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BROWN-HEADED COWBIRDS IN PONDEROSA PINE/DOUGLAS-FIR-DOMINATED LANDSCAPES IN THE NORTHERN ROCKY MOUNTAINS

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Abstract. Little is known about the habitat and landscape associations of Brown-headed Cowbirds (*Molothrus ater*) within conifer-dominated landscapes in the northern Rocky Mountains. We counted Brown-headed Cowbirds in 16 mature second-growth and 16 old-growth ponderosa pine (*Pinus ponderosa*)/Douglas-fir (*Pseudotsuga menziesii*) forests in western Montana and eastern Idaho during the breeding seasons of 1989, 1990, and 1991. We used aerial photo interpretation and ground-truthing to establish the landscape conditions surrounding each stand, and examined cowbird-habitat relations at two spatial scales: stand (mean = 143 ha) and landscape (518 ha).

Both second-growth and old-growth stands were located in landscapes composed primarily of forest. Second-growth stands were closer to more agricultural land. The amount of forest land, open land, grassland, recent logging, riparian habitat, and residences did not differ between landscapes surrounding both stand types.

Brown-headed Cowbirds were more abundant in mature second-growth stands and in landscapes with more mature forest (naturally occurring and second growth), open land (agricultural land and grassland), and deciduous riparian habitat, and less old-growth forest. Neither forest cover (including all ages of conifer forest), logged openings, residences, nor elevation were important predictors of cowbird numbers.

Our results suggest that landscape context was more important in determining cowbird numbers than stand attributes in pine-fir forests at the scale we examined. The strong negative relationship between cowbirds and landscapes with more old-growth implies that pristine landscapes had fewer cowbirds. We believe that amount of and distance from feeding sources are prime determinants of cowbird numbers in these landscapes, and that landscape features such as agricultural land and grassland sometimes represent feeding sources. In addition, cowbird numbers may be greater in pine-fir forests near riparian areas as a "spillover effect": cowbirds are attracted to riparian areas since they are dense with potential hosts and venture into nearby conifer forests secondarily. These hypotheses need to be tested in future studies.

Key Words: Brown-headed Cowbird, Douglas-fir, landscapes, mature second growth, *Molothrus ater*, old growth, ponderosa pine.

Little is known about the habitat and landscape associations that influence Brown-headed Cowbird (*Molothrus ater*) abundance within conifer-dominated landscapes in the northern Rocky Mountains (Robinson et al. 1995a; but see Tewksbury et al. *this volume*, Young and Hutto *this volume*). We studied lower elevation ponderosa pine (*Pinus ponderosa*)/Douglas-fir (*Pseudotsuga menziesii*)-dominated landscapes in western Montana and eastern Idaho. Two different types of human-induced changes in landscape patterns surrounding these forests have occurred in the years since European settlement: (1) habitat conversion of some forests and grasslands to human settlements (including housing, horse pastures, and agricultural land), and (2) habitat modification of many forests in terms of age, structure, and plant species composition by many different types of logging treatments and by fire suppression (Hejl 1992, 1994; Hann et al. 1997).

Old-growth ponderosa pine dominated the lower elevation conifer landscapes during presettlement times (estimates of approximately 60% old-growth ponderosa pine for western Montana; Losensky 1993). Continuous logging since settlement (around 1900; Losensky 1993) has transformed this old growth to a patchwork of clearcuts, immature, and mature forest with little of the original old growth remaining (estimates of 1–7% on the Lolo National Forest; J. M. Hillis, pers. comm.). To identify some of the impacts of this logging on bird communities, we initiated a study to compare the distribution of birds in old-growth ponderosa-pine/Douglas-fir forests with those in mature second-growth forests. We examined the effects of local habitat change and landscape patterns on bird distributions (for preliminary stand-level results, see Hejl and Woods 1991). Herein, we present our results on Brown-headed Cowbird abundances in relation to these habitat and landscape level patterns.

We examined cowbird-habitat relations at two spatial scales: stand and landscape. Our objectives were (1) to compare the abundance of cowbirds between mature second-growth and old-growth ponderosa pine/Douglas-fir stands, and

(2) to determine if components in the surrounding landscape affect the abundance of cowbirds within these forest stands.

METHODS

Study Sites

We selected 16 old-growth and 16 mature second-growth ponderosa pine/Douglas-fir-dominated sites in western Montana and eastern Idaho that met criteria for usable stands. The criteria for old-growth stands (determined by on-site inspection) were: (1) each study site was homogeneous in vegetative structure and composition, (2) each area was at least 8 ha in size and at least 200 m wide, (3) the dominant species on each site were Douglas-fir and ponderosa pine, (4) sites ranged from near 100% Douglas-fir to near 100% ponderosa pine for the large dominant trees, (5) the dominant trees were near-maximal age for the species in this geographic area (based on size of trees; often one to two trees were cored on a site to help with determinations) and had old-age characteristics, (6) no obvious large-scale disturbance by people had occurred on any site (except for the exclusion of fire in this region for roughly the past 50 years), and (7) stands were at least 0.8 km (0.5 mile) apart. The criteria for mature second-growth stands were the same as for the old-growth sites except that the dominant trees were younger and obvious large-scale human disturbance (logging 70 or more years ago, and sometimes thinning and prescribed fire) had occurred on the site. Old-growth stands were greater than 170 years old and mature second-growth stands were approximately 70 to 120 years old. Elevation ranged from 1,024 to 1,841 m.

We call our second-growth stands "mature second growth" throughout, because mature stands can result from logging (which we call second growth) or natural regeneration after a natural disturbance process such as fire (naturally occurring mature stands), and, for our stand analyses, we want to distinguish between human-induced and naturally created stands. We were unable to make this distinction for our landscape analyses, where natural and human-induced mature stands are pooled together.

Bird Observations

Four observers conducted 10-min point counts during each breeding season (13 May to 9 July) in 1989, 1990, and 1991 (as suggested by Verner 1985, 1988). Five points were located at 200-m intervals in each stand (with the exception of two stands, one with four points and the other with two; total = 156 points). Each site was visited four times. One to two sites (from two to ten points) were visited by an observer during a day. To remove observer bias from treatment effects, each observer visited each site once during a breeding season. Some observers differed between years (SJH was an observer all 3 years and JSY and another observer sampled in 1990 and 1991). Visits to a site occurred at 1- to 2-week intervals. Bird counts were conducted between one-half hour after dawn and 1100, and were confined to days with good weather. To sample points at different times in the morning, the transects were traveled in opposite directions on alternate visits. A two-week training session was conducted each year to minimize observer differences.

All observations of adult birds considered to be using the stand (i.e., at unlimited distances) were included in the analyses. Birds flushed as the observer traveled to the point were counted. Only the first detection of an individual bird was included in the abundance estimates. Repeat detections of the same individual from later point counts on the same stand were ignored.

Landscape Measurements

We defined our landscapes as 518-ha circular areas centered at the mid-point of each bird transect (radius = 1.3 km). We chose this size based on inspection of topographic maps for western Montana and eastern Idaho and determined that many third-order drainages approximated this size. Because we began with a community-based study, we selected a size that would likely be relevant for habitat selection for the majority of birds breeding on that site, not necessarily for Brown-headed Cowbirds. In a separate study designed to determine the appropriate scale for predicting cowbird distribution in deciduous riparian habitats in western Montana, Tewksbury et al. (1998) determined that the scale of 1 km correlated with cowbird numbers in riparian habitats better than other local scales.

Three of us (SJH, JSY, and S. Colt) independently interpreted aerial photographs of each site and the surrounding landscape. Each of us had spent one or more seasons in the field on each of these sites before we interpreted the photos. After each of us created overlays on orthophotoquads based on the aerial photographs, we then decided by consensus a single interpretation of each landscape. We ignored discontinuities less than 2 ha. In summer 1991, we ground-truthed a majority of cover types in each consensus landscape, emphasizing borderline cases, and made any necessary changes. One difficult distinction was between different ages of forest. For borderline cases, we cored one or two dominant trees in a stand to index tree age. Based on tree-aging data from our mature and old-growth stands, the mature category for the land-

scape analyses was arbitrarily chosen to be 70 to 169 years old (which included natural and second-growth stands) and old growth was greater than 170 years old.

We entered our landscapes into a GIS using a digitizing table and summarized the coverage of 14 vegetation categories. The categories we used were: old conifer forest, mature conifer forest, young conifer forest, shrub/scrub, grassland, agriculture, deciduous riparian, clearcut, logged (with leave trees), rock/scree, upland deciduous trees, water, road, and residences. Five of these categories were rare. For the landscape analyses, we used those categories that were prevalent and that, based on our biological intuition, we thought were potentially meaningful for cowbird occupancy: old conifer forest, mature conifer forest, total conifer forest, grassland, agriculture, open land (combination of grassland and agricultural land), deciduous riparian, logged (including clearcut with and without leave trees), and residences. In addition, because others (Verner and Ritter 1983) have had trouble isolating the importance of elevation from other variables, we also obtained the elevation of each site at the mid-point of each transect and analyzed this separately.

Data Analysis

Because Brown-headed Cowbird numbers were count data, we created Poisson regressions (McCullagh and Nelder 1983) between cowbird numbers and the stand and landscape variables.

To examine stand association, we created Poisson regressions between cowbird numbers (average number of adult cowbirds/point/visit to a site) and stand type (mature second-growth versus old-growth stands).

For landscape descriptions, we used Mann-Whitney U-tests to compare the acreage of each landscape variable between the two stand types and Kendall's Tau-b correlations to investigate relationships among landscape variables.

For landscape associations, we used the average number of adult cowbirds per point per visit to a site as the response variable. First, we created univariate Poisson regressions to examine the relationships between cowbird abundances and coverage of each of the landscape components and with elevation. Second, we created multivariate Poisson regressions with all appropriate landscape variables, considering that two or more landscape variables might work in concert to determine cowbird abundances. We examined scatterplots of the significant correlations at each stage. If needed, we examined the effects of outliers on our analyses. We chose an α of 0.05 for all analyses.

For the multivariate Poisson regression analysis, we started with the full model (including stand type as an indicator variable and all relevant two-way interactions among the landscape variables) and then removed variables one at a time whose parameter estimates were not significant at the 0.05 level, starting with the least significant term first. We included stand type as an indicator variable to examine whether stand or landscape associations were more important in determining cowbird numbers in these habitats. We used an r^2-like measure (model deviance/total deviance, hereafter called "r^2") to describe the goodness-of-fit of the model (D. Turner, pers. comm.).

RESULTS

Cowbird Associations at the Stand Level

Brown-headed Cowbirds were more abundant in mature second-growth than in old-growth stands ($P < 0.01$). Cowbirds were present on all 16 mature second-growth stands, with an average of 0.52 birds/point/visit (range: 0.10–1.47). Cowbirds were present only on 6 old-growth stands and averaged 0.05 birds/point/visit (range: 0.00–0.27).

Landscape Descriptions

Both mature second-growth and old-growth sites were located in landscapes composed primarily of forests, averaging 79% and 86%, respectively (Table 1). The mature second-growth stands were found in landscapes consisting mainly of mature forests, with little old growth nearby. Old-growth stands were located in landscapes composed of both mature and old-growth forests. Second-growth stands, on average, were closer to more agricultural land. The amount of forested land, open land, grassland, recent logging, riparian habitat, and residences did not differ between landscapes surrounding both stand types.

The amount of mature forest in these landscapes was negatively correlated with only one landscape variable, the amount of old growth in the landscape (Table 2). The amount of old growth in these landscapes was negatively correlated with the amount of open land, agricultural land, and residences.

Cowbird Associations at the Landscape Level

Univariately, the number of cowbirds was positively associated with the amount of mature forest and open land (agriculture and grassland) in these landscapes and was negatively associated with the amount of old growth (Table 3). The number of cowbirds was not associated with the amount of forest cover, grassland, logged

TABLE 1. AVERAGE (AND SE) COVERAGES (IN HA) FOR SELECTED VEGETATION CATEGORIES IN THE LANDSCAPES SURROUNDING AND INCLUDING THE 16 MATURE SECOND-GROWTH AND 16 OLD-GROWTH PINE-FIR STUDY SITES, AND STAND ELEVATION

Landscape variable	Mature second-growth	SE	Old growth	SE	P[a]
Elevation (m)	1,258	36.8	1,366	49.7	0.09
Total conifer forest	410	17.4	446	13.0	0.13
Mature	377	18.9	183	19.3	<0.01
Old growth	9	3.6	196	28.7	<0.01
Open land	60	15.3	23	6.3	0.10
Grassland	35	12.7	21	6.2	0.71
Logged	25	8.9	18	8.5	0.62
Agriculture	25	8.2	2	1.1	0.01
Deciduous riparian	14	3.7	9	1.5	0.57
Residence	11	4.4	1	0.8	0.10

[a] Result of Mann Whitney U-test comparing between stand types.

openings, agricultural land, riparian habitat, or residences. In addition, elevation was not a predictor of cowbird numbers.

When examined multivariately, Brown-headed Cowbirds were negatively associated with the amount of old-growth forest in the landscape ($P < 0.01$; "r^2" = 0.61). When we examined scatterplots of the multivariate relationship, we found that we had one strong outlier. The number of cowbirds on one of these sites was much greater than on the other 31 sites. The outlier site had 1.47 cowbirds/point/visit; the other 21 sites with cowbirds averaged 0.36 (SD = 0.29; range = 0.02–1.02) cowbirds/point/visit. Because the outlier site was located near (< 8 km) another one of our sites (which had the third highest cowbird numbers) and far (> 30 km) from the other sites, we removed both sites, and re-ran the analyses. With the two sites removed, cowbirds were positively associated with mature forest ($P < 0.01$), open land ($P < 0.01$), and deciduous riparian habitat ($P < 0.01$) in the multivariate Poisson regression and had a good fit of "r^2" = 0.81.

After we discovered the importance of an outlier, we re-did our univariate tests with the outlier site and its neighbor removed (Table 3). The positive relationships of cowbird numbers with mature forest and open land and negative relationship with old growth remained, but a negative relationship to total forest and positive relationships to grassland, agricultural land, and residences appeared, suggesting that most landscapes with cowbirds shared these features.

DISCUSSION

COWBIRD ASSOCIATIONS AT THE STAND LEVEL

Brown-headed Cowbirds were more abundant in 16 mature second-growth ponderosa pine/Douglas-fir stands than in 16 old-growth ones in western Montana and eastern Idaho. Most of our sites would be classified as mixed conifer by Young and Hutto (*this volume*). In their region-wide survey of bird distribution, Young and Hutto found that cowbirds were more abundant in ponderosa pine forests than any other conifer type, of intermediate abundance in Douglas-fir

TABLE 2. KENDALL'S TAU-B CORRELATIONS BETWEEN ACREAGES OF MATURE AND OLD-GROWTH CATEGORIES WITH ELEVATION AND WITH ALL OF THE OTHER SELECTED VEGETATION CATEGORIES IN THE LANDSCAPES

	Mature		Old growth	
Landscape variable	Correlation	P	Correlation	P
Elevation	−0.17	0.16	0.25	0.05
Total forested	−0.05	0.67	0.25	0.05
Mature	1.00	<0.01	−0.67	<0.01
Old growth	−0.67	<0.01	1.00	<0.01
Open land	0.08	0.52	−0.29	0.03
Grassland	−0.04	0.76	−0.15	0.26
Logged	0.04	0.75	−0.13	0.36
Agriculture	0.21	0.13	−0.33	0.02
Deciduous riparian	0.01	0.94	0.02	0.88
Residences	0.16	0.23	−0.34	0.02

TABLE 3. POISSON REGRESSIONS (SIGN OF THE COEFFICIENT, CHI-SQUARE AND ASSOCIATED P-VALUES) BETWEEN BROWN-HEADED COWBIRD NUMBERS AND LANDSCAPE CATEGORIES IN THE 518-HA CIRCLES SURROUNDING AND INCLUDING THE 16 MATURE SECOND-GROWTH AND 16 OLD-GROWTH PINE-FIR STUDY SITES

	All study sites			Without outlier and neighbor		
Landscape variable	Sign	Chi-square	P	Sign	Chi-square	P
Elevation	−	1.99	0.16	−	3.22	0.07
Total forested	−	2.66	0.10	−	10.63	<0.01
Mature	+	13.65	<0.01	+	7.12	0.01
Old growth	−	19.08	<0.01	−	19.20	<0.01
Open land	+	6.02	0.01	+	27.80	<0.01
Grassland	+	3.04	0.08	+	11.64	<0.01
Logged	+	0.10	0.75	−	0.39	0.53
Agriculture	+	3.59	0.06	+	11.34	<0.01
Deciduous riparian	−	0.00	0.98	+	1.87	0.17
Residences	+	2.61	0.11	+	7.24	0.01

and mixed-conifer forests, and rare in other conifer types. We found that within mixed-conifer stands, cowbirds are much more abundant in mature second-growth than in old-growth stands. Therefore, our intensive study, focusing on two types of stands primarily within Young and Hutto's mixed conifer forests, complements their extensive surveys within the northern Rocky Mountains.

COWBIRD ASSOCIATIONS AT THE LANDSCAPE LEVEL

We found Brown-headed Cowbirds to be more abundant in landscapes with more mature forest, open land, deciduous riparian habitat, and with less old growth. Young and Hutto (*this volume*) found them to be most abundant near agriculture and developed areas, with riparian being important in some cases.

RELATIVE IMPORTANCE OF STAND VS. LANDSCAPE ASSOCIATIONS

Our results suggest that landscape context is more important than stand conditions in pine-fir forests. Because stand type was not in either of the multivariate Poisson regressions, it is unlikely that the association with mature forests was simply a reflection of most cowbirds being in mature second-growth stands. The negative association of cowbirds with landscapes with more old growth implies that more pristine landscapes, those landscapes with less open land, agricultural land, and residences, had fewer cowbirds. Old-growth stands in this study were primarily located in the less accessible, and in some cases unlogged, portions of these mountains. Most of the old-growth stands were located far from human concentrations, although some were near individual houses, many of which had horses. Our results suggest that old-growth stands in similar landscape situations to those surrounding mature second-growth stands would have a similar number of cowbirds. Currently, most old-growth stands are in different situations.

In addition to the amount of mature and old-growth forests, proximity to open land (agricultural land and grassland combined) was a consistent predictor of cowbird distribution and abundance. Because cows and horses rarely occurred on these sites, we think that cowbirds probably uncoupled their breeding and foraging behavior in our study landscapes, similarly to cowbirds in the eastern Sierra Nevada (Rothstein et al. 1984) and to some in the western Sierra Nevada (Verner and Ritter 1983). We suggest that our category of open land weakly represents cowbird feeding areas. We often saw cows and horses on many of the lands that we called agricultural land and grassland. Cowbirds were present and foraging in many of these locations when cows or horses were present (especially agricultural lands), but not all agricultural lands or grasslands in the area of our study had grazing cows or horses, and the presence of grazing animals within any particular place likely changed during the course of our study. The fact that open land was a better predictor than either agricultural land or grassland alone provides further support for this hypothesis. Furthermore, if the proximity to feeding areas is a prime determinant of cowbird presence and abundance in ponderosa pine/Douglas-fir forests, we believe we would have found stronger relationships if we had the ability to determine the timing and extent of grazing or locations of bird-feeders on the landscapes we studied (Tewksbury et al. 1998). Cowbird feeding areas elsewhere in the West include meadows with free-ranging cattle, livestock corrals, feedlots, and bird-feeders (Verner and Ritter 1983, Rothstein et al. 1984, Airola 1986).

The two sites with high cowbird numbers that we removed in our final analysis may have been located in a unique area compared to the other 14 mature second-growth forests. When we removed both sites, cowbird relationships to landscape variables changed both univariately and multivariately. These two sites were located on forested hills in the middle of a bowl-shaped valley; the valleys on two sides of these forests have many agriculture lands, but no agricultural land was located within the landscape associated with either site. Most of the other 14 mature forests had nearby agricultural lands in only one direction. Therefore, not just the amount of nearby agricultural land, but the location of it in relation to the stand of interest, may be important in determining cowbird numbers in a particular conifer stand.

Proximity to potential feeding areas seems to be more important than proximity to openings per se near these mature second-growth and old-growth pine-fir forests. Cowbird presence did not correlate with the amount of logged openings (clearcuts and seed-tree cuts) in the landscape. Cows or horses were rarely found in the logged openings near our study sites. Regionwide, however, cowbirds were abundant in logged areas, but the proximity to agricultural lands was a greater determinant of cowbird presence than logging type (Young and Hutto *this volume*). In northern Idaho, no cowbirds or cowbird parasitism was found in an area punctuated with clearcuts or in extensive forest, although cowbirds were seen 11 km away (Hejl and Paige 1994; S. Hejl, unpubl. data). It is unclear from studies done elsewhere (Rosenberg and Raphael 1986, Thompson et al. 1992, Schmiegelow et al. 1997) if landscape effects via feeding sources are a more important determinant of cowbird abundance than openings per se across regions, or if the effects of silvicultural treatments on cowbirds vary by region.

The relative importance of distance from nearest known feeding source has been difficult to tease apart from elevation in other cowbird studies in the West (e.g., Verner and Ritter 1983). In our case, elevation was not an important predictor of cowbird abundance in pine-fir forests. Based on data from just a few locations, Verner and Ritter (1983) also suggested that elevation was not a driver of cowbird numbers in forests in the Sierra Nevada, but cowbird feeding sites in general co-varied with elevation, so they could not clearly isolate the effect of elevation.

The potential importance of the proximity of deciduous riparian areas to cowbird distribution in these conifer forests was only noted when the outlier and neighboring site were removed. In at least some conditions in the northern Rockies, therefore, cowbirds are more abundant in mixed-conifer forests that are located near riparian areas. Riparian areas in this part of the northern Rockies have greater densities of cowbirds and potential hosts than do pine-fir forests (Tewksbury et al. *this volume,* Young and Hutto *this volume*). We suggest that cowbird numbers are sometimes greater in the pine-fir forests near riparian areas as a "spillover effect": cowbirds are attracted to riparian areas because they are dense with potential hosts and venture into nearby conifer forests secondarily. This same effect could explain the higher density of cowbirds near riparian areas regionwide (Young and Hutto *this volume*). In eastern forests, Gates and Giffen (1991) found numbers of cowbirds and brood parasitism rates higher along a natural corridor created by a stream running through forest habitat and decreasing with distance from the stream. They similarly suggested that cowbirds are attracted to the higher density of nests along riparian corridors.

The trend of fewer cowbirds in more forested pine-fir landscapes parallels brood parasitism results by Tewksbury et al. (1998) obtained from deciduous riparian systems in agricultural and forested landscapes near some of our sites. Brood parasitism decreased in deciduous habitats in which the forested portion of the landscapes increased, but this result was attributed to decreased human habitation in more forested landscapes. We also suggest that forest cover is a surrogate variable. In pine-fir forests in western Montana and eastern Idaho, conifer forest cover is negatively associated with agricultural lands and grasslands, primary areas used by cowbirds for feeding. Indeed, the relationship between cowbird abundance and forest cover was weaker than relationships between cowbird abundance and four other significant landscape variables (all but residences and mature forest).

We are uncertain what landscape scale would be best for future studies in pine-fir forests. Our interpretations are limited to the landscape size that we selected (1.3 km). We believe that cowbirds on our outlier site and its neighboring site would have had similar landscape relations to the other sites, if we had chosen a larger landscape size. We suggest that future investigators of this topic select a larger scale and look at various scales nested within the largest size. Radiotelemetry results from the Sierra Nevada indicate that cowbirds commute 2–7 km between breeding and feeding habitats (Rothstein et al. 1984). Young and Hutto's (*this volume*) point count data from across the northern Rockies suggest 7–10 km as an upper limit for distance from agriculture. Tewksbury et al.'s (*this vol-*

ume) point count data for conifer and riparian systems in western Montana suggest 1–2 km from feeding sources, while radio-telemetry indicates that cowbirds travel from 0.5–3 km from feeding sources to riparian systems. Tewksbury et al.'s (1998) ideal scale for western Montana riparian systems was 1 km. The optimum scale for conifer systems may be different from riparian systems and may depend on habitat type, landscape variable of interest, and local cowbird feeding sources.

Because the association between cowbirds and deciduous riparian areas only appeared in the final analyses, we suggest future investigators test the hypothesis that cowbirds are sometimes more abundant in mixed-conifer forests that are located near riparian areas in the northern Rockies. Other interesting questions include the need to examine the importance of stand characteristics (e.g., forest composition and structure) to cowbird abundance, host density, cowbird-host relationships, and diurnal cowbird use patterns to understand more completely cowbird abundance in pine-fir stands, at a diversity of spatial scales (see Hochachka et al. *this volume*). In addition, we would like to know if landscape effects via feeding sources are a more important determinant of cowbird abundance than openings per se across regions, or if the effects of silvicultural treatments on cowbirds vary by region.

MANAGEMENT RECOMMENDATIONS

The presence, amount of, and distance to cowbird feeding sources (e.g., grazing animals in agricultural land, grasslands, or in logged openings; proximity to pack stations and bird feeders) are important factors to consider for cowbird management in western Montana and eastern Idaho. Cowbird feeding sources may in fact be the primary determinant of cowbird numbers in pine-fir forests in the northern Rockies. Cowbird numbers were greater in mature second-growth than in old-growth pine-fir stands in the northern Rocky Mountains, but this relationship was influenced by landscape factors that probably reflect cowbird feeding locations. In addition, the number of cowbirds on these sites (i.e., the greater abundance in mature second-growth versus old-growth stands) could change depending upon future cowbird feeding locations. If meadows with free-ranging cattle, livestock corrals or pastures, feedlots, bird-feeders or other cowbird feeding sources were located near old-growth stands, those stands could have as many or more cowbirds using them than did the second-growth stands during our study. Proximity to deciduous riparian areas may be a secondary factor determining which conifer stands are searched by cowbirds.

We do not know if any host species is threatened as a result of these relationships, although a number of potential hosts were more abundant in second-growth stands (Dusky Flycatcher [*Empidonax oberholseri*] and Cassin's Vireo [*Vireo cassinii*], two high priority species in this physiographic region according to Partners in Flight [C. Beardmore, pers. comm.], and Chipping Sparrow [*Spizella passerina*]; Hejl and Woods 1991). Olive-sided Flycatcher (*Contopus cooperi*), Hammond's Flycatcher (*Empidonax hammondii*), Warbling Vireo (*Vireo gilvus*), Nashville Warbler (*Vermivora ruficapilla*), Yellow-rumped Warbler (*Dendroica coronata*), Townsend's Warbler (*Dendroica townsendi*), and MacGillivray's Warbler (*Oporornis tolmiei*) are other potential hosts that breed in these stands and are high priority species in this area according to Partners in Flight. Hammond's Flycatcher, Townsend's Warbler, and MacGillivray's Warbler were more abundant in old-growth stands (Hejl and Woods 1991); it would be ideal to maintain current forest-dominated landscapes without cowbird feeding sources around these areas. Because each of the above-mentioned potential host species is found in both pine-fir stand types and in other habitats across the northern Rocky Mountains (R. Hutto, unpubl. data), it is unlikely that any species is threatened based solely on relationships in these habitats. With our current state of knowledge, we do not know if management activities such as silvicultural or fire treatments in these conifer stands would affect cowbird numbers in these landscapes.

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