PRODUCTIVITY OF EARLY SUCCESSIONAL SHRUBLAND BIRDS IN CLEARCUTS AND GROUPCUTS IN AN EASTERN DECIDUOUS FOREST

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Abstract: Uneven-aged forest management has been advocated as a silvicultural practice because of concerns about the negative effects of even-aged management on birds that dwell in mature forests. Recent evidence, however, indicates that in the northeastern United States, bird species that inhabit early successional habitats may be experiencing more widespread declines than their mature-forest counterparts. We compared the effect of group selection, a widely used form of uneven-aged forest management, and clearcutting on nest survival rates of early successional shrubland birds in the White Mountains of New Hampshire. There was no difference in daily nest survival rate between clearcuts (0.990) and groupcuts (0.987) for 16 bird species combined ($n = 290$), and no difference in daily nest survival rate between clearcuts (0.993) and groupcuts (0.987) for chestnut-sided warblers (*Dendroica pensylvanica*), the only species for which enough nests were found for separate analysis ($n = 217$). There was no difference in daily nest survival rates of all species combined between edge (0.983) and interior areas (0.992) of clearcuts ($n = 204$), and no difference in daily nest survival rates of chestnut-sided warblers between edge (0.984) and interior (0.993) areas of groupcuts ($n = 156$). Thus, our results suggest that clearcuts and groupcuts provide similar habitat for species of early successional shrubland birds that inhabit both clearcuts and groupcuts. Recent studies, however, indicate that some bird species that use larger openings such as clearcuts do not occupy smaller openings created by group selection, which may limit the utility of group selection in managing habitat for early successional shrubland birds.

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The use of even-aged forest management, which includes clearcutting and shelterwood cutting, has been challenged nationwide, partially because of its effects on populations of mature forest-dwelling Neotropical migrant birds (Lansky 1992). However, even-aged management is an important source of early successional habitat required by many species of wildlife (DeGraaf et al. 1992), including early successional shrubland birds, which are experiencing more widespread population declines than their mature forest counterparts (Askins 1993). Thus, managers are confronted with a potential conflict between the maintenance of mature forest and the creation of early successional shrubland habitat (Hagan et al. 1997).

Public concerns about clearcutting have resulted in increased emphasis on uneven-aged silvicultural systems (Costello et al. 2000). Group selection is an uneven-aged silvicultural system in which timber is harvested in approximately 0.02–0.80-ha patches every 10–20 years, creating an uneven-aged structure within a stand (Leak et al. 1987). Group selection is gaining increasing popularity with forest managers because it retains a substantial proportion of the mature forest bird community (Chambers et al. 1999, Robinson and Robinson 1999, Costello et al. 2000) yet creates early successional habitat within the harvested areas similar in structure to that created by even-aged management (Leak et al. 1987). Thus, group selection could potentially represent a compromise between even-aged management, which is increasingly unpopular with the public, and single-tree selection, which does not usually provide adequate habitat for early successional shrubland habitat specialists (Annand and Thompson 1997, King and DeGraaf 2000).

Previous studies on bird habitat use in clearcut and selection harvests (Annand and Thompson 1997, Chambers et al. 1999, Robinson and Robinson 1999) have emphasized that information on the effect of these treatments on avian reproductive success is needed to accurately assess the impact of various silvicultural methods on the ecology of early successional bird species. This is especially important in the case of comparisons

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of the relative effect of management techniques that create large (clearcut) versus small (groupcut) patches, because birds in small patches of grassland (Johnson and Temple 1990, Winter and Faaborg 1999) and forest (Porneluzi et al. 1993, Hoover et al. 1995) habitat are known to experience higher nest predation rates relative to birds in larger patches. Lower reproductive success in smaller habitat patches may be due to increased edge-related nest predation (Andren and Angelstam 1988, Hoover et al. 1995). Thus, data on reproductive success is critical to accurately evaluate the relative suitability of patches of early successional shrubland habitat created by clearcutting versus group selection (Van Horne 1983).

We compared the reproductive success of shrubland-nesting bird species between patches of regenerating forest created by clearcutting and group selection to augment the findings of these earlier studies of bird distribution in clearcut and groupcut stands. Based on the results of other studies of the nesting ecology of passerine birds in large versus small habitat patches, we predicted that nest survival would be lower in small habitat patches, and that this pattern would be associated with lower nest survival near clearcut and groupcut edges.

METHODS

We conducted this study at 3 sites on the White Mountain National Forest in Caroll and Coos counties, New Hampshire: (44°03′ N, 71°15′ W). The White Mountain National Forest is 303,930 ha in extent and is 97% forested (U.S. Forest Service 1986: III-30). The forest in the study area consisted of beech–birch–maple subtype of northern hardwoods forest in the following size distribution: 87% mature forest, 5% poletimber and 8% regeneration–sapling stands (U.S. Forest Service 1986: III-30).

We established a clearcut plot and a groupcut plot at each of the 3 sites. Clearcut plots encompassed clearcuts 6, 9, and 10 ha, and groupcut plots each encompassed 10 or 11 groupcuts. Groupcuts averaged 0.39 ha (SE = 0.12) and ranged in size from 0.20–0.69 ha. Plots at 2 sites, Blue Mountain and Double Head, were established during 1994 in 5-year-old cuts, and plots at a third site, Black Brook, were established in 1995 in 4-year-old cuts. All plots were flagged in 50- × 50-m grids to facilitate nest location and monitoring.

We located nests by following birds carrying food or nesting material. We marked nests by placing a small piece of red vinyl tape 3–5 m from the nest, and we checked nests every 3 days to determine nest fate. If a nest was empty and visibly damaged before the predicted fledging date and we were unable to locate adults feeding fledglings, we considered it depredated. Conversely, if the nest contained nestlings up to the predicted date of fledging and we were able to find adults feeding young, the nest was classified as successful. We assigned the midpoint between the last nest check and the date the nest was found depredated as the date of predation (Mayfield 1975). We calculated nest survival using the Mayfield estimator (Mayfield 1975), and compared nest survival rates between clearcuts and groupcuts using contrasts following Sauer and Williams (1989). In addition, we compared nest survival rates between 0–10 m (hereafter "cut edge") and >10 m (hereafter "cut interior") from forest–clearcut and forest–groupcut borders. To account for possible species-specific differences in vulnerability in nest predation, we conducted the above analyses separately for all species for which we had sufficient samples, as well as for all species pooled.

RESULTS

We located 290 nests of 16 species during the study (Appendix 1). The chestnut-sided warbler was the only species for which enough nests were found for separate analyses (n = 217). The species for which we had the next largest sample was the American redstart (n = 20). Ninety-eight percent of nests were located 0.25–2 m above ground level in woody vegetation. The remaining 2% of nests were located directly on the ground.

Nest survival rates of all species combined, and for chestnut-sided warblers considered separately, did not differ between clearcuts and groupcuts in any year or at any site (Table 1). Nest survival rates of all species combined, and of chestnut-sided warblers considered separately, did not differ between cut edges and cut interiors in either clearcuts or groupcuts (Table 2).

DISCUSSION

Contrary to our predictions, nest survival rates did not differ between clearcuts and groupcuts, or between cut edges and interiors. We expected that nest survival rates would be lower in small patches because the proportion of a fragment consisting of edge is inversely proportional to fragment size, and elevated nest predation rates near edges have been implicated as an important factor in the reduced nesting success often observed in small fragments of mature forest (Andren and Angelstam 1988, Hoover et al.

Table 1. Daily nest survival rates (± SE) of 16 bird species combined, and of chestnut-sided warblers considered separately, compared between clearcuts and groupcuts on 6 plots on the White Mountain National Forest, New Hampshire, 1994–96.

	All species[a]				Chestnut-sided warbler			
	Clearcut	Groupcut	*P*	*n*	Clearcut	Groupcut	*P*	*n*
1994								
Blue Mountain	0.993 ± 0.004	0.995 ± 0.004	0.78	51	1.000 ± 0.000	0.996 ± 0.004	0.32	30
Double Head	0.990 ± 0.007	0.976 ± 0.009	0.22	3	0.984 ± 0.010	0.979 ± 0.008	0.72	26
1995								
Blue Mountain	0.982 ± 0.006	0.987 ± 0.009	0.63	44	0.991 ± 0.006	0.985 ± 0.011	0.62	28
Double Head	0.981 ± 0.010	0.981 ± 0.006	0.34	30	0.981 ± 0.010	0.995 ± 0.005	0.25	24
Black Brook	1.000 ± 0.003	0.990 ± 0.010	0.32	18	1.000 ± 0.000	0.987 ± 0.013	0.31	15
1996								
Blue Mountain	0.996 ± 0.003	0.980 ± 0.010	0.11	41	0.994 ± 0.004	0.978 ± 0.011	0.16	29
Double Head	0.987 ± 0.008	0.987 ± 0.007	0.96	32	0.981 ± 0.011	0.985 ± 0.009	0.76	26
Black Brook	0.994 ± 0.004	0.989 ± 0.006	0.45	41	0.997 ± 0.003	0.988 ± 0.006	0.19	39
All years and plots	0.990 ± 0.002	0.987 ± 0.003	0.34	290	0.993 ± 0.002	0.987 ± 0.003	0.10	217

[a] Species studied are listed in Appendix 1, with number of nests observed for each species.

1995). Nest predation is higher within mature forest near clearcut and groupcut borders (King et al. 1996, 1998*a*), which may be attributed to increased predator abundance within mature forest near clearcut borders (King et al. 1998*b*). It is possible that the marginally higher predation rates we observed on chestnut-sided warbler nests in groupcuts are the result of the marginally higher rates of nest predation near edges we observed; however, further study is required to determine whether these nonsignificant trends represent actual patterns in predation rates in clearcuts and groupcuts.

Overall, nest survival rates in our study were high compared to most studies of cup-nesting passerines (Martin 1992). High nest survival rates in clearcuts and groupcuts are probably due to high levels of nest concealment (Rudnicky and Hunter 1993) and low predator abundance (King et al. 1998*b*) in recently harvested areas. Annand and Thompson (1997), and Morse and Robinson (1999) reported substantially lower nest success rates for shrubland birds in regenerating clearcuts (18–51%, and <15% probability of a nest surviving to fledge ≥1 young; respectively) than we observed at our study sites (60–98.6% probability of a nest surviving to fledge ≥1 young). Nest predation rates (Robinson et al. 1995) and the composition of nest predator communities (Andren 1992) change with changes in regional forest cover, factors which may explain the differences between our results from New Hampshire (97% forested), and those of Annand and Thompson (1997) and Morse and Robinson (1999) at their sites in southeast Missouri (85% forested), and southern Illinois (53% forested), respectively.

There is an emerging consensus among conservationists that for forest management to most effectively conserve biodiversity, disturbances created during the course of forest practices should mimic, to the greatest extent possible, the frequency and scale of the natural disturbance

Table 2. Daily nest survival rates (± SE) of 16 bird species combined, and of chestnut-sided warblers considered separately, compared between edge (0–10 m from edge) and interior (>10 m from edge) areas within clearcuts and groupcuts on 6 plots on the White Mountain National Forest, New Hampshire, 1994–96.

All species	Cut edge	Cut interior	*P*	*n*
Clearcuts	0.981 ± 0.008	0.993 ± 0.002	0.13	118
Groupcuts	0.984 ± 0.006	0.989 ± 0.003	0.42	86
Combined	0.983 ± 0.005	0.992 ± 0.002	0.07	204
Chestnut-sided warblers	Cut edge	Cut interior	*P*	*n*
Clearcuts	0.989 ± 0.007	0.995 ± 0.002	0.37	83
Groupcuts	0.982 ± 0.006	0.990 ± 0.003	0.25	73
Combined	0.984 ± 0.005	0.993 ± 0.002	0.10	156

regimes in which the ecosystem evolved (Hansen et al. 1991). Approximately 1% of eastern hardwood and hardwood–conifer forests regenerate from natural death and windthrow (Runkle 1990), which would result in forest ≤ 10 years old covering 10% of the forest area. This figure is similar to the amount of forest cover in this age class (8%) on the White Mountain National Forest. Although Runkle (1982) reported that natural regeneration in eastern forests resulted mostly from the death of individual trees, Curtis (1943) reported that 22 storms of hurricane intensity occurred in New England forests over a period of 3 centuries, and surmised that the period of disturbance for any 1 locality was as little as 150 years. Similarly, Leak et al. (1994) report significant disturbances resulting from windthrow occurring every 30 years in New England hardwood–hemlock forests. Thus, it appears that both the small gaps created by group selection and the larger patches created by clearcutting have natural analogs in the White Mountains, and hence, both have a legitimate place in the silviculturalist's repertoire (DeGraaf and Miller 1996).

MANAGEMENT IMPLICATIONS

Our results indicate that the nesting success of early successional shrubland birds in clearcuts and groupcuts is similar; however, some species that are characteristic of large openings, such as those created by clearcutting, are absent from smaller habitat patches created by group selection. For example, Annand and Thompson (1997) reported that at their sites in Missouri, 3 species of early successional shrubland birds, the yellow-breasted chat (*Icteria virens*), prairie warbler (*Dendroica discolor*), and rufous-sided towhee (*Piplio erythropthalmus*), were present in clearcuts 10.5–15.3 ha in size, yet absent from groupcuts of the same age 0.2–0.4 ha in size. Similarly, Robinson and Robinson (1999) reported that prairie warblers, blue-winged warblers (*Vermivora pinus*), and brown thrashers (*Toxostoma rufum*) were typical of the bird fauna of clearcuts at their sites in Illinois, yet were never detected in patches of regenerating forest 0.02–0.4 ha in size. Finally, Costello et al. (2000) detected alder flycatchers, indigo buntings, olive-sided flycatchers (*Contopus borealis*), eastern bluebirds (*Sialia sialis*), northern flickers (*Colaptes auratus*), rufous-sided towhees, song sparrows (*Melospiza melodia*), and tree swallows (*Tachycineta bicolor*) in clearcuts 8–12 ha in size in New Hampshire, but not in groupcuts of the same age 0.13–0.56 ha in size. Most of these area-sensitive species are considered species of special management concern in at least parts of their ranges (Peterson and Fichtel 1992, Hagan 1993, Smith et al. 1993, Thompson et al. 1993).

Conversely, some mature forest bird species, such as red-eyed vireos (Robinson and Robinson 1999, Costello et al. 2000), ovenbirds (*Seiurus aurocapillus*; Annand and Thompson 1997, Robinson and Robinson 1999) wood thrushes (Annand and Thompson 1997), and Swainson's thrushes (*Catharus ustulatus*; Chambers et al. 1999), are less abundant in stands managed by group selection than unmanaged stands. Gaps created by group selection displace the territories of many species of forest birds away from the harvest areas (Germaine et al. 1997), and appear to restrict within-stand movements of some forest birds (Desrochers and Hannon 1997). Finally, nest predation is higher in mature forest adjacent to groupcut edges (King et al. 1998*a*), and because group selection creates more edge per unit area cut (Franklin and Forman 1987), group selection will likely result in a greater increase of edge-related nest predation on birds in the forested portions of managed stands than would clearcutting (Thompson 1993).

Because the habitat created by group selection does not satisfy the habitat requirements of a substantial proportion of the early successional shrubland bird community, and the creation of groupcuts disrupts bird communities in the remaining mature forest in managed stands, sole reliance on group selection represents an ineffective compromise between the habitat requirements of early successional and mature forest birds. We suggest that a more effective strategy would be to consolidate mature and regenerating forest into larger blocks as suggested by Hagan et al. (1997), which would maximize the utility of the resulting habitat for both mature forest and early successional shrubland species.

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Appendix 1. Nests (n = 290) found in clearcuts and groupcuts on 6 plots on the White Mountain National Forest, New Hampshire, 1994–96.

Common name	Scientific name	Number of nests
Chestnut-sided warbler	(*Dendroica pensylvanica*)	217
American redstart	(*Setophaga ruticilla*)	20
Swainson's thrush	(*Catharus ustulatus*)	8
Veery	(*Catharus fuscesens*)	8
Rose-breasted grosbeak	(*Pheucticus ludovicianus*)	6
Alder flycatcher	(*Empidonax alnorum*)	6
Black-throated blue warbler	(*Dendroica caerulescens*)	5
Magnolia warbler	(*Dendroica magnolia*)	4
White-throated sparrow	(*Zonotrichia leucophrys*)	3
Common yellowthroat	(*Geothlypis trichas*)	3
Indigo bunting	(*Passerina cyanea*)	2
Red-eyed vireo	(*Vireo olivaceous*)	2
Gray catbird	(*Dumetella carolinensis*)	2
Hermit thrush	(*Catharus guttatus*)	2
American goldfinch	(*Carduelis tristis*)	1
Cedar waxwing	(*Bombycilla cedrorum*)	1