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Spruce grouse decline in maturing lowland boreal forests of New York

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ABSTRACT

Forest succession affects species that rely on specific successional stages of forest development as core habitat. The spruce grouse (*Falcipennis canadensis*) is a mid-successional boreal forest obligate declining in population size and range extent in the northeastern United States. We evaluated habitat occupancy from 2002 to 2006 and we contrasted spruce grouse habitat use at multiple spatial scales to determine if advancing succession of boreal forest influenced the species' distribution in New York from 2002 to 2012. We detected grouse at less than half ($n = 13$) of forest patches occupied from 1976 to 1987 and at one previously undocumented patch suggesting in aggregate a 71% reduction in extent of area occupied. Spruce grouse kernel home ranges reflected a 13× greater selection for short (<6 m) lowland conifer over tall (>6 m) lowland conifer, a 4.5× greater selection of short lowland conifer over upland conifer, and an 8× greater selection for ericaceous vegetation over tall lowland conifer. Within home ranges, bird radiolocations revealed an 8.5× greater selection for short lowland conifer over upland conifer, a 6.6× greater selection of short lowland conifer over ericaceous vegetation, a 5× greater selection of tall lowland conifer over upland conifer, and a 4× greater selection of tall lowland conifer over ericaceous vegetation. Occupied forest patches were 75% closer to other occupied patches than were formerly occupied patches. Moreover occupied patches were 10% larger, they were characterized by 90% less *Sphagnum* spp., 5× greater ericaceous shrub cover, 34% greater tree density, 71% less live vegetation >6 m tall, 8% less coniferous shrub cover, and contained about half of the live vegetation from 4 to 6 m above the ground. Trees were 20% younger in occupied versus formerly occupied patches ($\bar{x} = 43.37$ [SE = 41.82–44.95] versus 51.87 [SE = 50.95–52.81], respectively). We also observed 17% greater importance value (i.e., IV = 100 × [relative basal area × relative density × relative frequency]/3) of tamarack (*Larix laricina*) and a 43% less balsam fir (*Abies balsamea*) importance value suggesting a decreased component of earlier successional species in occupied versus formerly occupied patches. We conclude that reduced size and greater isolation of remaining habitat patches as well as forest succession have contributed to spruce grouse declines in New York, processes that could be reversed through establishment of mid-successional forest patches near remaining grouse-occupied habitats.

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1. Introduction

Reverting forest succession is a conservation strategy often in conflict with forest protection, the latter of which has been the primary tool for conserving many forest associated species in the northeastern USA. In the absence of natural disturbances, such forest protection ultimately results in forest maturation to stages that can become incompatible for many species of forest birds (Dessecker and McAuley, 2001; Holmes and Sherry, 2001). In New York, approximately 11,000 km^2 of land in the Adirondack and Catskill Parks is protected from residential and commercial development and resource extraction by the New York State Constitution (N.Y. Const. art. XIV, §1). Strict protection of vast areas of forest may well favor an increase in old growth forest and associated species, yet despite the increasing extent of forested habitat in the northeast until very recently (Drummond and Loveland, 2010), many early and mid-successional forest-associated species remain in decline due to maturing forest conditions (Dessecker and McAuley, 2001; Yahner, 2003).

The spruce grouse (*Falcipennis canadensis*) is a mid-successional stage boreal forest obligate in decline at the southeastern extent of its range (Bouta, 1991; Pence et al., 1990). At its southeast range extent, boreal forest occurs as patches of varying sizes in a matrix of deciduous forest, resulting in the species' highly subdivided and

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thus extinction-prone population structure (Fritz, 1979, 1985; Whitcomb et al., 1996). The spruce grouse was relatively abundant in New York in the late 1800s (Burroughs, 1871; DeKay, 1844); however, since 1871 the spruce grouse had apparently declined abruptly (Bouta, 1991; Bull, 1974; Fritz, 1977). The decline has been attributed to large-scale loss and fragmentation of habitat due to widespread commercial softwood logging and associated development (Bouta and Chambers, 1990), including forest loss to reservoir construction that began around 1880 (McMartin, 1994). However, despite the acquisition of hundreds of thousands of hectares of public lands and the subsequent reduction in widespread logging operations since the early 1900s, the population had undergone a nearly 50% reduction in its breeding range from 1987 to 2006 (Ross, 2008).

The spruce grouse is associated with short-needled conifers across its distribution, occurring in spruce-fir forests in New York and other northeastern states (Boag and Schroeder, 1992). Approximately 44% of the species' New York distribution from 1976 to 1987 occurs on state owned lands designated as the Adirondack Forest Preserve (Adirondack Park Agency, 2009), for which prohibition on timber harvesting has been suggested to exacerbate declines in the spruce grouse population (Bouta, 1991; Fritz, 1977, 1979). More specifically, maturation of conifer stands from lack of disturbance and long term fire suppression may limit regeneration of early stage forest and thereby limit spruce grouse populations, a fate that has affected many early and mid-successional forest-associated species in the northwestern United States (Dessecker and McAuley, 2001; Yahner, 2003).

Previous studies indicated that successional changes in forest structure may lead to local decreases in spruce grouse populations, e.g. in white spruce (*Picea glauca*) forests in Alaska (Ellison, 1975), lodgepole pine (*Pinus contorta*) in Alberta (Boag, 1991; Schroeder and Boag, 1991) and spruce-fir forests in Vermont (Pence et al., 1990). Bouta (1991) reported that transiently occupied spruce grouse patches (i.e., discrete patches of lowland conifer containing one or a few grouse and no evidence of breeding) in New York were comprised of stands with trees that were 40% older than trees at persistently occupied patches (i.e., discrete patches of lowland conifer containing multiple grouse individuals and evidence of breeding).

An improved knowledge of the structure, composition, size, and spatial arrangement of lowland spruce-fir forest patches preferred by spruce grouse is needed to understand whether forest management that ultimately results in mid-successional forest stands would benefit populations of the species in the southeastern extent of its range. For this reason, we evaluated patterns of spruce grouse occupancy in relation to forest age, structure, composition, stand (i.e., patch) size, and interpatch distances by comparing these elements between persistently occupied patches and formerly occupied patches. We defined formerly occupied patches as forest patches in which spruce grouse were known to occur during 1976–1987 surveys (Bouta, 1991; Fritz, 1979), but no longer had evidence of spruce grouse use during 2002–2006. We also compared home range habitat to available habitat at multiple scales from data collected during 2002–2012 to determine at which scale spruce grouse may differentially use available habitat types. We tested several hypotheses that underlie the argument for forest management to improve spruce grouse population viability, namely that spruce grouse have disproportionately (1) disappeared from patches with older forests, (2) persisted in patches with younger forests (i.e., mid-successional), (3) disappeared from smaller patches, and (4) disappeared from patches more distant from a colonizing source (i.e., nearest neighboring occupied patch). Moreover, we sought to determine at which spatial scale—at the patch or within individual home ranges—habitat management might be most relevant to the species.

1.1. Study area

Spruce grouse were studied from 2002 to 2012 at 56 patches within an approximately 125 km^2 region of St. Lawrence, Franklin, Essex, Clinton, and Hamilton counties that together represented the species' New York State distribution (Fig. 1). We delineated

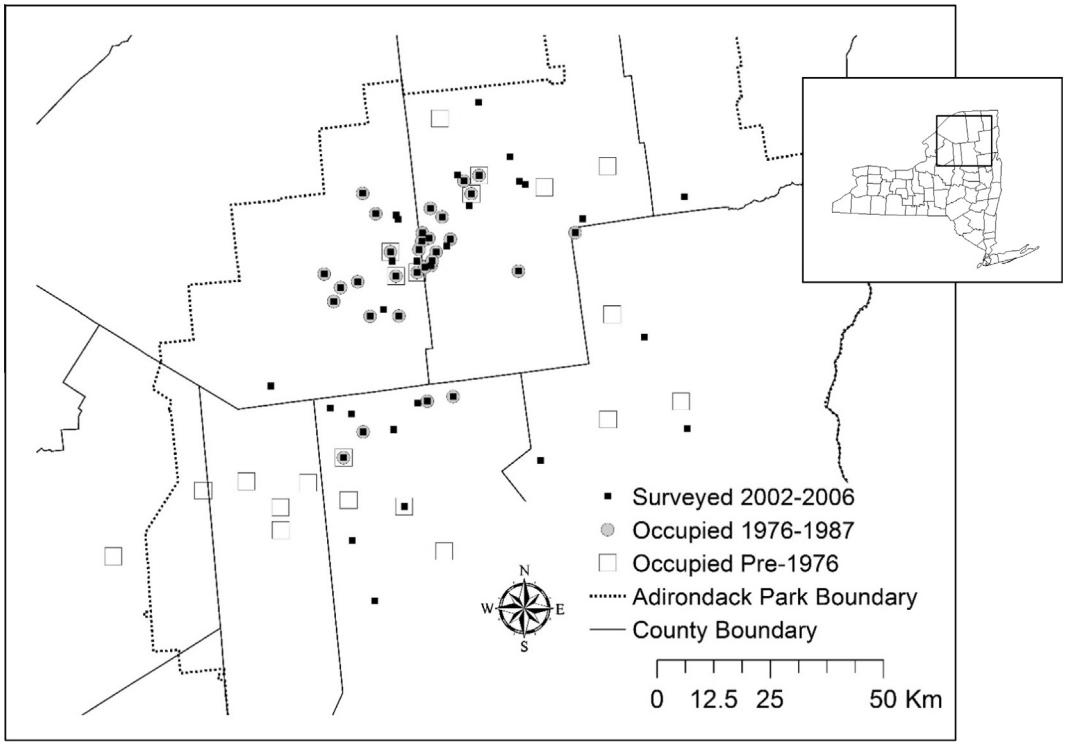

Fig. 1. Distribution of lowland coniferous forest patches surveyed for spruce grouse from 2002 to 2006 and patches occupied during pre-1974 (Bull, 1974) and 1976–1987 (Bouta, 1991; Fritz, 1977) in the Adirondack Mountain Region, New York, USA.