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BIRD MONITORING IN MONTANE MEADOW AND RIPARIAN HABITATS OF

DEVILS POSTPILE NATIONAL MONUMENT

FINAL REPORT 2002 - 2004




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EXECUTIVE SUMMARY

In 2002 – 2004, PRBO Conservation Science (PRBO) implemented a standardized bird monitoring and visitor education program in montane meadow and riparian habitats of Devils Postpile National Monument (referred to hereafter as DEPO or the monument). We established 15 point count stations along the San Joaquin River and Red's Meadow Creek within monument boundaries. We also established 1 mist netting station (of 10 net locations) at Soda Springs meadow near the DEPO Ranger Station, where we conducted visitor education in conjunction with mist netting and banding (education efforts are presented in a separate report, (Gates et al. 2004)). Here we provide results from these efforts, 13 results-driven recommendations, a discussion of bird responses to riparian and meadow restoration efforts at DEPO, and recommendations for a long term avian monitoring program at DEPO.

Ninety-seven bird species, including 10 species of concern have been documented within and in close proximity to the monument and we determined breeding status for each. We determined frequency of occurrence and relative abundance for 35 breeding species. The most abundant species detected were Oregon Junco, American Robin, Warbling Vireo, Steller's Jay and Song Sparrow.

We calculated an index of total abundance, species richness and species diversity for breeding species at each of the 15 point count stations and for the entire study transect. We detected a mean of 149 ($\pm$ 20.26) individuals and 25 ($\pm$ 4.58) breeding species over the course of the three year study. When compared to riparian sites east of the Sierra crest, indices of breeding bird diversity and richness were high at DEPO, especially at the Soda Springs meadow and Red's Creek Meadow sites.

We determined Sawyer and Keeler-Wolf habitat types for all point count stations. Four riparian habitat types and two upland types were assigned to DEPO sites. Most sites were characterized as Black Cottonwood/Lodgepole Pine and Mixed Willow/Lodgepole Pine. Breeding bird species richness was higher at Mixed Willow sites, though the difference was not significant. Willow cover was significantly and positively correlated with breeding bird species richness and breeding species abundance. Several vegetation variables were highly correlated with individual species abundance. Yellow Warbler and Song Sparrow abundance were both highly associated with vegetation in the herb (< 50 cm) layer while Wilson's Warbler and Western Tanager abundance was positively correlated with tree height. Greater cover of grass in the shrub layer (> 50 cm – 5 m) best predicted higher abundance for Oregon Juncos and MacGillivray's Warblers.

We used hatching year to after hatching year rations as an index of productivity for 38 breeding species. Species with exceptionally high productivity indices in all years were Calliope Hummingbirds and Red-breasted Sapsuckers. Species with very low indices of productivity included Audubon's Warblers in 2004 and Warbling Vireos in all years. We documented the movement of late summer migrants (Rufous Hummingbird) and upslope dispersal of Orange-crowned Warblers, as has been documented at other mountain meadow sites in the Sierra Nevada.

We recaptured several individuals in consecutive years at DEPO. Orange-crowned Warbler individuals, who presumably fledged from and bred at lower Sierra Nevada elevations, returned to DEPO during consecutive years after breeding concluded. Mountain White-crowned Sparrows, Oregon Juncos and Orange-crowned Warblers were first captured as hatch year birds at DEPO, and were captured as breeding or dispersing adults in subsequent years.

RECOMMENDATIONS

With the goal of enhancing and protecting riparian and meadow breeding bird populations and their habitat, we provide 13 habitat, management, and monitoring recommendations. Recommendations are based on results derived from PRBO's 2002 - 2004 DEPO bird monitoring program and from PRBO's wider bird monitoring effort in the eastern Sierra Nevada (1998 – 2004), unless otherwise cited. Recommendations 9 – 12 (labeled "CalPIF RBCP") are taken directly from the Riparian Bird Conservation Plan (RHJV 2000) and Recommendation 13 (labeled "CalPIF SNBCP") is taken directly from the draft Avian Conservation Plan for the Sierra Nevada Bioregion (Siegel and DeSante 1999). Results presented in these recommendations are also presented in detail in the Results and Discussion section of this report.

1. Maintain a diversity of riparian habitat types within the monument. Sites characterized as willow habitat types tended to harbor the highest number of breeding bird species, but black cottonwood, alder and aspen habitat types were also rich in bird species. These habitat types are structurally different from one another and provide different habitat niches for riparian breeding birds. Maintaining a diversity of riparian habitat types will sustain breeding bird diversity monument-wide.

2. Maintain and encourage vegetative structural diversity and habitat complexity. When considering the habitat needs of an entire breeding bird community, versus the needs of a few indicator species, it becomes clear that maintaining diverse vegetative structure and complexity is highly beneficial. The abundances of six bird species at the monument were positively correlated with vegetation found in three vertical layers: herb-class cover (< 50 cm), shrub-class cover (50 cm – 5 m) and tree-class cover (> 5 m). Diverse vegetation (in terms of height, structure and species) provides more available nesting substrate and more complex cover and protection from a variety of nest predators (Martin 1992). Additionally, a more diverse vegetative structure may benefit other important elements of avian breeding ecology such as easy access to nesting material, more singing perches or a wider variety of prey items.

3. Maintain and encourage willow cover. Breeding bird species richness and breeding bird abundance had a very strong positive correlation with percent willow cover at DEPO. This easy to plant and quick growing riparian shrub stabilizes stream banks and provides nesting habitat for numerous species breeding in the monument including Yellow Warblers, Song Sparrows, Dusky Flycatchers, Warbling Vireos, Calliope Hummingbirds and Mountain White-crowned Sparrows.

4. Maintain herbaceous cover and height. The abundance of several bird species was positively correlated with herbaceous cover. High growing herbaceous cover, (e.g. forbs and grasses that measured > 50 cm) were associated with Oregon Junco and MacGillivray's Warbler abundance in particular. Forbs and grasses (which often serve as forage for domestic livestock or wild ungulates) permitted to reach their full vertical height, provide optimum nesting substrate and concealment for ground and low shrub nesting species.

5. Monitor pine encroachment into the riparian zone. Conifer encroachment is one of the leading causes of aspen decline in the Sierra Nevada (D. Burton, Aspen Delineation Project, pers. com.). Across the eastern Sierra, conifer encroachment into aspen groves was

negatively correlated with bird species richness and abundance (Richardson and Heath *in press*) and conifer dominated riparian habitats were not as bird species rich as aspen or willow dominated riparian habitats (Heath and Ballard 2005). However, some pine cover in the riparian zone enhances structural diversity and provides nesting substrate for several species. Also, streamside pines stabilize banks and provide shade which regulates water temperatures for fish and aquatic invertebrates. Discerning an encroachment threshold and a careful consideration of trade-offs is recommended before management action is taken.

6. Limit management activities in riparian habitat (such as vegetation disturbance or removal) to the non-breeding season (mid September through early May). The breeding season for birds begins prior to the laying of an egg, when pair bonding, nest location choices and nest building takes place, and songbirds will take at least a month after the first egg is laid to fledge and care for young. Based on the timing of hatch year and reproductively active female captures, we deduce the breeding season for riparian and meadow breeding birds in the monument to be mid May through early September. June and July are peak breeding season months.

7. Avoid constructing new human facilities within or adjacent to riparian areas. We have no direct evidence from this study that riparian campgrounds or other riparian developments are detrimental to songbirds. However, other studies have connected high concentrations of Brown-headed Cowbirds to artificially rich sources of food associated with campgrounds, roads, towns, pack stations and small horse corrals in the eastern Sierra (Rothstein et al.1980, Rothstein et al. 1984). Songbirds should indirectly benefit from bear management practices that reduce the availability of human food at campgrounds, as this practice also reduces food availability for songbird nest predators such as Steller's Jays.

8. Meadow management and restoration efforts should, if possible, be coordinated with Inyo National Forest. Soda Springs meadow is geographically linked to a string of other meadow systems upstream from the northern DEPO boundary. These meadows (e.g. near Mineral Falls and Pumice Flat) are over twice the size of Soda Springs meadow and likely provide similar nesting and foraging habitat to that found in DEPO. It is also reasonable to assume that breeding birds disperse and move between these meadows (e.g. birds that fledge from DEPO may move upstream to INF meadows or visa-versa). Coordinating management and restoration efforts within geographically linked habitats should benefit wildlife species that disregard political boundaries.

9. *CalPIF RBCP*. Use standardized monitoring protocols. By standardizing monitoring techniques, researchers ensure that results can be compared across space and time. The USDA Forest Service published guidelines for standardized monitoring techniques for monitoring birds (Ralph et al. 1993).

10. *CalPIF RBCP*. Maximize the cost effectiveness and value of existing specialized monitoring programs for listed species (e.g., those oriented toward Northern Goshawk and Willow Flycatcher) by collecting standardized data on multiple species (such as point counts) in addition to any specialized protocols aimed at one species. Many state and federally sponsored surveys only monitor special-status species. By adding a standard protocol that provides information on multiple species while conducting special-status species surveys, researchers could rapidly expand their knowledge of California's birds. Such data could be shared and analyzed and results would be added to conservation plans and incorporated into management regimes. Even if resources are not immediately available for analysis, the

information will provide a baseline or historical perspective on bird distribution and abundance, thus allowing for preemptive measures to be taken to avoid the future listing of species we now consider common.

11. *CalPIF RBCP*. Consider reproductive success when monitoring populations and assessing habitat value. Conduct selective monitoring at key sites to determine factors influencing nest success for currently common species. The number of young produced (productivity) critically influences a bird population's presence and viability in an area. Low nest success could indicate a nonviable population. Relatively recent, local extirpation and declines of some western songbird species from their historical breeding range appear to be caused by low productivity (Johnson and Geupel 1996, Chase et al. 1997, Gardali et al. 2000, Ballard et al. 2003). Local extirpation may signal the early stages of a process of species extinction. By determining the factors associated with low reproductive success, monitoring may identify which management and restoration actions will help reverse songbird population declines. Monitoring common species has the duel benefit of providing statistical power for analysis, and providing gauges that allow management changes before it is too late.

12. *CalPIF RBCP*. Conduct intensive, long-term monitoring at selected sites. In order to analyze trends, long-term monitoring should continue for more than five years. Long-term monitoring should be conducted at reference sites that embody the characteristics restoration and management efforts strive to recreate. Long-term monitoring at key experimental sites can test the assumptions that currently drive restoration and management practices. Intensive monitoring includes collecting data on primary demographic processes and associated habitat characteristics and seeks to identify causal connections between habitat variables and species viability. Biologists collect data on reproductive success, breeding densities, reproductive success, parasitism, survival, vegetation data, suitable habitat requirements, and general life-history information. Managers can employ these data to make well informed, adaptable management plans.

13. *CalPIF SNBCP*. Where feasible, promote active restoration of meadows, including revegetation and restoration of natural hydrologic processes, in an adaptive management framework. Recent advances in stream restoration suggest that even deeply incised meadow streams can be successfully altered to restore natural flooding regimes to unnaturally dried-out meadows (Jim Wilcox pers. comm.). This is especially true where stream incision and associated drying of meadows primarily reflect the effects of past, rather than current land management practices. Meadow restoration projects, incorporating hydrologic as well as vegetative restoration, should be encouraged on public and private lands throughout the Sierra.

BACKGROUND AND INTRODUCTION

Montane meadow and riparian areas provide critical habitat for western bird populations (Miller 1951, Gaines 1974, Siegel and DeSante 1999, Manley and Davidson 1993, RHJV 2000), and are recognized in the Draft Avian Conservation Plan for the Sierra Nevada Bioregion as Priority Habitats for bird conservation (Siegel and DeSante 1999). Montane meadow and riparian habitat are extremely important for Sierra Nevada avifauna because they provide breeding habitat for numerous landbird species. Riparian areas also provide migratory habitat for disproportionately more species than surrounding uplands (Knopf et al. 1988), and montane meadows provide critical molting and pre-migration staging areas for juveniles and adults among many landbird species in the Sierra Nevada (Burnett and Geupel 2001, Siegel and DeSante 1999).

While Devils Postpile National Monument (DEPO) only encompasses 798 acres of the Sierra Nevada range, it harbors montane meadow and riparian habitats that are important for breeding, dispersing, and migrating avifauna. Conservation of bird populations requires an understanding of the habitat needs and demographic mechanisms necessary for population sustainability (Martin 1992, Nur and Geupel 1993). Until 2001, when voluntary bird censuses were conducted in DEPO (Parker and Parker 2001), little information on its avifauna existed.

The bird monitoring program established in montane meadow and riparian habitats of DEPO was designed to contribute to the understanding of avian demographics and habitat use patterns at both a local and regional scale (Table 1). Because only scant information on bird use of DEPO

Table 1. Proposed goals and tasks for PRBO's bird monitoring efforts at Devils Postpile National Monument 2002 – 2004.

Goals and Tasks	Completed?
Project Goals	
document use of montane meadow and riparian habitat by breeding, migrant, molting and pre-migration and meadow and non-meadow landbirds.	YES
provide educational opportunities for visitors on avian ecology, natural history and conservation and on the DEPO avian monitoring program.	YES
provide summary information for the development of a long term adaptive management monitoring plan.	YES
Specific Tasks	
conduct point counts and analyze habitat correlates of meadow and riparian dependent species.	YES
conduct mist netting for at least the 2002 field season	YES
publicize and implement the constant-effort mist netting operations for visitor education opportunities in the monument in DEPO.	YES
develop a conceptual long term adaptive management monitoring plan for birds utilizing meadow and riparian habitats in the monument in DEPO.	ON-GOING

was previously available, a primary objective was to document bird use in its comparatively pristine and protected meadow and riparian habitat. Another impetus for the initiation of the project, however, was to document changes of bird use in DEPO's Soda Springs meadow following a program of visitor management and meadow and riparian stream bank restoration. The monitoring program was intended to inform local restoration efforts as well as to place DEPO within the larger context of a region-wide riparian bird monitoring program, which is primarily investigating the responses of birds to riparian habitat restoration (Heath et al. 2004). Bird data collected at DEPO were also intended to contribute to the national Monitoring Avian Productivity and Survivorship (MAPS) program, to the Sierra Nevada Inventory and Monitoring network, and in particular to the networks of MAPS programs that have been established at neighboring Sequoia Kings Canyon and Yosemite National Parks. What makes the bird monitoring project at DEPO most distinctive among these other regional efforts, however, is our strong commitment to interpreting the bird monitoring and monument restoration efforts to the visiting public. Results of the education component of this project are presented in another report (Gates et al. 2004).

METHODS

Research Permits

All bird monitoring and education work was performed under National Park Service Scientific and Collecting Research Permits DEPO-2002-SCI-0001, DEPO-2003-SCI-0001 and DEPO-2002-SCI-0003.

Study Area Description

At 2,300 m in elevation, DEPO is located along the San Joaquin River, Madera County, on the western slope of the Sierra Nevada and nearest to the town of Mammoth Lakes, California. The study area is comprised of Soda Springs meadow adjacent to the monument Ranger Station and the riparian habitat associated with the San Joaquin River and Red's Meadow Creek within the monument boundaries (37º 37' N, 119º 05' W to 37º 52' N, 119º 05' W; Appendix 1 & 2).

Study Design

Due to the small size of DEPO, it was possible to cover most riparian habitat along the San Joaquin River and Red's Meadow Creek within DEPO boundaries with one point count transect. We therefore chose 50 meters downstream of the northern monument boundary as a starting point and placed the remaining fourteen points 250m apart along the remaining section of the river corridor, and one section of Red's Meadow Creek, using GPS to determine distances. We marked each point with orange flagging and a metal tag labeled with "DEPO", the point number and "PRBO BIRD STUDY".

The Soda Springs meadow mist netting station location was chosen primarily for the purpose of documenting, in detail, bird use of the meadow and to potentially monitor the response of birds to meadow rehabilitation and visitor management that occurred there. The site was also chosen for its proximity to the DEPO Ranger Station for the purpose of conducting visitor education.

Observer Training

PRBO biologists all trained in distance estimation and familiar with songs and calls of birds in the area, conducted all point count censuses. Additionally, all biologists practiced and calibrated distance estimation and local bird identification prior to censuses. A Leica Range Finder ™ was used to assist in estimating distances to each bird detected.

Mist Netting

Netting procedures conformed to the guidelines described in Ralph et al. (1993) and Monitoring Avian Productivity and Survivorship (MAPS) program protocol (DeSante et al. 2002). In summary, 10 mist nets were operated once every ten-day period, access to DEPO permitting. See Appendix 1 for census dates, GPS coordinates of net lanes and detailed map of netting locations. Nets were unfurled 15 minutes after local sunrise, checked every 30 minutes (more often in cold weather) and were operated for five hours during each census period. Birds captured were carefully removed from the net and processed nearby. Each bird captured (except game birds) received a United States

Fish and Wildlife Service (USFWS) band for permanent identification to enable estimates of survival from subsequent recaptures. Age, sex, wing length, breeding condition, weight, skull ossification, flight feather wear, molt, and fat score of each bird were recorded as described by Pyle (1997) prior to releasing the bird. Nets and poles were taken down immediately after netting concluded. PRBO biologists conducted all mist netting and banding under U.S. Department of the Interior, Bird Banding Lab permit # 09316-DZ.

Point Count Censuses

We censused all 15 points using the five-minute variable circular plot (VCP) point count method (Rosenstock et al. 2002) and followed general guidelines outlined in Ralph et al. (1993). We estimated the distance to each bird detected. We recorded all birds detected and type of initial detection (visual, song or call).

We visited all stations three times during the peak of the songbird breeding season (June) and spaced each of three visits at least 10 days apart. To minimize observer bias, a different observer conducted each of the three censuses when possible. Additionally, we conducted points in order from point 1 to 15 for two censuses and in the opposite direction (from point 15 to 1) for one census in order to minimize the effects of time of day on detection rates. We conducted censuses from within 30 minutes after local sunrise until approximately 4 hours later, and did not conduct counts in excessively windy or rainy conditions. We also recorded all observations of breeding behavior. Dates of censuses, GPS coordinates and transect description and map are presented in Appendix 2, data forms are in Appendix 4.

Habitat Assessment

We conducted vegetation assessments at each of the 15-point count stations in 2002. Using the relevé method described by Ralph et al. (1993), we estimated percent cover by height category for every species of plant located within 50m of point count stations. Height categories were "herb" (0 - 0.5m), "shrub" (0.5 - 5m) and "tree" (> 5m). We also estimated the width of the riparian zone at the point and perpendicular to the river (riparian width), the percent of riparian vegetation along this riparian width (riparian patchiness), and the percent of the 50m radius occupied by riparian vegetation (percent riparian). Vegetation variables and definitions are listed in Appendix 3.

We used our vegetation measurements and guidance provided by Sawyer and Keeler-Wolf (1995) to assign dominant habitat series (habitat types) to each point (Table 2). Four Sawyer and Keeler-Wolf riparian habitat types (Habitat I) and two upland habitat types (Habitat II) were assigned to DEPO

Table 2. Sawyer and Keeler-Wolf riparian and upland habitat types for 15 point count stations and percent of points characterized by each combined type, Devils Postpile National Monument.

	Sawyer and Keeler-Wolf upland Habitat II types	
Sawyer and Keeler-Wolf riparian Habitat I types	Jeffrey Pine	Lodgepole Pine
Aspen	7 %	13 %
Black Cottonwood	20 %	27 %
Mixed Willow	--	27 %
White Alder	--	7 %

sites. All points encompassed two distinct habitat types (riparian and upland). Most sites were characterized by Black Cottonwood / Lodgepole Pine and Mixed Willow / Lodgepole Pine.

Geographic Data

Location information was collected at all point count stations and mist net locations using a Garmin Global Positioning System (GPS II+) receiver. Positions were recorded in Decimal Degrees, NAD83 datum. All coordinates and estimated accuracy (figure of merit; FOM) were recorded. FOM of these points ranged from 0 to 6m. Point count locations and associated vegetation and bird data have been converted to Geographic Information System (GIS) coverages in ArcView 3.2 (ESRI 2000). All maps are represented in UTM (Universal Transverse Mercator) coordinates, Zone 11, NAD27 datum.

Statistical Analysis and Definitions

Breeding Bird Abundance, Breeding Species Richness, Breeding Species Diversity and By-species Abundance. We summarized indices of abundance, species richness and species diversity for all breeding species detected during point counts. We excluded all non-breeding migrant or transient species. We further limited the species included in the summaries to those that we determined to be most reliably recorded with the point count protocol. Thus we also removed species whose territories are typically so large that we could not assure independence of individual observations among points (swallows [*Hirundinidae*], shorebirds [*Scolopacidae* and *Charadriidae*], ducks [Anatidae], hawks [*Accipitridae*], Clark's Nutcrackers [*Nucifraga columbiana*], Common Ravens [*Corvus corax*] and California Gulls [*Larus californicus*]).

Using PointCnt 2.79 (Ballard 2004), we summarized by point, and by point/by transect diversity, richness and abundance for breeding species detected within 50m during point counts and summed over 3 visits, in each of 3 years (2002 - 2004). We evaluated the effect of annual variation and found it to be minimal ($\leq$ 5%). We therefore calculated the by-point yearly mean of 3 years.

Breeding Species Diversity: The transformation of Shannon's diversity index (or H', Krebs 1989) denoted N_1 (MacArthur 1965). The transformation expresses the data in terms of number of species and thus is more easily interpreted. Expressed mathematically:

$$N_1 = e^{H'} \text{ and } H' = \sum_{i=1}^{i=S} (p_i)(\ln p_i)(-1)$$

Where S = total breeding species richness and p_i is the proportion of the total numbers of individuals for each breeding species (Nur et al. 1999). High index scores indicate both high breeding species richness and more equal distribution of individuals among species.

Breeding Species Richness: Number of breeding species.

Breeding Bird Abundance: Number of individuals of all breeding species combined.

Relative Abundance: We calculated the mean number of individuals for each breeding species by point by transect, averaged over 3 visits for each year, and then took the mean of all years. We used all detections within 50m. Because few species are 100% detectable, such calculations underestimate true density. Therefore results should be considered an index of abundance (relative abundance).

Bird and habitat relationships: We investigated the relationship between breeding species richness, breeding species abundance and 21 vegetation and landscape variables. Of the over 200 variables available to us, we chose the 21 that have previously been shown to influence bird and species numbers in the eastern Sierra, and investigated several more that we hypothesized might also influence bird numbers (Table 9, Heath and Ballard 2003). We examined the relationship between each of these variables and breeding bird species richness, breeding species abundance, and individual species' abundances using one-way linear models. We combined all the significant terms from these one-way models in candidate models, which were then reduced to the most parsimonious subset using stepwise backward multiple linear regression. Residuals from linear regression models passed Skewness/Kurtosis tests for normality and Cook-Weisenberg tests for heteroscedasticity ($P>0.05$). We compared bird species richness between Sawyer Keeler-Wolf habitat types using Kruskall-Wallace equality of populations rank test. Statistical calculations were performed using STATA 8.0 (Stata Corp. 2003). Significance was assumed at $P < 0.05$.

Breeding Status

We determined breeding status for all species encountered from our surveys between late May and mid August 2002 - 2004, during censuses performed by Parker and Parker (2001) and during censuses performed by the Institute for Bird Populations (Siegel and Wilkerson 2004). We ranked species using the following four criteria of the Riparian Habitat Joint Venture breeding scale, modified from breeding bird atlas criteria (http://www.prbo.org/calpif/criteria.html):

No evidence of breeding: Species not detected during breeding season, or species known not to breed within the general study area.
Possible breeding: Species encountered singing or acting territorial only once during the breeding season (in suitable habitat).
Probable breeding: Singing individual encountered on 2 or more different days of standardized censuses (at least one week apart); territorial behavior noted more than once at the same location; pair observed in courtship behavior.
Confirmed breeding: distraction display; nest building (except woodpeckers and wrens); nesting material or fecal sack being carried by adult; independent juveniles with adults; active territory observed on at least three days (at least one week apart); active nest observed.

Data dictionary and electronic copies of data

A detailed explanation of all data bases derived from this project was provided to the National Park Service and DEPO along with the submission of this report. Electronic versions of all DEPO databases derived from this project were also submitted in DBF format.

RESULTS AND DISCUSSION

Bird species composition, distribution and breeding status

Ninety-seven bird species have been documented within and in close vicinity to DEPO, with five of those detected only by Parker and Parker (2001) and seven detected only by the Institute for Bird Population (IBP) surveys (Siegel and Wilkerson 2004, Appendix 5). Breeding status of the riparian and coniferous focal species was submitted for inclusion in the CalPIF statewide database to assist in documenting the most current California breeding distribution for these species. Distribution maps for the focal species are periodically updated to incorporate the most current data. See http://www.prbo.org/calpif/livemaps.html for the most current and interactive California distribution maps for all CalPIF riparian and coniferous focal species and http://cain.nbii.gov/prbo/calpifmap/ for the study site database in which DEPO has been included.

Federal or State Endangered, Threatened, Species of Concern or Sensitive Species

We detected 10 species that occur on one or more of the following lists: Federally Threatened, State Endangered, California Species of Special Concern, USFS Region 5 Inyo National Forest Sensitive Species or USFWS Birds of Conservation Concern for the Sierra Nevada Bird Conservation Region (Table 3).

Table 3. Listed species detected at Devils Postpile National Monument, 2002 - 2004.

Common name	Latin name	FT	SE	CA BSSC	USFS R5 INF SS	USFWS BCC BCR 15
Bald Eagle	*Haliaeetus leucocephalus*	**x**	**x**			
Northern Goshawk	*Accipiter gentiles*			3rd	**x**	
Black Swift	*Cypseloides niger*			3rd		**x**
Vaux's Swift	*Chaetura vauxi*			3rd		
Rufous Hummingbird	*Selasphorus rufus*					**x**
Williamson's Sapsucker	*Sphyrapicus thyroideus*					**x**
White-headed Woodpecker	*Picoides albolarvatus*					**x**
Willow Flycatcher	*Empidonax traillii*		**x**			
Olive-sided Flycatcher	*Contopus cooperi*			2nd		**x**
Yellow Warbler	*Dendroica petechia*			2nd		

FT = Federal Threatened; SE = State Endangered (CDFG 2004); CA BSSC = California Bird Species of Special Concern draft list, 2003 and priority # (CDFG & PRBO 2003); USFS R5 INF SS = USDA Forest Service Region 5 Inyo National Forest Sensitive Species (USFS 2001), USFWS BCC BCR 15 = United States Fish and Wildlife Service Birds of Conservation Concern, Sierra Nevada Bird Conservation Region (BCR 15) (USFWS 2002).

Bald Eagle. We detected this species in May of 2002 circling high above the Soda Springs meadow.

Northern Goshawk. We detected a Northern Goshawk on June 13, 2002 just below Rainbow Falls, perched on a snag on the edge of the Rainbow Fire area (at Point Count # 15). The second sighting, on June 23, 2004 was in a patch of lodgepole pines, just downstream of the junction of Red's Meadow Creek and the San Joaquin River (at Point Count # 9). The nearest current nesting location for the Northern Goshawk is on INF land a few miles northeast of the northeastern DEPO

boundary. It is highly likely that another pair nests at the southern end of DEPO – but we did not observe any breeding behavior.

Black Swift. We observed Black Swifts at Rainbow Falls in May and June of 2002 and 2003. Black Swifts often nest behind active water falls. In the summer of 2001, we did observe them exiting and entering from behind the falls at dusk during the nesting season – indicating a likely breeding colony.

Vaux's Swift. IBP observed these swifts during their June 2003 surveys (Siegel and Wilkerson 2004).

Rufous Hummingbird. Adult and hatch year Rufous Hummingbirds accounted for 5% of all of our new captures at DEPO. Rufous Hummingbirds breed from Alaska south to the northwestern tip of California (Calder 1993) and apparently use Soda Springs meadow as a migratory stop-over area as they head south to their wintering grounds in southern California and Mexico.

Williamson's Sapsucker. Although we only captured one individual in our mist nets, we detected this sapsucker at 33% of our point count stations and observed them feeding young in Lodgepole Pine groves on at least one occasion.

White-headed Woodpecker. We did not capture this species in our mist nets or observe them during point counts. We did, however, casually document them in forested and burn areas around Rainbow Falls in all years. Siegel and Wilkerson (2004) observed this species on 7% (n = 3) of their survey stations.

Willow Flycatcher. The sole observation of a Willow Flycatcher was an adult that we captured in our mist nets on August 8, 2002. The flycatcher was not in breeding condition. The timing of this capture coincides with captures of non-breeding Willow Flycatchers at other banding stations in the Mono Basin and Owens Valley alluvial fan (PRBO data). It is likely that the monument capture represents an adult dispersing from another breeding location. Nearest known current breeding locations for this State Endangered species are at the Owens River near Chalk Bluffs north of Bishop, Inyo County and at Rush Creek in the Mono Basin, Mono County (McCreedy and Heath 2004); nearby historic breeding sites include Mammoth Creek (Gaines 1992). The wet willow meadows found at and near DEPO are representative of typical Willow Flycatcher breeding habitats in the Sierra Nevada (Bombay et al. 2000) and the future occupation of DEPO's meadows by breeding Willow Flycatchers is possible.

Olive-sided Flycatcher. This species was observed on several occasions during the breeding season in each of the three years of our study. Siegel and Wilkerson (2004) detected Olive-sided Flycatchers in 31% of their census points throughout the monument.

Yellow Warbler. We only detected and captured a few individuals in each of the three years. We mostly captured males and the two females we did capture were not in breeding condition. It is probable that a few individuals nested within the monument, and we detected one territory at Soda Springs meadow in particular. It is possible, however, that higher densities nested in meadow systems north of the monument boundary, and our captures could represent dispersers or floaters from there. Yellow Warblers are at the edge of their elevational breeding limits at Devils Postpile, as they typically nest below 1,981 meters on the west slope of the Sierra Nevada (Gaines 1992).

<u>CalPIF Bird Conservation Plan focal species and Birds of Conservation Concern</u>

We detected 9 riparian, 11 coniferous forest, and 2 sagebrush CalPIF Bird Conservation Plan focal species within the study area (Table 4). Focal species are not necessarily sensitive or of concern, but are listed under the assumption that if a landscape is managed to meet the focal species' needs, other species will benefit. Several of the focal species are also still relatively common enough in California to provide adequate sample sizes for trend monitoring, determining habitat relationships or estimating demographic parameters – all factors that can assist in the management of healthy bird populations (RHJV 2004, Chase and Geupel *in press*, CalPIF 2000a, CalPIF 2000b, CalPIF *in prep*).

Table 4. California Partners in Flight riparian, coniferous forest, or sagebrush Bird Conservation Plan focal species detected at Devils Postpile National Monument by PRBO in 2002 – 2004, Parker and Parker (2001), and IBP (Siegel and Wilkerson 2004). See Appendix 5 for breeding status by site.

		CalPIF Bird Conservation Plan Focal Species[1]		
Common name	Latin name	Riparian	Coniferous Forest	Sagebrush
Spotted Sandpiper	*Actitis macularia*	**x**		
Vaux's Swift	*Chaetura vauxi*		**x**	
Black-backed Woodpecker	*Picoides arcticus*		**x**	
Olive-sided Flycatcher	*Contopus cooperi*		**x**	
Willow Flycatcher	*Empidonax trailii*	**x**		
Warbling Vireo	*Vireo gilvus*		**x**	
Tree Swallow	*Tachycineta bicolor*	**x**		
Red-breasted Nuthatch	*Sitta canadensis*		**x**	
Brown Creeper	*Certhia americana*		**x**	
Golden-crowned Kinglet	*Regulus satrapa*		**x**	
Swainson's Thrush	*Catharus ustulatus*	**x**		
Yellow Warbler	*Dendroica petechia*	**x**		
MacGillivray's Warbler	*Oporornis tolmei*		**x**	
Common Yellowthroat	*Geothlypis trichas*	**x**		
Wilson's Warbler	*Wilsonia pusilla*	**x**		
Western Tanager	*Piranga ludoviciana*		**x**	
Green-tailed Towhee	*Pipilo chlorurus*			**x**
Brewer's Sparrow	*Spizella breweri*			**x**
Fox Sparrow	*Passerella iliaca*		**x**	
Song Sparrow	*Melospiza melodia*	**x**		
Oregon Junco	*Junco hyemalis thurberi*		**x**	
Black-headed Grosbeak	*Pheucticus melanocephalus*	**x**		

<u>Breeding species abundance and frequency of occurrence</u>

Oregon Junco had the widest distribution; we detected them at 100% of point count stations (Table 5). Audubon's Warblers (80% of stations), American Robins (74%), Brown Creepers (67%), Warbling Vireos (60%), Steller's Jays (60%), and Mountain Chickadees (60%) were also widely

distributed. The most abundant species was Oregon Junco, followed by American Robin, Warbling Vireo, Steller's Jay, and Song Sparrow.

Table 5. Frequency of occurrence (% points present at, n = 15) and mean relative abundance[1] for all breeding species detected during 5-minute riparian point counts at Devils Postpile National Monument. Mean number of individuals detected within 50 meters per point, by transect, mean three visits in each of three years, 2002 – 2004.

Common name	Latin name	Frequency of occurrence (%)	Relative abundance
Calliope Hummingbird	*Stellula calliope*	13	0.01
Belted Kingfisher	*Ceryle alcyon*	7	0.01
Williamson's Sapsucker	*Sphyrapicus thyroideus*	33	0.04
Red-breasted Sapsucker	*Sphyrapicus rubber*	20	0.04
Hairy Woodpecker	*Picoides villosus*	33	0.06
Black-backed Woodpecker	*Picoides arcticus*	7	0.01
Olive-sided Flycatcher	*Contopus cooperi*	7	0.01
Western Wood-Pewee	*Contopus sordidulus*	40	0.19
Dusky Flycatcher	*Empidonax oberholseri*	13	0.02
Warbling Vireo	*Vireo gilvus*	60	0.24
Steller's Jay	*Cyanocitta stelleri*	60	0.21
Mountain Chickadee	*Poecile gambeli*	60	0.13
Red-breasted Nuthatch	*Sitta canadensis*	7	0.01
White-breasted Nuthatch	*Sitta carolinensis*	7	0.01
Brown Creeper	*Certhia americana*	67	0.13
House Wren	*Troglodytes aedon*	7	0.01
American Dipper	*Cinclus mexicanus*	40	0.09
Golden-crowned Kinglet	*Regulus satrapa*	20	0.02
Mountain Bluebird	*Sialia currucoides*	7	0.01
American Robin	*Turdus migratorius*	73	0.31
Townsend's Solitaire	*Myadestes townsendi*	27	0.04
Yellow Warbler	*Dendroica petechia*	13	0.03
Audubon's Warbler	*Dendroica coronata auduboni*	80	0.18
Mac Gillivray's Warbler	*Oporornis tolmei*	60	0.17
Wilson's Warbler	*Wilsonia pusilla*	47	0.17
Western Tanager	*Piranga ludoviciana*	47	0.07
Chipping Sparrow	*Spizella passerina*	13	0.01
Fox Sparrow	*Passerella iliaca*	7	0.01
Song Sparrow	*Melospiza melodia*	53	0.21
Mtn. White-crowned Sparrow	*Zonotrichia leucophrys oriantha*	7	0.01
Oregon Junco	*Junco hyemalis thurberi*	100	0.50
Brewer's Blackbird	*Euphagus cyanocephalus*	20	0.16
Brown-headed Cowbird	*Molothrus ater*	13	0.05
Cassin's Finch	*Carpodacus cassinii*	20	0.05
Pine Siskin	*Carduelis pinus*	33	0.10

To calculate number of individuals per hectare, multiply abundance by 1.27. To calculate the total number of individuals detected across the entire study area (averaged over 3 years and 3 visits), multiply abundance by number of points (15). Because few species are 100% detectable, such calculations underestimate absolute density. Therefore results should be considered a minimum relative estimate of abundance, or an index of abundance.

Breeding species abundance, richness and diversity

Mean breeding species abundance, richness and diversity was significantly different between points ($\chi^2 = 44.00$, $P < 0.001$; Table 6). Mean bird indices were highest at Red's Meadow Creek (point 8) and Soda Springs meadow (point 3). In comparison, mean breeding species diversity at PRBO's other eastern Sierra riparian sites ranged from 0.70 to 8.20 at Owens Valley and 1.25 to 13.30 at mostly Mono Basin and upper Owens River watershed points, 1998 – 2000 (Heath and Ballard 2003).

Table 6. Indices of breeding bird abundance (BBA), breeding species richness (BSR) and Shannon-Weiner index of breeding species diversity (BSD) for each point for breeding species detected on 5-minute fixed-radius riparian point counts, summed over 3 visits at Devils Postpile National Monument in each of three years, and mean of three years (2002 – 2004).

	2002			2003			2004			Three Year Mean		
Point	BBA	BSR	BSD	BBA	BSR	BSD	BBA	BSR	BSD	Mean BBA	Mean BSR	Mean BSD
1	14	9	7.44	7	5	4.71	19	9	8.06	13.33	8	6.74
2	14	5	3.96	7	5	4.37	8	5	4.46	9.67	5	4.26
3	28	12	10.21	19	9	6.44	10	6	5.45	19.00	9	7.37
4	16	10	8.44	5	3	2.59	6	5	4.76	9.00	6	5.26
5	8	6	5.66	5	4	3.79	4	3	2.83	5.67	4	4.09
6	8	7	6.73	2	2	2.00	2	2	2.00	4.00	4	3.58
7	9	6	5.67	6	4	3.46	4	3	2.83	6.33	4	3.99
8	19	9	7.60	15	8	7.32	25	13	11.00	19.67	10	8.64
9	5	3	2.59	2	2	2.00	8	3	2.65	5.00	3	2.41
10	7	5	4.71	3	1	1.00	2	2	2.00	4.00	3	2.57
11	6	5	4.76	6	4	3.78	13	10	9.44	8.33	6	5.99
12	14	8	7.17	14	7	6.26	6	5	4.76	11.33	7	6.06
13	20	8	6.18	15	9	7.85	13	6	5.32	16.00	8	6.45
14	11	7	6.04	7	6	5.74	11	8	7.54	9.67	7	6.44
15	9	4	3.71	7	7	7.00	8	4	3.75	8.00	5	4.82

Mean breeding bird species diversity by-point ranged from 4.55 to 6.06 (mean 5.25, Table 7). Comparable species diversity data from other Eastern Sierra watersheds was 5.50 - 6.20 (high elevation Mono Basin), 2.20 - 5.20 (Mono Basin restoration sites), 5.00 - 6.00 (Upper Owens River watershed) and 1.90 - 2.95 at Owens Valley alluvial fan sites (1998 - 2003, Heath et al. 2004).

Table 7. Total individuals, species richness and Shannon-Weiner index of species diversity for the entire Devils Postpile National Monument riparian transect, and mean by-point per-transect and standard error of the mean, for breeding species detected within 50m during 5-minute point counts, 2002 – 2004 and mean of 3 years.

	Total Abundance			Species Richness			Species Diversity		
Year	Total reach	Mean by-point	SE	Total reach	Mean by-point	SE	Total reach	Mean by-point	SE
2002	188	12.53	1.62	30	6.93	0.63	18.5	6.06	0.51
2003	120	8.00	1.35	24	5.07	0.66	17.65	4.55	0.55
2004	139	9.27	1.63	21	5.60	0.82	16.16	5.12	0.71
Mean	149 ±20.26	9.93	0.74	25 ±4.58	5.87	0.32	17.44 ±0.68	5.25	0.26

Mist netting captures provides another measure of species richness and abundance specific to DEPO's Soda Springs meadow site (Table 8), and augments results derived from point counts.

Table 8. Summary of mist netting effort during the breeding season at Soda Springs meadow, Devils Postpile National Monument, 2002 - 2004.

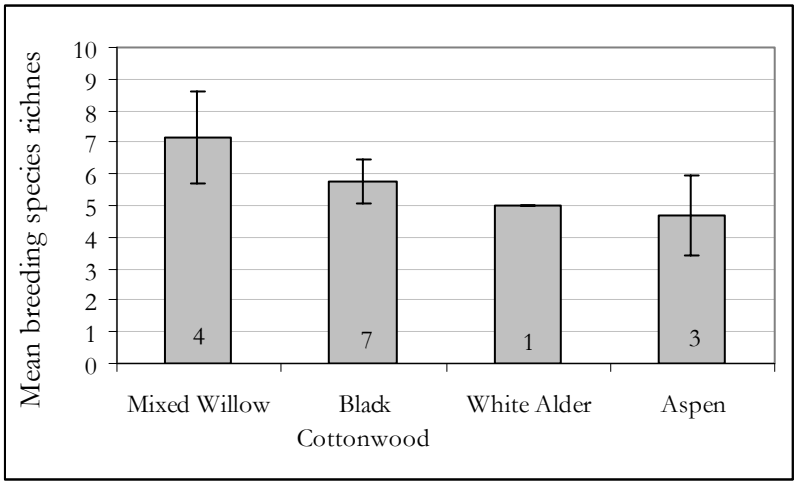
	Number of birds		
	2002	2003	2004
Captures total	255	243	317
Captures / 100 net hours	57.63	63.47	66.79
New captures	199	165	207
Captured but unbanded	5	7	9
Recaptures – total	51	71	101
Individuals recaptured	27	44	56
Total number of species captured	30	23	37

The total number of new and recaptured individuals and species (migrants and breeders) was highest at DEPO in 2004. Capture rates at DEPO were higher than capture rates at Mono Lake banding sites Rush, Wilson and Mill Creeks in 2003 (37.87 – 43.28 birds/100 net hrs.), but lower than that recorded at Lee Vining Creek in 2003 (83.25 birds/100 net hrs). Species richness at DEPO ranged from a low of 23 in 2003 to a high of 37 in 2004; similar to the range of 27 to 43 recorded at Mono Lake sites (Heath et al. 2004).

Habitat characteristics in relation to breeding bird species richness and abundance

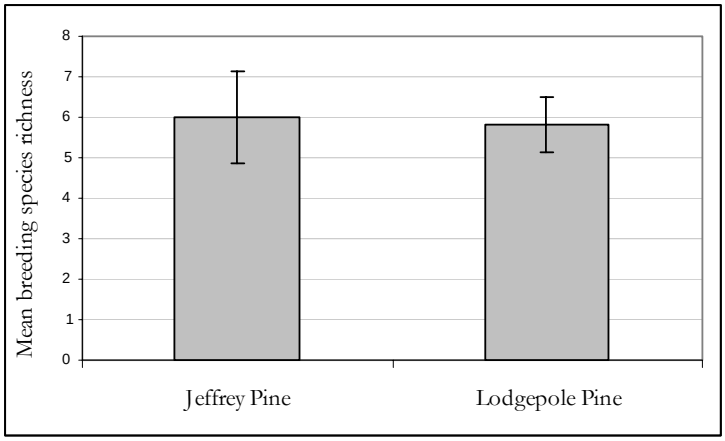
Breeding bird species richness was highest at Mixed Willow sites, but the difference was not significant between any habitats (most likely due to low sample size, $\chi^2 = 1.74$, $P = 0.63$, Figure 1). At other riparian sites in the eastern Sierra Nevada, breeding bird diversity and richness was highest at Aspen sites (Heath and Ballard 2003, Heath and Ballard 2005).

Figure 1. Mean species richness and standard error bars by Habitat I types. Based on mean number of species within 50m, mean of three years, 2002 – 2004. Number of points at base of bars.



Breeding bird species richness was not significantly different between sites that consisted of Jeffrey Pine or Lodgepole Pine upland habitat types (Figure 2; $\chi^2 = 0.15$, $P = 0.69$).

Figure 2. Mean species richness and standard error bars by Habitat II type. Based on number of species within 50m, mean of three years, 2002 – 2004.



Bird habitat models: breeding bird species richness and total breeding species abundance

Summary statistics for the 21 vegetation and landscape variables we investigated in bird-habitat models is presented in Appendix 6. Willow cover best predicted breeding bird species richness (Table 9). We found that species richness increased by 18% for each 1% that Willow cover increased. This model explained 41% of the variation in bird species richness at our study sites.

Table 9. Breeding bird species richness in relation to habitat features within 50m of point count stations at Devils Postpile National Monument. Multiple linear regression model (using stepwise, backward elimination procedure) presented. Breeding bird species richness (mean of 3 annual visits, 2002 – 2004) as dependent term.

Dependent Variable:	Model Statistics:	
Breeding bird species richness	n = 15, $P = 0.006$, R^2adj. = 41%	
Variable	Coefficient	P
willow cover	0.1818	0.006

Willow cover best predicted breeding bird abundance (Table 10). The relationship was very strong: for each 1% that Willow cover increased, we found that species abundance increased by 46%. This model explained 49% of the variation in bird abundance at our study sites.

Table 10. Breeding bird abundance in relation to habitat features within 50m of point count stations at Devils Postpile National Monument. Multiple linear regression model (using stepwise, backward elimination procedure) presented. Breeding bird species richness (mean of 3 annual visits, 2002 – 2004) as dependent term.

Dependent Variable:	Model Statistics:	
Breeding bird species abundance	n = 15, $P = 0.002$, R^2adj. = 49%	
Variable	Coefficient	P
willow cover	0.4565	0.002

Riparian and Coniferous Forest Bird Conservation Plan focal species bird habitat models

We investigated the relationship between the abundance of 6 CalPIF riparian and coniferous forest plan focal species and the same 21 vegetation and landscape variables listed in Appendix 6. There were important differences among the 6 habitat models – indicating the value of managing for a variety of habitat characteristics.

Yellow Warbler abundance was positively correlated with grass cover in the herb-class layer (Table 11). Heath and Ballard (2003) demonstrated a similar correlation in the eastern Sierra Nevada. Because Yellow Warblers tend to nest in willows or other shrubs at least 1 meter from the ground, it is likely that the relationship between grass cover and Yellow Warbler abundance may be the best indicator (of the variables we measured) of some other habitat attributes we did not measure. For example, a robust grass layer may indicate a wetter site which supports more vigorous willow growth or more insect production – thereby providing nesting substrate and higher food abundance for Yellow Warblers.

Table 11. CalPIF riparian and coniferous focal species Yellow Warbler, Song Sparrow, Wilson's Warbler, Oregon Junco, MacGillivray's Warbler and Western Tanager abundance in relationship to habitat features within 50m of point count stations. Multiple linear regression models (using stepwise, backward elimination procedure) presented. Mean abundance of each species at sites where their abundance > 0 (mean of 3 annual visits, 2002 – 2004) as dependent term in all cases.

Dependent Variable	Model Statistics	Explanatory Variable	Coeff.	*P*
Yellow Warbler abundance	$P = 0.006$ R^2adj. = 42%	herb-class grass cover	0.0085	0.01
Song Sparrow abundance	$P = 0.0001$ R^2adj. = 74%	herb-class cover deciduous cover	0.0239 0.0632	0.01 <0.01
Wilson's Warbler abundance	$P < 0.05$ R^2adj. = 21%	highest average tree ht.	0.0539	<0.05
Oregon Junco abundance	$P < 0.001$ R^2adj. = 63%	shrub-class grass cover	0.2060	<0.01
MacGillivray's Warbler abundance	$P < 0.001$ R^2adj. = 58%	shrub-class grass cover	0.1228	<0.01
Western Tanager abundance	$P = 0.005$ R^2adj. = 42%	highest average tree ht.	0.0252	<0.01

Song Sparrow abundance was positively correlated with vegetation in the herb-class layer and with overall deciduous cover. These vegetative characteristics accounted for 74% of the variation in Song Sparrow abundance. Sites with tall herbaceous cover (with a shrub component) are ideal nesting conditions for Song Sparrows, which typically nest low to the ground at the base of deciduous shrubs such as willow.

Oregon Juncos demonstrated a very strong positive correlation with shrub-class grass cover, whereas we found that for each 1% increment increase in shrub-class grass cover, Oregon Junco

abundance increased by 20%. Oregon Juncos nest and forage on the ground and would benefit from high grass cover for both nest and foraging concealment.

MacGillivray's Warblers were also positively correlated with shrub-class grass cover. The positive relationship between the abundance of these species and grass in the shrub layer demonstrates that these species not only benefit from a high area grass cover, but also grass height. Sites with high percent grass cover greater than 50cm in height had higher bird abundance.

Wilson's Warbler and Western Tanager abundance was positively correlated with highest average tree height. Western Tanagers frequently place their nests on the outer branches of high conifer trees. We also detected most tanagers as they sang from unseen locations in the upper reaches of tall conifers. It is unlikely that Wilson's Warbler abundance is directly correlated with tree height, as Wilson's Warblers use understory plants (forbs and shrubs) for nesting. However, tree height likely represents some others substrate feature, such as canopy cover or shade. We found Wilson's Warblers most frequently at riparian sites that included a conifer canopy component and they tend to prefer moist shaded riparian areas (rather than open willow meadows) at other nesting sites in California (PRBO data).

Estimates of productivity

Soda Springs meadow exhibited high young (Hatch Year) to adult ratios in all years for Calliope Hummingbirds and Red-breasted Sapsuckers, suggesting high productivity for those species (Table 12). We did not capture any hatch year Audubon's Warblers in 2004, suggesting that productivity for that species was very low for that year. Although we captured several adult Warbling Vireos in each year, we caught very few to no young birds, indicating low productivity in all years. Adult and young capture rates for MacGillivray's Warblers were higher in 2003 and 2004 than in 2002 when we captured no adults. This trend was mirrored by our point count data in which we detected more MacGillivray's Warblers in 2004 than in either 2003 or 2002 (PRBO data). Oregon Junco ratios were similar in all years.

Table 12. Species and age class of all individuals banded at Soda Springs meadow, Devils Postpile National Monument during constant effort mist netting during the 2002 – 2004 breeding seasons. Solely migrant, transient and dispersing species in *italics*. Total = all birds captured combined, Adjusted Total = breeding species only. Latin names provided in Appendix 5.

	2002			2003			2004		
Common Name	AHY	HY	ratio	AHY	HY	ratio	AHY	HY	ratio
Spotted Sandpiper	~	~	~	0	1	~	~	~	~
Broad-tailed Hummingbird	~	~	~	~	~	~	0	2	~
Calliope Hummingbird	3	4	1.33	2	3	1.50	1	1	1.00
Rufous Hummingbird	*3*	*9*	*3.00*	*2*	*3*	*1.50*	*7*	*5*	*0.71*
Red-breasted Sapsucker	5	5	1.00	4	5	1.25	6	7	1.17
Williamson's Sapsucker	~	~	~	~	~	~	0	1	~
Red-shafted Flicker	~	~	~	~	~	~	0	2	~
Willow Flycatcher	*1*	*0*	*0*	~	~	~	~	~	~
Dusky Flycatcher	2	1	0.50	~	~	~	2	0	0
Solitary Vireo	~	~	~	~	~	~	1	0	0

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Table 13. – continued from previous page -

	2002			2003			2004		
Common Name	AHY	HY	ratio	AHY	HY	ratio	AHY	HY	ratio
Cassin's Vireo	1	0	0	~	~	~	~	~	~
Warbling Vireo	13	1	0.08	4	0	0	13	2	0.15
Steller's Jay	0	1	~	2	0	0	~	~	~
Mountain Chickadee	~	~	~	3	0	0	1	0	0
Red-breasted Nuthatch	~	~	~	~	~	~	1	0	0
Brown Creeper	0	1	~	~	~	~	1	0	0
House Wren	0	1	~	~	~	~	0	1	~
Marsh Wren	~	~	~	~	~	~	*0*	*1*	~
Golden-crowned Kinglet	1	0	0	~	~	~	~	~	~
Swainson's Thrush	~	~	~	~	~	~	*1*	*0*	*0*
American Robin	8	0	0	8	0	0	9	0	0
Orange-crowned Warbler	*17*	*15*	*0.88*	*9*	*27*	*3.00*	*9*	*22*	*2.44*
Nashville Warbler	1	1	1.00	1	1	1.00	2	0	0
Yellow Warbler	4	0	0	3	0	0	5	2	0.40
Audubon's Warbler	10	12	1.20	23	5	0.22	15	0	0
Hermit Warbler	1	0	0	~	~	~	1	0	0
Mac Gillivray's Warbler	0	2	~	4	6	1.50	9	7	0.78
Wilson's Warbler	10	2	0.20	5	11	2.20	21	4	0.19
Spotted Towhee	0	2	~	~	~	~	~	~	~
Western Tanager	~	~	~	3	0	0	~	~	~
Brewer's Sparrow	1	1	1.00	~	~	~	0	1	~
Black-throated Sparrow	~	~	~	*0*	*1*	~	~	~	~
Savannah Sparrow	~	~	~	~	~	~	*1*	*1*	*1.00*
Fox Sparrow	0	1	~	~	~	~	0	1	~
Song Sparrow	13	11	0.85	12	8	0.67	9	3	0.33
Lincoln's Sparrow	~	~	~	~	~	~	1	1	1.00
Mtn. White-crowned Sparrow	2	8	4.00	2	0	0	5	4	0.80
Oregon Junco	10	4	0.40	10	2	0.20	17	6	0.35
Brewer's Blackbird	~	~	~	3	1	0.33	4	0	0
Lazuli Bunting	1	0	0	1	1	1.00	1	2	2.00
Brown-headed Cowbird	1	0	0.00	1	0	0	1	0	0
Cassin's Finch	3	0	0	~	~	~	12	0	0
Pine Grosbeak	~	~	~	1	0	0	3	0	0
Pine Siskin	7	0	0	1	0	0	1	0	0
Lesser Goldfinch	~	~	~	~	~	~	0	1	~
Total	**118**	**83**	**0.70**	**104**	**74**	**0.65**	**160**	**77**	**0.48**
Adjusted Total	**97**	**58**	**0.60**	**93**	**44**	**0.49**	**142**	**48**	**0.34**

Site fidelity and recruitment

As expected, we recaptured over twice as many individuals in 2004 as in 2003 (Table 13). It is possible to calculate survivorship for one year with three years of banding and two years of recaptures. However, survivorship estimates are more accurate with multiple years of potential

recaptures (Nur et al. 1999). Song Sparrow and Oregon Junco were the most frequently recaptured species.

Table 13. Number of individuals recaptured in years subsequent to the year of their original capture consecutive years at Devils Postpile National Monument, 2002 – 2004.

Species	Year of first capture	Year of recapture	
		2003	2004
American Robin	2002	1	2
	2003	--	1
Audubon's Warbler	2002	1	1
	2003	--	2
MacGillivray's Warbler	2003	--	1
Mountain White-crowned Sparrow	2002	2	2
Orange-crowned Warbler	2003	--	3
Oregon Junco	2002	2	3
	2003	--	5
Red-breasted Sapsucker	2002	1	1
	2003	--	1
Song Sparrow	2002	3	2
	2003	--	2

Five individuals of four species were originally captured in 2002 and were subsequently captured in 2003 and 2004 (Table 14). Five individuals of 3 species were first banded as hatch year birds and were recaptured in subsequent years as breeding adults (Table 15). Interestingly, Orange-crowned Warblers do not breed at DEPO, but apparently demonstrate site-fidelity to areas used during their post-breeding movements.

Table 14. Number of individuals captured for three consecutive years at Devils Postpile National Monument, 2002 – 2004.

Species	Number of individuals
Red-breasted Sapsucker	1
Mountain White-crowned Sparrow	2
Oregon Junco	1
Song Sparrow	1

Table 15. Individuals first banded as hatching year birds that were recaptured in subsequent years as adults, Devils Postpile National Monument, 2002 – 2004.

Individuals by species	Year of original capture	Year(s) of subsequent captures
Mountain White-crowned Sparrow	2002	2003, 2004
Orange-crowned Warbler	2003	2004
Orange-crowned Warbler	2003	2004
Orange-crowned Warbler	2003	2004
Oregon Junco	2002	2003, 2004

Timing of migration, post-breeding dispersal, and breeding

The earliest capture dates for hatch year birds was early June (Rufous Hummingbird; Figure 3) and mid June (Orange-crowned Warbler; Figure 4) – both in 2004. Hatching year birds of these two species were the first captured in all years (Figures 3 - 10).

Rufous Hummingbirds breed from the tip of northern California north to Alaska (Calder 1993), but utilized Soda Springs meadow during theirsoutherly migration. Juvenile Rufous Hummingbirds accounted for 11% of all hatch year captures in 2002, 4% in 2003 and 6% in 2004.

Orange-crowned Warblers breed throughout west slope Sierra Nevada foothills and after fledging or breeding, move upslope to take advantage of later spring conditions (Gaines 1992). It is these post-breeding dispersers that use Soda Springs meadow throughout the summer, and apparently some individuals follow this pattern in multiple years (Table 13 & 15). Adult Orange-crowned Warblers arrive as early as late May and may represent very early breeders from lower elevations. Orange-crowned Warblers accounted for 17% - 41% of hatch year captures and 7% - 11% adult captures.

Our mist netting operations begin too late and finish too early to document clear patterns of migration or dispersal for other species, although it is likely that late May captures of Wilson's Warblers are largely made up of migrants, as is seen at other banding locations in the eastern Sierra during that time (Heath et al. 2004).

Figure 3. Timing and number of adult (AHY) and hatch year (HY) Rufous Hummingbird captures at Soda Springs meadow, Devils Postpile National Monument, 2002 – 2004. Capture rates standardized as number of birds captured per 100 hours of mist net operation.

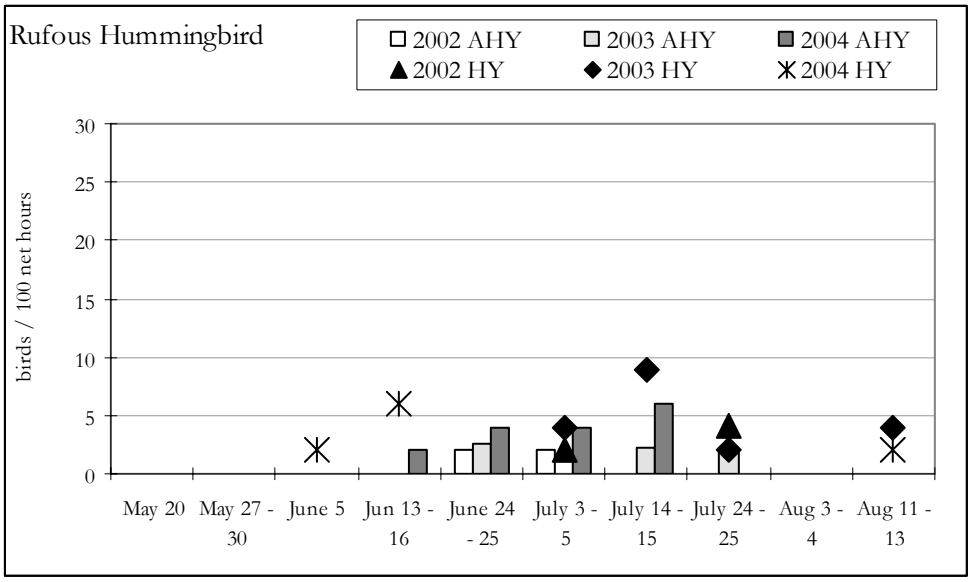
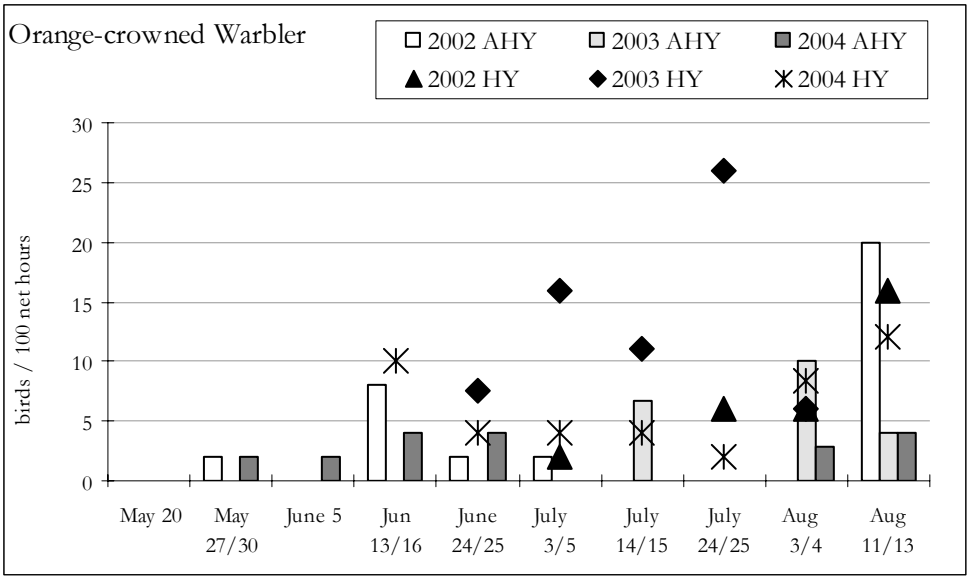


Figure 4. Timing and number of adult (AHY) and hatch year (HY) Orange-crowned Warbler captures at Soda Springs meadow, Devils Postpile National Monument, 2002 – 2004. Capture rates standardized as number of birds captured per 100 hours of mist net operation.



Hatching year birds of breeding species are first captured as early as late June (Song Sparrow; Figure 5) and early July (Mountain White-crowned Sparrow; Figure 6), indicating that nest initiation can begin in early to mid May for those species at DEPO. Captures for these species were two weeks earlier in 2004 than in any other year, probably due to earlier spring conditions brought on by an earlier snow melt. For example, 2004 was the first year that we were able to access the DEPO road and begin mist netting prior to May 27, due to a shallow and quickly melting snow pack during that month.

Figure 5. Timing and number of adult (AHY) and hatch year (HY) Song Sparrow captures at Soda Springs meadow, Devils Postpile National Monument, 2002 – 2004. Capture rates standardized as number of birds captured per 100 hours of mist net operation.

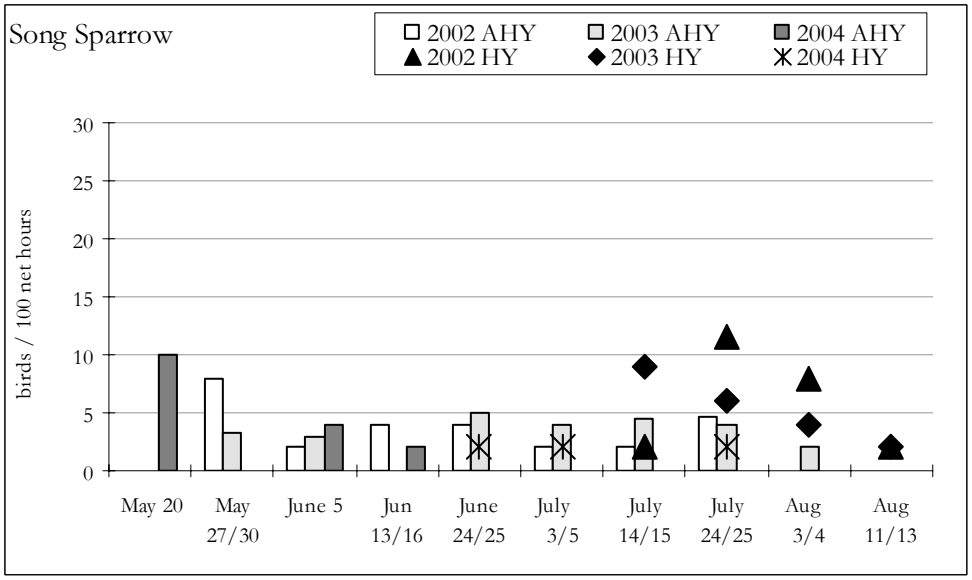
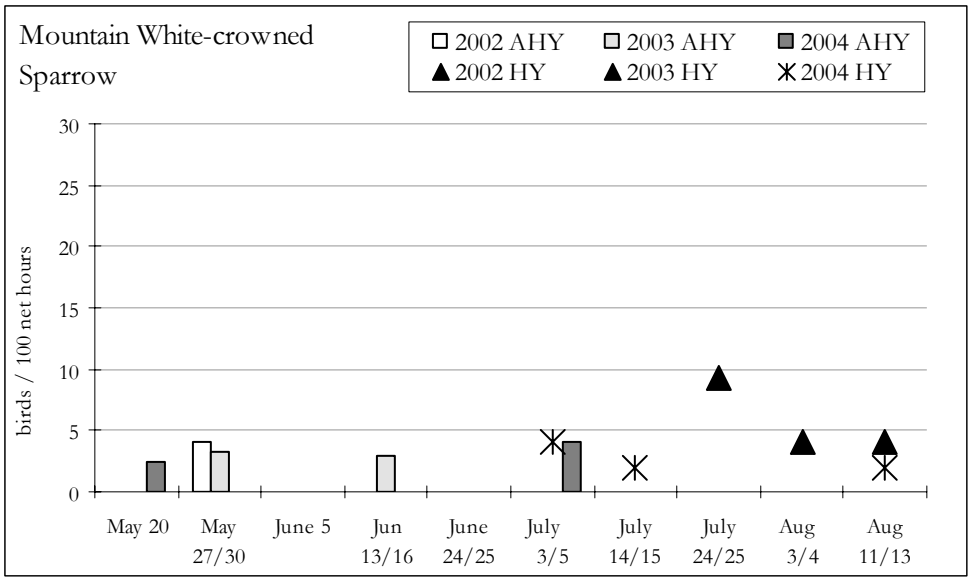


Figure 6. Timing and number of adult (AHY) and hatch year (HY) Mountain White-crowned Sparrow captures at Soda Springs meadow, Devils Postpile National Monument, 2002 – 2004. Capture rates standardized as number of birds captured per 100 hours of mist net operation.



Young Audubon's Warblers and Wilson's Warblers were captured in mid July at the earliest (Figures 7 - 8), indicating a mid June nest initiation date for those species. Calliope Hummingbirds and Red-breasted Sapsuckers, who's young were also captured in mid July (Figures 9 – 10), have longer incubation and brooding periods than warblers. It is therefore likely that nest initiation for these species began in earlier June. In general, we captured adult females with full brood patches as late as third week of July and mid August, indicating they were incubating eggs during that time. We conclude that young could potentially fledge as late as last week of August at DEPO.

Figure 7. Timing and number of adult (AHY) and hatch year (HY) Audubon's Warbler captures at Soda Springs meadow, Devils Postpile National Monument, 2002 – 2004. Capture rates standardized as number of birds captured per 100 hours of mist net operation.

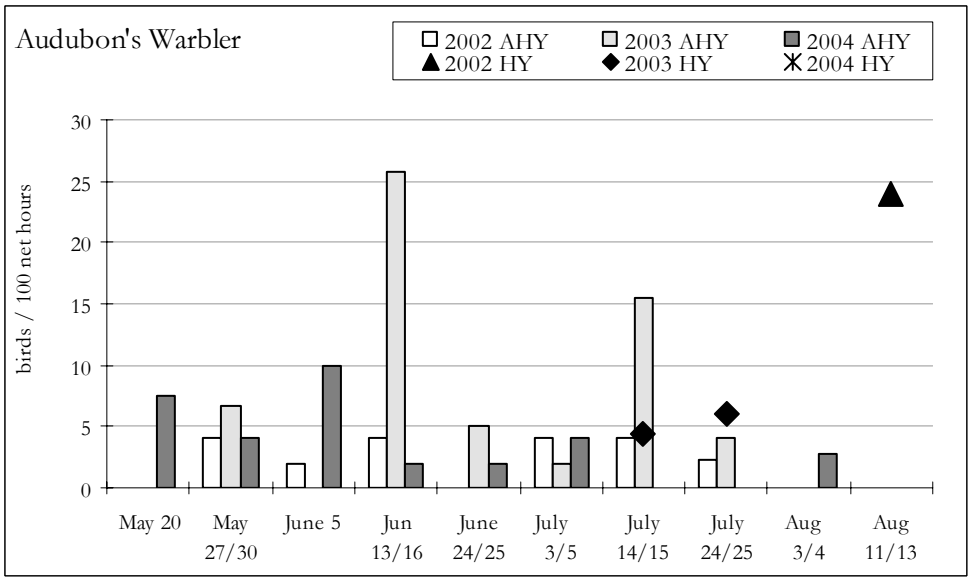


Figure 8. Timing and number of adult (AHY) and hatch year (HY) Wilson's Warblers captures at Soda Springs meadow, Devils Postpile National Monument, 2002 – 2004. Capture rates standardized as number of birds captured per 100 hours of mist net operation.

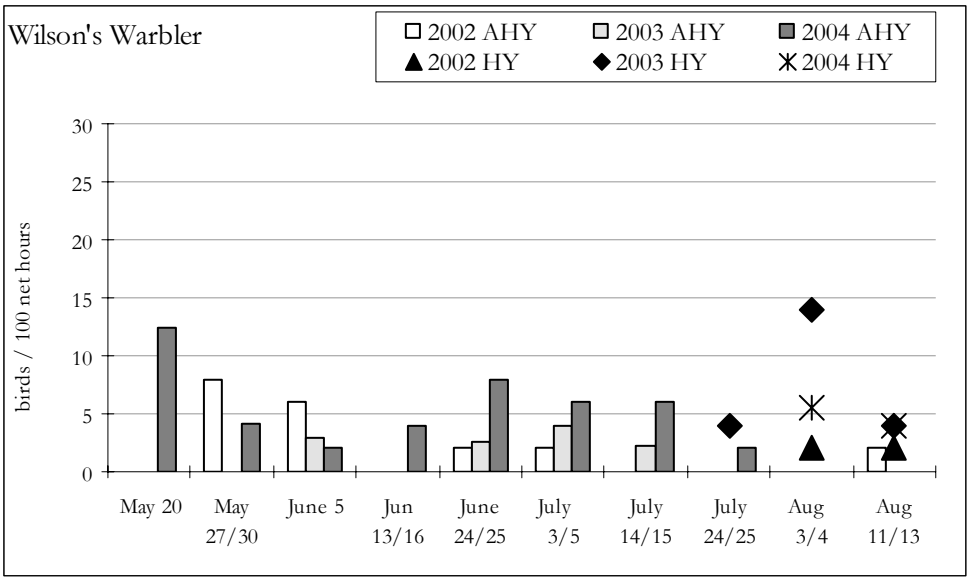
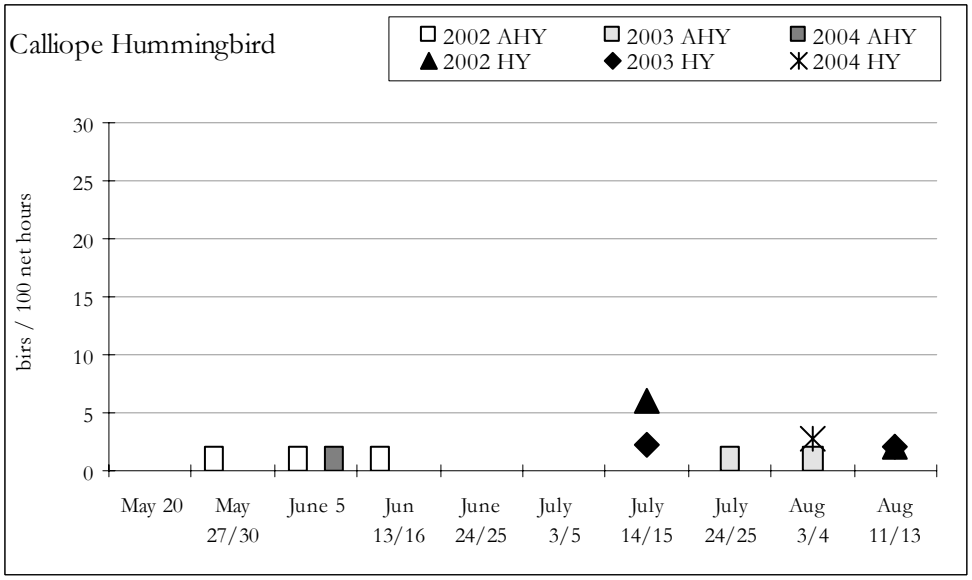
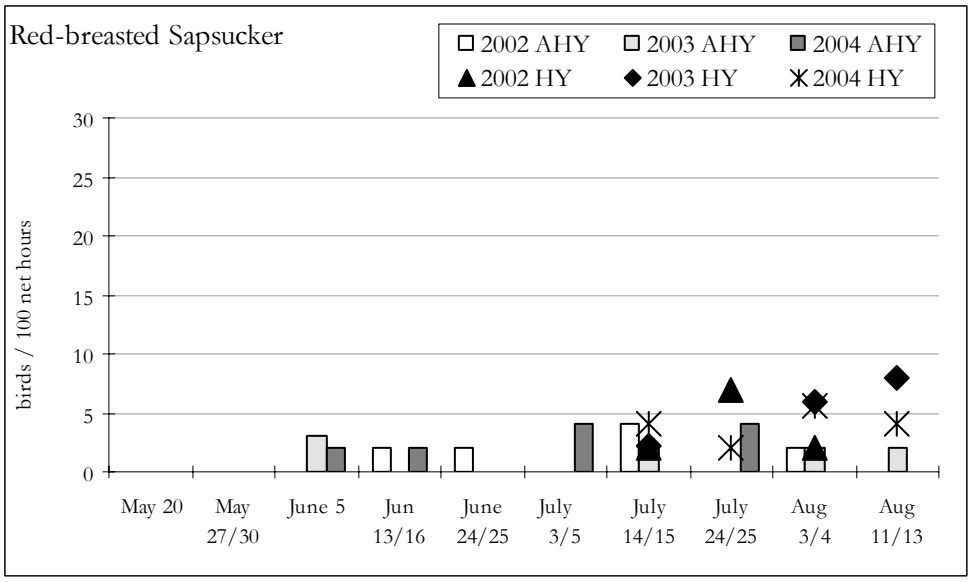


Figure 9. Timing and number of adult (AHY) and hatch year (HY) Calliope Hummingbirds captures at Soda Springs meadow, Devils Postpile National Monument, 2002 – 2004. Capture rates standardized as number of birds captured per 100 hours of mist net operation.



Audubon's Warblers nest primarily on the outer branches of Lodgepole Pine or fir, while Red-breasted Sapsuckers can create and nest in cavities of pine, cottonwoods, or aspen. Yet, both species and their young are frequently captured in our mist nets placed among the willows of Soda Springs meadow, demonstrating their use of the meadow for foraging, territorial displays, or other behaviors. Audubon's Warblers account for 11% of all adult captures.

Figure 10. Timing and number of adult (AHY) and hatch year (HY) Red-breasted Sapsuckers captures at Soda Springs meadow, Devils Postpile National Monument, 2002 – 2004. Capture rates standardized as number of birds captured per 100 hours of mist net operation.



Bird responses to riparian and meadow restoration

Restoration efforts in Soda Springs during the time of the study included:

- limiting visitor access to Soda Springs meadow and the banks of the San Joaquin River via fencing, social trail closures, signage, education and enforcement.
- stabilizing a small section of San Joaquin river bank, and planting willows, alders, and scattering grass seeds and duff.
- planting willow stakes and grass plugs into meadow user trails.

The visitor management efforts have proved to be cosmetically successful so far, as social trails through the willows and across the meadow are re-vegetating and visitor access has been channeled through a few high use areas. Additionally, willow plantings along the San Joaquin River had a high survivorship rate through their first winter.

Whether NPS restoration efforts are influencing bird use of the meadow or riparian reaches of the river is difficult to directly determine at this time. The MAPS program is designed primarily to monitoring demographic trends on a regional or national scale. While this program can also be useful in determining local trends, it is often difficult to determine if changes in bird capture rates are the result of local or large-scale trends in bird populations, especially in the context of a short term project. However, scale issues of this sort are an inherent challenge for any monitoring program and can potentially be offset by the benefits gained from a long-term (e.g. decadal) study (e.g. Ballard et al. 2003).

What has proved more difficult for our ability to determine bird responses to restoration efforts at DEPO has been the size of the restoration effort. The total indirectly affected area (e.g. Soda

Springs meadow in its entirety and 50m of upstream river bank) is 0.05 ha, with the directly affected area being relegated to a handful of user trails and one 10m x 5m stream bank. Even in its most pristine state, a habitat patch of this size might only support one to three territories of any given bird species. Fluctuations on the scale of 1 – 3 territories or 1 – 2 species fall within the range of annual variation, and will therefore probably remain as anecdotal rather than statistically significant evidence of bird response to restoration efforts. The exception might be the documentation of the influx of a highly sensitive species (e.g. Willow Flycatcher, Great Gray Owl (*Strix nebulosa*). Such an event would be detectable and might provide stronger evidence of a shift in habitat quality or disturbance.

Nevertheless, results derived from our point count and habitat data indicate that throughout the riparian and meadow habitats of the monument, greater willow and herbaceous cover are positively correlated with bird species richness and abundance of select riparian and meadow species (Tables 10 - 12). Therefore, restoration activities that increase or restore these habitat characteristics should, in turn, benefit bird species that depend on those habitats.

Finally, the purpose of the stream bank restoration was not only to restore previously damaged habitat, but also to ensure that further damage would not occur to the still intact meadow or the stream bank (S. Fritzke pers. com.). Therefore, restoration efforts such as this might not directly benefit bird populations by significantly increasing their numbers at Soda Springs meadow, but the measures are proactive and will prevent further, and perhaps more damaging habitat loss from occurring.

Our experience with restoration monitoring efforts region-wide and our understanding of basic bird-habitat relationships derived from DEPO data, allow us to form the opinion that restoration activities which aim at recreating hydrological and ecological function, which encourage vegetation growth in the herbaceous and shrub layers, and which aim at preventing further damage to meadow and riparian habitats are inherently beneficial to breeding birds in the monument.

Conceptual long term adaptive management monitoring plan

A proposed task of the DEPO bird monitoring project was to design a conceptual long term adaptive management monitoring plan for birds utilizing meadow and riparian habitats in the monument. Based on our three years experience at the monument, we conclude that there is much value in continuing the present bird monitoring and education strategy at DEPO.

It has become apparent that the current monitoring strategy is not acute enough to directly measure the current restoration efforts in the monument. For this reason, the strategy is not inherently adaptive. There are several more finer-tuned studies that could be performed to directly investigate the response of such a small scale restoration effort. For example: more frequent mist netting and banding efforts to document bird body mass changes over the course of the day or the season or between pre and post treatment (e.g. Petit 2000); nest monitoring and accompanying parental behavioral observations and time-budget measures at the nest site as a measure of reproductive success in relationship to food availability; color-banding breeding individuals, mapping territories, and finding and monitoring nests before and after treatment.

However, we propose that intensive studies such as these, albeit interesting, do not contribute as much to DEPO or to regional monitoring and conservation efforts as the continuation of the in-place monitoring and education program. While the program is not necessarily appropriate for contributing

to an adaptive management framework (e.g. directly measuring the success of DEPO's restoration project), the program will meet several important objectives. The continuation of a long-term MAPS, education and point count program in riparian and meadow habitats of DEPO will allow us to:

1. Determine over-winter survivorship rates for select short and long distance migrants that breed at DEPO.

2. Determine annual productivity for select species that breed at DEPO.

3. Document post-fledgling and migration timing and movement of select species.

4. Determine bird species diversity, richness and abundance of birds utilizing meadow and riparian habitats at DEPO.

5. Determine bird and habitat relationships.

6. Monitor long-term trends in 1, 2, 3 and 4.

7. Provide a baseline for which to measure bird responses to stochastic events.

8. Educate up to 500 visitors per year on bird monitoring techniques, bird and habitat conservation issues and ecology, and the importance of National Park Service lands for the protection of healthy bird populations.

9. Contribute to regional and national bird monitoring and conservation efforts such as PRBO's eastern Sierra bird monitoring program, MAPS (DeSante et al. 2002), and CalPIF Bird Conservation Plans.

The value of data gathered from a constant effort mist netting program increases with each year and valid trend monitoring can only take place over the long-term. For example, while three years of banding and two years of recapture data may allow us to determine adult survivorship for one year for some species, more years are necessary to properly calculate recapture probabilities and to more accurately estimate survivorship rates (Nur et al. 1999). We expect that with at least five years of data, we will be able to calculate over-winter survivorship for several species including Audubon's Warbler, Song Sparrow, Oregon Junco and Orange-crowned Warbler.

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Appendix 1. Mist netting census dates, GPS locations of net sites and net lane diagram, Devils Postpile National Monument, 2002 and 2003.

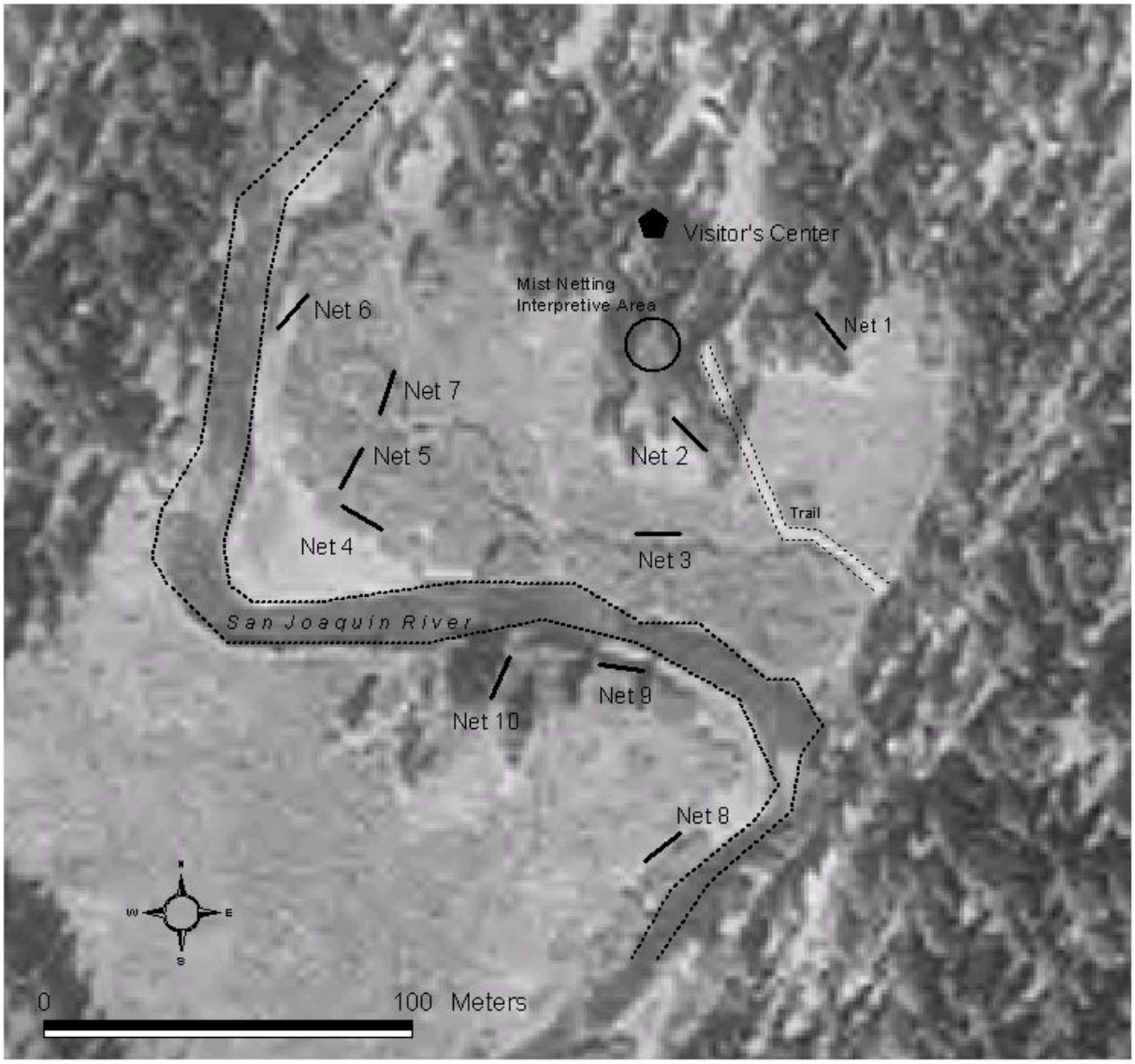
Appendix 1 – Table A. Mist netting census dates at Devils Postpile National Monument, 2002 - 2004. Banding site was not accessible during census period 1 in 2002 or 2003.

		Census Periods								
		2	3	4	5	6	7	8	9	10
2002	--	May 30	June 5	June 13	June 24	July 4	July 14	July 24	Aug 3	Aug 13
2003	--	May 30	June 7	June 13	June 25	July 3	July 15	July 24	Aug 4	Aug 13
2004	May 20	May 27	June 5	June 16	June 24	July 5	July 15	July 25	Aug 4	Aug 11

Appendix 1 – Table B. GPS locations of mist net locations at Devils Postpile National Monument, 2002 - 2004 in decimal degrees, NAD83.

Net Number	lat	lon
DEPO 1	37.62940228	-119.0846247
DEPO 2	37.62967587	-119.0841902
DEPO 3	37.62912870	-119.0845979
DEPO 4	37.62912333	-119.0855152
DEPO 5	37.62921989	-119.0856386
DEPO 6	37.62960613	-119.0858478
DEPO 7	37.62950421	-119.0854777
DEPO 8	37.62838304	-119.0847588
DEPO 9	37.62882829	-119.0848179
DEPO 10	37.62872636	-119.0852363

Appendix 1 – Figure A. Mist net locations at Devils Postpile National Monument, 2002 - 2004.



Appendix 2. Point count transect census dates, GPS locations, point count locations and point count description for Devils Postpile National Monument, 2002 - 2004.

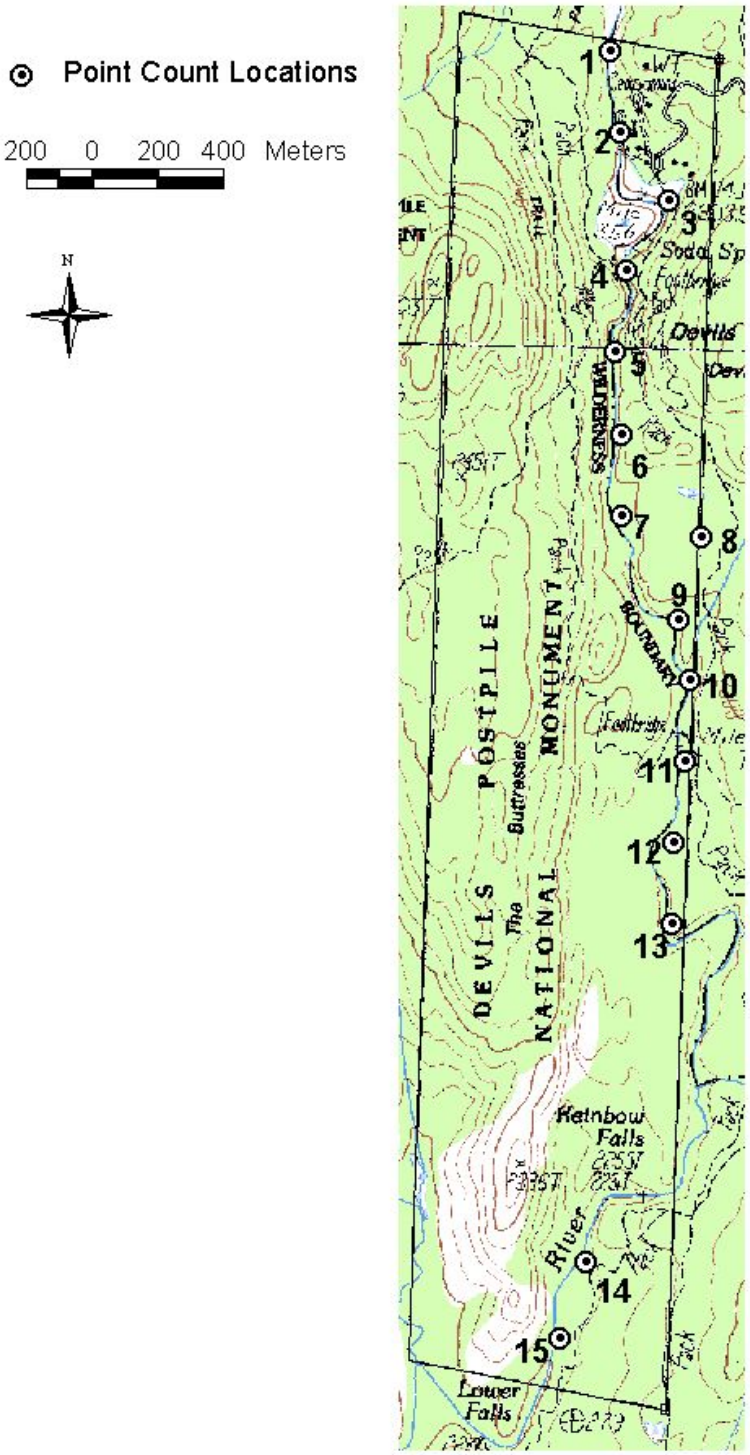
Appendix 2 – Table A. Point count transect, 4-letter code, year, number of points, and census dates in 2002 - 2004.

Site	Code	Year	# points	Visit 1	Visit 2	Visit 3
Devils Postpile National Monument	DEPO	2002	15	13 June	26 June	8 July
Devils Postpile National Monument	DEPO	2003	15	7 June	19 June	30 June
Devils Postpile National Monument	DEPO	2004	15	May 31	June 11	June 23

Appendix 2 - Table B. GPS locations of all point count stations conducted in 2002 - 2004, in decimal degrees, NAD83.

Station	Site	LAT	LON
DEPO	1	37.633039	-119.086277
DEPO	2	37.630829	-119.085853
DEPO	3	37.629005	-119.084142
DEPO	4	37.627037	-119.085526
DEPO	5	37.624826	-119.08588
DEPO	6	37.622584	-119.085569
DEPO	7	37.620326	-119.085526
DEPO	8	37.619800	-119.082769
DEPO	9	37.617542	-119.083504
DEPO	10	37.615916	-119.083042
DEPO	11	37.613663	-119.083182
DEPO	12	37.611474	-119.083493
DEPO	13	37.609243	-119.083504
DEPO	14	37.599946	-119.086202
DEPO	15	37.597833	-119.087007

Appendix 2 – Figure A. Point Count Locations, Devils Postpile National Monument, 2002 - 2004.



Appendix 2 – continued. Point Count location description.

STATION: Devils Postpile (DEPO) **INTERVALS BETWEEN POINTS:** 250 m
FLAG MARKING POINT: orange flagging and metal tags **TOTAL # POINTS**: 15

NOTES: The transect runs from the upstream (North) boundary of Devils Postpile, along the San Joaquin River downstream to the Southern boundary. After point 13, the River turns east into USFS land, and for this portion of the River, you just walk along the Rainbow Falls trail for about 25 minutes until you then re-enter DEPO land and follow the instructions for point 14. All points on east side of the River.
ACCESS: Drive to Devils Postpile. Park in the appropriate parking space and walk up River until you reach the Devils Postpile northern boundary (only about 300m from parking area).

Point # 1: From the Northern DEPO boundary, walk about 50m downstream. After passing a large root from a downed tree on the west side of the trail, go toward creek. Point is on a willow about 3m east of a 20 cm DBH lodgepole pine, and on the right (north) side of a small creek access trail.
Point # 2: Continue downstream. Point is about 40m downstream from the base of a waterfall, on a lodgepole pine about 8m from the waters edge and next to the bear box for campsite B6.
Point # 3: Walk passed the ranger station and follow gravel path. At small culvert under the trail that drains the eastern meadow, go toward the River along the willow edge. Point on willow 9m from the culvert.
Point # 4: Continue downstream along trail. At the junction with the path that crosses the River, go toward the River on the downstream side of a large basalt outcrop. Point on lodgepole about 5m from river and next to a 3m high gnarled white fir which is about 4m from basalt outcropping.
Point # 5: Fallow trail downstream to the Devils Postpile. About ¾ of the way down the postpile, take trail to the river marked "picnic". Point on gooseberry downstream from picnic bench, about 8m from the water and slightly downstream from an old square fireplace monument.
Point # 6: Continue down the trail until it begins to head up steep and away from the river. Go to River at downstream angle. Point is on the edge of the ravine and on the downstream end of a 10m snag that has fallen and parallels the rim. The snag is about 20m upstream from a 3m high, 1m DBH snag.
Point # 7: Continue along river edge. Point is on Lodgepole 12m from the water. A snag has fallen on the ground and forms a 1m high arch and leans against the point tree. Also, 14m upstream from the point is a 3m diameter root wad with rocks and exposed roots.
Point # 8: Continue downstream until you hit a side channel. Follow side channel east for 250m until you reach a small meadow with 1m high lodgepole pines. Point is on a 1.5m high lodgepole, 7m upstream from a snag that has fallen with a NPS boundary sign on it. Perpendicular to the snag is a severely charred snag that has fallen.
Point # 9: Return to the main river channel. Point is on a 6m DBH lodgepole pine on a steep cliff at the eastern most end of a sharp east turn in the river. Just downstream from point is a steep moss covered basalt cliff, and the river takes another steep turn to the south. (point at corner of east and south bends).
Point # 10: Only 200m from point 9. Following the river, you will come to a small dry drainage from the east. Follow this to the river and a small patch of cottonwoods. Point is on downstream end of a sandbar on a 3m cottonwood sapling next to a charred snag, and about 180 m upstream from large footbridge crossing river.
Point # 11: Pass the footbridge and continue down east side of river. You will come to an area where the river flattens and quiets down and another small grove of cottonwoods in on east bank. Point on cottonwood on the edge of the grove that is facing the basalt wall, about 15m from the river and 35 m upstream from the alder shrub edge.
Point # 12: Continue downstream until you come to an open sandy area with many fallen snags. In the middle of the river adjacent to the point is a rocky island with black cottonwoods. Point is in a group of 3 black charred snags about 7m from the river and 55m upstream from the grassy meadow.
Point # 13: You will come to a sharp easterly flowing bend in the river with black cottonwoods on the east side of the bank Point is 30m upstream from the black cottonwoods and the bend. The point is on a lone lodgepole snag, about 12m from the river's edge and just upstream from several fallen snags.
END of DEPO land: head straight east up to the main trail (passing several small deer trail). Follow signs to rainbow falls. Do not go down to base of falls, but continue along trail another 250m downstream from falls. It will take you about 20 minutes to get to point 14.
Point # 14: About 250m downstream from rainbow falls on a skinny Jeffrey Pine next to the river. Point is about 100m downstream from a steep cliff and about 100m upstream from an amazing smooth granite outcrop on the west side of the river.
Point # 15: Head back to the trail. At 250m, look for a 25m long fallen snag (1m DBH) that runs parallel to the creek, but slightly upslope from the edge. Point is at the middle of this snag. At the end of the snag is a 1.2m DBH red fir.

Appendix 3. Variables investigated in point count habitat assessments, 2002.

DEFINITIONS

Tree: Vegetation > 5m tall, regardless of species

Shrub: Vegetation > 50cm < 5m, regardless of species

Herb: Vegetation ≤ 50cm, regardless of species

Snag: A dead standing tree with DBH >10 cm

Log: A dead fallen tree with DBH > 10cm

Total woody: All woody vegetation combined regardless of height categories – as viewed from above.

Litter: Ground materials such as leaves, fallen branches, dead grass, etc. Anything that is not a log (as defined above) is litter.

Cover: The percent of ground (within the 50m radius circle) obscured from above. For layer descriptions, this is the absolute cover. For species lists cover is relative to the other species in the layer (with the exception of Total Woody – see below).

Width of riparian: The estimated width of the riparian vegetation from one edge of the riparian vegetation to another, perpendicular to the stream (if > 100m, use GIS). Riparian vegetation is defined as willow, cottonwood, wetland species and not saltbush, grass/meadow, etc. River not included in estimate unless it falls between two riparian edges.

Riparian Patchiness: The percent of the riparian width "line" that is taken up by riparian vegetation, as viewed from above. If the riparian is wide, but very patchy (ie willows interspersed with pasture) the riparian patchiness may be low. If the riparian strip is narrow, but solid riparian veg, riparian patchinees = 100%.

Percent Riparian: Estimated percent cover of total riparian vegetation within 50m radius circle.

VARIABLES

Habitat types: Defines the habitat types according to Sawyer/Keeler-Wolf series (Sawyer and Keeler Wolf 1995) present within the 50m radius circle. Two to three habitat are typically defined.

Habitat percent: Percent of the 50m radius plot that corresponds to the defined habitat(s).

Number of snags and **Number of logs**

Width of riparian zone at the point, perpendicular to the river

Riparian Patchiness of riparian zone at the point, perpendicular to the river

Percent Riparian within 50m radius circle of the point

Absolute cover (%) of **tree** layer(s)

Absolute cover (%) of **shrub** layer(s)

Absolute cover (%) of **herb**

Absolute cover (%) of **total woody**

Absolute cover (%) of **standing water** (includes ponds, shallow floodwater etc.)

Absolute cover (%) of **running water** (creeks, aqueducts, rivers)

Absolute cover (%) of **litter**

Absolute cover (%) of **road** (including paved, dirt, gravel, human trails or campground, parking lots etc.)

Absolute cover (%) of **rocks** (i.e. large boulders, cliffs, river rocks, lava flows)

Absolute cover (%) of **bare ground** that is not road or rock (sandbar, gravel bar, decomposed granite, soil)

Average **high** height of **tree** layer(s) and corresponding species

Average height of the **low**er bounds of the **tree** layer(s) and corresponding species

Average **high** height of **shrub** layer(s) and corresponding species

Average height of the **low**er bounds of the **shrub** layer(s) and corresponding species

Average **high** height of **herb** layer(s) and corresponding species

Average height of the **low**er bounds of the **herb** layer(s) and corresponding species

Minimum of tree DBH and corresponding species

Maximum of tree DBH and corresponding species

LAYER COMPOSITION VARIABLES

% relative cover of each species within the tree layer, recorded by species (should equal 100%)

% relative cover of each species within the shrub layer, recorded by species (should equal 100%)

% relative cover of each species within the herb layer, recorded by species (should equal 100%)

% absolute cover of the five most abundant woody species, regardless of height or layer, recorded by species. Plus (or including if they are of the top five) any exotic species such as Russian Olive or Salt Cedar. Combine all salix species into "SALIX" for this category for total willow cover. (may not equal 100%).

Appendix 4. Point count and point count habitat assessment data collection forms, 2002 - 2004.

PRBO Variable Circular Plot (VCP) Point Count Data Form

Pg. _____ of_____

State

Region

Station

Month

Day

Year

Visit

First Name Last Name Address Telephone Email

Point #		Time				Species				≤ 10	10-20	20-30	30-40	40-50	50-75	75-100	> 100	Fly-overs	Breeding Observ.

Breeding Obs Codes: CO=copulation, MC=material carry, FC=food carry, NF=nest found, FL=fledglings, FS=fecal sac carry, DD=distraction display, PA=pair, DI=display

Appendix 4. Point count and point count habitat assessment data collection forms, 2002.

PRBO POINT COUNT HABTIAT ASSESSMENT FORM

Initials_______Date:_______State: CA County: _____Project________Station:______Point#:______
Radius: 50m Hab1________Hab1%____ Hab2________Hab2%____Hab3________Hab3%______
Snags≥10_____Logs≥10_____Riparian width______m Rip. Patchiness ______% % Rip. _______%

Layer	Tot Cov %	Height (m)				DBH (cm)			
		Low	Spec	High	Spec	Min	Spec	Max	Spec
≥ 5m (Tree1)									
≥ 5m (Tree2)									
.5 to <5m (Shrub1)						▨	▨	▨	▨
.5 to <5m (Shrub2)						▨	▨	▨	▨
0 to .5m (Herb1)						▨	▨	▨	▨
“TOTAL WOODY” (TW		▨	▨	▨	▨	▨	▨	▨	▨
Standing H_2O		▨	▨	▨	▨	▨	▨	▨	▨
Running H_2O		▨	▨	▨	▨	▨	▨	▨	▨
Litter		▨	▨	▨	▨	▨	▨	▨	▨
Road/trail		▨	▨	▨	▨	▨	▨	▨	▨
Rock		▨	▨	▨	▨	▨	▨	▨	▨
Bare Ground		▨	▨	▨	▨	▨	▨	▨	▨

Sublayer		Cover	Species

Sublayer		Cover	Species

Sublayer		Cover	Species

Appendix 5. Breeding status of all bird species observed at and within close vicinity of Devils Postpile National Monument, May 20 – August 13, 2002 - 2004, including Parker and Parker (2001), and Institute of Bird Populations surveys (Siegel and Wilkerson 2004).

Common name	Latin name	Breeding status	Common name	Latin name	Breeding status
Turkey Vulture	*Cathartes aura*	0	Lewis' Woodpecker	*Melanerpes lewis*	0*
Mallard	*Anas platyrhynchos*	1	Williamson's Sapsucker	*Sphyrapicus thyroideus*	1
Bufflehead	*Bucephala albeola*	2***	Red-breasted Sapsucker	*Sphyrapicus ruber*	1
Common Merganser	*Mergus merganser*	1	Downy Woodpecker	*Picoides pubescens*	2
Bald Eagle	*Haliaeetus leucocephalus*	0	Hairy Woodpecker	*Picoides villosus*	1
Cooper's Hawk	*Accipiter cooperii*	2	White-headed Woodpecker	*Picoides albolarvatus*	2
Northern Goshawk	*Accipiter gentilis*	2	Black-backed Woodpecker	*Picoides arcticus*	3
Red-tailed Hawk	*Buteo jamaicensis*	2	Red-shafted Flicker	*Colaptes auratus*	1
Golden Eagle	*Aquila chrysaetos*	0	Olive-sided Flycatcher	*Contopus cooperi*	3
American Kestrel	*Falco sparverius*	2**	Western Wood-Pewee	*Contopus sordidulus*	1
Mountain Quail	*Oreortyx pictus*	2	Willow Flycatcher	*Empidonax traillii*	0
Virginia Rail	*Rallus limicola*	2**	Hammond's Flycatcher	*Empidonax hammondii*	2
Spotted Sandpiper	*Actitis macularia*	1	Gray Flycatcher	*Empidonax wrightii*	0*
Wilson's Snipe	*Gallinago delicata*		Dusky Flycatcher	*Empidonax oberholseri*	3
California Gull	*Larus californicus*	0	Cassin's Vireo	*Vireo cassinii*	2
Mourning Dove	*Zenaida macroura*	2	Warbling Vireo	*Vireo gilvus*	1
Great Horned Owl	*Bubo virginianus*	0	Steller's Jay	*Cyanocitta stelleri*	1
Common Nighthawk	*Chordeiles minor*	0	Clark's Nutcracker	*Nucifraga columbiana*	2
Black Swift	*Cypseloides niger*	1	Common Raven	*Corvus corax*	1
Vaux's Swift	*Chaetura vauxi*	0**	Tree Swallow	*Tachycineta bicolor*	2
White-throated Swift	*Aeronautes saxatalis*	2**	Violet-green Swallow	*Tachycineta thalassina*	2
Anna's Hummingbird	*Calypte anna*	2	Cliff Swallow	*Petrochelidon pyrrhonota*	2
Calliope Hummingbird	*Stellula calliope*	1	Mountain Chickadee	*Poecile gambeli*	3
Rufous Hummingbird	*Selasphorus rufus*	0	Red-breasted Nuthatch	*Sitta canadensis*	2
Belted Kingfisher	*Ceryle alcyon*	2	White-breasted Nuthatch	*Sitta carolinensis*	2

Confirmed Breeding - 1 Probable Breeding - 3 Possible Breeding - 2 No Evidence of Breeding, Migrant, Transient, or Disperser - 0 (see methods for further explanation of codes)

* observed only by Parker and Parker (2001), **observed only by IBP (Siegel and Wilkerson 2004), *** observed only by Parker and Parker (2001) outside of DEPO boundaries

Appendix 5. continued. Breeding status of all bird species observed at and within close vicinity of Devils Postpile National Monument, May 20 – August 13, 2002 - 2004, including Parker and Parker (2001), and Institute of Bird Populations surveys (Siegel and Wilkerson 2004).

Common name	Latin name	Breeding status	Common name	Latin name	Breeding status
Brown Creeper	*Certhia americana*	1	Marsh Wren	*Cistothorus palustris*	0
Rock Wren	*Salpinctes obsoletus*	2**	American Dipper	*Cinclus mexicanus*	1
House Wren	*Troglodytes aedon*	1	Golden-crowned Kinglet	*Regulus satrapa*	3
Ruby-crowned Kinglet	*Regulus calendula*	2***	Savannah Sparrow	*Passerculus sandwichensis*	0
Blue-gray Gnatcatcher	*Polioptila caerulea*	2	Fox Sparrow	*Passerella iliaca*	3
Mountain Bluebird	*Sialia currucoides*	2	Song Sparrow	*Melospiza melodia*	1
Townsend's Solitaire	*Myadestes townsendii*	1	Lincoln's Sparrow	*Melospiza lincolnii*	2
Swainson's Thrush	*Catharus ustulatus*	0	Mtn. White-crowned Sparrow	*Zonotrichia leucophrys oriantha*	1
Hermit Thrush	*Catharus guttatus*	3	Oregon Junco	*Junco hyemalis thurberi*	1
American Robin	*Tudus migratorius*	1	Black-headed Grosbeak	*Pheucticus melanocephalus*	2
Orange-crowned Warbler	*Vermivora celata*	0	Lazuli Bunting	*Passerina amoena*	1
Nashville Warbler	*Vermivora ruficapilla*	3	Red-winged Blackbird	*Agelaius phoeniceus*	0**
Yellow Warbler	*Dendroica petechia*	3	Western Meadowlark	*Sturnella neglecta*	2***
Audubon's Warbler	*Dendroica coronata auduboni*	1	Brewer's Blackbird	*Euphagus cyanocephalus*	1
Hermit Warbler	*Dendroica occidentalis*	2	Brown-headed Cowbird	*Molothrus ater*	3
Mac Gillivray's Warbler	*Oporornis tolmei*	1	Pine Grosbeak	*Pinicola enucleator*	3
Common Yellowthroat	*Geothlypis trichas*	2**	Purple Finch	*Carpodacus purpureus*	0
Wilson's Warbler	*Wilsonia pusilla*	1	Cassin's Finch	*Carpodacus cassinii*	1
Western Tanager	*Piranga ludoviciana*	1	Purple Finch	*Carpodacus purpureus*	0
Green-tailed Towhee	*Pipilo chlorurus*	3	Red Crossbill	*Loxia curvirostra*	2
Spotted Towhee	*Pipilo maculatus*	3	Pine Siskin	*Carduelis pinus*	3
Chipping Sparrow	*Spizella passerina*	2	Lesser Goldfinch	*Carduelis psaltria*	2
Brewer's Sparrow	*Spizella breweri*	2	Evening Grosbeak	*Coccothraustes vespertinus*	2
Black-throated Sparrow	*Amphispiza bilineata*	0			

Confirmed Breeding - 1 Probable Breeding - 3 Possible Breeding - 2 No Evidence of Breeding, Migrant, Transient, or Disperser - 0 (see methods for further explanation of codes)

* observed only by Parker and Parker (2001), **observed only by IBP (Siegel and Wilkerson 2004), *** observed only by Parker and Parker (2001) outside of DEPO boundaries

Appendix 6. Summary statistics of vegetation and landscape variables used in bird habitat models. Absolute percent cover estimates and counts for the 50m radius circle surrounding point count stations (n = 15).

Variables	mean	SE	min.	max.
tree-class cover (> 5.0 m)	25.00 %	2.63	10	40
White Fir cover (all heights)	0.93 %	0.61	0	8
Lodgepole Pine cover (all heights)	19.67 %	3.22	0	40
Jeffrey Pine cover (all heights)	4.53 %	1.32	0	15
Aspen cover (all heights)	1.73 %	0.77	0	8
Black Cottonwood cover (all heights)	3.00 %	1.21	0	15
Willow cover (all heights)	5.40 %	2.09	0	25
conifer cover (all heights)	25.13 %	2.10	12	40
deciduous cover (all heights)	6.93 %	2.28	0	25
shrub-class cover (0.50 – 5.0 m)	26.67 %	2.47	10	50
shrub-class *Juncus* cover (0.50 – 5.0 m)	0.13 %	0.08	0	0.9
shrub-class grass cover (0.50 – 5.0 m)	2.52 %	0.95	0	12
herb-class cover (< 0.50 cm)	22.67 %	3.65	10	60
herb-class grass cover (< 0.50 cm)	9.22 %	1.76	1.50	28
herb-class mugwort cover (< 0.50 cm)	1.57 %	0.49	0	6
riparian width	27.67 m	4.44	5	60
riparian patchiness	58.33 %	5.95	25	100
snagsg10	10.73 snags	3.48	0	55
logsg10	32.87 logs	10.09	0	140
Maximum tree DBH	120 cm	4.78	100	150
Highest average tree height	37.73 m	1.71	25	50