Relationships Between Forest Songbird Populations and Managed Forests in Idaho

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Abstract — Many species of songbirds have experienced population declines in the eastern U.S. in recent years, but conclusive data on population trends and factors affecting populations in the West are lacking. Few studies have evaluated the importance of surrounding land configuration to songbird abundances. In 1992, we initiated a study in mixed conifer forest in west-central Idaho to compare songbird composition and abundances among two untreated watersheds and three watersheds having clearcuts. Watersheds were selected on the basis of their large size, accessibility, dominant tree type, and timing and extent of management. Based on 1992 point counts of 29 selected bird species, we identified four species that had significantly lower mean birds/count station in managed study areas than in untreated areas. These were hermit thrush (*Catharus guttatus*), Swainson's thrush (*Catharus ustulatus*), pileated woodpecker (*Dryocopus pileatus*), and warbling vireo (*Vireo gilvus*). Twelve species were significantly more abundant in clearcut watersheds than in untreated watersheds, whereas abundances of 13 species did not differ between treated and untreated study areas. Variation in bird species richness among study areas may have been influenced by sampling intensity. Negative or positive responses to management were not clearly associated with migratory status. We discuss 1993 modifications to our study design and future use of a Geographic Information System (GIS) to measure landscape characteristics.

INTRODUCTION

Many forest-dwelling birds, particularly those that breed in North America and winter in Central and South America (neotropical migrants) have shown population declines over the last 10-20 years (Robbins et al. 1989a). Declining trends of songbird populations are best documented in the eastern U.S., where habitat fragmentation is proposed to be a primary contributor to species loss (Robbins et al. 1989b, Faaborg and Clawson 1991, Freemark and Merriam 1986, Whitcomb et al. 1981). However, no single contributing factor explains declines for all species in all geographic areas (Finch and Stangel 1993). Because data on population trends are lacking for many western songbird species, and relatively little is known of songbird habitat relationships in this region, comparisons to eastern studies are difficult.

Large areas of intact forest remain in the western U.S., but management is changing the landscape configuration. The resulting pattern is extensive forested areas increasingly containing more clearings. This differs from the predominant pattern in the east and mid-west where isolated forest patches are surrounded by clearings. Nevertheless, this alteration introduces habitat characteristics related to fragmentation (Van Dorp and Opdam 1987, Franklin and Forman 1987). Despite conflicting trends from Breeding Bird Survey data (reviewed by Finch 1991), evidence suggests that many forest-dwelling birds are negatively affected by reductions in habitat area due to increased nest predation and parasitism (problems associated with edge), and that a high proportion of these species are long-distance migrants (Temple 1986, Terborgh 1992, Askins et al. 1990, Whitcomb et al. 1981). In 1992 we initiated a study in mixed conifer forests in west-central Idaho to examine the

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composition of forest bird communities in managed and relatively intact (untreated) landscapes. In the context of this study, landscape pattern is the variation in vegetation cover resulting from natural influences (topography, fire, soils) and management activities (primarily timber harvest). Patterns vary by the size, shape, and distribution of forest and nonforested stands.

This paper reports on the study design, methods, and preliminary results based on the first year's (1992) data. The objectives were to: 1) determine if the sampling scheme was appropriate for a landscape analysis, 2) analyze overall bird species compositions and abundances in relation to general landscape pattern (managed vs. untreated), 3) evaluate differences in abundances of selected species among managed and untreated landscapes, and 4) determine if neotropical migratory birds or other bird species should be highlighted as species of special management concern in interior mixed conifer forests.

The results of our study will ultimately be used to predict species occurrences in managed and untreated western forests, and to offer recommendations to land use agencies for managing avian abundance and diversity in commercial forests of the western United States.

METHODS

Study Areas

Our study area includes the western half of the Payette National Forest in west central Idaho. Study areas were selected using a hierarchical process. A map of Douglas-fir (*Pseudotsuga menziesii* var. *glauca*) forest coverage was generated for the Payette National Forest from the University of Idaho Gap Analysis database (completed for the state of Idaho at a scale of 1:200,000). Douglas-fir forest is 1 of 33 groupings of broad vegetation categories designated as "wildlife habitats" by the Gap Analysis mapping system (Scott et al. 1990). Based on this vegetation group's distribution, potential study areas were then examined on 7.5' ortho-quadrangle maps. Using aerial photographs, timber inventory stand maps (Payette National Forest files), and ground verification, potential study areas were corrected for actual vegetation types and stand configuration.

Five study areas were selected, including 3 managed areas and 2 untreated areas. These were delineated from previously mapped watershed boundaries and contained primarily Douglas-fir/mixed conifer forests that represented a gradient of management. The managed areas were located in the upper Bear Creek drainage on the Council Ranger District (RD); the Price Valley area on the New Meadows RD; and the Bear Basin area on New Meadow and McCall ranger districts. Control areas included the French Creek roadless area on the McCall RD and Ponderosa State Park adjacent to the McCall RD (fig 1). The study areas ranged from 1376-1922 m in elevation.

Sample Stations and Census Methods

Sample Point Distribution

Sample points were located in forested stands only. Stand delineations were determined from timber inventory classification maps and photos, on which stands were classified by strata (age class and density). To minimize variability introduced by sources other than the treatment, stands were selected based on the following criteria: 1) forest types and range of age classes should be similar among treated and nontreated areas, 2) the range of elevations among all areas should vary less than 350 m, 3) slope should be less than 30% on average, and 4) stands should be accessible by road, mountain bike, or minute hike. Ponderosa State Park, a large block of relatively homogeneous habitat, was not classified into stands. This study area was divided into six geographic areas for placement of sample stations.

Sample stations were distributed in each stand along a transect or in a grid pattern. Transect bearings were determined from aerial photographs and established on the ground with a field compass. Within each stand, stations were paced to 225-250m apart. The number of stations/stand varied with size of the stand, ranging from 2 to 7. A total of 151 census stations was established among the 5 study areas, ranging from 24 to 32 stations per area.

Bird Count Techniques

Birds were counted using the variable circular-plot method (Reynolds et al. 1980). Observers visited each point three times from mid-May through mid-July 1992, recording all birds seen and heard during an eight minute sample period. Time of visit and observer were rotated per visit to reduce bias (Verner 1985). Distance from the station center (point) to the initial detection of each bird was estimated in meters. Counts were not conducted on days with wind 10 km/hr or during moderate to heavy precipitation.

Analysis

Mean numbers of birds per point for each species were tallied for each of the five study areas. These values were standardized by the number of visits per point. Oneway ANOVA's were used to compare abundances of counted species among study areas. We selected 29 bird species and 1 mammal species (red squirrel, a mammalian nest predator) based on their presence and abundance on three or more watersheds. We estimated point count abundance per species by averaging count data across all points and visits/point for each watershed. Levene's test was used to test for homogeneity of variances of mean counts among

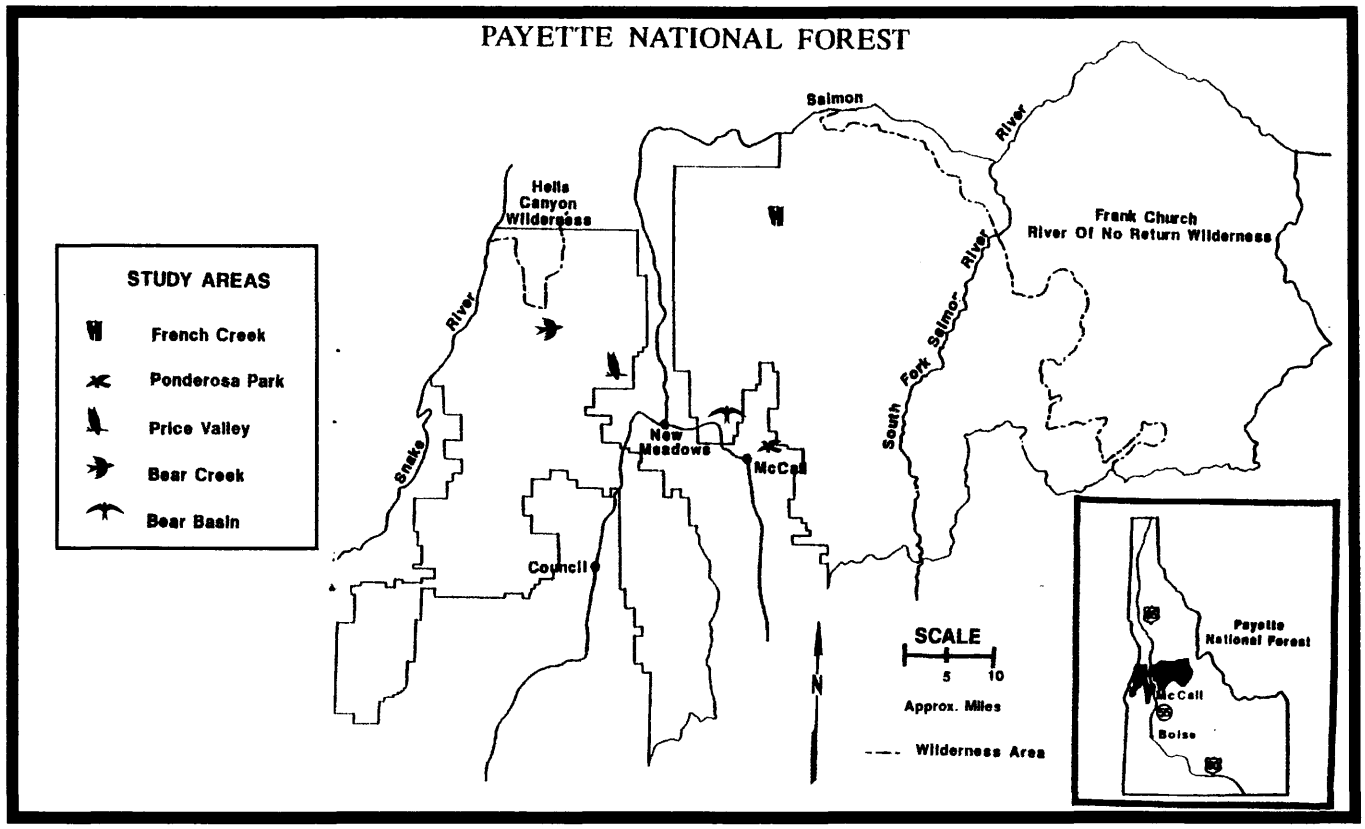

Figure 1. — Location of study areas on Payette National Forest in west-central Idaho.

study areas. For those species for which the assumption of homogeneity was violated, we computed Welch's statistic for assessing variation in mean counts among areas.

Contrast tests were used to determine if mean counts of pooled species and mean counts of each of 30 selected species varied between managed versus untreated watersheds. Levene's test for homogeneity of variance was used to select appropriate test statistics (pooled or separate t probabilities). We used multiple comparison tests (Tukey-HSD multiple range test, $p = 0.05$) to isolate differences in mean numbers of birds among specific pairs of study areas. We also used oneway ANOVA's to compare mean numbers of birds among and within stands within each watershed.

RESULTS

A total of 52 avian species was recorded across the five study areas. Of these, 19 were long-distance (neotropical) migrants, 17 were short-distance migrants, and 16 were residents. Total species richness (avian plus red squirrel) per study area ranged from lows of 30 and 34 in the untreated areas to 35, 37, and 43 in the managed areas (Table 1). Red squirrel presence was recorded during point counts in all areas. Twenty three species occurred in numbers too low for statistical analysis. These included three woodpeckers, three diurnal raptors, one owl, two corvids, one grouse, and thirteen passerines. Three species were recorded in only one study area: winter wren in Bear Creek, varied thrush in French Creek, and Townsend's solitaire in Price Valley. Brown-headed cowbirds were recorded in three of the five areas: Ponderosa Park, Bear Basin, and Bear Creek.

Mean numbers of birds/point significantly varied among all five areas ($F_{1,146}=14.75$; $p=0.0000$) and also varied between untreated and treated areas (Contrast tests: $t_{146}=2.20$, $p=0.03$). French Creek, an untreated area, had the lowest mean number of birds per point (10.46), significantly differing from two managed areas, Price Valley (12.75 birds/point) and Bear Basin (12.84) ((Tukey-HSD multiple range test, $p < 0.05$)), as well as from untreated Ponderosa Park (13.10) ($p < 0.05$). In addition, Bear Creek (managed) had significantly lower mean numbers of birds per point (11.57) than Bear Basin (managed) and Ponderosa Park (untreated) ($P < 0.05$). Mean bird counts/point were as similar among stands as within stands in each of the three managed watersheds (Table 1). In contrast, both untreated watersheds showed significantly more variation in total numbers of birds among stands than within stands (Table 1).

Of the 29 bird species which were statistically analyzed, 10 were long-distance migrants, 11 were short-distance migrants, and 8 were resident species (Table 2). Red squirrel had a higher overall abundance than any bird species. The most abundant bird species, based on mean numbers/point across all study areas, were red-breasted nuthatch (see Appendix A for scientific names), Swainson's thrush, and western tanager, respectively (Table 2).

Table 1. — Total numbers of species/area, mean number of birds/point, and stand variation in numbers of birds/point in untreated and managed study areas.

WATERSHED	NO. POINTS	TOTAL NO. SPECIES/ AREA	NO. BIRDS/ POINT Mean	SD	STAND VARIATION[1]
Untreated					
French Creek	32	34	10.46	1.43	0.048
Ponderosa Park	24	30	13.10	1.57	0.050
Managed					
Price Valley	21	37	12.75	1.55	0.831
Bear Creek	30	35	11.57	1.94	0.237
Bear Basin	44	43	12.84	1.50	0.234

[1] *Probability values from analysis of variance tests comparing bird numbers/point among and within stands.*

Table 2. — Analyses of variance, contrast tests, and trends in mean numbers of birds per point among untreated and managed watersheds.[1]

SPECIES	UNTREATED FC[2]	PP	MANAGED PV	BC	BB	F PROBABILITIES ANOVA	CONTRAST	CONTRAST TREND
Long-Distance Migrants								
Olive-sided flycatcher	0.00	0.04	0.14	0.27	0.09	0.002	0.000	+ (***)
Hammond's flycatcher	0.01	0.03	0.14	0.05	0.01	0.154	0.067	+ (*)
Dusky flycatcher	0.05	0.29	0.36	0.12	0.25	0.000	0.163	ns
Swainson's thrush	1.23	1.99	1.08	1.48	0.95	0.000	0.002	- (**)
Solitary vireo	0.07	0.04	0.28	0.05	0.18	0.003	0.004	+ (**)
Warbling vireo	0.21	0.18	0.11	0.08	0.08	0.258	0.039	- (*)
Townsend's warbler	0.39	1.06	1.02	0.37	1.21	0.000	0.171	ns
MacGillivray's warbler	0.04	0.19	0.23	0.27	0.21	0.000	0.014	+ (*)
Western tanager	0.95	1.14	1.27	1.37	1.14	0.068	0.020	+ (*)
Chipping sparrow	0.12	0.50	0.72	0.50	0.71	0.000	0.000	+ (***)
Short-Distance Migrants								
Northern flicker	0.00	0.06	0.10	0.10	0.06	0.089	0.021	+ (*)
Brown creeper	0.08	0.22	0.11	0.25	0.20	0.062	0.455	ns
Golden-crowned kinglet	0.09	0.22	0.11	0.23	0.12	0.378	0.971	ns
Ruby-crowned kinglet	0.21	0.26	0.68	0.13	0.67	0.000	0.000	+ (***)
Hermit thrush	0.53	0.01	0.16	0.03	0.16	0.000	0.001	- (***)
American robin	0.02	0.08	0.12	0.17	0.23	0.000	0.001	+ (***)
Yellow-rumped warbler	0.47	0.47	0.83	0.92	0.57	0.013	0.001	+ (***)
Dark-eyed junco	0.57	0.17	0.26	0.33	0.83	0.000	0.129	ns
Brown-headed cowbird	0.00	0.12	0.00	0.00	0.12	0.001	0.366	ns
Cassin's finch	0.02	0.00	0.05	0.07	0.01	0.243	0.146	ns
Pine siskin	0.00	0.12	0.19	0.08	0.08	0.099	0.205	ns
Residents								
Hairy woodpecker	0.07	0.00	0.03	0.05	0.06	0.364	0.613	ns
Pileated woodpecker	0.08	0.15	0.06	0.07	0.01	0.009	0.061	- (*)
Steller's jay	0.00	0.03	0.03	0.02	0.03	0.549	0.376	ns
American crow	0.00	0.00	0.00	0.02	0.08	0.087	0.028	+ (*)
Common raven	0.02	0.00	0.03	0.10	0.04	0.240	0.049	+ (*)
Mountain chickadee	0.58	1.24	0.93	1.08	0.89	0.000	0.604	ns
Red-breasted nuthatch	1.27	1.35	1.16	1.33	1.35	0.845	0.819	ns
Red crossbill	0.16	0.40	0.13	0.10	0.29	0.069	0.115	ns
Red squirrel	2.71	2.11	1.70	1.47	1.66	0.000	0.000	- (***)

[1] *ANOVAs compare mean numbers of birds across all five watersheds, and contrast tests compare mean numbers in untreated vs. managed watersheds. Contrasts indicate significant (* $p<0.10$; ** $p<0.01$; *** $p<0.001$; ns = not significant) positive ("+") or negative ("-") trends of bird numbers in relation to fragmentation.*

[2] *FC=French Creek, PP=Ponderosa Park, PV=Price Valley, BC=Bear Creek, BB=Bear Basin.*

Seventeen species had significant differences in mean numbers/point between managed and untreated study areas (Table 2). Four bird species had lower mean numbers in managed watersheds than in untreated areas. These were hermit thrush ($p = 0.001$), Swainson's thrush ($p = 0.002$), warbling vireo ($p = 0.039$), and pileated woodpecker ($p = 0.061$). Red squirrel also showed a highly significant decline in managed areas ($p < 0.001$). Twelve species were more abundant in managed areas than in untreated ones: northern flicker, olive-sided flycatcher, Hammond's flycatcher, American crow, common raven, ruby-crowned kinglet, American robin, solitary vireo, yellow-rumped warbler, MacGillivray's warbler, western tanager, and chipping sparrow.

Thirteen species had no significant difference in mean numbers in managed vs. untreated areas. Of these, five species showed no significant difference in mean numbers across all areas (refer to ANOVA probabilities, Table 2). The remaining eight species did not show a significant difference in contrast tests of managed and untreated areas, but showed a significant difference in mean numbers among the five study areas (ANOVA probabilities, Table 2). These were dusky flycatcher, mountain chickadee, brown creeper, Townsend's warbler, dark-eyed junco, brown-headed cowbird, red crossbill, and pine siskin.

DISCUSSION

It is important to recognize that these results are preliminary, based on point counts conducted in 1992. Total numbers of species in each study area may have been influenced by sampling intensity, which varied among watersheds. Bear Basin, with the highest number of recorded species, also had the greatest number of sampling points (44). Ponderosa Park had the lowest number of recorded species (30) and the second lowest number of sampling points (24).

Mean total bird detections differed significantly between the two untreated watersheds, French Creek and Ponderosa Park, which in fact had the low and high extremes, respectively. However, for 15 of the 30 species, mean birds/point were similar between the two untreated areas, suggesting that these two areas shared certain habitat attributes to which these species showed a common response. These attributes possibly were related to lack of treatment.

Mean counts differed between French Creek and treated areas for more species than between Ponderosa Park and treated areas. A better understanding of the history of these two untreated areas helps to interpret these trends. French Creek, an extensive roadless area, is a large block of interior forest where timber has not been harvested. Ponderosa Park is a state park that also has not been actively managed for timber, but unlike French Creek, it is situated on a relatively narrow (range 500-1200 meters) peninsula extending into Payette Lake. In addition, it is close to the town of McCall, and it supports recreational use on trails and in a campground which may create disturbances not found in French Creek. We hypothesize that overall bird abundance may be higher in Ponderosa Park than in French Creek because it has increased edge and disturbance effects that attract certain species whose numbers may increase in relation to these habitat features. Hejl et al. (1993) report that dusky flycatcher, chipping sparrow, and brown-headed cowbird are more abundant in disturbed second growth forests with clearcuts than in uncut old growth in the western United States. Thus, species whose abundances in Ponderosa Park were similar to those in managed areas (e.g., dusky flycatcher, chipping sparrow, brown-headed cowbird, pine siskin, and mountain chickadee (Table 2)) may be responding to edge and disturbance effects. Landscape measurements and tests are needed to confirm this hypothesis.

Mean numbers of birds differed among stands in each of the untreated areas but not in the three managed areas. Only forested areas were sampled in each study area; thus, this analysis compared bird numbers among and within forested stands, but not between clearings and forested stands. We interpret stand variation in bird numbers within untreated areas as a product of clumped distributions of birds. Aggregations of bird abundance in unmanaged forests may be related to natural clumping of habitat features that vary among stands. Further investigation of the relationships between bird abundances and habitat characteristics within unbroken forest blocks is needed to verify this interpretation. Lack of significant differences in mean bird numbers among stands within managed areas may indicate that these landscapes were relatively homogeneous in their degree of fragmentation and/or that remaining stands were similar in habitat features, so that birds responded similarly in abundance among stands. A dominant attribute of remaining forested stands in managed watersheds is their association with clearcuts. The shared feature of clearcut/forest borders may outweigh effects of natural habitat variation among stands. This could explain similarities in bird abundance among stands in treated watersheds.

ANOVAs indicated variation in mean numbers of birds/point among all five study areas and were useful in interpreting differences in avian use of these areas. For example, 13 species showed no significant differences in mean numbers between managed and untreated areas, yet abundances of eight of these species differed significantly among all five areas. This suggested that some species were selecting certain habitat characteristics regardless of whether the landscapes were managed or unmanaged. Pairwise comparisons of study areas helped to pinpoint the areas where bird numbers of each species differed. This information highlights the need to evaluate how specific habitat features influence bird distributions independently of, or in concert with, management effects.

A negative response to fragmentation did not appear to be correlated with migratory status in this preliminary assessment. More long-distance migratory species showed a positive response than a negative or nonsignificant response. More short-distance migrants showed a nonsignificant response than either positive or negative. Responses for individual species need

to be evaluated on a case-by-case basis. Our results showed, however, that more species responded positively to treatment than negatively, suggesting that treatment created more habitat for more species. However, since the majority of species that responded favorably to treatment are already common or abundant, we do not believe that management benefitted species of concern. Species of most concern to managers are those whose populations are listed as threatened, endangered, sensitive, or declining, or whose populations are of economic importance (e.g., game species) (Finch 1992). Three of the four species that responded negatively to management in our study - hermit thrush, Swainson's thrush, and pileated woodpecker - have been identified as potentially sensitive to forest management (Raphael 1987, Hejl et al. 1993). Increases in local species richness due to forest management must be considered in relation to changes in regional biological diversity, especially if regional changes are due to losses or population reductions of sensitive species (Finch and Ruggiero 1993).

Based on these preliminary results, the study has been modified to more completely assess relationships between landscape features and bird abundances. The primary modifications for the second year include 1) division of watersheds into 300 ha landscapes to standardize comparison of areas, and 2) extension of sampling into all habitats on the landscape in the proportion in which habitat patches occur to better describe variability within watersheds. Sampling intensity will remain consistent across all landscapes. A GIS will be used to characterize landscapes based on selected fragmentation measures, including size and spatial distribution of forest and nonforest, distance to nearest similar habitat (contagion), total length of edge, and perimeter-areas relationships (Ripple et al. 1991, Rex and Malanson 1990, O'Neill et al. 1988).

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APPENDIX 1 - SCIENTIFIC NAMES OF BIRD SPECIES

COMMON NAME	SCIENTIFIC NAME
Hairy woodpecker	*Picoides villosus*
Northern flicker	*Colaptes auratus*
Pileated woodpecker	*Dryocopus pileatus*
Olive-sided flycatcher	*Contopus borealis*
Hammond's flycatcher	*Empidonax hammondii*
Dusky flycatcher	*Empidonax oberholseri*
Stellar's jay	*Cyanocita stelleri*
American crow	*Corvus brachyrhynchos*
Common raven	*Corvus corax*
Mountain chickadee	*Parus gambeli*
Red-breasted nuthatch	*Sitta canadensis*
Winter wren	*Troglodytes troglodytes*
Brown creeper	*Certhia americana*
Golden-crowned kinglet	*Regulus satrapa*
Ruby-crowned kinglet	*Regulus calendula*
Townsend's solitaire	*Myadestes townsendi*
Swainson's thrush	*Catharus ustulatus*
Hermit thrush	*Catharus guttatus*
Varied thrush	*Ixoreus naevius*
American robin	*Turdus migratorius*
Solitary vireo	*Vireo solitarius*
Warbling vireo	*Vireo gilvus*
Yellow-rumped warbler	*Dendroica coronata*
Townsend's warbler	*Dendroica townsendi*
MacGillivray's warbler	*Oporornis tolmiei*
Western tanager	*Piranga ludoviciana*
Chipping sparrow	*Spizella passerina*
Dark-eyed junco	*Junco hyemalis*
Brown-headed cowbird	*Molothrus ater*
Cassin's finch	*Carpodacus cassinii*
Red crossbill	*Loxia curvirostra*
Pine siskin	*Carduelis spinus*