Ornis Fennica 74: 161–166. 1997

Winter foraging of the Black Woodpecker *Dryocopus martius* in managed forest in south-central Sweden

Grzegorz Mikusiński

Mikusiński, G., Grimsö Wildlife Research Station, Department of Conservation Biology, Swedish University of Agricultural Sciences, S-730 91 Riddarhyttan, Sweden. E-mail: grzegorz.mikusinski@nvb.slu.se

Received 2 September 1997, accepted 9 October 1997

The results of the study on winter foraging of radio-tagged Black Woodpeckers *Dryocopus martius* (n = 6) in south-central Sweden (59°40´N, 15°25´E) are presented. The foraging places (n = 112) of tracked individuals were described and fresh droppings collected from these places (n = 83) were analysed. Among different types of dead wood, cut stumps created by forestry were found to be the most important foraging substrate and constituted from 64 to 78% of all strata used by particular individuals. Woodpeckers used stumps proportionally to their availability, however selection for stumps of larger diameter was observed. Carpenter ants *Camponotus herculeanus* were the most important food items found in all droppings. I discuss the shift in the foraging habits of the Black Woodpecker which enabled the species to successfully spread into heavily managed forest plantations.

1. Introduction

Almost all European woodpecker species are specialists in their foraging habits and require several habitat qualities which are abundant only in primeval forests (Cramp 1985, Wesołowski & Tomiałojć 1986, Angelstam & Mikusiński 1994). Due to anthropogenic impact on their habitats, most woodpeckers have experienced marked population declines in different parts of the continent (Glutz & Bauer 1980, Cramp 1985, Koskimies 1993, Tucker & Heath 1994), and in particular where the impact has been large (Mikusiński & Angelstam 1997, 1998). Among the obligate insectivores, the Black Woodpecker *Dryocopus martius* is the only woodpecker which has expanded its range and increased its abundance in several countries in central and western Europe, recolonizing areas from where it had disappeared earlier due to deforestation (Cuisin 1985, Mikusiński 1995). This expansion has been related to increasing availability of coniferous stands as a result of reforestation processes which have restored the forest cover in these countries (Mikusiński 1995).

Opposite to trends observed in central and western parts of the continent, in the northern part of the species' range in Europe (e.g. in Finland, Russia and possibly in northern Sweden) population declines have been reported (Dementiev et al. 1951, Järvinen et al. 1977, Ahlén & Tjernberg 1992). In general, these declines have been interpreted as results of intensive forestry, and the removal of natural habitat qualities, which have caused differences in food and nesting sites availability in managed vs. primeval boreal forests. In particular, the scarcity of vertical foraging substrates in managed forest possibly affects the abil-

ity of the Black Woodpecker to survive winter conditions in the northern part of its geographical range (Mikusiński 1995, Saari & Mikusiński 1996).

The Black Woodpecker forages mostly on ants, Formicidae, and a variety of insects living in dead wood (Cramp 1985). With its large size (body mass 200–350g) and massive beak it is able to utilize food resources in woody substrates not readily available for other woodpeckers. Hence, the Black Woodpecker is able to extract carpenter ants *Camponotus herculeanus* from colonies in living trees, snags or logs, as well as to search for beetles or their larvae under the thick bark (Glutz & Bauer 1980, Cramp 1985).

It has been suggested that the Black Woodpecker has problems to satisfy its daily energy requirements during cold and snowy winters (Nilsson et al. 1992, Mikusiński 1995). Accordingly, Nilsson et al. (1992) demonstrated that the mean winter temperature influenced positively the abundance of Black Woodpecker in the subsequent breeding season in Sweden, and Saari and Mikusiński (1996) showed that the snow cover was negatively related to local Finnish population levels. At the individual level, Rolstad et al. (1998) reported the effect of snow depth on habitat selection of the Black Woodpecker. Also in the Grey-headed Woodpecker *Picus canus*, a species with similar foraging ecology, habitat selection and foraging behavior are influenced by winter severity (Rolstad & Rolstad 1995).

In this paper, I describe the results of telemetric studies on winter foraging of the Black Woodpecker in managed forest in south-central Sweden. Particular emphasis is put on the use of food resources available in managed forests. The study aims at a better understanding of large-scale population changes recently observed in Europe by studying the species at the level of individuals.

2. Study area

The study was carried out in winter 1991/92 in the Grimsö Wildlife Research Area (59°40´N, 15°25´E) located at the southern edge of the boreal zone in Sweden (Sjörs 1965). The area is dominated by managed coniferous forest, mainly Scots pine *Pinus sylvestris* and Norway spruce *Picea abies*, which cover over 70%. Deciduous stands comprise only a small proportion of the forests. The forest is characterized by a young age; less than 1% of the stands is older that 60 years (Swenson & Angelstam 1993). Bogs and fens cover 18% of the area, while the rest is covered mostly by lakes and farmland. A more detailed description of the study area is provided by Angelstam et al. (1982).

3. Material and methods

A total number of 7 birds were captured and equipped with radio-transmitters (weight – 7g) produced by Televilt International, Lindesberg, Sweden. Birds were captured at their roost holes using a hoop net on a long pole. The transmitters were attached to two central rectrices so that it could be moulted. The expected transmitter's life-was 2 months, but in one case the transmitter obviously stopped sending signals very shortly after attachment to the bird. The tracking effort was distributed evenly among birds, and covered an area of about 200 km^2. After general positioning of a bird by triangulation (Kenward 1987), the individual was carefully approached by the observer attempting to hear feeding activities. When the obvious sounds of foraging were recorded, the observer usually waited in the vicinity of the foraging individual during the following ten minutes. After this time, the bird was approached further in order to locate the foraging site. If the foraging site was found, a detailed description was made. The following categories of foraging substrates were distinguished: soil, ant-hill, living tree, snag (height > 1 m), log, and stump (height < 1 m). The place was also searched for the presence of fresh droppings, which, if present, were collected for further analysis. The analysis of droppings was performed by a trained entomologist and aimed at identifying and counting the prey items. First, each dropping was crumbled, and then examined in small portions under a stereomicroscope (magnification 25–80×). Individual ants were tallied by the number of heads of each species found in droppings from a particular foraging sites. A detailed description of the data for each tracked woodpecker individual is presented in Table 1.

I also estimated the amount of different types of dead wood available within the home-ranges

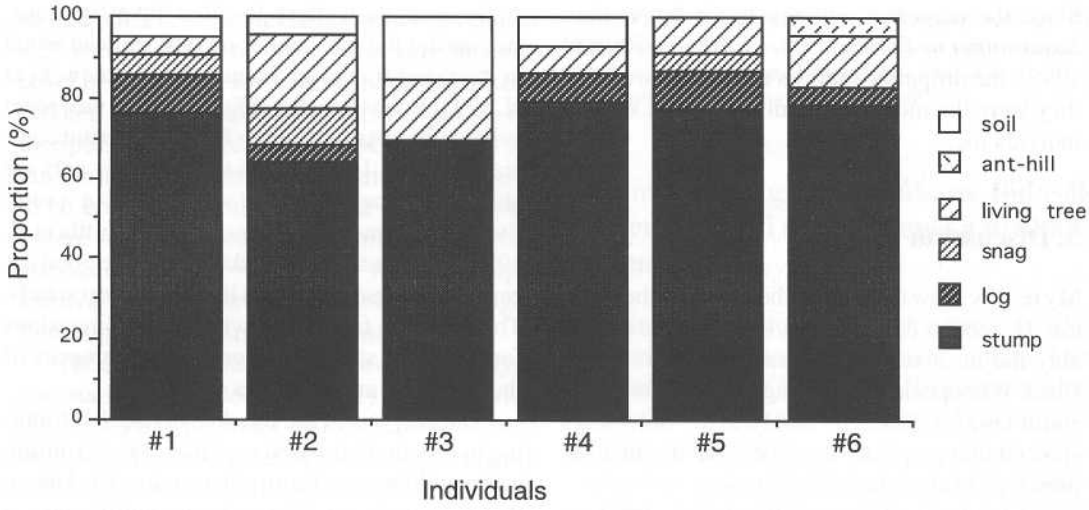

Fig. 1. The proportions of different foraging substrates used by six radio-tracked Black Woodpeckers at the Grimsö Wildlife Research Area from December 1991 to February 1992.

of two birds (#4 and #5). The estimation of home-ranges was made using the minimum convex polygon method (White & Garrott 1990), and was based on 34 and 50 radio-locations, respectively. Dead wood was censused along 4-m-wide transect distributed at 200 m intervals in a north–south direction. In total, the inventory covered about 2% of the home-range of each individual. All kinds of dead wood with a diameter larger than 5 cm were counted, measured, and classified as stumps, logs or snags.

4. Results

The foraging strata used by all six individuals were dominated by stumps (Fig. 1). The frequency of the use of stumps in relation to other feeding substrates used by woodpeckers did not differ between individuals ($\chi^2 = 2.05$, df = 5, $p > 0.05$). The use of stumps vs. other foraging substrates by birds #4 and #5 was not significantly different from the relative abundance of stumps and other substrates in their home-ranges according to the census of dead wood (#4: $\chi^2 = 0.04$, df = 1, $p > 0.05$; #5 $\chi^2 = 0.85$, df = 1, $p > 0.05$). In the home-ranges of birds #4 and #5, stumps made up respectively 80.6% and 73.7% of dead wood items present on transects. However, both individuals were selecting stumps of larger size that those available in their home-ranges (Table 2).

Four different types of prey were identified (Table 3). In all cases the carpenter ants *C. herculeanus* dominated other types of prey in frequency.

Table 1. Description of data collected on winter foraging of the Black Woodpecker at the Grimsö Wildlife Research Area.

Individual	Sex	Foraging sites described (N)	Droppings collected (N)	Study period
#1	Male	21	14	06 Dec. 91–28 Jan. 92
#2	Female	22	11	04 Dec. 91–25 Jan. 92
#3	Female	13	12	13 Dec. 91–24 Jan. 92
#4	Male	14	10	05 Dec. 91–21 Jan. 92
#5	Male	19	14	05 Dec. 91–06 Feb. 92
#6	Male	23	22	20 Dec. 91–06 Feb. 92
Totals		112	83	04 Dec. 91–06 Feb. 92

Since the carpenter ants are much larger than *Lasius niger* or *Formica* spp. (Rolstad & Rolstad 1995), the dropping analysis clearly showed that they were the most important food of all studied individuals.

5. Discussion

My results show that during the period of the study (i.e. December to February), stumps were invariably the most important foraging substrates for Black Woodpeckers in managed boreal forests in south-central Sweden. Analysis of droppings showed that carpenter ants were the dominating prey type of the Black Woodpecker.

The foraging habits of Black Woodpeckers described in this study confirms the species may coexist with intensive forestry in terms of available food resources. A similar pattern of winter foraging of the Black Woodpecker has been reported by Rolstad et al. (1998) from a managed forest located about 200 km west of the Grimsö Wildlife Research Area. According to the results of my own inventory of dead wood within the study area, as well as to other investigations, stumps are the most common type of dead wood in managed forests in Scandinavia (Majewski et al. 1995, Rolstad et al. 1998). Stumps in turn seem to be an important substrate for carpenter ant colonies (Sanders 1970). Since the carpenter ants are able to recolonize young forest stands in a relatively short time after clear-cutting (Punttila et al. 1991), the Black Woodpecker may have good access to food resources even in young forest stands. The selection for stumps with larger dimensions found in this study matches with preferences of the carpenter ants (Sanders 1970).

The analysis of the Black Woodpecker foraging in this study is based on data collected during a very mild winter. From other studies it is known that the species is able to locate and forage on stumps covered by up to 70 cm of snow (Pynnönen 1943, Glutz von Blotzheim & Bauer 1980, Cramp 1985, Rolstad et al. 1998). The maximum observed snow cover in my study period was 8 cm, and most of the days were snow-free or almost snow-free. Under these circumstances, Black Woodpeckers certainly did not have any problem in localizing stumps. Rolstad et al. (1998) found

Table 2. Dimensions of stumps used by birds #4 and #5 and available in their home-ranges (two-tailed Mann-Whitney test).

Individual	Used		Available		z	p
	Mean (cm)	n	Mean (cm)	n		
#4						
Diameter	35.5	10	19.9	911	−3.97	0.0001
Height	36.4	11	23.9	911	−3.50	0.0005
#5						
Diameter	39.6	17	18.5	1191	−5.85	0.0001
Height	42.8	16	23.7	1191	−5.19	0.0001

Table 3. The result of analyses of droppings collected from Black Woodpecker foraging sites. Numbers indicate the total number of prey items found in droppings from particular birds, while figures in parentheses show the frequency of occurrence of given prey type.

Individual	*Camponotus herculeanus*	*Lasius niger*	*Formica* spp.	Elateridae (Coleoptera)
#1	578 (100%)	160 (14%)	–	1 (7%)
#2	445 (100%)	646 (18%)	–	1 (9%)
#3	447 (100%)	–	–	–
#4	591 (100%)	–	–	–
#5	717 (100%)	–	–	–
#6	939 (100%)	–	105 (9%)	2 (9%)

no difference in substrate use between winters with < 30 and 30–70 cm of snow. However, the snow cover in northern Fennoscandia may often exceed 200 cm, certainly making stumps inaccessible for the species. Here, the presence of vertical foraging substrates (i.e. snags and infected trees) seems to be crucial for winter survival of the species. Future studies should link the foraging behavior and diet of the Black Woodpecker with snow depth and availability of foraging substrates in managed forests of the northern boreal zone.

The casual compatibility of the dead wood type (cut stumps) provided by forestry and the foraging demands of the Black Woodpeckers observed in this study at the level of individuals, helps to understand the successful spread of the species in managed forests of central and western Europe. Apparently, the species was able to shift its critical winter foraging resource from snags, containing beetle larvae and being common in natural forest, to stumps inhabited by carpenter ants, available in high quantities in managed forest (Majewski et al. 1995, Rolstad et al. 1998). Studies on the Black Woodpecker diet performed in the cold season in more natural forests in eastern Europe (Pynnönen 1943, Pospelov 1956, Papadopol & Mandru 1977), indeed indicate higher proportion of beetle larvae, than studies from more altered forests in western Europe (Cuisin 1975, 1977, Pechacek & Kristin 1993, this study).

New trends in forestry practices, especially cutting with retention of deciduous and dead trees, as well as the creation of artificial snags, which have been implemented in Sweden the last few years, will gradually change the proportional availability of different types of dead wood in managed forest (Angelstam & Pettersson 1997). These new vertical structures will certainly affect the use of foraging substrates by the Black Woodpecker, and may be of particular importance in the northern managed forest. At the same time, these elements will eventually provide nesting sites and foraging substrate for other resident boreal species, which unlike the Black Woodpecker are far less fortunate in heavily managed forests.

Acknowledgments. I thank Piotr Cempulik for his participation in the field work and Roland Dobosz for analysing the droppings. I am also grateful to Per Angelstam, Lennart Hansson, Przemysław Majewski, and Raimo Virkkala for comments on the manuscript. Kristoffer Jasinski checked the language. The study was financed by the Swedish Environmental Protection Agency and the private foundations "Stiftelsen Oscar och Lili Lamms Minne" and "Olle och Signhild Engkvists stiftelser".

Sammanfattning: **Spillkråkans födosök under vintern i mellansvenska brukade skogar**

Resultaten från studien av sex sändarförsedda spillkråkors *D. martius* vintertida födosök i ett mellansvenskt (59°40´N, 15°25´E) skogslandskap presenteras. Födosökplatserna (n = 112) för positionsbestämda individer beskrevs och och färska spillningar (n = 83) därifrån samlades in och analyserades. Bland olika typer av död ved, var stubbar efter huggna träd det viktigaste substratet för födosök och utgjorde 64–78% av de strukturer som användes av respektive spillkråkorna. Stubbarna användes i proportion med tillgången, men en preferens för stors stubbar observerades. Hästmyra *C. herculeanus* var det viktigaste födoslaget och noterades i alla spillningar. Jag diskuterar förändringen i spillkråkans födosökvanor vilken möjliggör en framgångsrik spridning även i intensivt brukade skogsområden.

References

Ahlén, I. & Tjernberg, M. (eds.) 1992: Artfakta. Sveriges hotade och sällsynta ryggradsdjur 1992. — Databanken för hotade arter, Uppsala, Sweden.

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

Angelstam, P. & Pettersson, B. 1997: Principles of present Swedish forest biodiversity management. — Ecological Bulletins 46: 191–203.

Angelstam, P., Lindström, E. & Widén, P. 1982: Cyclic shifting of predation and other relationships in a south taiga small game community. — Trans. Intern. Congr. Game Biol. 14: 53–60.

Cramp, S. 1985: The birds of the Western Palearctic. Volume IV: Terns to Woodpeckers. — Oxford University Press, Oxford.

Cuisin, M. 1975: Observations sur le Pic noir (Dryocopus martius. L.) dans le departement de l'Aube. — L'Oiseau 45: 197–206.

Cuisin, M. 1977: Le Pic noir (Dryocopus martius. L.) en foret. Bilan des observations sur son regime alimentaire et nouvelles donnees sur con activite de charpentier.

— L'Oiseau 47: 159–165.

Cuisin, M. 1985: Range expansion of black woodpecker Dryocopus martius in Western Europe. — British Birds 78(4): 184–187.

Dementiev, G. P., Gladkov, N. A., Ptushenko, E. S., Spangenberg, E. P. & Sudilovskaya, A. M. 1951: Birds of Soviet Union. Vol. 1. — Sovetskaya Nauka, Moskva.

Glutz von Blotzheim, U. N. & Bauer, K. M. 1980: Handbuch der Vögel Mitteleuropas. Band 9. Columbiformes – Piciformes. — Akademische Verlagsgesellschaft, Wiesbaden.

Järvinen, O., Kuusela, K. & Väisänen, R. A. 1977: Effects of modern forestry on the number of breeding birds in Finland 1945–1975. — Silva Fennica 11: 284–294. (In Finnish with English summary.)

Kenward, R. 1987: Wildlife radio tagging. — Academic Press, London.

Koskimies, P. 1993: Population sizes and recent trends of breeding birds in the Nordic countries. — National Board of Waters and the Environment, Report 144.

Majewski, P., Angelstam, P., Andrén, H., Rosenberg, P., Swenson, J., Hermansson, J-O & Nilsson, S. G. 1995: Research in eastern Europe to solve nature conservation problems in the Nordic countries. — In: Angelstam, P., Mikusiński, G. & Travina, S. (eds.), Swedish University of Agricultural Sciences, Department of Wildlife Ecology, Report 28, p. 46. (In English and Russian.)

Mikusiński, G. 1995: Population trends in Black Woodpecker in relation to changes in cover and characteristics of European forests. — Ecography 18: 363–369.

Mikusiński, G. & Angelstam, P. 1997: European woodpeckers and anthropogenic habitat change. — Vogelwelt 118: 1–7. (In press.)

Mikusiński, G. & Angelstam, P. 1998: Economic geography, forest distribution and woodpecker diversity in central Europe. — Conservation Biology 12. (In press.)

Nilsson, S. G., Olsson, O., Svensson, S. & Wiktander, U. 1992: Populations trends and fluctuations in Swedish woodpeckers. — Ornis Svecica 2: 13–21.

Papadopol, A. & Mandru, C. 1977: Contributions à la connaissance de l'espéce Dryocopus martius (L.), (Aves, Picidae), en Roumanie. — Trav. Mus. Hist. Nat. 18: 309–326.

Pechacek, P. & Kristin, A. 1993: Diet of woodpeckers in Berchtesgaden National Park. — Vogelwelt 114: 165–177.

Pospelov, S. M. (Поспелов, С. М.) 1956: [Economical importance of woodpeckers in Leningrad county.] — Zool. Zhurnal 35: 600–605. (In Russian).

Punttila, P., Haila, Y., Pajunen, T. & Tukia, H. 1991: Colonisation of clearcut forests by ants in the southern Finnish taiga: a quantitative survey. — Oikos 61: 250–262.

Pynnönen, A. 1943: Beiträge zur Kenntnis der Biologie Finnischer Spechte II. Die Nahrung. — Ann. Zool. Soc. Zool.–Bot. Fenn. Vanamo 9: 1–59.

Rolstad, J., Majewski, P. & Rolstad, E. 1998: Black woodpecker use of habitats and feeding substrates in a managed Scandinavian forest. — J. Wildl. Manage. 62. (In press.)

Rolstad, J. & Rolstad, E. 1995: Seasonal patterns in home range and habitat use of the Grey-headed Woodpecker Picus canus as influenced by the availability of food. — Ornis Fennica 72: 1–13.

Saari, L. & Mikusiński, G. 1996: Population fluctuations of the resident woodpecker species on the island of Aasla, SW Finland. — Ornis Fennica 73: 168–178.

Sanders, C. J. 1970: The distribution of carpenter ant colonies in the spruce-fir forests of northwestern Ontario. — Ecology 51: 865–873.

Sjörs, H. 1965: Forest regions. — Acta Phytogeogr. Suecica 50: 48–63.

Swenson, J. E. & Angelstam, P. 1993: Habitat separation by sympatric forest grouse in Fennoscandia in relation to boreal forest succession. — Can. J. Zool. 71: 1303–1310.

Tucker, G. M. & Heath, M. F. 1994: Birds in Europe: Their Conservation Status. — Cambridge, U.K.: BirdLife International (BirdLife Conservation Series no. 3).

Wesołowski, T. & Tomiałojć, L. 1986: The breeding ecology of woodpeckers in a temperate primaeval forest – preliminary data. — Acta Ornithologica 22: 1–21.

White, G. C. & Garrot, R. A. 1990: Analysis of wildlife radio-tracking data. — Academic Press, San Diego.