Use of a Landbird Monitoring Database To Explore Effects of Partial-Cut Timber Harvesting

Jock S. Young and Richard L. Hutto

ABSTRACT. We used data from the USDA Forest Service Northern Region Landbird Monitoring Program to investigate the effects of partial-cut timber harvesting on bird abundances in conifer forests within the northern Rocky Mountains. We present point-count data from four separate years of the long-term monitoring database, which included between 467 and 907 points, depending on the year. Five bird species were significantly more abundant in uncut forest stands in at least one year, and 17 species were more abundant in partially cut stands in at least one year. Four and eight species from these two groups, respectively, showed the same differences in a short-term, control/treatment comparison conducted in the same region, and no species showed contradictory treatment effects when the two studies were compared. Provided that vegetation data are coupled with bird abundance data, and provided that enough points are visited to compensate for an uncontrolled design, these results suggest that data from long-term monitoring points can be useful not only as sources of information about long-term population trends, but as sources of information about habitat relationships and the effects of land use. For. Sci. 48(2):373–378.

Key Words: Bird survey, forest management, habitat use, northern Rockies, point counts.

Determining the effects of partial-cut timber harvesting on landbird species is a major concern in the northern Rocky Mountains, as elsewhere. However, most previous studies have dealt with even-aged systems such as clearcuts (Sallabanks et al. 2000). In a review of the literature, Hejl et al. (1995) found only 13 studies of the effects of partial-cut timber harvesting on birds in the entire Rocky Mountains. These included a variety of practices such as overstory removal and group selection, and most studies had very few replicates. Recent trends have resulted in increasing acreages of forest managed using partial-cut (uneven-aged) silviculture systems (Thompson et al. 1995). Thus, there is a need for data on the effects of partial-cut harvesting practices on all forest bird species.

Long-term monitoring projects provide a wealth of data that can be used for many purposes in the short term, before the analysis of long-term trends is possible. When vegetation data are collected at each point, correlative relationships can be studied for any habitat variable measured. Although such data sets are not the products of studies designed to test the effects of specific management practices, they include a much greater number of sites than are typically included in before–after/treatment–control studies, so they have the potential to provide meaningful information about management effects. For example, bird and vegetation data collected from about 6,000 long-term monitoring points established in association with the USDA Forest Service (USFS) Northern Region Landbird Monitoring Program (NRLMP) have already provided the information needed to establish bird-habitat relationships among natural and human-modified cover types (Hutto and Young 1999).

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In the NRLMP, long-term monitoring is conducted across the region on a biennial basis, while in the intervening years we conduct more focused, single-year projects that address current information needs, especially as they relate to known management issues and potential population declines that may one day reveal themselves through the long-term monitoring efforts. One such study in 1997 examined the effects of partial-cut timber harvesting on bird abundance in midelevation, conifer forests on three national forests in northwestern Montana and northern Idaho (Hutto and Young, unpublished data). Here we examine the same question using data from the long-term monitoring database to see whether opportunistic use of a long-term database might expose the same general patterns that appeared from more carefully designed studies of management treatment effects.

**Study Area**

Transects for the USFS Northern Region Landbird Monitoring Program were placed in stratified random locations (along tertiary roads and trails) throughout the nonwilderness national forest lands of western Montana and northern Idaho (detailed methods can be found in Hutto and Young 1999). National forest lands in this region are primarily coniferous forest, ranging from dry ponderosa pine (*Pinus ponderosa*) and Douglas-fir (*Pseudotsuga menziesii*) to wet, dense, western red-cedar (*Thuja plicata*) and western hemlock (*Tsuga heterophylla*) forests, but transects also included riparian areas, clearcuts, grassland, sagebrush (*Artemesia* spp.), and other vegetation types. Elevations ranged from 450–2,700 m, with about 90% of the points between 760 and 2,300 m.

**Methods**

Point counts were conducted once per year along transects consisting of 10 points. Points were systematically placed 300 m apart along the road or trail. Transects were usually separated by several miles. Vegetation variables were estimated from one 30-m-radius plot at each point. We began monitoring from permanent points on an annual basis, so we have data from each of 3 yr (1994–1996). We began biennial sampling at about half of these transects in 1998. We included analyses of data from the 2000 field season in this article, but did not include the 1998 data because the number of partial-cut sites was low.

**Vegetation Treatment Categories**

After point counts were conducted each year, field observers described the vegetation at each point. We used the cover type designated by each observer in each year to select the points used in this report. Conifer forest stands were categorized into cover types based on tree species composition, successional stage, canopy cover, and perceived evidence of past logging.

For the comparison in this article, we selected points that were surrounded by unlogged “Mature” or early postharvest “Partial Cut” cover types for at least a 100 m radius (no edge nearby) and were within mixed-conifer, Douglas-fir, or grand fir (*Abies grandis*) dominated stands. Other common tree species included western larch (*Larix occidentalis*), lodgepole pine (*Pinus contorta*), and ponderosa pine. We used only those points from west of the Continental Divide. We included all types of partial-cut harvesting (e.g., thinning, shelterwood, seed tree), as long as the stands still included at least 1% cover of mature conifer trees. Some transects were not run every year, and many points did not meet the above criteria in all years that they were visited because observers in different years classified the same points differently with respect to cover type, canopy cover, or presence of edge. We analyzed each year separately because these problems made it impossible to pool the data across years and because we wanted to test the effectiveness of a single year of monitoring data.

**Bird Survey Methods**

The bird counts followed recommendations discussed by Ralph et al. (1995) and methods described by Hutto et al. (1986). A 10 min. point count was conducted at each of the 10 sampling points along a transect. Points were visited once each breeding season between mid-May and mid-July. All birds seen or heard within the count period were recorded. Field observers generally began counts about 15 min. after sunrise (after the predawn chorus), and completed counts between 0630 and 1100 hr (MST). Counts were not conducted on days with continual rain or high winds.

**Analysis Methods**

We used logistic regression ( Hosmer and Lemeshow 1989) to test for differences between the proportion of points with detections in uncut and partial-cut stands for all bird species detected on at least 25 points. Logistic regression models the effects of independent variables on the probability of a particular species occurring on a site or, as is technically the case here, the probability of a species being detected during a standard 10 min. point count. Because most abundances per point count were 0 or 1 for any particular species, little information was lost by modeling detections (yes or no) rather than actual abundances at each point.

We then used logistic regression to test the effect of canopy cover to determine if that variable may be a more useful predictor of bird occurrence than the categorical treatment variable. If there were no residual treatment effects after canopy cover was present in the model, this would suggest that the effect of logging was due entirely to the reduction in canopy cover. For these analyses we used a pooled dataset of the 3 yr from 1994 to 1996. Repeat visits to individual points were treated as independent counts. Although not strictly correct for confirming significance, this method gave an indication of the relative effects of treatment and canopy cover.

**Results**

Because there were some changes in transects visited each year and there was observer variability in the categorization of stands, a different set of points was analyzed from one year to the next (Table 1). Of all points visited in more than one year, 21% were “switched” between mature and partial-cut categories by different observers, and more than half were considered neither mature nor partial cut in at least one year.
Eighty-five bird species were detected within 100 m of an observer using regionwide monitoring points that fell within either uncut or partial-cut forest stands, with 33 species detected on at least 25 points in at least one year (species and scientific names listed in Table 2). The abundances of 22 of these 33 species were significantly different between uncut and partial-cut forest stands in at least one year (Table 2, penultimate column), with five species (brown creeper, winter wren, golden-crowned kinglet, varied thrush, and Townsend’s warbler) being more abundant on points in uncut stands, and 17 species more abundant on points in cut stands. No species had contradictory treatment effects in different years.

Of the 22 species showing significant differences between treatments in at least one year, 12 had similar results in the 1997 study (Table 2, last column), which was based on 35 uncut stands and 37 partial-cut stands (Hutto and Young, unpublished data). Four of these species were more abundant at uncut points and 8 were more abundant at partial-cut points (Table 2).

When the effect of canopy cover was included in the regression models along with the treatment effect (Table 3), it was apparent that the treatment effect could be explained almost entirely by canopy cover changes for many species (e.g., mountain chickadee, brown creeper, golden-crowned kinglet, ruby-crowned kinglet, varied thrush, and Townsend’s warbler). Furthermore, some species showed strong correlations with canopy cover but almost no treatment effect (e.g., chestnut-backed chickadee, hermit thrush, black-headed grosbeak, and pine siskin), suggesting that canopy cover may be the more useful variable. On the other hand, many species still had strong treatment effects after canopy cover was accounted for (e.g., Cassin’s vireo, winter wren, yellow-rumped warbler, western tanager, chipping sparrow, dark-eyed junco, and brown-headed cowbird), suggesting that the treatment effect was due to some other variable associated with the logging treatment rather than the decrease in canopy cover itself.

**Discussion**

Of the five species that were more abundant in uncut stands, all but the varied thrush also had significant differences in a separate control-treatment study (Hutto and Young, unpublished data). These five species were also among the most consistent species showing such relationships in numerous studies reviewed by Hejl et al. (1995), and are species of potential concern because mature forests are more likely to be converted to partial cuts in the future, rather than the reverse.

Many of the bird species that were more abundant in the partial-cut stands, such as the hairy woodpecker, mountain chickadee, yellow-rumped warbler, and western tanager, are open-forest species that might be expected to be more common in thinned conifer forests than anywhere else, and may be of little concern, especially because many of these species are common in all types of harvested forest (Hutto and Young 1999). However, we still do not know if these species are doing as well in these newly created habitats as their relative abundance suggests, or if cutting practices might be creating unusual forest structures that might, in turn, act as "ecological
Table 2. *P*-values from logistic regression analyses of differences in bird occurrences between mature uncut and partial-cut forest stands for separate years within the USFS Northern Region Landbird Monitoring Program database. All significant treatment effects from different years within a species were in the same direction (shown in the "Effect" column). Results are shown for years with at least 25 detections of a given species. The last column shows the sign of the significant results in an independent control-treatment study (Hutto and Young, unpublished data) for comparison. Species are in taxonomic order.

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<td>0.53</td>
<td>0.93</td>
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<td>0.50</td>
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<td>0.02</td>
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<td>Winter wren, <em>Troglodytes troglodytes</em></td>
<td>0.18</td>
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<td>&lt;0.01</td>
<td>0.03</td>
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<td>Golden-crowned kinglet, <em>Regulus satrapa</em></td>
<td>0.73</td>
<td>0.01</td>
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<td>Ruby-crowned kinglet, <em>Regulus calendula</em></td>
<td>0.72</td>
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<td>0.03</td>
<td>+</td>
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<td>0.01</td>
<td>+</td>
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<td>Swainson’s thrush, <em>Catharus ustulatus</em></td>
<td>0.68</td>
<td>0.74</td>
<td>0.28</td>
<td>0.33</td>
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<td>0.32</td>
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<td>American robin, <em>Turdus migratorius</em></td>
<td>0.03</td>
<td>0.11</td>
<td>0.53</td>
<td>0.61</td>
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<td>Varied thrush, <em>Ixoreus naevius</em></td>
<td>0.37</td>
<td>0.03</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
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<tr>
<td>Orange-crowned warbler, <em>Vermivora celata</em></td>
<td>0.01</td>
<td>&lt;0.01</td>
<td>0.02</td>
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<td>+</td>
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<tr>
<td>Yellow-rumped warbler, <em>Dendroica coronata</em></td>
<td>0.04</td>
<td>0.94</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
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<td>Townsend’s warbler, <em>Dendroica townsendi</em></td>
<td>0.71</td>
<td>0.25</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>-</td>
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<td>MacGillivray’s warbler, <em>Oporornis tolmiei</em></td>
<td>0.04</td>
<td>0.01</td>
<td>0.02</td>
<td>0.58</td>
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<td>Western tanager, * Piranga ludoviciana*</td>
<td>0.34</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>0.02</td>
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<td>Chipping sparrow, <em>Spizella passerina</em></td>
<td>0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
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<td>Dark-eyed junco, <em>Junco hyemalis</em></td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>0.01</td>
<td>0.06</td>
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<td>Brown-headed cowbird, <em>Molothrus ater</em></td>
<td>0.30</td>
<td>0.03</td>
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<tr>
<td>Red crossbill, <em>Loxia curvirostra</em></td>
<td>0.93</td>
<td>0.50</td>
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<td>Pine siskin, <em>Carduelis pinus</em></td>
<td>0.30</td>
<td>0.31</td>
<td>0.14</td>
<td>0.26</td>
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"Traps" by providing the birds with cues for settling without providing habitat that is otherwise suitable. One concern is that the brown-headed cowbird is much more likely to occur in partially cut than in uncut forests (Table 2; Young and Hutto 1999) and the presence of this nest parasite may contribute to the creation of unsuitable but otherwise attractive habitat.

The results from this study indicate significant changes in the bird community as a result of partial-cut timber harvesting. Many of these changes can be ascribed to the decrease in canopy cover (Table 3). Because of the almost infinite variability in timber harvest prescriptions currently conducted on the landscape, continuous variables such as canopy cover may actually be more useful tools than categorical treatment variables for discerning management effects. However, there were several species that showed treatment effects without being greatly influenced by canopy cover, so treatment *per se* may still be an important variable. These species appear to be affected by something associated with the treatment process itself, whether resulting from differences in understory or tree architecture, or any number of other possible explanations. Interestingly, all but one of these species (the winter wren) showed positive, rather than negative, effects of treatment.

When comparing results of these analyses to an independent control-treatment study (Hutto and Young, unpublished data), 12 species had significant treatment effects in the same direction (8 positive and 4 negative) and none in opposite directions. The pileated woodpecker and the Swainson’s thrush were the only species that showed effects in the 1997 study but none based on the monitoring database. The detection rate of woodpeckers was higher in the 1997 study due to the addition of supplemental data from outside the 10 min. count period. Because woodpeckers were not well sampled using standard point-count methods during the passerine breeding season, they may be difficult to study in many monitoring programs without a modified protocol.

The long-term monitoring database had the advantage of greater sample sizes, but points were sampled without a priori control over site conditions. Consequently, the database included a complex mixture of logging treatment types (Figure 1). The monitoring database also resulted from single visits to each point in a given year. Nonetheless, the long-term monitoring database revealed significant differences...
between treatments for ten bird species that did not show such differences in the 1997 study (Table 2), including two species that were detected too infrequently in that study. Even if the sample sizes for some of these species were too small for firm conclusions, many of the results undoubtedly indicated true treatment effects, especially for species with large differences in abundance such as the brown-headed cowbird and dusky flycatcher.

The failure to detect differences in the abundances of some species in the more focused, management-effect study, relative to the regionwide database, may have been due to their relatively uncommon occurrence in the forest types included in the 1997 study. The long-term monitoring database may have included more points with these species because it included a greater diversity of forest structures. Species such as the warbling vireo, MacGillivray's warbler, and black-headed grosbeak are bird species of shrubby riparian areas and clearcuts, and do not occur as commonly in partial-cut forests (Hutto and Young 1999), especially recent harvest units without a well-developed shrub layer, as was the case in the 1997 control-treatment study. The fact that there were more shrubs on uncut sites in the 1997 study may have been one reason why neither the warbling vireo nor the MacGillivray's warbler were more common in the partial-cut sites.

The usefulness of collecting vegetation data in this type of monitoring program was compromised by the difficulty of collecting accurate data at thousands of points. Because the vegetation data were collected by the bird surveyors, the information gathered was, by necessity, quick and simple. Measurements were often qualitative, with heavy reliance on ocular estimates. Preseason training helped reduce, but certainly not eliminate, variability in these estimates. Quantitative methods can theoretically achieve more precise estimates (Block et al. 1987), but only with the investment of substantial time and effort in measuring enough plots to overcome the sampling error inherent in the placement of individual plots. Ocular estimates are likely to be the most precise alternative when strict time constraints are imposed by the necessity to collect vegetation data at thousands of points. However, we emphasize that it is important to take the effort and expense of gathering accurate vegetation data for each site if short-term habitat-relationships data are to be used from a monitoring program. Therefore, we have taken
photographs at every point, as well as hiring experienced forestry personnel to conduct additional plots at many points, and will use all of this information to reclassify points that may have been misclassified in one or more years.

Substantial variability in observer estimates of vegetation is expected in any study (Gotfrid and Hansell 1985, Block et al. 1987), and it is not surprising that it was especially high in our data set. The wide range of canopy cover estimates in both treatment categories was probably as much a result of observer error as it was variation in actual conditions. There was also no way to determine which observer's data were the most accurate. This was probably a reason for major differences in apparent treatment effects among years. For example, 1994 was the only year in which there were more points in partial-cut stands than in uncut stands (Table 1). Apparently the observers in that year were more apt to classify an uncertain stand as partially cut. This could be why so few species had significant relationships in 1994 (only 7, compared with 13–20 in the other 3 yr). This problem is partly overcome by the ability to analyze the results of several different years separately, but it weakens the inferences that can be made. Nonetheless, we were able to expose treatment effects in most of the expected species.

Provided that sufficiently accurate vegetation data are coupled with bird abundance data, and provided that enough points are visited to compensate for an uncontrolled design, these results suggest that data from long-term monitoring points can be useful not only for information about long-term population trends, but also in the short term as a source of information about habitat relationships and the effects of land use on bird populations (e.g., Hutto and Young 1999, Young and Hutto in press). The land use effects revealed here also suggest that regional bird populations may be strongly affected when increasing acreages of partial-cut forestry are summed across a new landscape (Thompson et al. 1995).

**Literature Cited**


