sites (black dots) and abandoned holes (open dots) are shown. Territory which disappeared is marked as (x).

DISCUSSION

Previous studies have revealed that during one census with audio-stimulation up to 80%–90% of territories of the Middle Spotted Woodpecker could be found (Günther 1992, Kosiński & Winiecki 2003, but see Südbeck & Gall 1993 and literature cited there). However, these results were not obtained by using independent methods and were not performed by different observers (cf. Kosiński & Winiecki 2003). Nevertheless, the results of previous analyses agree well with our findings. The small discrepancy between the single-visit method and the other methods may be connected with a lower level of experience in the observer using this method as well as other factors e.g. determining birds activity. According to the low calling activity of adults in the pre-breeding season, Südbeck & Gall (1993) argued that at least five complete censuses should

Table 1. Expenditure of time and the abundance of the Middle Spotted Woodpecker according to different census methods. N — number of territories, * — number of nests, D — density (terr./10 ha).

Method	Total time (h)	Speed of the survey (ha/h)	N	D
Single-visit with audio-stimulation	5.0	15.6	9	1.2
Three-visits with audio-stimulation	9.0	8.7	11	1.4
Standard mapping	20.0	3.9	11	1.4
Nest-searching	35.5	2.2	10*	1.3

be performed during March and April to assess the number of territories precisely. However, our results suggest that three complete visits with audio-stimulation could produce an estimation of the breeding population close to absolute.

The distribution of territories (clusters) obtained by using the standard mapping method and that obtained using the three-visit method generally overlapped each other. Moreover, the distribution of nest-sites corresponds with the clusters delineated. A discrepancy between the distributions of territories obtained by using both methods could be a consequence of the amount of information and the interpretation of collected facts (e.g. Morozov 1994). It was stated that the playback technique might attract birds away from territory boundaries (Johnson et al. 1981). In this way the picture of territorial distribution obtained by the audio stimulation method should vary from the standard mapping method. Unexpectedly, in some cases the distribution of woodpecker territories based on the audio-stimulation method in relation to the nest-sites was closer than that obtained by the standard mapping method.

It was revealed that the nest-searching method being of low effectiveness, between 50 and 80%, does not allow the estimation of the abundance of the Middle Spotted Woodpecker over a large area (Kempa 2003, Kosiński & Winiecki 2003, Kempa & Kosiński, unpubl. data). Moreover, Günther (1992) summarized that during the long-term (6 years, 130 ha study plot) intensive studies up to 56% of nest holes and families were found in one breeding season (see also Pettersson 1985). The high effectiveness of the nest-searching in the Smoszew Forest is in opposition to the results of previous studies. It is likely that the high efficiency of searching for and locating holes has probably improved due to the increasing experience and knowledge of how and where to find them. Moreover, the search for nest holes was made in a smaller plot size in comparison to previous studies. Furthermore, earlier studies were carried out in spatially more complicated habitats, e.g. in riverine forests (Kosiński & Winiecki 2003) or oakslope forests (Günther 1992). On the other hand, the various effectiveness of the nest-searching method between different areas and breeding seasons could be affected by differences in breeding success (Pasinelli 2001). It is worth noting that the nest-searching method is not sufficiently adequate to estimate the distribution and abundance of territories as some territories could be occupied by unpaired or "floater" birds (Schmitz 1993, Pasinelli 2001, Robles & Olea 2003). However, it could be a good way of estimating the distribution and abundance of breeding pairs.

The speed of the survey, independent of the method used in the pre-breeding season, was clearly higher than recommended for a combined version of the mapping method (Tomiałojć 1980). However, it should be remembered that only one species (not the whole community) was censused. Moreover, it was found that a lower speed of survey also has some disadvantages connected with the liklihood of the movement of individuals and multiple registrations of the same birds, especially of those species with large home ranges (Tomiałojć 1980). In our studies, we decided to separate one territory into two artificial "paper territories". It should be emphasized that the most intensively used part of the home range ("core area") by males, in the pre-breeding season covered approximately 7 ha (Pasinelli et al. 2001) and is approximately twice as large as that of the Great Spotted Woodpecker (Bachmann & Pasinelli 2002) and larger than in the majority of small passerines.

Generally, our results confirm earlier assumptions and indicate that methods using the playback technique, especially the three-visit method, give satisfactory results and are time and cost saving. In consequence, it can be appropriate for assessing the distribution and number of populations, e.g. in landscape scale, as well as for monitoring purposes. However, further studies could be advantageous in assessing the temporal (between seasons) and spatial (between habitats or geographical) variation of the accuracy of the three-visit method with audio-stimulation.

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STRESZCZENIE

[Dokładność i wydajność różnych metod służących do oceny liczebności dzięcioła średniego]

Metoda stymulacji głosowej jest zalecana do oceny liczebności dzięcioła średniego. Do chwili obecnej nie dokonano jednak porównania jej efektywności w stosunku do standardowej lub kombinowanej wersji metody kartograficznej, które uważane są za najbardziej dokładne. Celem badań było stwierdzenie czy metody oceny liczebności dzięcioła średniego wykorzystujące stymulację głosową pozwalają na dokładne określenie wielkości populacji. Dokonano porównania wyników uzyskanych czterema metodami: metodą pojedynczej kontroli ze stymulacją głosową, metodą trzech kontroli ze stymulacją głosową, standardową metodą kartograficzną opartą na pięciu liczeniach oraz metodą polegającą na wyszukiwaniu zajętych dziupli. Badania prowadzono na powierzchni 78.2 ha w okolicach miejscowości Smoszew koło Krotoszyna, w

południowej Wielkopolsce. Powierzchnię badawczą porastał w przeważającej części stary las liściasty z dominacją dębu. Wszystkie liczenia wykonano w okresie przedlęgowym (22 marca–24 kwietnia), charakteryzującym się największą aktywnością głosową gatunku związaną z łączeniem się w pary oraz ustalaniem i obroną terytoriów. Gniazda wyszukiwano na przełomie kwietnia i maja oraz maja i czerwca. W celu uzyskania niezależnych ocen liczebności każda z metod, za wyjątkiem metody wyszukiwania gniazd, stosowana była przez innego obserwatora.

Stwierdzono, że metoda trzech kontroli ze stymulacją głosową oraz standardowa metoda kartograficzna charakteryzowały się najwyższą i taką samą wykrywalnością — w obu przypadkach odnotowano jedenaście terytoriów (Tab. 1, Fig. 1). Metoda wyszukiwania gniazd oraz metoda pojedynczej kontroli ze stymulacją głosową były mniej dokładne i pozwoliły wykryć odpowiednio: 91% (n = 10) i 82% (n = 9) terytoriów. Metoda trzech kontroli była ponad dwukrotnie (2.2) mniej czasochłonna w porównaniu ze standardową metodą kartograficzną. Najbardziej czasochłonna była metoda wyszukiwania gniazd, która wymagała średnio 3h i 33'/dziuplę (Tab. 1). Terytoria wykreślone w oparciu o dane uzyskane standardową metodą kartograficzną oraz metodą trzech kontroli w znacznym stopniu nakładały się na siebie (Fig. 1).

Uzyskane wyniki wskazują, że metoda trzech kontroli ze stymulacją głosową pozwala na uzyskanie dokładnych danych dotyczących liczebności i rozmieszczenia terytoriów dzięcioła średniego, oszczędza czas i zmniejsza koszty związane z prowadzeniem badań. W konsekwencji może być użytecznym narzędziem służącym do oceny liczebności i rozmieszczenia populacji, na przykład na powierzchniach krajobrazowych oraz w badaniach monitoringowych.

T. Cofta