

Do the size and landscape context of forest openings influence the abundance and breeding success of shrubland songbirds in southern New England?

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Abstract

Early successional birds have declined in the northeastern United States due to the regeneration of forest on abandoned farm fields and the suppression of natural disturbances that once provided appropriate habitat. These species have become increasingly dependent on early successional habitats generated by such activities as timber harvesting. Recent approaches of timber harvesting, which range from single-tree harvesting to clearcutting, create forest openings of different sizes and configurations embedded in landscapes with different land use patterns. To assess the importance of forest openings created by timber harvesting for shrubland birds, we surveyed birds on 50 m radius plots in 34 harvest sites (0.5–21 ha). We collected data on multi-scaled habitat variables ranging from plot-level vegetation characteristics to land use patterns within 1 km of each study site. We also monitored mating and nesting success of Blue-winged Warblers (*Vermivora pinus*) in 10 forest openings.

The abundance of most shrubland species was influenced by plot-level habitat variables, such as tree density and vegetation height, rather than shrubland area or the composition of land uses in the surrounding landscape. Only Eastern Towhees (*Pipilo erythrophthalmus*) were more frequent in survey plots in larger forest openings. In contrast, neither abundance nor reproductive activity of Blue-winged Warblers was correlated with the size of the forest opening. Their abundance was negatively related to vegetation height, however. Only 54% of the territorial male Blue-winged Warblers in forest openings were mated. We documented relatively low nest success rates of 21.1% during the egg laying and incubation nest stages, but increased success rates during the later stages of nesting.

Our results indicate that even small forest openings with low vegetation provide habitat for Blue-winged Warblers and other shrubland birds. The overall reproductive rate of territorial male Blue-winged Warblers in forests openings was low during the 2 years of the study, however. Further studies are needed to assess the long-term value of this type of habitat for sustaining shrubland bird populations.

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1. Introduction

Forestry in southern New England is increasingly dominated by uneven-aged management characterized by selective cutting of individual trees or small groups of trees (DeGraaf et al., 1992). Single-tree and group selection harvesting is also becoming more common on both public and private land in many other regions in eastern North America in response to public concerns about the visual and environmental impacts of

clearcuts, especially the problems of soil erosion, stream sedimentation, and degradation or loss of habitat for forest species. Ironically, many declining species in eastern North America depend on early successional woody habitats such as regenerating forest, and these species generally benefit from even-aged management techniques that create large expanses of open habitat (Hunter et al., 2001; Dettmers, 2003). An important question for forest managers is whether these species can also use the smaller openings that are created as a result of new methods and regulations for timber harvesting.

Numerous studies have documented that recent clearcuts support a diversity of birds that are “shrubland specialists” (species that are restricted to low, woody vegetation) (Conner and Adkisson, 1975; Webb et al., 1977; Crawford et al., 1981; Hagan et al., 1997; Yahner, 1997). These species are rare or

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absent in mature forests, so they depend upon some sort of disturbance, such as fire, windstorms, severe flooding, or logging, to generate low, woody habitat (Askins, 2002). Shrubland species are also generally rare or absent in the small openings in forests created by single-tree and group selection harvesting (Annand and Thompson, 1997; Rodewald and Smith, 1998; Robinson and Robinson, 1999; Costello et al., 2000; Moorman and Gynn, 2001). These small openings are colonized by only a few species of shrubland specialists and forest-edge species along with species such as the Hooded Warbler (*Wilsonia citrina*) that are best characterized as canopy gap specialists (Annand and Thompson, 1997; Germaine et al., 1997). Canopy gap specialists generally are associated with mature forests, not extensive open habitats, because they are often concentrated in small, shrubby openings created by tree falls. Thus, different harvesting methods favor different sets of bird species.

Another approach to reducing the negative environmental effects of even-aged management is to shift from large clearcuts to small clearcuts (including patch cuts in the 0.5–2 ha range). This approach has been adopted in state forests in Connecticut, where clearcuts are generally no larger than 4 ha (10 acres). Compared to large clearcuts, small clearcuts reduce problems with soil erosion and stream sedimentation while still favoring regeneration of commercially important oaks (which grow better in open, sunny conditions (Meadows and Stanturf, 1997)). If these small clearcuts provide habitat for shrubland birds, then they may be preferable to individual or group selection cuts in regions where conservation of shrubland species is a high priority. The pressing question is how large an opening is needed to provide appropriate and productive habitat for shrubland birds. Rudnický and Hunter (1993) addressed this question by surveying bird populations in standardized plots in clearcuts with a wide range of areas (2–112 ha) in Maine. When they included all of their sites in the analysis, they found that the frequency of occurrence of particular species was not related to clearcut area. When the analysis was limited to clearcuts ≤ 20 ha, however, many species showed positive trends in frequency of occurrence as clearcut area increased, suggesting that these species may be sensitive to clearcut area for small clearcuts. In a mist-net study of regenerating clearcuts in longleaf pine forests in South Carolina, Kremetz and Christie (2000) carefully standardized sampling effort for all of their measures of bird abundance and productivity. They found no relationship between area of clearcuts and either abundance or productivity (as measured by juvenile: adult ratios) of scrub-successional birds for clearcuts that ranged in area from 3 ha to 57 ha. In contrast, Rodewald and Vitz (2005) found weak evidence that several species of shrubland birds were less frequent in mist net samples from small clearcuts than in samples from large clearcuts. They found stronger evidence that shrubland birds tended to avoid the area near the forest edge, which would tend to reduce densities in small or irregularly shaped clearcuts. Thus, the limited number of studies that address this question do not provide a clear answer about whether the area of habitat patches should be an important management concern.

The distribution and abundance of early successional birds is potentially determined not only by vegetation characteristics and the area of forest openings, but also by the amount and pattern of early successional habitats in the surrounding landscape (Lichstein et al., 2002). Habitat selection by birds often occurs at multiple spatial scales, and may be influenced by habitat variables both within and surrounding habitat patches (Cody, 1985). Although a substantial amount of research has focused on the landscape-scale effects of habitat selection in birds of mature forests, not much is known about the importance of surrounding landscape features in explaining shrubland bird distributions.

The objectives of this study were to (1) determine the minimum area of early successional habitat required by different species of shrubland specialists, (2) test whether the size of openings is related to reproductive success by monitoring the mating and nest success of the Blue-winged Warbler (*Vermivora pinus*), a shrubland specialist, and (3) analyze the relative importance of habitat characteristics in explaining bird distributions at three spatial scales (i.e., plot, patch, and landscape scales). Our broader goal was to determine whether small clearcuts provide suitable habitat for a diversity of early successional birds, and, if so, whether their value for these species diminishes if the clearcuts are too small or if they are too isolated from other early successional habitat.

2. Methods

2.1. Study areas

Study sites consisted of 34 forest openings located in the Nehantic, Pachaug, Cockaponset, Salmon River, and Meshomasic state forests in southeastern Connecticut. These clearcuts, deferment cuts, shelterwood cuts, and wildlife openings were created and managed by the Connecticut Department of Environmental Protection. All study sites were openings dominated by low, woody vegetation surrounded by mature forest. They ranged in size from 0.6 ha to 21 ha and had been created by harvests during the preceding 3–11 years. We avoided group selection cuts (which are <0.6 ha) because previous studies showed that these primarily support mature-forest and canopy-gap specialists rather than shrubland species, and thus are different from larger openings (Costello et al., 2000). Adjacent study sites were separated from one another by at least 10 m of forest. The greatest distance between study sites was 61 km. The average distance from other forest openings (including other study sites) was 235 m, and all study sites were at least 100 m from powerline rights-of-way or other shrubby habitats.

2.2. Abundance and reproductive success of birds

In 1997, we determined densities of breeding shrubland songbirds on 50 m, fixed-radius circular plots (Bibby et al., 2000) near the center of each forest opening. Each survey plot was visited once during the early breeding season (28 May–13 June) and once during the late breeding season (16 June–7

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