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Woodpeckers abundance in the Białowieża Forest – a comparison between deciduous, strictly protected and managed stands

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Abstract: In 2007–2009 we counted all woodpeckers along seven transects (4.6–8.0 km long) in deciduous stands of the Białowieża Forest, NE Poland. Three transects ran along stands of the strictly protected part of the Białowieża National Park (BNP) and four in managed stands of the forest. The total number of recorded woodpeckers per 1 km of transect (hereafter treated as an index of abundance) was on average 9.0 (SE=0.4) in BNP and 5.4 (SE=0.4) in managed stands. The most common species was Great Spotted Woodpecker *Dendrocopos major*, while the least numerous were Wryneck *Jynx torquilla*, Grey-headed Woodpecker *Picus canus* in all transects, and Three-toed Woodpecker *Picoides tridactylus* in managed stands. In comparison with 1999–2001, indices of abundance of all woodpeckers increased in 2007–2009 by 1.4/km in BNP and by 0.8/km in managed stands due to increasing index of *D. major*. We found that woodpeckers' situation in managed stands is getting worse compared to BNP. This study confirms the importance of ecological reference of the Białowieża National Park, especially for White-backed Woodpecker *D. leucotos* and Three-toed Woodpecker.

Występowanie dzięciołów w liściastych drzewostanach Puszczy Białowieskiej – porównanie drzewostanów ściśle chronionych i użytkowanych. Abstrakt: W latach 2007–2009 wykonano liczenia wszystkich gatunków dzięciołów wzdłuż transektów (4,6–8 km długości) przebiegających przez lasy liściaste Puszczy Białowieskiej. Trzy transekty wyznaczono w Białowieskim Parku Narodowym, a cztery w zagospodarowanej części Puszczy Białowieskiej. Indeksy liczebności dzięciołów były najwyższe na transektach znajdujących się w parku narodowym (średnio 9,0) a najniższe w lasach gospodarczych (średnio 5,4). Najczęściej spotykanym gatunkiem był dzięcioł duży *Dendrocopos major*, zaś najrzadziej krętogłów *Jynx torquilla* i dzięcioł zielonosiwy *Picus canus* (na wszystkich transektach) oraz dzięcioł trójpalczasty *Picoides tridactylus* w drzewostanach zagospodarowanych. Średnie indeksy liczebności wszystkich dzięciołów łącznie w parku narodowym były prawie dwukrotnie wyższe niż w zagospodarowanej części Puszczy. W porównaniu do lat 1999–2001 zagęszczenie wszystkich gatunków dzięciołów wzrosło średnio o 1,4/km w parku narodowym i o 0,8/km na transektach w lasach zagospodarowanych. Aktualnie prowadzona gospodarka leśna w Puszczy Białowieskiej może osłabić znaczenie obszaru Puszczy Białowieskiej dla utrzymania różnorodności biologicznej w skali regionalnej. Prowadzi ona też do przekształcania drzewostanów ważnych dla najbardziej zagrożonych gatunków dzięciołów – dzięcioła białogrzbietego *D. leucotos* i trójpalczastego.

Woodpeckers are used as indicator species for assessing conservation value at the stand scale. Such specialized species as e.g. the Middle Spotted Woodpecker *Dendrocopos medius*, White-backed Woodpecker *D. leucotos* and Lesser Spotted Woodpecker *D. minor* are considered as one of the best indicators for deciduous stands (Roberge & Angelstam 2006, Roberge et al. 2008a). Suitability of the woodpecker group for assessing avian diversity at the landscape scale is also confirmed (Mikusiński et al. 2001). Woodpeckers are relatively easy to detect, their populations can be reliably monitored, and their foraging and nesting activities can positively influence the abundance and richness of other forest birds (Drever et al. 2008). In some natural areas, woodpeckers can also improve local economy attracting many foreign birdwatchers (Walankiewicz 2009). Woodpeckers are important keystone species as they excavate cavities in trees for nesting which are then used by a variety of other forest species.

The Białowieża Forest is an ancient woodland straddling the border between Byelorussia and Poland. It is the last large remain of the primeval lowland forest, once spread across Europe. It is characterized by a high degree of naturalness and all but one European woodpecker species breed there (Wesołowski et al. 2003). However, the whole Białowieża Forest is not well protected yet, as intensive management lasting for more than hundred of years prevails over most of its area. This leads to differences in habitat characteristics in protected *vs*. managed stands and coupled differences in densities of species sensitive to management (e.g. Wesołowski 1995, Bobiec 2002, Walankiewicz et al. 2002). For many years, including recent times, Polish State Forestry claims that the Białowieża Forest is the best protected forest of Europe (Kwiatkowski 2011). They also claim, that all ongoing activity in managed stands of the the Białowieża Forest leads into restoration of its primeval status. However, numerous studies did not confirm this; in contrary, have proven that the situation is getting worse, in respect to the naturalness of tree stands and status of endangered species (Wesołowski 1995, Bobiec 2002, Walankiewicz et al. 2002, Wesołowski 2005, Czeszczewik & Walankiewicz 2006). Significant differences in woodpecker community and their relation to dead wood resources between primeval deciduous stands of BNP and managed stands of the Białowieża Forest were found in a study conducted in 1999–2001 (Walankiewicz et al. 2002). Since then, new protection areas were established in the managed part of the forest – they partly covered stands with transects which we were studied. However, in almost all nature reserves including new ones, forest management was still applied until 2008: the dead wood was removed, including all infested spruces, small clear-cuts were planted with oak and pine and fenced.

The aim of this study was to investigate whether and how protection – as declared by state forestry (Kwiatkowski 2011), affects woodpecker community in managed stands. As a reference, we used data collected in years 1999–2001 on the same transects and using the same method (Walankiewicz et al. 2002). In 2003, a new nature reserve was established in managed stands of the Białowieża Forest and now substancial fragments of all transects includes protected area. We expect that after a few years of protection both woodpecker habitat and abundance will improve. We also expected higher diversity and occupancy of woodpeckers in stands previously managed, and now protected since 2003. In contrast, we did not expect any significant changes within unmanaged and strictly protected deciduous primeval stands of the Białowieża National Park (hereafter BNP).

Study area

The study was conducted in the Białowieża Forest (52°29'–52°57'N, 23°31'–24°21'E), NE Poland. Its central part (47.47 km^2) represents well preserved nearly natural forest, protected by law since 1921 as the Białowieża National Park, enlarged to 105.2 km^2 in 1996. The total

area of the BNP consists only ca 16% of the Polish part of Białowieża Forest. The oldest part of BNP was never logged or planted and tree stands have a primeval origin. Forest is multispecies, multilayer and unevenaged, with high amount of dead wood. The most common type of the forest is the lime-hornbeam-oak *Tilio-Carpinetum* stand dominated by hornbeam *Carpinus betulus*, lime *Tilia cordata*, oak *Quercus robur*, Norway spruce *Picea abies*, maple *Acer platanoides* and other species. River valleys and depressions are covered with ash-alder stands (with ash *Fraxinus excelsior*, alder *Alnus glutinosa* and spruce). Coniferous spruce-pine forests (with spruce and Scots pine *Pinus sylvestris* and some admixture of broadleaved trees) grow on sandy soils (Faliński 1986).

The rest of the Białowieża Forest (ca 84% of the Polish part) is administrated by the Polish State Forestry, and regular management (logging, plant *etc*.) is conducted there. About one-fifth of this area (*c*. 120 km^2) is protected as nature reserves, although these reserves were also a source of timber for a long time. In particular, infested or freshly killed spruces were removed, but also big dead oaks and other dead trees were regarded as potential source of pests. In many places in deciduous stands, fences were set and oaks were planted in rows. In general nature reserves are also managed but less intensively than typical managed forest. The tree stands in managed part of the Białowieża Forest are of various ages; however on average they are younger and dead wood is much less abundant there compared to the BNP stands (e.g. Bobiec 2002, Walankiewicz et al. 2002, Czeszczewik & Walankiewicz 2006, Czeszczewik 2009).

We conducted surveys along seven transects in deciduous stands (all locations and names – see Walankiewicz et al. 2002). Three of them were located in the Białowieża National Park: BMM (5.7 km long), BBB (5.5 km) and BPM (4.6 km). Four transects were located in managed part of the Białowieża Forest, where management (selective cutting, clear cuts and fenced plantations) was conducted: ZOB (8 km), ZPH (7 km), ZBU (6.1 km), and ZKR (4.9 km). All transects were fixed along the forest roads, mainly in lime-hornbeam-oak stands. Only short fragments went through swampy ash-alder forest. In 2003, a new nature reserve "Lasy Naturalne Puszczy Białowieskiej" was established in the Białowieża Forest and deployed in 19 fragments of this forest track. During the study 54% of transects ZOB and ZKR, 44% ZBU, and 23% of ZPH went along borders of this reserve or through reserve area. After reserve establishment, logging became less intensive but most of infested spruces were still removed until March 2008. Due to intervention by one of the Polish non-governmental organisation since that time only dead trees which are close to roads and tourist paths are cut down and left on the forest floor. In summary, forestry practices had strong impact on structure of these tree stands (in particular, the amount of dead wood) within this reserve almost till the end of study period.

Methods

The data were collected in 2007–2009 (31 March – 25 May). Three counts on each transect were conducted using "bike transect method" (Walankiewicz et al. 2002). Surveys were conducted early morning between 04:50–07:50 by observers experienced in distinguishing of woodpecker drumming and calls. During bicycle riding performed slowly (ca 5.5 km/h) along the transect, all heard and seen woodpeckers were recorded. Mornings with calm weather without precipitation or wind were chosen to conduct surveys. Assuming detectability to be fairly stable, this method allows to compare relative numbers of woodpeckers (indices of abundance) recorded in different stands within the same year and between years. In each season, and for each woodpecker species, a survey with the highest number of records was chosen from one of three counts and was subsequently used in anal-

ysis. The index of abundance was expressed as the number of woodpeckers recorded per 1 km of the transect. Results are presented as means and one standard error (±SE). Results were considered significant at $P < 0.05$ level. Because data were not distributed normally, Kruskal-Wallis test was used for comparisons between transects or study years, Mann-Whitney test for comparisons between median indices between BNP and managed stands. Spearman rank correlation was used for comparison indices of the Great Spotted Woodpecker and other woodpeckers. All calculations were performed using Statistica 9.0.

Results

Eight species of woodpeckers *Picidae* were recorded in total. All species were observed in both transects running through the Białowieża National Park and through the managed stands (Table 1). In the national park, 7–8 woodpecker species were recorded in each transect, while in managed stands the number of species ranged between 5 and 8. The high-

Table 1. Indices of woodpeckers abundance on transects in 2007–2009. DA – *Dendrocopos major*, DE – *D. medius*, DI – *D. minor*, DL – *D. leucotos*, DM – *Dryocopus martius*, PT – *Picoides tridactylus*, PU – *Picus canus*, J – *Jynx torquilla*

Tabela 1. *Indeksy liczebności poszczególnych gatunków dzięciołów na transektach w latach 2007–2009. (1) – transekt, (2) – długość transektu, (3) – rok, (4) – wskaźnik liczebności, (5) – zagregowany indeks liczebności dzięciołów (wszystkie gatunki). DA* – Dendrocopos major*, DE* – D. medius*, DI* – D. minor*, DL* – D. leucotos*, DM* – Dryocopus martius*, PT* – Picoides tridactylus*, PU* – Picus canus*, J* – Jynx torquilla

Transect (1)	Length (km) (2)	Year (3)	Index of abundance (individuals/km) (4)								
			DA	DE	DI	DL	DM	PT	PU	J	Total (5)
BMM	5.7	2007	6.1	0.7	0	1.1	0.7	1.2	0	0	9.8
		2008	7.2	0.7	0.2	0.7	0	0.5	0.2	0	9.5
		2009	5.8	0.7	0.2	0.5	0.5	0.4	0	0	8.1
BBB	5.5	2007	7.1	1.5	0.5	0.7	0	0.5	0	0	10.4
		2008	4.5	0.7	0.4	0.4	0.4	0.2	0	0.4	6.9
		2009	8.2	1.5	0	0.5	0.5	0.5	0	0	11.3
BPM	4.6	2007	6.5	1.1	0.7	0.9	0.9	0.7	0.2	0.2	11.1
		2008	4.8	0.2	0.7	0.9	0.7	0.4	0	0	7.6
		2009	4.1	0.7	0	0.9	0.2	0,2	0	0	6.1
ZOB	8	2007	5.1	0.6	0.5	0.1	0.1	0.5	0	0	7.0
		2008	3.4	0.4	0.4	0.3	0.3	0.4	0.3	0	5.3
		2009	5.5	0.6	0.5	0.1	0.4	0.1	0	0	7.3
ZPH	7	2007	4.1	0	0	0.4	0.1	0	0	0.1	4.9
		2008	3.1	0.3	0	0.3	0.1	0.1	0	0	4.0
		2009	4.6	0.6	0	0.4	0.3	0	0	0	5.9
ZBU	6.1	2007	4.9	0.2	0.3	0.3	0.3	0	0.2	0	6.2
		2008	2.6	0.3	0.3	0.3	0	0	0	0	3.6
		2009	3.1	0.3	0	0.8	0.2	0.2	0.2	0.2	4.9
ZKR	4.9	2007	4.5	0.6	0.6	0.4	0.4	0	0	0	6.5
		2008	3.3	0.4	0	0.2	0.2	0	0	0	4.1
		2009	4.3	0.6	0	0.4	0.4	0	0	0	5.7

est number of species was observed in BPM transect in the national park and ZBU, while the lowest in ZKR transect (in managed stands). BPM and ZKR were the shortest transects (4.6 and 4.9 km, respectively).

Transects located in the national park produced highest abundance indices in all years; the only exception was in 2009, when the index on transect ZOB in managed stands was higher than on transect BPM (Table 1). Differences of indices in transects between three years of study were not significant (Kruskal-Wallis test: $H_{3,7}=2.87$, $P>0.05$). Medians of abundance indices between transects were different significantly (Kruskal-Wallis test: $H_{7,3}=13.86$, $P<0.05$, Fig. 1). Medians of abundance indices in the national park were higher than in managed stands however differences were not significant (Mann-Whitney test: $Z=1.94$, $P>0.05$).

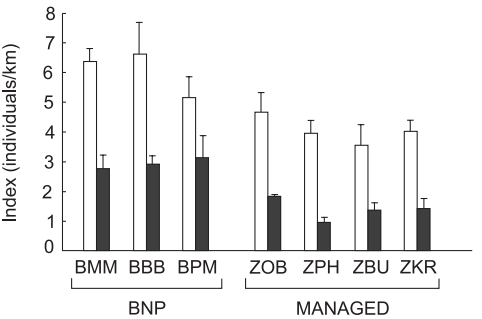

Fig. 1. Average values of indices of the Great Spotted Woodpecker *Dendrocopos major* (white bars), and other woodpeckers abundance (black bars), on transects in 2007–2009. Bars – averages, whiskers – standard errors

Rys. 1. *Średnie wartości wskaźników liczebności dzięcioła dużego (białe słupki) i innych dzięciołów (ciemne słupki) na transektach w latach 2007–2009. Dzięcioł duży – białe słupki, pozostałe gatunki – czarne słupki. Słupki – średnie, wąsy – błędy standardowe*

The Great Spotted Woodpecker *Dendrocopos major* outnumbered other woodpecker species. The abundance index of *D. major* was positively correlated with the total number of other species ($r_s=0.86$, $P<0.05$, $N=7$). Averaged indices of abundance calculated for all other species excluding *D. major* were similar in all study years (Kruskal-Wallis test: $H_{3,7}=1.09$, $P>0.05$), but they were on average twice as high in the national park as in man-

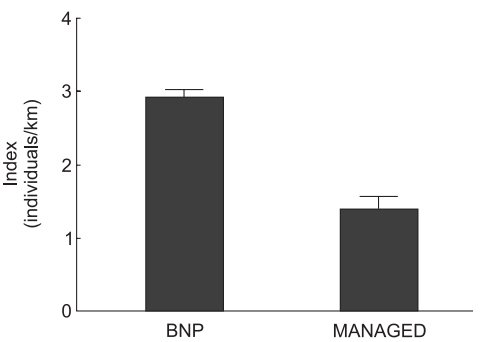

Fig. 2. Average values of indices of woodpeckers abundance excluding Great Spotted Woodpecker *Dendrocopos major* in the Białowieża National Park (BNP) and managed stands of Białowieża Forest (MANAGED) in 2007–2009; bars – averages, whiskers – standard errors

Rys. 2. *Średnie wartości wskaźników liczebności dzięciołów oprócz dzięcioła dużego w Białowieskim Parku Narodowym (BNP) oraz w lasach zagospodarowanych Puszczy Białowieskiej (MANAGED) w latach 2007–2009; słupki – średnie, wąsy – błędy standardowe*

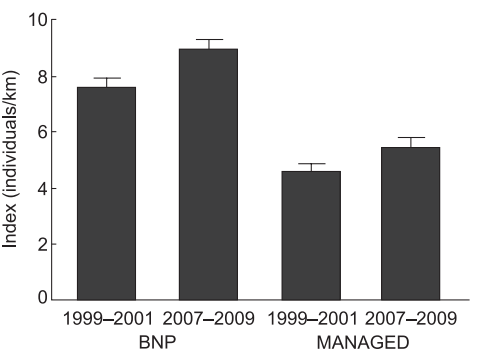

Fig. 3. Average values of indices of woodpecker abundance in 1999–2001 and 2007–2009 in the Białowieża National Park (BNP) and managed stands of Białowieża Forest (MANAGED); bars – averages, whiskers – standard errors. Data from 1999–2001 after Walankiewicz et al. (2002)

Rys. 3. *Średnie wartości wskaźników liczebności dzięciołów w latach 1999–2001 i 2007–2009 w Białowieskim Parku Narodowym (BNP) oraz w lasach zagospodarowanych Puszczy Białowieskiej (MANAGED); słupki – średnie, wąsy – błędy standardowe. Dane z lat 1999–2001 za Walankiewicz et al. (2002)*

aged stands (2.9 ±0.1, and 1.4 ±0.2, respectively; Fig. 2), but these differences were not significant (Mann-Whitney test: $Z=1.94$, $P>0.05$). The index of abundance of three species associated predominantly with dead wood – the White-backed Woodpecker, Three-toed Woodpecker and Black Woodpecker – were on average almost 2.5 times higher in transects in the national park than in managed stands: 1.7 ±0.2 and 0.7 ±0.0, respectively but this difference was not statistically significant (Mann-Whitney test: $Z=1.94$, $P>0.05$).

In 2007–2009, averaged index of abundance (all woodpecker species) was slightly higher compared to 1999–2001 (Walankiewicz et al. 2002), but differences were not significant (in BNP: $Z=–1.75$, $P>0.05$, in managed stands: $Z=–1.30$, $P>0.05$; Fig. 3).

Discussion

In many parts of the world's forests, intensive management has resulted in habitat loss for many forest species. Among them, woodpeckers have been affected negatively due to their special requirements for resources that are scarce in managed forests (Roberge et al. 2008a, 2008b). We expected that after a few years of protection, the habitat suitability for woodpeckers in previously managed stands will be improved and, as a result, the abundance of woodpecker species should be higher. However that was not the case. In newly established nature reserve, all dead trees including infested spruces were still removed until the beginning of 2008, which is possibly responsible for the lack of increase of woodpeckers' abundance – an effect we expected to found. It's however possible, that the period of protection was too short to result in higher density of woodpeckers (apart from removal of dead wood, which reduces food availability thus and negatively affects woodpeckers' habitat (Angelstam et al. 2002).

A fairly similar situation was reported eight years earlier along the same transects, when a positive correlation between snag density and woodpecker abundance was found. In this study, we found that the density of dead standing trees was fivefold higher in the Białowieża National Park than in managed stands (Walankiewicz et al. 2002). Angelstam et al. (2002) found, that the amount of dead wood and large deciduous trees was closely correlated with the presence of the specialized woodpeckers. It seems that situation in the managed stands of the Białowieża Forest is worsening gradually since both nature reserves and managed stands are still transformed into man-made stands with fenced monoculture plantations, which are present even in the oldest nature reserve of the Białowieża Forest i.e. the Władysław Szafer reserve (unpubl. data).

Only two species, Great Spotted and Middle Spotted Woodpeckers increased in number in comparison to earlier study (Walankiewicz et al. 2002), while the White-backed, Black and Grey-headed Woodpeckers have declined in both BNP and managed stands. The numbers of Great Spotted and Middle Spotted Woodpeckers strongly fluctuate mainly due to winter conditions (e.g. Wesołowski & Tomiałojć 1997). However, the last species is also sensitive on forest management and requires older continuous stands (e.g. Kosiński 2006, Pasinelli 2007, Roberge et al. 2008a). Decreasing abundance of the White-backed Woodpecker was noticed earlier in managed stands of the Białowieża Forest (Czeszczewik & Walankiewicz 2006). Moreover, the Three-toed Woodpecker number increased only in the national park and it most likely is a result of bark beetle outbreak during study years. This outbreak occurred in the same time in managed stands as well, but foresters immediately removed almost all of infested spruce trunks from managed stands (own observations). It seems that food availability of this endangered woodpecker decreased in managed deciduous stands as a result of massive removal of spruces. It is worth to stress that although Three-toed Woodpecker is well known as

species associated with spruce stands in BNP, it breeds also in all deciduous stands with small admixture of old spruces (Wesołowski et al. 2005).

Summing up, managed deciduous stands of the Białowieża Forest are still populated by quite rich woodpecker group compared to other European lowland forests (Mikusiński et al. 2001, Roberge et al. 2008a). Their situation compared to BNP is not improving since in newly established nature reserve all dead trees including infested spruces were still removed till the beginning of 2008. Such type of forest management definitely impoverished woodpeckers' habitat.

This study confirms the importance of the whole Białowieża Forest (the Białowieża National Park in particular) as a reference for studies conducted in other forests of Europe. It is worth to stress that the current type of forest management in the Białowieża Forest would undermine the importance of this area for the maintenance of forest biodiversity (Angelstam et al. 2002), and will transform stands important for two endangered woodpecker species i.e. White-backed Woodpecker and Three-toed Woodpecker into simplified stands in even age (Wesołowski 2005).

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References

Angelstam P., Breuss M., Mikusiński G., Stenström M., Stighäll K., Thorell D. 2002. Avian landscape ecology: pure and applied issues in the large-scale ecology of birds. Proc. of the eleventh annual IALE (UK) conference, Univ. of East Anglia, UK, 10–13 September 2002. Pp. 25–38.

Bobiec A. 2002. Living stands and dead wood in the Białowieża forest: suggestions for restoration management. Forest Ecol. Manag. 165: 125–140.

Czeszczewik D. 2009. Marginal differences between random plots and plots used by foraging White-backed Woodpeckers demonstrates supreme primeval quality of the Białowieża National Park, Poland. Ornis Fenn. 86: 30–37.

Czeszczewik D., Walankiewicz W. 2006. Logging and distribution of the White-backed Woodpecker *Dendrocopos leucotos* in the Białowieża Forest. Ann. Zool. Fenn. 43: 221–227.

Drever M.C., Aitken K.E.H., Norris A.R., Martin K. 2008. Woodpeckers as reliable indicators of bird richness, forest health and harvest. Biol. Conserv. 141: 624–634.

Faliński J.B. 1986. Vegetation dynamics in temperate zone lowland primeval forests: Ecological studies in Białowieża Forest. Dr W. Junk. Publ. Dordrecht, pp. 1–537.

Kosiński Z. 2006. Factors affecting the occurrence of middle spotted and great spotted woodpeckers in deciduous forests – a case study from Poland. Ann. Zool. Fenn. 43: 198-210.

Kwiatkowski M. 2011. Puszcza Białowieska: Reaktywacja. Centrum Informacyjne Lasów Państwowych, Warszawa.

Mikusiński G., Gromadzki M., Chylarecki P. 2001. Woodpeckers as indicators of forest bird diversity. Conserv. Biol. 15: 208–217.

Pasinelli G. 2007. Nest site selection in middle and great spotted woodpeckers *Dendrocopos medius* and *D. major*: implications for forest management and conservation. Biodivers. Conserv. 16: 1283–1298.

Roberge J.-M., Angelstam P. 2006. Indicator species among resident forest birds – A cross-regional evaluation in northern Europe. Biol. Conserv. 130: 134–147.

Roberge J.-M., Angelstam P., Villard M.-A. 2008a. Specialised woodpeckers and naturalness in hemiboreal forests – Deriving quantitative targets for conservation planning. Biol. Conserv. 141: 997–1012.

Roberge J.-M., Mikusiński G., Svensson S. 2008b. The white-backed woodpecker: umbrella species for forest conservation planning? Biodivers. Conserv. 17: 2479–2494.

Walankiewicz W. 2009. Birds. In: Białowieża National Park. Know it, Understand it, Protect it. In: Okołów C., Karaś M., Bołbot A. (eds). Białowieski Park Narodowy, Białowieża, pp. 143–154.

Walankiewicz W., Czeszczewik D., Mitrus C., Bida E. 2002. Znaczenie martwych drzew w lasach liściastych dla zespołu dzięciołów w Puszczy Białowieskiej. Not. Orn. 43: 61–71.
Wesołowski T. 1995. Value of Białowieża Forest for the conservation of White-backed Woodpecker (*Dendrocopos leucotos*) in Poland. Biol. Conserv. 71: 69–75.
Wesołowski T. 2005. Virtual conservation: How the European Union is turning a blind eye to its vanishing primeval forests. Conserv. Biol. 19: 1349–1358.
Wesołowski T., Czeszczewik D., Mitrus C., Rowiński P. 2003. Ptaki Białowieskiego Parku Narodowego. Not. Orn. 44: 1–31.
Wesołowski T., Czeszczewik D., Rowiński P. 2005. Effects of forest management on Three-toed Woodpecker *Picoides tridactylus* distribution in the Białowieża Forest (NE Poland): conservation implications. Acta Ornithol. 40: 53–60.
Wesołowski T., Tomiałojć L. 1997. Breeding bird dynamics in a primaeval temperate forest: Long-term trends in Białowieża National Park (Poland). Ecography 20: 432–453.

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