

**Effects of Forest Management, Wildfire and Trail Use on Ponderosa Pine
Forest Birds on Heil Ranch, Boulder County Open Space**

Year-end Report 2004

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Abstract

During the summers of 1999 to 2004 we studied the breeding bird community in the Ponderosa Pine habitats of the Boulder County Open Space property, Heil Ranch. To date, we have located and monitored 397 nests of 25 species, as well as surveyed birds at 30-point count locations on the property to determine the distribution and abundance of these species. This study was initially undertaken to examine the responses of the avian community to trail construction and increased recreation on the property. Besides opening the property to recreational use, Boulder County Open Space has undertaken an extensive management plan and thinning near our study sites since 2003. This management provides a wonderful opportunity to examine the response of forest birds to this change in forest structure. To examine the potential impacts of this forest management activity, we monitored 20 new point count stations and located and monitored 107 nests in both thinned and unthinned areas. Overall relative abundance of birds seems to be stable over the longer study time period despite a dip in 2002 during the severe drought. However, overall nesting success on the property has dropped dramatically over the 6-year study period for focal species suggesting negative impacts to the long-term viability of the population at Heil. Overall, thinning appears to have positively affected the bird community at Heil with high use and nesting within the thinned areas and more open portions of the forest. However, nest predation was high within thinned areas, providing a cautionary indication that thinned areas should be pursued, but that natural, open-canopy forest probably provides the best nesting habitat and thus should be protected from disturbance wherever possible.

Introduction

Background:

Ponderosa pine (*Pinus ponderosa*) stands along the east slope of the Colorado Front Range can be characterized by a park-like appearance. Typical vegetation includes an open canopy of ponderosa pine and scattered Douglas' fir (*Psuedotsuga menziesii*), and an understory composed of five major plant associations including shrubs, herbaceous plants, mixed grass and rock outcrops (Little, 1971; pers. obs.). A number of Neotropical migrants breed in ponderosa pine and adjacent montane riparian habitat of Boulder County, many of which are considered sensitive across their southwestern range. Among those species, the Broad-tailed Hummingbird (*Selasphorus platycercus*), Hammond's Flycatcher (*Empidonax hammondi*), Dusky Flycatcher (*E. oberholseri*), Cordilleran Flycatcher (*E. occidentalis*), Townsend's Solitaire (*Myadestes townsendi*), Plumbeous Vireo (*Vireo Plumbeus*), Warbling Vireo (*Vireo gilvus*), MacGillivray's Warbler (*Oporornis tolmiei*), Virginia's Warbler (*Vermivora virginiae*), and Green-tailed Towhee (*Pipilo chlorurus*) are considered species of concern across Arizona, New Mexico and Colorado (Winternitz and Crumpacker, 1985; Rich and Breadmore, 1997; Hall et al., 1997).

Years of fire suppression in the foothills of Boulder County have had a pronounced effect on the forest-grassland interface, and on the forest ecosystem itself. The ponderosa pine forest occurs at a lower elevation than historically (Veblen and Lorenz, 1991), and the stand is overstocked with a high density of trees, making the forest more susceptible to catastrophic fires and pine beetle infestations (Finch et al., 1997). The current thinning, extensive burning by the Overland Fire and proposed future prescribed burning of ponderosa pine forests on Boulder County Open Space should restore large-scale disturbance processes that will dramatically alter the age-structure of the ponderosa pine forest. In turn, these changes may support higher avian species diversity and maintain more stable populations of open-forest aerial insectivores, granivores, and tree-drilling bird species (Hejl, 1994; Finch et al., 1997). However, information on the effects of thinning and burning on ponderosa pine forest avian communities is problematic because the literature is wrought with methodological problems (Dobkin 1994, Hejl, 1994; Hutto, 1995; Finch et al., 1997). Furthermore, our work has shown that Brown-headed Cowbirds (*Molothrus ater*) are likely to positively respond to canopy openings created in the ponderosa pine forest (Chace and Cruz, 1999, Chace et al. 2003). Avian nest predators, e.g., Steller's Jays, may respond to canopy openings like cowbirds and may also negatively impact open-cup nesting songbirds. As a result, obtaining data on the specific responses of the avian community on Heil Ranch to forest management and future controlled burning is valuable not only to Boulder County Open Space for use in management decisions, but also to land managers elsewhere.

The foothill ponderosa pine forests along the Colorado Front Range are an important, unique and understudied habitat. Throughout Colorado, these areas are becoming increasingly developed, either as residential areas, or as open space properties used extensively for recreation by the local human population. Non-consumptive recreational activities (e.g., hiking, nature study, biking, trail running) are generally thought to be inconsequential to wildlife. However, habitat modification and disturbance associated with trail use can negatively affect songbird productivity and survival, ultimately resulting in avian community changes (Knight and Cole, 1995; Anderson, 1995; Marzluff, 1997). Disturbance effects along trails are most significant during the early part of the nesting cycle (Gotmark, 1992). Recreationists may disturb nesting birds and inadvertently advertise nest locations to predators (Gutzwiller, 1995). Our past data on recreational impacts on Heil Ranch suggest that although most species of forest birds continue to use areas around trails, some species react negatively to recreational use and nesting success is lower near trail areas.

Over the past six years we have obtained avian distribution and abundance data from 30 point count locations on the Heil Ranch property. We have also obtained breeding biology data from 224 nests of 25 species (Cruz and Swanson 2003). We can, therefore evaluate the structural (e.g., avian richness) and functional (e.g., reproductive success) responses of the breeding bird community at Heil Ranch to management, wildfire, and continued trail use. In addition to the current analyses, our data provide extensive data on the ponderosa pine forest bird community that can be used to examine any shifts resulting from future changes on the property.

Relatively undisturbed ponderosa pine habitats are rare in eastern Colorado, and we were fortunate to have the opportunity to study the Heil Ranch property before it's opening to the public and before extensive habitat modification had begun. This allows us to have accurate baseline data to be used in comparison to post-management, post-burn and post-recreational data. This type of site specific, multi-year baseline is rare and adds strength to our study not common in the literature on recreation, wildfire and forest management.

Methods

Point Count Station Establishment: In 1999 we established a total of 20 locations for point counts on the Heil Ranch property. In 2000, 2001, 2002 and 2003, in accordance with our goals we increased this number to 30 stations, ten along each of 3 transects. These transects included a canyon (CANY) transect starting from the parking lot, running along the Lichen Trail and extending into Plumley Canyon, a proposed trail (PRTR) transect along the route of the new Ponderosa trail extending to the center of the property, and a no trail (NOTR) transect running to the west of the new Ponderosa trail in an area not slated for development. Comparisons between these transects can be found in our previous year-end reports looking at recreational use impacts on the bird community.

In 2004, we located an additional 20 point count locations. We continued to monitor the PRTR points but shifted our focus to forest management taking place on Heil Ranch. The 20 new point count locations included 10 located in areas with no trail that had been thinned. Each of these was located at least 50 m from the trail and at least 100 m from the edge of the mechanically thinned area. We also set up 10 control non-thinning points. Five of these were contained within unthinned open canopy forest approximating the conditions which are the target of the thinning operations. The last five points were located in dense, closed canopy forest similar to the conditions present in the thinned area prior to treatment.

Avian Censusing: From June 1 through July 15 we undertook point counts at the chosen locations along each of the transects above. Counts took place for 10 minutes and were performed 3 times at each location before July 15. During each count, all birds seen or heard within 50 meters were identified and recorded. Additional species within 150 meters were also noted. All counts took place between 0530 and 1000, with most counts being completed by 0900. For each point a Relative Abundance Index (RAI) was determined using the following formula:

Total Number of Independent Observations of Birds/Total Number of Census Periods

Each singing male, pair or family group of birds observed or heard was considered an independent observation for the purpose of this study. Only birds seen or heard within 50 meters of the point were tallied in the RAI.

Breeding Productivity: Through observations of nesting behavior (Ralph et al., 1993) and area searches, we located nests at three sites on the Heil Ranch property. These sites were the parking and picnic area, two separate areas within mechanically thinned forests along the ponderosa and wapiti trail and areas within unthinned, open canopy forest east of the ponderosa loop on Red Hill. Once found, nests locations were marked with flagging placed approximately 10 m from the nest. Nests were monitored at least once every three days from the day they were found until the nest either failed or the young fledged. Contents were observed directly or with a 6-m mirror pole. Efforts were made not to influence natural rates of nest success using methods designed to prevent nest abandonment and the location of nests by predators (Picozzi, 1975; Westmoreland and Best, 1985; Major, 1989; Martin and Geupel, 1993).

We analyzed nesting success of species for which we found more than 6 nests using the Mayfield method (Mayfield, 1976) with suggested adjustments made by Manolis et al. (2000). This method gives an estimate of the proportion of nests of a species that will fledge at least 1 young based on actual observations from nests of that species. Note however, that this does not take into account cowbird parasitism.

Nest Site Selection: At the conclusion of the breeding season we measured the following vegetation variables at each nest site; nest height, nesting substrate, substrate height, average canopy height in an 11.3 m radius around the nest, number of trees (by size class and species) in an 11.3 m radius around the nest, number of woody stems (by species) in a 5 m radius around the nest, canopy cover at the nest site and at 4 locations 1 m from the site, and percent of various ground cover types in a 5 m radius around the nest. All vegetation variables were measured using standardized protocols.

We are currently in the process of analyzing all our nest site data and comparing it to data taken at random sites. This analysis should allow us to determine whether some species prefer specific microsite characteristics for their nests.

GIS Analysis: We intend to use data layers from Arcview to determine landscape level patterns of bird distribution, abundance, and nesting success on the Heil Ranch property. Specific variables used will include vegetation type, slope, aspect, canopy cover, forest treatment and distance from trails and/or roads.

Results

Avian Censusing: In 2004, we successfully censused birds at all 30 of our established point count locations. These points were all contained within ponderosa pine forest or ponderosa pine woodland habitat.

We detected a total of 27 bird species at our point count locations on Heil Ranch in 2004 (Appendix 1). This number of species is lower than previous years due to the lack of point count locations in habitats other than ponderosa pine. These numbers are consistent with the number

of species found previously in ponderosa dominated habitats on Heil Ranch. Our previous 5 years of point counts indicated that species typical of riparian areas (e.g. Warbling Vireo, Black-headed Grosbeak) and foothills scrub habitat (e.g. Blue-Gray Gnatcatcher, Spotted Towhee) are generally uncommon on Heil Ranch, as there are few extensive patches of these vegetation types. Species typical of grasslands (e. g. Western Meadowlark and Lark Sparrow) are also present in low numbers in open meadows and savannah-like ponderosa areas. Species typical of Ponderosa Pine forests are widespread on the Heil Ranch property, and a few species typical of higher montane coniferous forests (e. g. Townsend's Solitaire and Dark-eyed Junco) are present, especially near the western edge of the property. The avian community on Heil Ranch appears to be similar to that of other Ponderosa Pine dominated open space properties in Boulder County (pers. obs.).

A comparison of abundance data over the period 1999-2004 suggests that most birds had relatively similar numbers overall between years. There was a significant production of cones by the ponderosa pines in 2001, resulting in dramatically increased numbers of Red Crossbills and Pygmy Nuthatches. Overall in 2002, abundance of many species were lower than in previous years. This trend seems to have been in response to the drought during 2002. During 2003, abundance of many species increased dramatically from 2002 and several species reached abundances higher than in any previous years of the study. These species include Chipping Sparrow, Lesser Goldfinch, Mourning Dove, Plumbeous Vireo, Pygmy Nuthatch, and Western Wood-Pewee. These abundances continued in 2004, suggesting relatively stable abundances of breeding birds in years without severe drought.

To determine the impacts of thinning on forest bird use of the ponderosa pine forest, we examined point counts performed in forest areas that had been thinned over the last two years, unthinned forests with closed canopy conditions similar to those found in the thinned areas before treatment (unthinned- closed canopy) and unthinned areas with relatively open canopies similar to the target conditions for areas being treated (unthinned- open canopy) (Table 1). Relative abundance of all species recorded in the point counts reached their highest levels in thinned areas and unthinned- open canopy areas. No species were found to reach their highest relative abundance in unthinned- closed canopy areas. Species showing the highest relative abundance in thinned areas included American Robin, Pygmy Nuthatch, Spotted Towhee, Stellar's Jay, Western Tanager and Western Wood-Pewee (Figure 1). Species reaching their highest abundances in unthinned- open canopy areas included Chipping Sparrow, Lesser Goldfinch, Mourning Dove, Plumbeous Vireo and Western Tanager (Figure 2). In addition, Mourning Dove, Plumbeous Vireos, Spotted Towhee, Stellar's Jay and Western Tanagers were never recorded in unthinned- closed canopy areas. No Brown-headed Cowbirds were detected in point counts in any of the three habitat types (Table 1).

Breeding Productivity: In 2004, we located and monitored 107 nests of 25 species (Appendix 1). Over the 6-year period we have located and monitored a total of 397 nests of 25 species (Appendix 2). Additionally we have confirmed nesting by 18 other species (Appendix 2), primarily cavity nesters; nests of which we did not monitor.

Overall, we found significantly more nests in 2004 than we did in 2003. This was most likely due to increased nest searching resources available in 2004. In 2002, despite extensive nest searching effort, we found only 1 nest in the parking/picnic areas, which was directly contradictory to high numbers found in previous years. In 2003, this trend reversed and we found 13 nests of 7 species. During 2004, we found 20 nests of 10 species, a number

comparable to years prior to 2002 (18 nests in 2000 and 24 nests in 2001) suggesting that birds are again using this area for nesting (Table 2).

Analysis of nesting success using the Mayfield method shows that there is a large amount of annual variation in nesting success of the various avian taxa on Heil Ranch (Table 3). In 2003, we saw a drastic decrease in nesting success for three of the four species examined. American Robins, Mourning Doves, and Plumbeous Vireos showed the lowest nesting success since the beginning of this study. In 2004, this trend continued for American Robins and Mourning Doves. Sufficient numbers of Plumbeous Vireo nests were not located to examine nesting success for this species in 2004. Additional species showing dramatic drops in nesting success include Chipping Sparrow, Lesser Goldfinch and Western Wood-Pewee (Table 3). No species with sufficient nest data for examination of Mayfield nesting success showed increased or stable nesting success over the six-year study period.

Cowbirds detections were low for all years of the study. In 2004, the detections were lowest with no detections for the entire summer (Table 1). Parasitism in 2004 was also at its lowest level of the 6 years studied with only 1 of 53 potential host nests parasitized (2.3%). In 1999, at least 5 of 48 potential host nests (10.4%) were parasitized, in 2000, at least 14 of 82 potential host nests (17.1%) were parasitized, in 2001, at least 10 of 69 potential host nests (14.5%) were parasitized, in 2002, only 5 of 69 (7.2%) nests were parasitized and in 2003, 1 of 32 potential nests (3.1%) were parasitized (Figure 3).

Absolute occurrence of nests on our study areas is difficult to determine. The lack of nests in an area does not necessarily represent that the species is not nesting there, only that we were unsuccessful at finding any nests. However, our nesting data for thinned and unthinned areas (primarily open-canopy) suggest that there may be only one species that nested only in the thinned areas, the Western Tanager (Table 4). In contrast, three species, the American Robin, Chipping Sparrow and Lesser Goldfinch seem to be absent from nesting in the thinned areas. Of species that nested in both areas, three (Common Nighthawk, Mourning Dove and Western Wood-Pewee) experienced higher predation rates in the thinned versus the unthinned areas. Plumbeous Vireos had higher predation and parasitism rates in the unthinned areas (Table 4).

Discussion

Recreational Impacts: We have been examining the forest bird community at Heil Ranch for 6 years. During this time period, recreational opportunities have been opened to the public, mechanical thinning and wildfire have changed the forest habitat and a severe drought (2002) has occurred. Our data over the length of the study has allowed us to examine what effects if any these impacts have on the abundance and nesting success/breeding biology of ponderosa pine forest birds. Early suggestions in our relative abundance data were that several species showed sharp declines following the introduction of recreational use to the property. Since that time however, those species with few exceptions have increased to match or exceed their abundance before recreational use. Our data for 2004 suggest that this is continuing and overall, relative abundance of birds seems to be stable.

Another potential effect of the recreational activity was seen in 2002 when nesting birds completely disappeared from the parking lot/picnic area. Several species had numerous nests in this area before 2002 suggesting a dramatic shift in the usage of this area. In 2003, this trend reversed, and in 2004, this reversal intensified. Birds are again nesting in the parking lot/picnic

area in numbers seen prior to 2002. This steep decline combined with that of relative abundance near trails in 2002 suggests an interesting effect of the drought. Areas remote from recreational use did not show the decline in either abundance or nesting activity, thus rejecting the hypothesis that the result was due solely to the drought. Instead, this data suggest that the synergistic effects of the drought and disturbance resulting from recreation may have led to the decline in both nesting and overall use of areas with recreational use during the drought. This idea is not new to ecology and actually synergistic effects have been discussed in a variety of ecosystems.

Alternatively, birds may be habituating to human use of the areas independently of the drought conditions.

Despite the rebound in relative abundance and nesting use of the parking lot/picnic area, nesting success over all on the property has continued to decline. This year, some species showed extremely low nesting success including the Chipping Sparrow (0.043), Mourning Dove (0.028) and Western Wood-Pewee (0.212). These numbers represent the probability that any given nest will rear at least 1 offspring successfully to fledging. This suggests that although birds are still using this area, their nesting success is not sufficient to have a self-sustaining population. This is troublesome and suggests two things. The first is that the introduction of recreation to the property or some other change in the suitability of the habitat has led to reduced nesting success. The second is that Heil Ranch may represent an “ecological trap” to these species, providing suitable-appearing habitat that attracts birds only to experience low nesting success.

One positive development on Heil Ranch has been the decrease in Brown-headed Cowbird use of the property and the resulting parasitism of open cup nesting bird species. The numbers of cowbirds, although always low, have decreased dramatically over the years and in 2004, no cowbirds were detected and only a single nest was parasitized. This suggests that removal of cattle from the property and other changes associated with the counties management are working positively to limit the use of this property by Brown-headed Cowbirds. In addition, the lack of cowbird activity also counters the idea that forest management and wildfire may increase cowbird use of an area due to new openings in the forest being created.

Because parasitism is a low threat to open cup nesters in this system, other causes of failure account for the low nesting success. Predation and abandonment were the primary reasons for nest failure in 2004. This suggests that changes associated with recreational use, infrastructure construction/maintenance and/or forest management may be encouraging use of the area by nest predators and creating disturbance of birds resulting in abandonment.

Forest Management Effects: Our examination of forest management led to some very interesting results. Birds on Heil Ranch are not using dense, closed-canopy ponderosa pine forest, a finding that has been supported by other researchers. No species reached their highest relative abundances in these forests. Many species used thinned forest as well as open-canopy unthinned areas. This suggests that thinning operations may be doing a good job of mimicking the open-canopy forest conditions that are the goals of manual thinning and eventual prescribed burning. In addition, a variety of species nested even in the most recently thinned areas pointing towards quick recovery of the habitat following thinning to conditions suitable for use by forest birds.

However, Stellar’s Jays, a nest predator were also found to reach their highest relative abundance in the thinned areas. This combined with a higher rate of nest predation in the thinned vs. unthinned areas supports the hypothesis that thinning may attract use by corvids even though this does not seem to be the case for cowbirds.

Management Suggestions: Overall data of forest bird populations seems to be positive in relation to occurrence and use for nesting in relation to both recreation and forest management. However, the dramatic decrease in nesting success suggests a loss of sustainability in the bird population for the long-term. To address this issue, we suggest that future expansion of recreational use be planned carefully to avoid impacting the entirety of the property. In addition, areas of open canopy forest should be avoided since these seem to provide the most desirable habitat and best chance for nesting success for a variety of species. Finally, synergistic effects may be operating between recreational use and stressors such as severe drought. Caution should be exercised to provide areas away from recreational use that will provide continued use and success during times of stress for the natural community.

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Appendix 1. Birds recorded as present or nesting in ponderosa pine forests of Heil Valley Ranch for summer 2004.

Common Name	Scientific Name	Present in Censuses	Nesting
American Goldfinch	<i>Carduelis tristis</i>	X	
American Crow	<i>Corvus brachyrhynchos</i>	X	
American Robin	<i>Turdus migratorius</i>	X	X
Blue-gray Gnatcatcher	<i>Polioptila caerulea</i>		X
Broad-tailed Hummingbird	<i>Selasphorus platycercus</i>	X	X
Cedar Waxwing	<i>Bombycilla cedrorum</i>		X
Chipping Sparrow	<i>Spizella passerine</i>	X	X
Cordilleran Flycatcher	<i>Empidonax occidentalis</i>	X	X
Common Nighthawk	<i>Chordeiles minor</i>	X	X
Common Poorwill	<i>Phaleinoptilus nuttalii</i>	X	
Hammond's Flycatcher	<i>Empidonax hammondi</i>		X
Hairy Woodpecker	<i>Picoides villosus</i>	X	X
House Finch	<i>Carpodacus mexicanus</i>	X	X
House Wren	<i>Troglodytes aedon</i>	X	X
Lark Sparrow	<i>Chondestes grammacus</i>		X
Lesser Goldfinch	<i>Carduelis psaltria</i>	X	X
Mountain Bluebird	<i>Sialia currucoides</i>		X
Mountain Chickadee	<i>Parus gambeli</i>	X	X
Mourning Dove	<i>Zenaidura macroura</i>	X	X
Northern Flicker	<i>Colaptes auratus</i>	X	X
Plumbeous Vireo	<i>Vireo plumbeus</i>	X	X
Pygmy Nuthatch	<i>Psitta pygmaea</i>	X	X
Spotted Towhee	<i>Pipilo maculatus</i>	X	
Stellar's Jay	<i>Cyanocitta stelleri</i>	X	
Tree Swallow	<i>Tachycineta bicolor</i>		X
Townsend's Solitaire	<i>Myadestes townsendi</i>	X	
Violet-green Swallow	<i>Tachycineta thalasina</i>	X	X
Warbling Vireo	<i>Vireo gilvus</i>	X	
White-breasted Nuthatch	<i>Sitta carolinensis</i>	X	
Western Bluebird	<i>Sialia mexicana</i>	X	X
Western Tanager	<i>Piranga ludoviciana</i>	X	X
Western Wood-Pewee	<i>Contopus sordidulus</i>	X	X
Yellow-rumped Warbler	<i>Dendroica coronata</i>	X	X

Appendix 2: Breeding status of selected bird species on the Heil Ranch property, 1999 - 2003.

Species	Nest Type	Breeding Status	Reason for Status
American Robin	Open Cup	Confirmed	Nests Located (50)
Glue-gray Gnatcatcher	Open Cup	Confirmed	Nests Located (05)
Black-headed Grosbeak	Open Cup	Confirmed	Nests Located (05)
Broad-tailed Hummingbird	Open Cup	Confirmed	Nests Located (15)
Brown-headed Cowbird	Brood Parasite	Confirmed	Parasitized Nests
Canyon Wren	Cavity	Confirmed	Cavities Located
Cedar Waxwing	Open Cup	Confirmed	Nests Located (09)
Chipping Sparrow	Open Cup	Confirmed	Nests Located (50)
Common Bushtit	Hanging	Probably	Flocks
Common Poorwill	Ground	Confirmed	Nests Located (02)
Common Nighthawk	Ground	Confirmed	Nests Located (17)
Cordilleran Flycatcher	Open Cup	Confirmed	Nest Located (04)
Dark-eyed Junco	Open Cup	Confirmed	Fledged Young
Grace's Warbler	Open Cup	Confirmed	Nest Located (01)
Hairy Woodpecker	Cavity	Confirmed	Cavities Located
Hammond's Flycatcher	Open Cup	Confirmed	Nests Located (05)
House Finch	Open Cup	Confirmed	Nests Located (02)
House Wren	Cavity	Confirmed	Fledged Young
Lark Sparrow	Open Cup	Confirmed	Nests Located (15)
Lazuli Bunting	Open Cup	Confirmed	Nests Located (03)
Lesser Goldfinch	Open Cup	Confirmed	Nests Located (45)
MacGillivray's Warbler	Open Cup	Confirmed	Fledged Young
Mountain Bluebird	Cavity	Confirmed	Cavities Located
Mountain Chickadee	Cavity	Confirmed	Cavities Located
Mourning Dove	Open Cup	Confirmed	Nests Located (37)
Northern Flicker	Cavity	Confirmed	Cavities Located
Pine Siskin	Open Cup	Confirmed	Nests Located (01)
Plumbeous Vireo	Open Cup	Confirmed	Nests Located (33)
Pygmy Nuthatch	Cavity	Confirmed	Cavities Located
Red-breasted Nuthatch	Cavity	Probable	Pairs
Red Crossbill	Open Cup	Confirmed	Nests Located (01)
Rock Wren	Cavity	Confirmed	Cavities Located
Spotted Towhee	Open Cup	Confirmed	Nests Located (02)
Stellar's Jay	Open Cup	Confirmed	Fledged Young
Tree Swallow	Cavity	Confirmed	Cavities Located
Townsend's Solitaire	Open Cup	Confirmed	Nests Located (04)
Vesper Sparrow	Open Cup	Confirmed	Nests Located (01)
Violet-green Swallow	Cavity	Confirmed	Cavities Located
Virginia's Warbler	Open Cup	Confirmed	Fledged Young
Warbling Vireo	Open Cup	Confirmed	Nests Located (02)
Western Bluebird	Cavity	Confirmed	Cavities Located
Western Tanager	Open Cup	Confirmed	Nests Located (28)
Western Wood-Pewee	Open Cup	Confirmed	Nests Located (60)
White-breasted Nuthatch	Cavity	Confirmed	Cavities Located
Yellow-rumped Warbler	Open Cup	Confirmed	Fledged Young

Table 1: A comparison of bird species relative abundance index (RAI) in thinned and non-thinned areas of Heil Ranch

Species	Thinned	Unthinned- Open canopy	Unthinned- Closed canopy
American Robin	0.567	0.363	0.333
Brown-headed Cowbird	0.0	0.0	0.0
Broad-tailed Hummingbird	0.067	0.0	0.0
Chipping Sparrow	1.367	1.818	0.467
Hammond's Flycatcher	0.0	0.0	0.0
Lark Sparrow	0.0	0.0	0.0
Lesser Goldfinch	0.333	1.454	0.20
Mountain Chickadee	1.667	0.0	0.20
Mourning Dove	0.367	0.454	0
Plumbeous Vireo	0.333	0.727	0.0
Pygmy Nuthatch	1.0	0.545	0.467
Rock Wren	0.0	0.0	0.0
Spotted Towhee	0.033	0.0	0.0
Stellar's Jay	0.1	0.090	0.0
Western Tanager	0.233	0.545	0.0
Western Wood-Pewee	0.80	0.182	0.20

Table 2: A comparison of the nesting success of birds at the Heil Ranch parking/ picnic area.

Species	Year	# Nests	% Depredated	% Parasitized
American Robin	1999	1	0	0
	2000	3	33	0
	2001	6	13	0
	2002	0	--	--
	2003	3	33	0
	2004	2	0	0
Broad-tailed Hummingbird	1999	1	0	0
	2000	0	--	--
	2001	2	50	0
	2002	0	--	--
	2003	3	33	0
	2004	0	--	--
Chipping Sparrow	1999	3	100	0
	2000	3	67	33
	2001	2	50	0
	2002	0	--	--
	2003	1	0	0
	2004	1	100	0
Hammond's Flycatcher	1999	1	0	0
	2000	1	100	0
	2001	1	0	100
	2002	0	--	--
	2003	0	--	--
	2004	0	--	--
Lesser Goldfinch	1999	0	--	--
	2000	2	50	0
	2001	5	40	0
	2002	0	--	--
	2003	3	0	0
	2004	5	20	0
Mourning Dove	1999	1	0	0
	2000	1	0	0
	2001	0	--	--
	2002	0	--	--
	2003	1	0	0
	2004	0	0	0
Plumbeous Vireo	1999	4	75	75
	2000	2	50	50
	2001	2	50	50
	2002	0	--	--
	2003	0	--	--
	2004	0	--	--
Western Tanager	1999	1	0	0
	2000	2	50	0
	2001	2	0	50
	2002	0	--	--
	2003	1	0	0
	2004	0	--	--
Western Wood-Pewee	1999	4	0	0
	2000	4	25	25
	2001	4	25	0
	2002	1	0	0
	2003	1	0	0
	2004	3	0	0

-- denotes no nests found

Table 3: A comparison of the nesting success of birds at Heil Valley Ranch over 6-year Study period.

Species	1999	2000	2001	2002	2003	2004
American Robin	---	0.58	0.77	0.53	0.07	0.21
Chipping Sparrow	0.16	0.49	0.25	0.53	--	0.04
Common Nighthawk	*	*	*	*	*	0.36
Lesser Goldfinch	*	0.72	0.44	0.90	0.66	0.25
Mourning Dove	0.32	0.28	0.15	0.85	0.08	0.03
Western Tanager	0.38	0.36	0.52	0.66	*	*
Western Wood-Pewee	0.68	0.62	0.33	0.76	*	0.21

* denotes insufficient nests to calculate

Table 4: Nesting Data for Select Species at Heil Valley Ranch in Thinned and Unthinned Study Plots during the summer of 2004

Species	Area	# Nests	% Depredated	% Parasitized	Mayfield Nesting Success
American Robin	Thinned	0	--	--	*
	Unthinned	12	17	0	0.248
Broad-tailed Hummingbird	Thinned	3	0	0	*
	Unthinned	2	0	0	*
Chipping Sparrow	Thinned	0	0	0	*
	Unthinned	10	20	0	0.052
Common Nighthawk	Thinned	5	20	0	0.388
	Unthinned	2	0	0	0.330
Lesser Goldfinch	Thinned	0	0	0	*
	Unthinned	6	17	0	*
Mourning Dove	Thinned	2	100	0	0.0004
	Unthinned	5	0	0	0.061
Plumbeous Vireo	Thinned	2	0	0	*
	Unthinned	2	50	50	*
Western Tanager	Thinned	2	50	0	*
	Unthinned	0	0	0	*
Western Wood-Pewee	Thinned	2	100	0	0.166
	Unthinned	14	21	0	0.339

-- denotes no nests found

* denotes insufficient nests to calculate

Figure 1. Relative Abundance of Species More Abundant on Thinned Plots in 2004

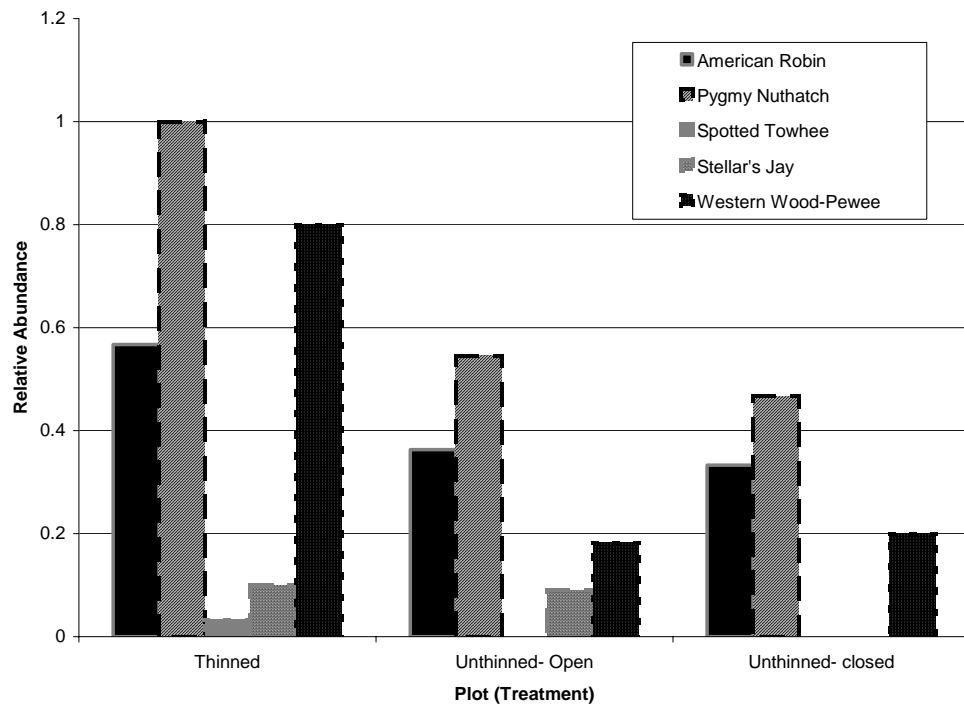


Figure 2. Relative Abundance of Speices More Abundant on Unthinned- Open canopy Plots in 2004

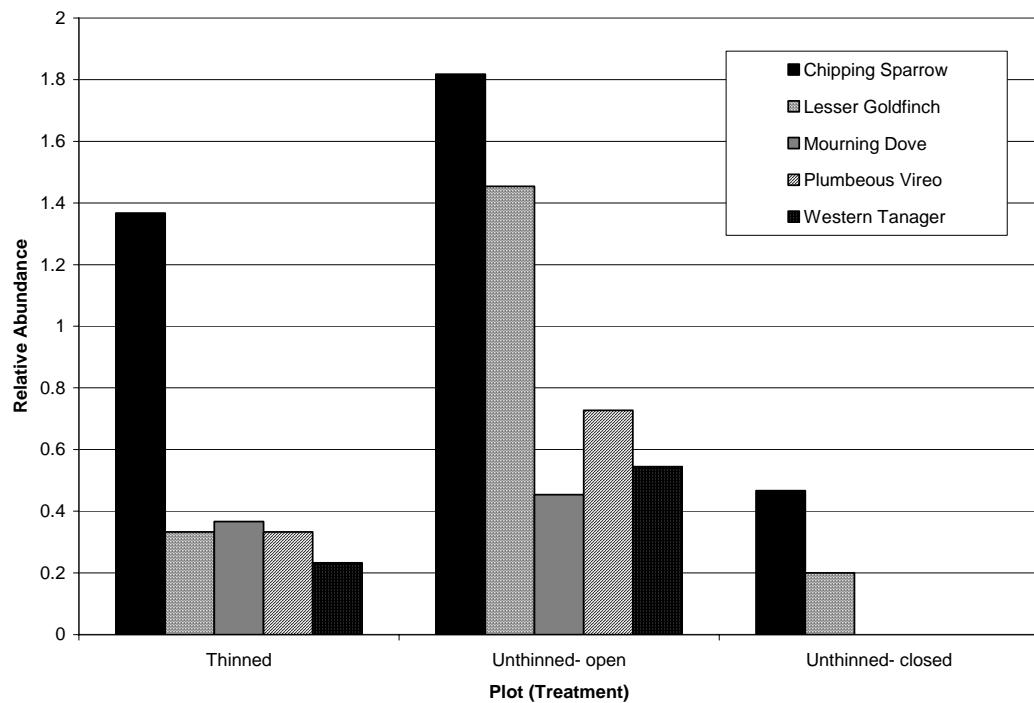


Figure 3. Relative Abundance of and Parasitism by Brown-headed Cowbirds on Heil Valley Ranch Across Years

