Ann. Zool. Fennici 43: 131–136 ISSN 0003-455X
Helsinki 28 April 2006

A comparison of the age-class structure of black-backed woodpeckers found in recently burned and unburned boreal coniferous forests in eastern Canada

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Received 7 Oct. 2005, revised version received 17 Feb. 2006, accepted 4 Feb. 2006

Huot, M. & Ibarzabal, J. 2006: A comparison of the age-class structure of black-backed woodpeckers found in recently burned and unburned boreal coniferous forests in eastern Canada. — *Ann. Zool. Fennici* 43: 131–136.

Black-backed woodpeckers (*Picoides arcticus*) may depend on recently burned forest patches to maintain viable population levels. We wanted to determine how these habitats are colonized by this species and by which age classes. Data collected at the Observatoire d'oiseaux de Tadoussac (situated on the north shore of the St. Lawrence River (Québec, Canada)) suggest that an important movement of juveniles occurs during the autumn. It was therefore hypothesized that in the year following fire, burned forest sites would be colonized by a higher percentage of juvenile birds than intact mature stands. In accordance to this hypothesis, there was a difference in woodpecker age structure between the two habitat types ($\chi^2 = 9.43$, df = 2, $P = 0.0088$, $n = 186$). However, differences are mainly explained by the higher number of third calendar year birds at burned forest sites, suggesting that a part of the colonization occurs in the same year as the fire by second year birds, rather than by juveniles during the autumn.

Introduction

Census studies have demonstrated that black-backed woodpecker densities are usually much greater in recently burned coniferous forest than in unburned forest (Hutto 1995, Murphy & Lehnhausen 1998, Hoyt & Hannon 2002). Those habitats could be referred to as optimal and sub-optimal respectively. These elevated densities in burned areas are usually of limited duration (a few years) and are linked to outbreaks of wood-boring insects (Murphy & Lehnhausen 1998, Hoyt & Hannon 2002). This implies that the recurrent occurrence of fire (a natural process in the boreal forest zone) may be a critical element in the maintenance of populations of this species, and that unburned forest might represent a sink habitat (Hutto 1995).

Although the black-backed woodpecker is considered a resident of the boreal forest, it is known to make irregular southward irruptions from its normal northern distribution range. Small groups of individuals have been recorded south to the north-eastern and even mid-eastern United States (Van Tyne 1926, West & Speirs 1959, Dixon & Saab 2000). Between 1950 and 1982, larger invasions lasting several years were recorded in the Maritime Provinces of Canada

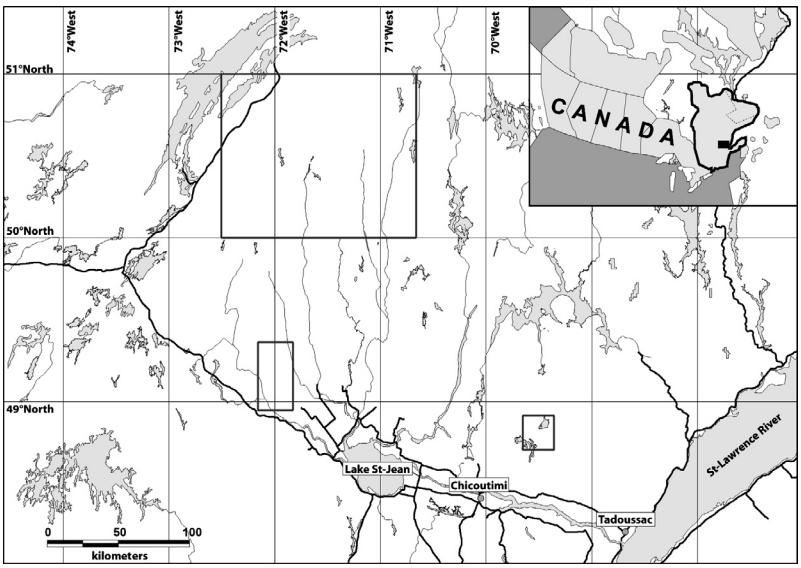

Fig. 1. Location of the study area in northern Québec (Canada).

and in some states of the north-eastern United States (Yunick 1985). Some of these early movements (1950s) were linked to successful breeding following an abundance of wood boring insect larvae after the occurrence of large fires in Ontario (Axtell 1957). By contrast, later irruptions are thought to have been caused by low prey availability or possible overpopulation following such population explosions (Short 1982). Apart from these anecdotal reports, very little information is available on the movement patterns that are characteristic of this species and how individuals compete for space in recently burned and unburned forest.

Field data collected in five consecutive years (2000–2005) by the Observatoire d'oiseaux de Tadoussac, Tadoussac, Québec, Canada (Fig. 1) on black-backed woodpeckers migrating southwest along the north shore of the St. Lawrence River, show that 95% of the individuals ringed (n = 343) in the autumn (mid-September to mid-November) are juveniles (hatching year (Observatoire d'oiseaux de Tadoussac, unpubl. data)). This indicates an important dispersal of juveniles of this species during the autumn. It is known for many bird species that yearlings have a general tendency to relocate themselves to unoccupied territories, the distance travelled often depending on the occupancy of suitable territories encountered, habitat suitability and their support capacity (Van Balen 1980). Based on the above information, it seems likely that as it is mostly yearlings that disperse during the autumn, that it should be this age class that colonizes recently burned forest areas during the autumn of the year in which the fire occurred.

Villard and Schieck (1997) showed that black-backed woodpeckers can nest in burned stands during the same year in which the fire occurred. However, the authors did not note the age of the individuals observed during the nesting attempts. If these are 'floaters' (young of the preceding year) that find a nesting territory in a newly burned forest, the colonization could take place much sooner than during the autumn dispersal of juveniles. Few studies are currently available regarding territorial fidelity in the black-backed woodpecker, but a few recaptures of banded individuals suggest that site fidelity is high (Dixon & Saab 2000). This is supported by the fact that other species of the genus *Picoides* also show high site fidelity (e.g., *P. dorsalis* (American woodpecker); L. Imbeau, pers. comm. and *P. tridactylus* (European three-toed woodpecker) P. Pechacek, pers. comm.). Therefore, adult birds should dominate the age class structure of unburned forest sites.

In this study, we characterize black-backed woodpecker colonisation of burned forest in the boreal zone of Québec (Canada) one year after fire. We hypothesize that second year birds (age based on calendar year (Pyle 1997)) will be

overrepresented in the age structure of recently burned zones in comparison with the age structure found in unburned forest sites. Moreover, if 'floaters' occupied the burned areas during the first summer season after fire, there should be an overrepresentation of three-year-old woodpeckers in these sites as compared with that in unburned forest sites.

Materials and methods

Study areas

Both types of habitat (recently burned and unburned mature forest) were mainly composed of mature stands of black spruce (*Picea mariana*) and jack pine (*Pinus banksiana*) interspersed with small stands of balsam fir (*Abies balsamea*) and scattered white birch (*Betula papyrifera*). The sampling took place from 10 May–27 June 2003, 27 April–8 July 2004, and 15 May–10 July 2005.

Since the black-backed woodpecker is known to colonize recently burned coniferous forest sites fairly rapidly after the occurrence of fire (Villard & Schieck 1997, Murphy & Lehnhausen 1998), it was important to select sites that burned during the previous summer season in order to have an accurate idea of the age classes colonizing burned sites. Site selection was done on the basis of fire occurrence in mature conifer forest during the 2002 and 2003 spring and summer periods. These years were relatively unproductive in terms of total accessible burned forest areas in northern Québec. Two burned forested areas were chosen: the first, a 2002 burn, near the Tournemine logging Camp (Chantiers-Chibougamau Ltée; 51.0486°N, 72.6225°W), and the second, a 2003 burn, near Saint-Thomas-Didyme (48.9958°N, 73.0491°W) (Fig. 1). These areas were selected because there were relatively few accessible and still unharvested, or only partly harvested, sites at the time scheduled for woodpecker captures one year after the burn. Therefore, birds captured in these two burned sites can be considered as having colonized the sites within the year after the fire event, and should provide an accurate picture of the immediate colonization pattern by black-backed woodpeckers of these burned areas.

A similar effort was invested in the capture of birds in unburned forest, a habitat known to support much lower black-backed woodpecker densities than recently burned forests (Murphy & Lehnhausen 1998). Sampling for woodpecker age structure in unburned mature forest was done in regions ranging from immediately adjacent to the burned areas and up to several hundred kilometres from them, according to road access, logistics, and the maturity of conifer stands.

Capture methods

If no black-backed woodpeckers were seen or heard upon arrival at a given site, vocalisations of this species (Elliott *et al*. 1997) were played for a maximum of 20 minutes. Following a response, vocalisations were immediately stopped until mist nets were installed. Nets were disposed differently according to site characteristics, tree and snag density, branch layout and wind conditions during capture. Nets were installed in small open areas with few or no perching sites, and surrounded by uncut burned fragments, riparian strips or unburned stands, in order to force low flight altitude by the woodpeckers. In addition, when no snags were available, short snag "look-a-likes" were positioned upright between nets to provide a suitable perching site. Finally, a small speaker playing the rattle call ("pet-pet-wreoo") of a black-backed woodpecker (Dixon & Saab 2000) was placed at the base of the snag. Black-backed woodpeckers use this call both agonistically against conspecifics and when establishing territories (Dixon & Saab 2000). Typically, woodpeckers attracted by this method perch at the top of a tree surrounding the open area and then fly in low to investigate the calls and finally end up in one of the mist nets. On certain sites captures were done at the nest cavity.

Molt patterns and ageing

The black-backed woodpecker, like most North American (Pyle 1997) and European woodpeckers (Miettinen 2001), is well known to renew its flight feathers in a sequential pattern during each annual molt. Retained feathers are usually paler

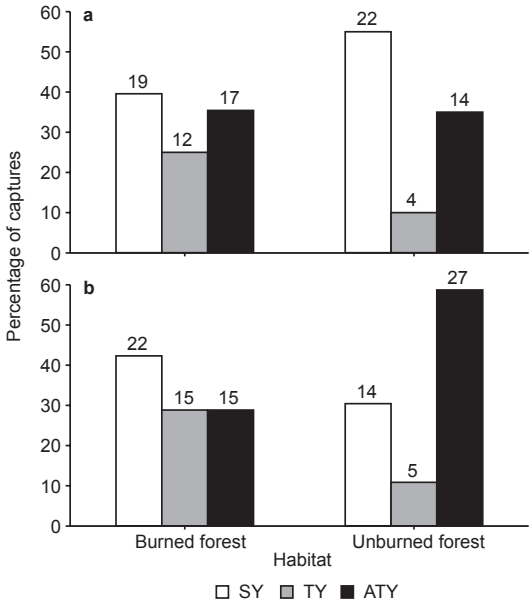

Fig. 2. Age structure of black-backed woodpecker populations occupying burned and unburned coniferous forest of Quebec: (**a**) females and (**b**) males. Age structure is represented in three classes: birds in their second calendar year (SY), third calendar year (TY) and more than 3 years (ATY). Numbers of individuals caught are presented above each column.

and more worn than renewed ones, with feathers often showing accelerated wear in areas lacking pigment (white) (Pyle 1997). The age can be precisely determined to up to three years by the examination of primary coverts and secondaries patterns (Pyle 1997). In spring, nestling of the year before are considered as second calendar year birds (SY) and those hatched two years before as third calendar year birds (TY). Thereafter birds showing unknown retention patterns are categorized as being older than three years (ATY).

Statistical analysis

A contingency analysis using a Pearson chi-square test was used to determine whether the age class structure (SY, TY and ATY) obtained from black-backed woodpeckers captured both in recently burned and in unburned mature conifer forest were different. A similar contingency analysis was also used to verify whether inter-habitat variations in the proportion of each sex and in the three age classes occurred.

Results

A total of 186 black-backed woodpeckers were captured, 100 at burned forest sites and 86 at unburned forest sites, and their age determined (Fig. 2). Second-year black-backed woodpeckers were the most abundant at burned forest sites and ATY were the most abundant at unburned forest sites. We found a significant difference in terms of woodpecker abundance per age class between the two habitat types (χ^2 = 9.43, df = 2, P = 0.0088, n = 186) but this difference was mostly due to the abundance of TY individuals at burned versus unburned forest sites (Fig. 2). Prior to analysis, data from each habitat type were pooled regardless of sampling year. No sex-wise differences in habitat frequentation were observed (χ^2 = 0.041, df = 1, P = 0.8394, n = 186). On the other hand, we found a difference in the age structure between habitats for males (χ^2 = 9.876, df = 2, P = 0.0072, n = 98), but not for females (χ^2 = 3.814, df = 2, P = 0.1485, n = 88). When assessed independently, the age structure of each sex was markedly different (Fig. 2) indicating that the pooled age structure was mostly influenced by inter-habitat differences in the abundance of males of the different age classes.

Discussion

Age class structure

The age structure analysis indicates that the black-backed woodpeckers in our study exhibit a different age class structure at recently burned forest sites than at unburned mature conifer forest sites. Contrary to initial expectations, juveniles (TY) were not as abundant at burned sites when compared to the other age classes (Fig. 2). In fact, ATY birds were almost as abundant as TY birds at burned forest sites. This was unexpected because the only known movements in Québec seem to be by current year birds (Observatoire d'oiseaux de Tadoussac, unpubl. data). In theory,

by dispersing after fledging juveniles may, on a regional scale, come into contact with a new territory. Also, if recently burned forest areas are considered as being the best habitat for the black-backed woodpecker, individuals should be inclined to respond positively to such disturbances as new territories become available, regardless of whether the individual possesses a territory or not at the time of the fire event. However, the present results suggest another possibility: that the movement of individuals recorded at Tadoussac (*see* Fig. 1) during the autumn is only a partial representation of what is actually happening in terms of movement of this species throughout the year. It seems logical that a good number of woodpeckers near the burn respond to it by colonizing the area immediately. This input of potentially already established and/or older individuals from near the perturbation further complicates the interpretation of the age class structure observed in both habitat types. It also indicates that black-backed woodpeckers of other age classes may move at other periods of the year than the autumn. For birds caught in burned areas, certain indications, such as the presence of charcoal on the breast and the wear of tail feathers, could provide an estimate of the time an individual has spent in the burned area (J. Ibarzabal, unpubl. data). Interestingly, in late April and early May we caught not only SY birds but also ATY birds with little or no charcoal stains on their breast feathers and with non-abraded tails, indicating that they had recently arrived in the burned area. This result suggests the presence of 'floaters' within the population, which move to find new territories or mates at other periods of the year than during the autumn.

Furthermore, the present results show a major inter-habitat difference in the abundance of TY birds, with unburned forest being less frequented by this age class than burned forest. As hypothesized before, this finding may be explained by the fact that some woodpeckers that we estimate as yearling 'floaters' (SY by 1 January following their hatching year) could find the burned area during the summer of the year in which the fire occurred (Villard & Schieck 1997). Since woodpeckers were caught the year after the fire occurred, these birds were now in their third year which makes it plausible that the low presence of these TY birds would be more pronounced in unburned habitat. It is possible that many TY birds found in unburned forest were still without an established territory at the time of the study. If this was the case, it is possible that they were less frequently caught because the playback technique targets territorial individuals. In such a situation, less three-year-olds would be caught at unburned forest sites because they are not territorial and it may be more difficult to acquire a territory and defend it.

On the other hand, the relatively high abundance of TY birds at the recently burned sites in the present study could indicate that it is easier for an individual of this age class (still relatively young for a woodpecker) to gain access to a territory with high food availability and other possible advantages. While TY birds may be present but simply not responding in unburned forest, this doesn't explain why more SY than TY birds were detected in unburned forest. As individuals get older, experience should lead towards facilitated territory acquisition and the TY birds in our study should be more present than SY birds.

Habitat selection between sexes

Our results show no differences in habitat selection between sexes. This finding is in contrast with the results obtained by Murphy and Lehnhausen (1998), who showed that for black-backed, three-toed and particularly hairy woodpeckers, females were far less numerous than males in the study area. The authors suggested inter-sexual displacement difference between foraging sites and habitats selected by males. In the case of age structure by sex (Fig. 2a and b), the difference in the number of ATY males in unburned forest may be due to differences in habitat suitability according to gender, suggesting that for some reason males could have a higher tendency to remain in unburned forest once a territory has been established. Males of other species are known to show greater philopatry to their territory with age than females, notably after reproductive failure (Catchpole 1972). Difficulties in establishing territories may also influence older males to remain on known sites in order to facilitate territory defence (Greenwood & Harvey 1976).

Conclusion

Contrary to our expectations, age structure between theoretically optimal and sub-optimal habitats (burned and unburned sites) shows little contrast. Even if the annual north–south autumn migration contributed to the colonization of burned forest areas, age structure suggests that colonization can begin during the year in which the fire occurred by SY birds. Furthermore, the finding that males were represented in such different numbers per age class and habitat in comparison to females was not expected. We believe that these results will help in understanding to what extent the black-backed woodpecker can use unburned forest habitat. Although there are indications suggesting that recently burned areas offer better habitat for population maintenance (Hutto 1995), the presence of young and old age classes in unburned forest point to the fact that it could also be an alternative habitat for this species. These results give the first overview of the abundance of this species per age class in two different habitats and, therefore, offer one of the few detailed insights into habitat frequentation by this species. Future studies should focus on movement analysis by age class to determine the habitat colonization capacity of black-backed woodpeckers and to determine site fidelity.

Acknowledgements

This work was supported by the Consortium de Recherche sur la Forêt Boréale, the Fondation de l'Université du Québec à Chicoutimi and the Ministère des Ressources Naturelles et de la Faune. We thank C. Buidin, Y. Rochepault, F. Gagnon, P. Desmeules, L. Morin, S. Boily and J. Tremblay for their help in the field, and Chantiers Chibougamau Ltd., Abititi Consolidated Inc. and Bowater Inc. for technical assistance. A. Coughlan provided useful comments on an earlier version of this manuscript.

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