



Assessing the relative use of clearcuts, burned stands, and wetlands as breeding habitat for two declining aerial insectivores in the boreal forest



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ABSTRACT

Fires are an ecological process essential for species dependent on early successional habitat in forested landscapes. In a wildlife context, clearcut forestry practices can mimic forest fires through the creation of early successional forest clearings, however, evidence that clearcuts provide the same ecological value as fire is mixed. In temperate deciduous/hardwood forests, many species that depend on early successional habitat are known to use clearcuts, including Eastern Whip-poor-wills (*Antrostomus vociferous*) and Common Nighthawks (*Chordeiles minor*), two threatened aerial insectivorous birds. However, the relative importance of recent clearcuts as breeding habitat relative to other more naturally open habitat types in the boreal forest is unknown. In May–July 2015 we studied occupancy and detectability of these two species in the boreal forest of northwestern Ontario. We first determined whether occupancy differed among three open habitats: burned stands, recent clearcuts, and open wetlands, and whether it differed in relation to the size of clearcut patches. We also examined how detectability of each species varied with time of day, season and weather conditions. Site occupancy for the Eastern Whip-poor-will and Common Nighthawk averaged 0.413 and 0.437, respectively. We found no significant difference in occupancy of either species in relation to burned stands, recent clearcuts, or open wetlands, although Eastern Whip-poor-will occupancy tended to be higher in burned stands. Occupancy did not show a linear relationship with patch size but neither species was found in the smallest open patches (<3 ha), perhaps indicating a minimum size threshold, although further study is needed. The detection of each species was positively correlated with the occurrence of the other species, suggesting that they were both selecting similar site characteristics. Detectability for Eastern Whip-poor-will was highest after sunset and increased over the course of the breeding season, while for Common Nighthawk, detectability was similar during and after sunset and decreased over the season. Our results suggest that Eastern Whip-poor-will and Common Nighthawk show similar preference for natural and managed open sites and that recent clearcuts may provide early successional habitat in the absence of burned stands. Our results also extend the known breeding range of Eastern Whip-poor-will, which further emphasizes the need for future research on these poorly studied species in the boreal forest.

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1. Introduction

Natural disturbances such as forest fires are crucial for maintaining biodiversity (Rowe and Scotter, 1973; Hunter, 1990; McRae et al., 2001; Swanson et al., 2011). Forest fires help to alter light, moisture and nutrient conditions, increase habitat complexity, and create stands of varying age including areas of early successional forest (Swanson et al., 2011). Disturbance dependent species rely on early successional habitat generated by fires, yet, both fire occurrences and disturbance dependent bird species are

in decline in North America (DeGraaf and Yamasaki, 2003). In some boreal regions, fires are increasingly being suppressed and forest harvest is acting as a non-natural disturbance regime (Hunter, 1990). Large-scale clearcut forestry practices are thought to mimic certain aspects of forest fires in terms of the spatial extent and removal of forest cover (Hunter, 1993; Haila et al., 1994; Wuerther, 1995; DeLong and Tanner, 1996; McRae et al., 2001). However, evidence that clearcuts provide the same ecological value as burned stands to wildlife is mixed. For example, burned stands and clearcuts appear to support similar mammalian communities (Simon et al., 2002a; Fisher and Wilkinson, 2005), but clearcuts relative to burned stands can have different moth species assemblages (Chaundry-Smart et al., 2012), lower bird species

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diversity (Bock and Lynch, 1970; Schulte and Niemi, 1998) and lower songbird abundance (Simon et al., 2002b). Given these different responses across taxa, further research is needed to determine the value of clearcuts relative to burned stands for wildlife and to assess the potential of clearcuts as a management tool for supplementing or creating additional habitat for species that rely on early successional or open habitats (DeGraaf and Yamasaki, 2003; Dawson and Bortolotti, 2006; Akresh et al., 2015) (see Fig. 1).

In addition to knowing whether a species uses early successional habitat created by forestry practices, it is also important to understand whether species respond to patch size, given that patch size is a variable that forest managers can control. Research has shown that arthropods, birds, and mammals show varying responses to the size of clearcut or other types of managed open patches (Shure and Phillips, 1991; Lehnen and Rodewald, 2009; Kaminski and Islam, 2013; Bouchard and Hebert, 2016; English et al., 2016). For example, while there is commonly a minimum patch size threshold for most early successional bird species (Annand and Thompson III, 1997; DeGraaf and Yamasaki, 2003; Rodewald and Vitz, 2005), a smaller group of species show area sensitivity in larger open patches (Lehnen and Rodewald, 2009; Shake et al., 2012; Kaminski and Islam, 2013). The size of clearcut or other early successional habitat patches has also been found to have varying effects on non-avian taxa including use by grizzly bears (*Ursus arctos*, Nielsen et al., 2004), abundance of small mammals (Foster and Gaines, 1991) and insect community structure (Shure and Phillips, 1991; Bouchard and Hebert, 2016).

Aerial insectivores, including Eastern Whip-poor-wills (*Antrostomus vociferous*) and Common Nighthawks (*Chordeiles minor*), have undergone rapid population declines in North America over the past 30 years (North American Bird Conservation Initiative Canada, 2012). Since 1970, the two species have declined similarly with population losses of 71% for Eastern Whip-poor-will and 73% for Common Nighthawk (Environment Canada, 2014c). Both species are currently designated as threatened by the Committee on the Status of Endangered Wildlife in Canada (Cink, 2002; COSEWIC, 2009; Brigham et al., 2011). Critical to effective recovery planning for declining species and species at risk is an understanding of breeding habitat requirements. At more southern temperate

latitudes, Eastern Whip-poor-will and Common Nighthawk are known to nest on the ground along forest edges in early successional habitat, including regenerating clearcuts and burned stands (Canterbury et al., 2000; Cink, 2002; Wilson and Watts, 2008; COSEWIC, 2009; Brigham et al., 2011; Tozer et al., 2014; Akresh and King, 2016; English et al., 2016). However, there has yet to be a direct comparison of the value of early successional habitats created by fire and clearcutting in more northern boreal forests for either species nor how each species responds to the size of clearcut patches. Further research on these topics is important given the suggestion that observed population declines could be caused by a decline in the availability of early successional forest habitat due to fire suppression (Fisher et al., 2004; Tozer and Strickland, 2012; Purves, 2015).

In this study, we investigated whether site occupancy of Eastern Whip-poor-wills and Common Nighthawks varied across recently burned stands, recent clearcuts, and open wetlands in the boreal forest of northwestern Ontario. Using our sample of recent clearcut sites we also investigated whether the size of the clearcut patch influenced the occupancy of either species. Last, we examined the factors that influenced detection probability for each species to inform future survey efforts. To our knowledge, this study provides the first comparison of the suitability of early successional habitats created by fire and clearcutting for breeding, as well as the first estimate of site occupancy for either species in the boreal forest.

2. Methods

2.1. Study area

Research was conducted from late May through early July 2015, north and west of Thunder Bay, Ontario, Canada. We examined occupancy patterns of Eastern Whip-poor-wills and Common Nighthawks at two study areas approximately 260 km apart near Atikokan, Ontario (48.616, -92.308, “Boreal Hardwood study area”) and Gull Bay, Ontario (49.853, -89.180, “Boreal Softwood study area”) along the edge of the Boreal Hardwood Transition and the Boreal Softwood Shield bird conservation regions

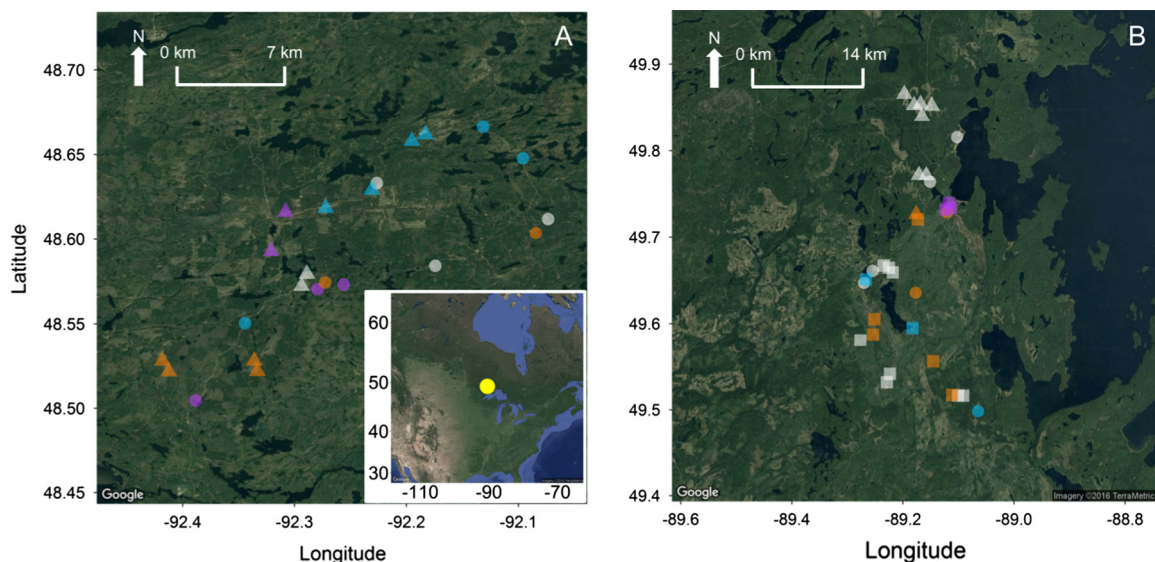


Fig. 1. Location of sampling sites in the Boreal Hardwood study area (A) and Boreal Softwood study area (B). Triangles represent recent clearcut sites, circles represent open wetland sites, and squares represent burned stands. White shapes represent sampling sites with no detections, blue shapes represent sites where only Common Nighthawks were detected, purple shapes represent locations where only Eastern Whip-poor-wills were detected, and orange shapes represent sites where both species were detected. The yellow circle in the inset in (A) represents the general location of the study areas in North America. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

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