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Long-term effects of precommercial thinning on small mammals in northern Maine

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Abstract

Precommercial thinning (PCT) is being practiced increasingly throughout the Acadian forest of eastern North America to meet silvicultural objectives; however, effects of this practice on wildlife, both immediately and several years post-treatment are not well understood. Forest dependent small mammals have ecological roles as prey for numerous avian and mammalian predators, dispersers of seeds, fruit, and spores, and contribute to nutrient cycling. Researchers in the northwestern USA have suggested that thinning of young, regenerating clearcuts may increase the abundance and diversity of some forest-dependent small mammals by increasing rates of forest development and enhancing the ecological representation of mid-successional stands across managed landscapes. We examined the effects of PCT within conifer-dominated forest stands 1-, 6-, 11-, and 16-years post-treatment, on abundances of mice, voles, and shrews, and on within-stand structure in the commercially managed, Acadian forests of northern Maine. We live-trapped small mammals on 24 herbicide-treated clearcuts treated with PCT and on 13 similar, unthinned stands during summers of 2000 and 2001. Thinning of mid-successional conifer stands resulted in increased abundances, (red-backed voles, *Clethrionomys gapperi*, $P = 0.008$; masked shrews, *Sorex cinereus*, $P < 0.001$) or had no detectable effect on (deer mice, *Peromyscus maniculatus*, $P = 0.544$; short-tailed shrews, *Blarina brevicauda*, $P = 0.517$) the 4 most common species of Muridae and Soricidae in northern Maine. In general, abundance of deer mice responded more positively to increasing development class and to the number of years since thinning than other species of small mammals. Several within-stand habitat characteristics associated with stand maturity, such as larger stem diameters and a partially open canopy, occurred in thinned stands. Thus, PCT may accelerate the development of habitat attributes typical of mid-successional conifer stands in intensively managed stands within the Acadian Forest. PCT may increase abundances of small mammal species associated with mid-seral forest conditions at the scale of the forest stand.

Keywords: Forest structure; Maine; Deer mice; Precommercial thinning; Red-backed voles; Shrews; Small mammals; Wildlife

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1. Introduction

The Acadian forest, ranging from northern New England east through the maritime Canadian provinces, includes the ecological transition zone between eastern deciduous forest to the south and boreal forest to the north (Seymour and Hunter, 1992). Timber harvest is a significant economic use of this region, and commercial timberland accounts for 86% of the land area of Maine (Maine Forest Service, 1998), 82% of New Brunswick, 68% of Nova Scotia, and 35% of Quebec (Canadian Council of Forest Ministers, 2002). Currently, about 4% of Maine's commercial timberland is managed using high production silvicultural practices, including precommercial thinning (PCT), herbicide release, and plantations (Maine Forest Service, 1998). Similarly, the eastern Maritime Provinces of Canada have experienced 1.2- to 1.5-fold increases in the land area under intensive management from 1990 to 2000. During 1990–2000, the extent of PCT increased from 4352 to 9950 ha in Maine (Maine Forest Service, unpublished data; Maine Forest Service, 2001), from 14,930 to 40,354 ha in New Brunswick, from 22,791 to 98,158 ha in Quebec, and from 3228 to 8113 ha in Nova Scotia (Canadian Council of Forest Ministers, 2002). Thus, as thinning has affected an increasing percentage of regenerating forest habitat across the Acadian forest, this practice has been questioned in relation to its effects on early successional wildlife species and on mid-to-late seral species such as red-backed voles (*Clethrionomys* spp.) (Carey and Johnson, 1995; Suzuki and Hayes, 2003).

Precommercial thinning reduces the density of overstocked stands to minimize mortality from competition and to accelerate growth of residual trees (Ker, 1987; Seymour et al., 1984; Brissette and Frank, 1999; Brissette et al., 1999). Stands previously treated with PCT in Maine have grown at a sufficient rate to allow for the first economically viable commercial entry as soon as 16 years after thinning (ages 30–35 years). Characteristics of forest overstory (Ker, 1987; McCormack and Lemin, 1998; Brissette and Frank, 1999; Homyack et al., 2004), understory (Doerr and Sandburg, 1986; Newton et al., 1989; Wilson and Watts, 1999; Lindgren and Sullivan, 2001; Homyack et al., 2004), and microclimate (Reynolds et al., 1997) change dramatically after PCT and with stand succession. By reducing competition from crop trees via thinning, stem diameters (Harrington and Reukema, 1983; Ker, 1987; McCormack and Lemin, 1998; Brissette and Frank, 1999; Brissette et al., 1999; Pothier, 2002) and crowns (McCormack and Lemin, 1998; Brissette and Frank, 1999; Brissette et al., 1999; Lindgren and Sullivan, 2001; Sullivan et al., 2001) of residual crop trees increase rapidly, causing stands to bypass the stem exclusion stage of forest succession characterized by self-thinning (Smith et al., 1997). The reduction of competition among crop trees for nutrients, space, and light results in reduced mortality of residual stems (Ker, 1987; Brissette and Frank, 1999; Brissette et al., 1999). Without mortality of large diameter trees, however, recruitment of coarse woody debris (CWD) may be reduced (Carey and Johnson, 1995; Hayes et al., 1997; Homyack et al., 2004). These structural changes associated with PCT within forest stands could potentially influence, either positively or negatively, a variety of forest mammals dependent on overstory or understory structure, such as snowshoe hares (*Lepus americanus*) (Sullivan and Sullivan, 1988; Homyack, 2003) and various species of small rodents (Yahner, 1986; Nordyke and Buskirk, 1991; Witt and Huntly, 2001; Mengak and Guynn, 2003) and shrews (Yahner, 1986; Mengak and Guynn, 2003). However, studies in the Pacific Northwest have indicated that thinning of second-growth forests may diversify the landscape and increase richness of wildlife species by accelerating stand succession (Carey and Johnson, 1995; Hayes et al., 1997; Sullivan et al., 2001).

Forest-dwelling voles (*Clethrionomys* spp.), mice (*Peromyscus* spp., *Napeozapus* spp.), and shrews (Soricidae) are relevant taxa for examining responses of wildlife to PCT because they are consumers of invertebrates, fungi, and vegetation (Hamilton, 1941), and are prey for many avian (Mendall, 1944) and mammalian carnivores (Soutiere, 1979; Dibello et al., 1990; Cumberland et al., 2001). Additionally, small mammals may assist the revegetation of non-forested areas by dispersing spores of hypogeous fungi present in their feces (Maser et al., 1978; Kirkland, 1990) and contribute to nutrient cycling (Brooks and Healy, 1988). Small mammal abundances are reported to be positively associated with some attributes of forest structure, including downed and decaying dead wood (Richens, 1974; Hayes and Cross, 1987; Carey and