Effects of Silvicultural Treatments on Forest Birds in the Rocky Mountains: Implications and Management Recommendations

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Abstract — The short-term effects of timber harvesting practices on landbird species vary widely among species. Thus, the maintenance of populations of all species will require a long-term management strategy that involves maintenance of a variety of habitats over a broad landscape.

INTRODUCTION

Despite widespread timber harvesting in the Rocky Mountains, and despite mandates (e.g., NFMA 1976) to maintain populations of all vertebrate species on Forest Service management areas, there are relatively few studies (18 by our count; Hejl et al., in press) on the effects of silvicultural practices on songbird populations. This situation can be expected to change, now that current silvicultural treatments are beginning to incorporate multiple objectives, including the objective to maintain populations of nongame species. In this paper, we review a synthesis (see Hejl et al., in press) of existing literature that deals with effects of timber harvesting practices on nongame landbirds in the Rocky Mountains, and we provide specific management guidelines that address the needs of nongame species, particularly neotropical migratory songbirds.

METHODS

Habitat and Silvicultural Categories

We perused a wide variety of federal publications, ornithological and ecological journals, and unpublished reports for studies dealing with effects of timber harvesting on either landbird or raptor communities within the Rocky Mountains. Census data from a given study site were classified into one of the following vegetative cover types: ponderosa pine, (2) mixed-conifer, (3) lodgepole pine, (4) spruce-fir, (5) Cascadian forest, or (6) aspen. Harvest method was also categorized as either a clearcut (where, at most, a handful of snags were left), or an incomplete cut (any cutting treatment besides clearcut). We do not know if "uncut" sites or "control" sites from most studies were truly never cut. We assumed that, if anything, they were lightly cut. We also do not know the ages of uncut stands, but most were probably mature forests.

Synthesis of Census Data

For each study, we scored each bird species as one that declined (-1), was unaffected (O), or increased (+l) in abundance as a result of timber harvesting activity. The overall effect on each species was then evaluated by calculating the average score over all studies. Thus, a mean of -1.0 would indicate that every study reported an increase in density in response to timber harvesting, and a mean of 1.0 would indicate that every study reported a decrease in density in response to timber harvesting.

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Old-growth Associates

We summarized results of studies in the Rocky Mountains to find possible indications of old growth associates. Four studies compared uncut or lightly cut "old-growth" forests to immature or mature second-growth stands, and another two studies compared birds in uncut mature vs. old-growth forests.

Effects of Forest Fires

We reviewed the existing literature on the relationship between forest fires and landbirds in the northern Rockies, and also used census results from 38 sites in Montana that burned in the 1988 forest fires (Hutto, MS).

RESULTS

Differences Between Cut and Uncut Conifer Forests

Brown Creeper abundance differed consistently between harvested and unharvested treatments; creepers were always less abundant in clearcuts or partially logged forests than in uncut areas (Table 1). Twelve other species (e.g., Red-breasted Nuthatch, Ruby-crowned Kinglet, Golden-crowned Kinglet, and Mountain Chickadee) were also always less abundant in recent clearcuts than uncut forest, but were not always so in partially cut forests. Pygmy Nuthatch and Pine Grosbeak were always less abundant in partially logged areas but not so in clearcuts. In general, a large majority of species appear to be less abundant in treated as compared to unlogged areas (Table 1).

All permanent resident species were less abundant in recently clearcut forests than in uncut forests, but only about 60% of the migrants were less abundant. In addition, 94% of the residents were less abundant in partially logged forests, while about 40% of the migrants were less abundant.

Ten species were consistently more abundant in one of the three age categories of clearcuts or in partially cut forests--Mountain Bluebird and Townsend's Solitaire in early clearcuts; Mountain Bluebird, Warbling Vireo, MacGillivray's Warbler, Rufous Hummingbird, American Kestrel, and Broad-tailed Hummingbird in 10-20-year-old clearcuts; Cassin's Finch in older clearcuts and Calliope Hummingbird, House Wren, and Rock Wren in partial cuts. All species that were more abundant in logged areas are migrants.

Differences Between Cut and Uncut Aspen Forests

We found only two studies on effects of logging treatments on birds in aspen forests. These were conducted in different areas (Utah, Colorado), and involved treatments on vastly different scales. The combined results are equivocal, and underscore the need for more specific, practical information for managers.

Old-Growth and Second-Growth Associates

No species was consistently more abundant in old-growth or mature second-growth stands across four studies that compared such stands. In general, however, woodpeckers and nuthatches were more abundant in old-growth than in mature second-growth stands. In two of four studies, six species (Hairy Woodpecker, Western Wood-Pewee, Brown Creeper, Golden-crowned Kinglet, Swainson's Thrush, and Townsend's Warbler) were relatively more abundant in old-growth stands and four species (Dusky Flycatcher, Solitary Vireo, Chipping Sparrow, Brown-headed Cowbird) were relatively more abundant in mature, second growth stands. All but two of these species are migrants.

Raptors

Only three raptor species were sampled adequately enough to be listed in our assessment of bird presence in various logging treatments across forests in the Rocky Mountains (Table 1). Northern Goshawk appeared to be positively affected by young clearcuts, and negatively affected 10-20 years later. Red-tailed Hawks and American Kestrels were, on average, positively affected by clearcuts.

A review of the owl (vis-à-vis timber harvesting) literature suggests that at least three owl species may be associated with old-growth habitats in the Rocky Mountains--Flammulated Owl, Mexican Spotted Owl, and Boreal Owl.

Effects of Forest Fires

Fire is the single-most important factor influencing the development of landscape patterns in the northern Rockies (Habeck and Mutch 1973, Gruell 1983, Agee 1991). Moreover, landbird communities associated with standing dead "forests" that characterize early post-fire habitats are unique and distinctly different from clearcuts (Hutto, MS). The distinctness is largely due to the relative abundance of species that are nearly restricted in their habitat distribution within the Rocky Mountains to early post-fire conditions (e.g., Black-backed Woodpecker), and to species not restricted to, but relatively abundant in, early post-fire habitats (e.g., Olive-sided Flycatcher). These

Table 1. — Indices of the tendency for a bird species to be more or less abundant in clearcut or partially cut forest than in uncut forest. A given study was scored according to whether the species increased (+1), decreased (-1), or was unaffected by cutting (0). Values in table are averages of these scores over all studies in which the species was recorded. Species are listed in order from -1.00. Sample sizes in parentheses. This table was taken directly from Hejl et al., in press.

Species[a]	NTMB[b] status	Clearcuts			Partially Cut
		0-10 yrs	10-20 yrs	20-40 yrs	
Red-breasted Nuthatch	P	-1.00 (8)	-1.00 (4)	-1.00 (3)	-0.70 (10)
Brown Creeper	B	-1.00 (8)	-1.00 (5)	-1.00 (3)	-1.00 (12)
Golden-crowned Kinglet	P	-1.00 (8)	–	–	-0.60 (10)
Ruby-crowned Kinglet	B	-1.00 (8)	-1.00 (4)	-1.00 (3)	-0.40 (10)
Mountain Chickadee	P	-1.00 (7)	-1.00 (5)	0.00 (3)	-0.77 (13)
Winter Wren	P	-1.00 (6)	–	–	-0.20 (5)
Varied Thrush	P	-1.00 (6)	–	–	-0.75 (4)
Townsend's Warbler	A	-1.00 (6)	–	–	-0.40 (5)
Black-capped Chickadee	P	-1.00 (5)	–	–	-0.67 (3)
Swainson's Thrush	A	-1.00 (5)	–	–	-0.50 (6)
Three-toed Woodpecker	P	-1.00 (4)	-1.00 (3)	–	-0.50 (6)
Solitary Vireo	A	-1.00 (4)	0.00 (4)	–	0.33 (9)
Evening Grosbeak	P	-1.00 (3)	–	–	–
Hammond's Flycatcher	A	–	-1.00 (3)	–	–
White-breasted Nuthatch	P	–	-1.00 (3)	–	-0.14 (7)
Pygmy Nuthatch	P	–	–	–	-1.00 (5)
Cooper's Hawk	B	–	–	–	-0.67 (3)
Violet-green Swallow	A	–	–	–	-0.60 (5)
Gray Jay	P	-0.75 (8)	-1.00 (3)	0.00 (3)	-0.25 (4)
Warbling Vireo	A	-0.75 (4)	1.00 (3)	–	0.33 (9)
Western Tanager	A	-0.75 (4)	-1.00 (4)	–	0.09 (11)
Orange-crowned Warbler	A	-0.67 (3)	–	–	-0.50 (4)
Yellow-rumped Warbler	B	-0.67 (9)	-0.67 (6)	0.67 (3)	-0.46 (13)
Hairy Woodpecker	P	-0.62 (8)	-0.67 (6)	-0.33 (3)	-0.25 (12)
Common Nighthawk	A	–	-0.67 (3)	–	-0.50 (4)
Red Crossbill	P	–	-0.25 (4)	–	-0.33 (3)
Red-naped Sapsucker	B	-0.60 (5)	-0.25 (4)	0.67 (3)	0.17 (6)
Clark's Nutcracker	P	-0.60 (5)	–	–	0.33 (3)
Hermit Thrush	B	-0.60 (5)	-1.00 (3)	–	-0.80 (10)
Black-headed Grosbeak	A	-0.60 (5)	0.20 (5)		0.22 (9)
Steller's Jay	P	-0.50 (4)	0.00 (4)	–	-0.29 (7)
Common Raven	P	-0.43 (7)	-0.33 (3)	–	-0.17 (6)
Pine Siskin	B	-0.38 (8)	-0.17 (6)	0.00 (3)	-0.08 (12)
Northern Flicker	B	-0.37 (8)	0.33 (6)	0.33 (3)	-0.17 (12)
Pine Grosbeak	P	-0.33 (3)	–	–	-1.00 (3)
Cassin's Finch	B	-0.33 (3)	-0.50 (4)	1.00 (3)	0.60 (5)
Western Wood-Pewee	A	-0.20 (5)	–	–	-0.50 (4)
Fox Sparrow	B	-0.20 (5)	–	–	–
MacGillivray's Warbler	A	-0.17 (6)	1.00 (3)	–	0.17 (6)
American Robin	B	-0.10 (10)	0.33 (6)	0.33 (3)	0.15 (13)
Rufous Hummingbird	A	0.00 (5)	1.00 (3)	–	0.33 (3)
House Wren	A	0.00 (3)	-0.25 (4)	–	0.86 (7)
Wilson's Warbler	A	0.00 (5)	–	–	–
Williamson's Sapsucker	B	–	–	–	0.00 (5)
Cordilleran Flycatcher	A	–	–	–	0.00 (6)
Western Bluebird	B	–	–	–	0.20 (5)
Chipping Sparrow	A	0.13 (8)	0.50 (6)	–	0.60 (10)
Olive-sided Flycatcher	A	0.20 (10)	0.00 (3)	–	0.67 (9)
Red-tailed Hawk	B	0.33 (3)	0.33 (3)	–	0.33 (3)
Tree Swallow	B	0.33 (3)	–	–	–
White-crowned Sparrow	B	0.40 (5)	–	–	–
Dark-eyed Junco	B	0.60 (10)	0.67 (6)	0.67 (3)	0.38 (13)
Northern Goshawk	B	0.67 (3)	-0.75 (4)	–	–
Mourning Dove	B	0.67 (3)	0.33 (3)	–	0.67 (3)
Townsend's Solitaire	B	0.80 (5)	0.00 (5)	0.00 (3)	-0.25 (8)
Mountain Bluebird	B	1.00 (7)	0.80 (5)	–	0.67 (6)
Lincoln's Sparrow	A	–	0.67 (3)	–	–
American Kestrel	B	–	1.00 (3)	–	–
Broad-tailed Hummingbird	A	–	1.00 (3)	–	0.25 (4)
Calliope Hummingbird	A	–	–	–	1.00 (3)
Rock Wren	B	–	–	–	1.00 (3)

[a]Only those results from sample sizes greater than three are included in the table.
[b]Neotropical migrant (NTMB) status, as designated in the Partners in Flight Newsletter (1992, Vol. 2, No. 1, p. 30): A = long-distance migrant species, those that breed in North America and spend their nonbreeding period primarily south of the United States, B = short-distance migrant species, those that breed and winter extensively in North America, P = permanent resident species that primarily have overlapping breeding and nonbreeding areas.

associations deserve greater attention by land managers because frequent, low intensity understory fires do not satisfy the needs of fire-dependent bird species; such species rely on the presence of large, high-intensity crown fires that characterize the historical fire regime of many conifer forest types in the northern Rockies.

DISCUSSION

To a manager in need of information on timber harvesting effects on Rocky Mountain birds, it should be clear that too few studies have been conducted. We are unable to discuss effects of alternative silvicultural techniques except in very general (clearcuts vs. all other) terms. Moreover, there are no quantitative data on the range of habitats occupied by landbird species (which is necessary before we can evaluate the extent to which a negative effect on a species in one habitat type translates into a serious effect on the species as a whole), no data on cumulative landscape effects, few data from other than the breeding season, and no data on reproductive or survival success in relation to treatments.

Nevertheless, there is no question that clearcuts have negative effects on many forest-dependent species and positive effects on many species that frequent open forests or open habitats in general. This result alone raises two important management issues, which are discussed below. In turn, these issues lead us directly to a series of management recommendations. First, different species within various behavioral guilds respond differently to a given silvicultural treatment (for example, Hammond's Flycatcher is negatively affected by clearcutting, while Olive-sided Flycatcher is not, or the migratory Ruby-crowned Kinglet declines, while the migratory Mountain Bluebird does not). Thus, managing for "guilds" of species would be to the detriment of those species that respond atypically in comparison with the guild as a whole. In terms of managing for maintenance of bird populations, there is no substitute for understanding habitat needs of each species, and for monitoring populations of as many of them as possible. Thus, we still need a species-by-species management approach, but that can be accomplished largely through development of land-based management plans coupled with species-by-species monitoring efforts (see below).

Secondly, determining "effects of timber harvesting" is much more complicated than conducting studies such as those described in the papers we reviewed. This is because "effect" can be measured as either a short-term or a long-term consequence of harvesting activity. The literature deals exclusively with short-term consequences, but managers' legal mandates require a long-term, broad-scale perspective that allows only land use patterns that will not cause the widespread or complete disappearance of natural populations, patterns, and processes. Thus, a timber harvesting practice that might cause a relatively great amount of short-term change from pre-harvest conditions may actually be integral to a long-term strategy for maintaining populations of all wildlife species, especially in areas that experience frequent and widespread disturbance. Therefore, rather than simply asking what the short term effect of a given harvest method is, we should be asking, What is the best long-term strategy for achieving (mimicking) natural patterns and processes over the long term, and How should we manage for those species that fall through the cracks even after our strategy mimics nature as well as any can?

To illustrate, consider that conifer forests of the Northern Rocky Mountains are part of a fire-maintained system and that there is much less vegetation cover in early successional stages now than prior to fire control in some cover types. If, of all timber harvesting practices, clearcuts come closest to matching patterns produced by an intense fire regime, then perhaps clearcutting, which produces the greatest change from pre-harvest conditions in an immediate sense, is the best practice in a long-term sense. The point here is not to argue that clearcuts are similar to post-fire bird communities; they are not (Hutto, MS). The point is to emphasize that the least harmful timber harvesting practice may not be the one that appears over the short run to cause minimal change from pre-harvest conditions. Current thinking and future research efforts need to be directed along these lines if we are to make progress in managing land for the maintenance of migratory landbirds, resident landbirds, and all other plant and animal species (i.e., biological diversity).

MANAGEMENT RECOMMENDATIONS

Assuming that an important management goal is to maintain natural populations, patterns, and processes over broad landscapes, we recommend the following management guidelines:

1. Manage for Desired Landscape Patterns

Harvest-by-harvest decisions should not be made in the absence of a clear picture of trends and conditions over a broad landscape. Unfortunately, emerging landscape patterns are largely products of incremental habitat modification with little or no consideration of how each unit fits into the larger scene. Therefore, we recommend that managers develop a clear picture of the landscape (including the proportions and juxtaposition of cover types) that they are trying to create and maintain so that decisions on single harvests are made in the context of a desired landscape picture, and in light of the processes and patterns that would normally produce that landscape.

In general, we recommend managing timber harvesting activities to either (1) have negligible impact in the present, and not affect the probability that natural processes (e.g., fires, insect outbreaks) occur in the treatment area in the future, or (2) have moderate to extreme impact on the land and biological community, but in a manner that is close to what some natural process would have been expected to do in the same place at about the same time. The first option means cutting in a manner such that the same species and processes (e.g., fire) persist on the management unit. The second option means understanding that management activities should never be viewed as substitutes for natural processes because human activities differ in important ways from natural disturbance (e.g., clearcutting differs in important ways from fire-caused disturbance).

Some critics would claim that a changing world makes it difficult to know what the existing landscape patterns "ought to be", and that past environments may be inappropriate models for desired future conditions. We agree it is presumptuous to assume that we know what "ought to be", but we disagree that such an approach is unworkable. It is not that hard to identify largely "unnatural" distributions and proportions of land cover types that are a consequence of current management practices. Botanists have provided a good deal of information about what landscapes looked like before mechanized land-use became the norm, and it would be well worth putting that information to use. Managing at the landscape level will require improved inter-agency coordination, and knowledge of the conditions of private lands in the same region. In short, management decisions will have to be made in the context of broader bio-regional planning efforts.

This is quite different from traditional wildlife management schemes, where the goal is to maximize the production of a select few (mostly game) species. It is also a matter of changing management priorities, NOT a matter of finding money to pay more attention to nongame species.

2. Manage for the Maintenance of Natural Disturbance Regimes

Because the adaptive histories of most species in natural ecosystems are linked to natural periodic disturbance, it is highly unlikely that the maintenance of biodiversity will be possible without allowing natural disturbances to occur as they have historically. This means a huge public education effort (by a better-informed Smokey the Bear?) so that (1) fires, blowdowns, insect outbreaks, and the like are properly viewed as natural events, and (2) efforts to maintain these processes are understood and encouraged by both natural resource managers and the public. Only then will land managers have a reasonable chance of doing whatever else it takes to manage for natural processes.

3. Use Knowledge of the Local Ecology

Be cautious about extrapolating results from other areas. Everything from habitat use to food requirements changes markedly from one place to another. Rely heavily on information about the natural history and ecology of the local area for management decisions.

4. Move Toward Multi-Species Management

It is a predictable result that some species are benefitted and some hurt through any silvicultural method. The result is not trivial, however. Managers will have to deal increasingly with this fact as they generate information for the larger numbers of species that will be part of newer multi-species management schemes. Management for the maintenance of larger systems will, in fact, emphasize this apparent conflict. We say "apparent" conflict because managing for some species and against others is not a conflict when viewed from the perspective of a large landscape and a long time period. Pieces of the larger landscape should be managed to the detriment of some species and benefit of others, but there should always be enough variety in the constantly shifting mosaic of successional stages such that all native species are being managed for simultaneously over a broader landscape. Defining the pieces of the puzzle (cover types and other elements) necessary to maintain populations of all vertebrates requires knowledge of the habitat needs of a larger number of species than wildlife biologists have traditionally considered, especially nongame species.

5. Use Single-Species Management Only When Necessary

Manage for single species only when they become species of special concern, threatened, or endangered, and only for as long as it takes for the species to recover.

6. Monitor Both Landscape Patterns and Species Populations

Even though we recommend managing for landscape patterns, and monitoring how well the "target" landscape is being maintained, this does not remove the need for a multi-species monitoring program. One could be maintaining a "proper" landscape, but still witness population declines of bird species because of improper management elsewhere, or because of the decline of habitat elements that cannot be monitored at the landscape level. Thus, ecosystem management is not a move away from monitoring single species, it is a move away from managing the land for the benefit of relatively few species.

For landscape monitoring, we recommend using a GIS to monitor how successfully the landscape is matching the suspected "natural" pattern of cover types, including their sizes, proportions, and juxtapositions. For bird monitoring, we recommend using as many species as possible to monitor how successfully we are managing for the maintenance of all wildlife species. Landbirds are a powerful tool here because a large number of species can be monitored as easily as one. Moreover, the range of conditions that landbirds occupy is so varied that the monitoring of these species might be expected to provide a good indication of how well we are managing for the variety of species that are not monitored through other methods.

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