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BIRD MONITORING, HABITAT ASSESSMENT AND VISITOR EDUCATION IN MONTANE MEADOW AND RIPARIAN HABITATS OF

DEVILS POSTPILE NATIONAL MONUMENT

RESULTS FROM THE 2002 AND 2003 FIELD SEASON

H. River Gates and Sacha K. Heath
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PRBO Conservation Science
P.O. Box 332
Lee Vining, CA 93541
760-647-6109
www.prbo.org

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SUMMARY

In 2002, PRBO Conservation Science (PRBO) implemented a standardized bird monitoring and education program in montane meadow and riparian habitats of Devils Postpile National Monument (DEPO). We established 15 independent point count stations along the San Joaquin River and Red's Meadow Creek within monument boundaries. We also established 10 mist nets at Soda Springs Meadow near the Monument Ranger Station, where we conducted visitor education in conjunction with mist netting and banding. Data derived from DEPO are comparable with those of statewide riparian bird monitoring efforts and complement National Park Service-wide inventory efforts. In 2003, a second year of songbird monitoring and visitor education was successfully completed.

Eighty-eight species have been documented within and in close proximity to the Monument and we determined breeding status for each. Breeding status of focal species for the California Partners in Flight (CPIF) and Riparian Habitat Joint Venture Riparian Bird Conservation Plan and CPIF's Coniferous Forest Bird Conservation Plan were submitted for inclusion in the most current breeding distribution for those species. DEPO was also added to the online CPIF database that houses statewide standardized monitoring locations and results.

We determined frequency of occurrence and relative abundance for 30 breeding species in 2002 and 24 breeding species in 2003. The most abundant species included Oregon Juncos, American Robins and Warbling Vireos in 2002 and Oregon Juncos, Steller's Jays and American Robins in 2003. Species detected at over 30% of the stations in 2002 included Oregon Juncos, American Robins, Warbling Vireos, Song Sparrows, Mountain Chickadees, Audubon's Warblers, Western Wood-Pewees, and Steller's Jays. In 2003, Oregon Juncos, Steller's Jays, American Robins, Audubon's Warblers, MacGillivray's Warblers and Song Sparrows were detected at over 30% of the stations.

We calculated an index of total individuals, species richness and species diversity for breeding species at each of the 15 point count locations and total and mean indices for the entire study area. In 2002, we detected 188 breeding individuals and 30 breeding species across three visits and within 50m during riparian point counts at DEPO. We detected 120 breeding individuals and 24 breeding species in 2003. When compared to riparian sites of similar elevation and with the same number of points east of the Sierra Nevada crest, total transect breeding bird diversity and species richness were high at DEPO, especially at the Soda Springs Meadow site.

We determined Sawyer and Keeler-Wolf habitat types for all point count stations. Four riparian habitat types and two upland habitat types were assigned to DEPO sites. Most sites were characterized by Black Cottonwood / Lodgepole Pine and Mixed Willow / Lodgepole Pine.

We determined productivity indices for 24 breeding species in 2002 and 20 breeding species in 2003. Soda Springs Meadow exhibited high hatch year to adult ratios, suggesting good productivity overall. In both 2002 and 2003, species with exceptionally high productivity indices include Calliope Hummingbirds, Red-breasted Sapsuckers, Audubon's Warblers, MacGillivray's Warblers, Wilson's Warblers and Mountain White-crowned Sparrows.

We tallied 283 (2002) and 362 (2003) DEPO visitors who attended mist netting demonstrations at the Soda Springs Meadow site. Avian ecology and identification, meadow restoration and management, bird and habitat conservation, and avian monitoring methods were interpreted to visitors during the 5 hour mist netting sessions. Visitors of all ages viewed live birds in the hand and witnessed the monitoring method first hand.

BACKGROUND AND INTRODUCTION

Montane meadow and non-meadow 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 habitat has been demonstrated as extremely important for Sierra Nevada avifauna because it provides breeding habitat for numerous landbird species and because these meadows serve as important supplemental habitat for species that breed in other habitats (e.g. coniferous forest). It has also been demonstrated that montane meadows provide critical molting and pre-migration staging areas for juveniles and adults among many landbird species in the Sierra Nevada (Siegel and DeSante 1999).

Although riparian areas account for less than 1% of the western United States landscape, they provide breeding and migratory habitat for disproportionally more species than surrounding uplands (Knopf et al. 1988). The loss or degradation of riparian habitat have been implicated as key factors in western North American landbird population declines (Terborgh 1989, DeSante and George 1994, Ohmart 1994). As such, riparian areas have been identified as the most critical habitat for avian conservation across California (Miller 1951, Gaines 1974, Manley and Davidson 1993, RHJV 2000).

While Devils Postpile National Monument (DEPO) only encompasses 798 acres of the Sierra Nevada range, it harbors montane meadow and riparian habitats that are crucial for breeding and migrating avifauna. Until 2001, when voluntary bird censuses were conducted in DEPO (Parker and Parker 2001), scant information regarding the avifaunal presence or absence, breeding status, distribution, abundance, or habitat use was available for the Monument. Results from this 2001 effort reported 57 species present between late May and early September. Of these, 5 are riparian focal species considered in the California Partners in Flight Riparian Bird Conservation Plan (RHJV 2000) and 16 are species that critically depend on montane meadow habitat in the Sierra Nevada (Siegel and DeSante 1999). Many of the species detected at DEPO are described in the Draft Avian Conservation Plan for the Sierra Nevada Bioregion as declining or likely declining in the Sierra Nevada (Siegel and DeSante 1999).

Human recreational visitation at DEPO reaches as high as 2,500 (DEPO data) per day during the summer, and the willow meadow found at Soda Springs Meadow and the riparian corridor of the San Joaquin River are of the greatest attractions due to fishing and recreational opportunities available there. DEPO management efforts are currently underway to rehabilitate the meadow habitat, which has been compromised due to the many unchecked user trails established over the years, and to stabilize the riparian riverbanks that are highly eroded.

It has been recognized that birds can be excellent indicators of environmental health and data on bird populations can provide an ideal means to monitor the effectiveness of management practices and restoration efforts (Ralph et al.1993, RHJV 2000). Complementary to this, conservation of bird populations requires an understanding of the habitat needs and demographic mechanisms necessary for population sustainability (Martin 1992, Nur and Geupel 1993).

Combining restoration and management efforts with avian monitoring programs can have the three-fold benefit of: a) contributing to the overall assessment of bird population health over the long term, b) guiding management activities so that they may enhance bird populations and other species and

functions of riparian and meadow systems, and c) assisting managers in evaluating management and restoration practices.

Efforts at DEPO will contribute to ongoing statewide and regional bird conservation efforts and monitoring programs. PRBO Conservation Science's (PRBO) Eastern Sierra Riparian Songbird Conservation project (ESRSC) study area surrounds and borders DEPO (Heath et al. 2002a). Management agencies that are adjacent or have jurisdiction within DEPO (e.g. Inyo National Forest, California Department of Fish and Game) have participated as collaborative partners in ESRSC since its inception. The ESRSC is part of a statewide effort to address the decline of riparian breeding songbirds and their habitats in California (RHJV 2000). It is a highly collaborative effort among multiple federal, state and private organizations that are guided by the assumption that songbirds are model organisms for monitoring the health of riparian systems and the effects of various land management practices on these systems.

In 2002, PRBO and DEPO implemented a standardized songbird demographic monitoring program that focused on the montane meadow and riparian habitats and associated bird species of DEPO. This effort set the groundwork for future monitoring of the effects of meadow rehabilitation and visitor management. The monitoring program also acted as an interpretive tool for visitors. This work will supplement the basic National Park Service-wide bird inventory that is proposed separately with Sequoia Kings Canyon National Park (SEKI), will be incorporated into the ESRSC project, and will include DEPO as a collaborative partner in the project and in statewide California Partners in Flight efforts. In 2003, a second year of songbird monitoring and visitor education was successfully completed.

The goals of the effort are to:

- document use of montane meadow and riparian habitat by migrant, molting and pre-migration and meadow and non-meadow breeding landbirds.
- provide educational opportunities for visitors on avian ecology, natural history and conservation and on the DEPO avian monitoring program and meadow restoration and management efforts.
- provide summary information for the development of a long-term adaptive management monitoring plan for DEPO.

METHODS

Research Permits

We worked under National Park Service Scientific and Collecting Research Permits DEPO-2002-SCI-0001 and DEPO-2003-SCI-0001.

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 Visitor Center 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).

Study Design

Due to the small size of the Monument, it was possible to cover all riparian habitat along the San Joaquin River and Red's Meadow Creek within the Monument by one point count transect. We therefore randomly chose 50 m downstream of the 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 station with orange flagging and metal tags 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 monitoring the response of birds to meadow rehabilitation and visitor management that will occur there. The site was also chosen for its proximity to the Monument Visitor's Center for the purpose of conducting visitor outreach and 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 for two weeks prior to censuses. Throughout the season, observers calibrated distance estimations on a weekly basis, and a Leica Range Finder ™ was used during the censuses.

Mist Netting

Netting procedures conformed to the guidelines described in Ralph et al. (1993) and Monitoring Avian Productivity and Survivorship (MAPS) protocol (DeSante et al. 2000). In summary, 10 mist nets were operated once every ten-day period, 9 times between May 30 and August 13 in 2002 and May 30 and August 13 in 2003 (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 and 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. USFWS-permitted PRBO biologists conducted all mist netting and banding.

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 (between June 13 and July 8 in 2002; June 7 and June 30 in 2003) and spaced each of three visits at least 10 days apart. To minimize observer bias, a different observer conducted each of the three censuses. 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). We used our vegetation measurements and guidance provided by Sawyer and Keeler-Wolf (1995) to assign dominant habitat series (habitat types) to each point. Data forms are provided in Appendix 4, detailed description of habitat assessment variables are provided in Appendix 3.

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 Total Individuals, Species Abundance, Species Richness and Species Diversity
We summarized indices of total detections, 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*] and Common Ravens [*Corvus corax*] and California Gulls [*Larus californicus*]).

We summarized data by point, transect, and by point per transect for each year. We summarized total detections, individual breeding species abundance, species richness and species diversity for each of 15 individual point count stations for by point summaries, and took the mean of individual point summaries for by point per transect summaries for each year. By point per transect summaries allow for comparisons between groupings of greater or fewer numbers of points.

Total detections and species abundance: We calculated the total number of breeding species individuals detected (all breeding species combined) for each point count station using all detections within 50m summed over three visits. We also calculated the mean number of breeding species individuals (for each species) by point per transect, averaged over three visits, using all detections within 50m. Because few species are 100% detectable, such calculations probably underestimate absolute density. Therefore results should be considered a minimum estimate of abundance (*relative abundance*).

Species richness: We calculated the number of all breeding species for each point count station using all detections within 50m summed over three visits, using Point Count 2.75 (Ballard 2002).

Species diversity: We used Point Count 2.75 (Ballard 2002) to calculate breeding species diversity for each point count station using all detections within 50m summed over three visits. We used a 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 species richness and p_i is the proportion of the total numbers of individuals for each species (Nur et al. 1999). High index scores indicate both high species richness and more equal distribution of individuals among species. We used Kruskall-Wallace equality of populations rank test to evaluate differences in species diversity between years.

Bird and habitat correlations
We examined relationships between breeding bird diversity, the abundance of several species, and 16 habitat variables in a series of pairwise correlations.

Statistical calculations were performed using STATA 7.0 (Stata Corp. 1999). Significance was assumed at $P < 0.05$ after Bonferroni adjustment.

Breeding Status

We determined breeding status for all species encountered at all study sites between late May and mid August 2002 and 2003, during censuses performed by Parker and Parker (2001) and during censuses performed by the Institute for Bird Populations (IBP data 2003). We used observations recorded before, during, and after mist netting sessions, point count censuses and during project set up and vegetation assessments. 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):

0 No evidence of breeding: Species not detected during breeding season, or species known not to breed within the general study area.
2 Possible breeding: Species encountered singing or acting territorial only once during the breeding season (in suitable habitat).
3 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.
1 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 Devils Postpile National Monument along with the submission of this report. Electronic versions of all Devils Postpile databases derived from this project were also submitted in DBF format.

Personnel

PRBO Terrestrial Biologist Sacha Heath conducted study design and set-up, point count censuses, mist netting and visitor education. PRBO biologists Grant Ballard, Leah Culp, River Gates, Noah Hamm, Gernot Huber, Quresh Latif, Yen Luc, and Chris Tonra conducted mist netting and visitor education. PRBO biologists Noah Hamm, Gernot Huber, and Yen Luc conducted point count vegetation assessments. PRBO biologists River Gates, Noah Hamm and Jeff Maurer conducted point count censuses.

RESULTS AND DISCUSSION

Bird species composition, distribution and breeding status

Eighty-eight bird species have been documented within and in close vicinity to the Monument, 6 of which were detected only by Parker and Parker (2001) and 8 of which were detected only by IBP surveys (IBP data 2003, Appendix 5). We determined breeding status for all species encountered and ranked their breeding status using the RHJV breeding scale. Breeding status of the riparian and coniferous focal species was submitted for inclusion in the CPIF 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 CPIF riparian and coniferous focal species and http://cain.nbii.gov/prbo/calpifmap/ for the study site database in which DEPO has been included.

Sensitive and focal species, species of special concern and critical mountain meadow species
We detected a total of 38 sensitive, focal or critical montane meadow species at DEPO (Table 1). Twelve species are considered sensitive or of concern and 15 species are riparian or coniferous focal species. We documented 17 species that have been identified as critically dependent on montane meadow habitat in the Sierra Nevada (Siegel and DeSante 1999). Focal species (such as those for the riparian and coniferous forest bird conservation plans) are not necessarily sensitive or of concern, but are listed under the assumption that if a landscape is managed to meet the needs of the focal species' needs, other species will benefit (Lambeck 1997, RHJV 2000, CPIF 2000).

Table 1. Sensitive and focal species detected at Devils Postpile National Monument, 2002 and 2003, including Parker and Parker (2001), and IBP surveys (IBP data 2003). See Appendix 5 for breeding status.

Common name	Latin name	Federal	DFG CSSC	USFWS MNBMC	State	RHJV RFS	CPIF CFS	CPIF SNB CMMS	Aud. WL
Bald Eagle	*Haliaeetus leucocephalus*	FTD			SE				
Northern Goshawk	*Accipiter gentilis*		3RD	X					
Golden Eagle	*Aquila chrysaetos*				SFP				
Vaux's Swift	*Chaetura vauxi*		3RD				X	X	
Black Swift	*Cypseloides niger*			X					X
Rufous Hummingbird	*Selasphorus rufus*								X
Belted Kingfisher	*Ceryle alcyon*							X	
Lewis' Woodpecker	*Melanerpes lewis*								X
Red-breasted Sapsucker	*Sphyrapicus ruber*							X	
White-headed Woodpecker	*Picoides albolarvatus*								X
Black-backed Woodpecker	*Picoides arcticus*						X		
Willow Flycatcher	*Empidonax traillii*				SE	X		X	
Olive-sided Flycatcher	*Contopus cooperi*		2ND	X			X		
Gray Flycatcher	*Empidonax wrightii*			X					
Warbling Vireo	*Vireo gilvus*					X			
Tree Swallow	*Tachycineta bicolor*							X	
Brown Creeper	*Certhia americana*						X		
House Wren	*Troglodytes aedon*							X	
Golden-crowned Kinglet	*Regulus satrapa*						X		
American Robin	*Turdus migratorius*							X	

-Table continued on next page-

Table 1. Continued. Sensitive and focal species detected at Devils Postpile National Monument, 2002 and 2003, including Parker and Parker (2001), and IBP surveys (IBP data 2003). See Appendix 5 for breeding status. .

Common name	Latin name	Federal	DFG CSSC	USFWS MNBMC	State	RHJV RFS	CPIF CFS	CPIF SNB CMMS	Aud. WL
Orange-crowned Warbler	*Vermivora celata*							X	
Nashville Warbler	*Vermivora ruficapilla*							X	
Yellow Warbler	*Dendroica petechia*		2ND			X		X	
Hermit Warbler	*Dendroica occidentalis*			X					X
Wilson's Warbler	*Wilsonia pusilla*					X		X	
Mac Gillivray's Warbler	*Oporornis tolmei*						X	X	
Western Tanager	*Piranga ludoviciana*						X		
Chipping Sparrow	*Spizella passerina*							X	
Brewer's Sparrow	*Spizella breweri*			X					X
Black-throated Sparrow	*Amphispiza bilineata*			X					
Fox Sparrow	*Passerella iliaca*						X		
Song Sparrow	*Melospiza melodia*					X		X	
Lincoln's Sparrow	*Melospiza lincolnii*							X	
Mtn. White-crowned Sparrow	*Zonotrichia leucophrys oriantha*							X	
Oregon Junco	*Junco hyemalis thurberi*						X		
Black-headed Grosbeak	*Pheucticus melanocephalus*					X			
Lazuli Bunting	*Passerina amoena*							X	

FTD = Federally Threatened, proposed for delisting; CDFG CSSC = California Department of Fish and Game Species of Special Concern draft list 2001 and priority #; SE= state endangered, SFP= state fully protected; USFWS MNBMC= Fish and Wildlife Service, Migratory Nongame Birds of Management Concern; RHJV RFS= California Partners in Flight Riparian Habitat Joint Venture riparian focal species; CPIF CFS = California Partners in Flight coniferous forest focal species, CPIF SNB CMMS = California Partners in Flight Draft Avian Conservation Plan for the Sierra Nevada Bioregion Critically Meadow Dependent Species, Aud. WL = Audubon Watch List (CDFG and PRBO 2001, USFWS 1995, Siegel and DeSante 1999, RHJV 2000, CDFG 2002, CPIF 2002, Audubon 2002)

Northern Goshawks, Black Swifts, Red-breasted Sapsuckers, Black-backed Woodpeckers, Warbling Vireos, Brown Creepers, House Wrens, Golden-crowned Kinglets, American Robins, Nashville Warblers, Yellow Warblers, Wilson's Warblers, MacGillivray's Warblers, Western Tanagers, Fox Sparrows, Song Sparrows, Mountain White-crowned Sparrows, Oregon Juncos, and Lazuli Buntings were observed as probable or confirmed breeders within the study area. Rufous Hummingbird, Willow Flycatcher, Hermit Warbler and Black-headed Grosbeak were only present as migrants at DEPO in 2002. In 2003, Vaux's Swifts were observed as migrants by IBP surveys. (IBP data 2003)

Breeding species abundance and frequency of occurrence

Thirty species in 2002 and 24 species in 2003 fit our criteria for inclusion in breeding species summaries (see Methods pp. 6-7). In 2002, we detected Oregon Juncos, American Robins, Warbling Vireos, Song Sparrows, Mountain Chickadees, Audubon's Warblers, Western Wood-Pewees, and Steller's Jays at over 30% of the stations. In 2003, we detected Oregon Juncos, Steller's Jays, American Robins, Audubon's Warblers, MacGillivray's Warblers and Song Sparrows at over 30% of stations (Table 2).

The most abundant species included Oregon Juncos, American Robins and Warbling Vireos in 2002. In 2003, Oregon Juncos, Steller's Jays, and American Robins were the most abundant species. Oregon Junco abundance was higher at DEPO than at other eastern Sierra riparian location in 2001, with the exception of Wolf Creek where Oregon Junco abundance was slightly higher (0.78, Heath et al. 2002b, Heath and Ballard 2002). Other species' abundance was average among other eastern Sierra riparian sites.

Table 2. Frequency of occurrence and mean relative abundance[1] for all breeding species detected during 5-minute 50m fixed-radius point counts. Number of individuals detected by point per entire study area and mean of three visits at Devils Postpile National Monument, 2002 and 2003.

		2002		2003	
Common name	Latin name	% points present (n = 15)	Mean relative abundance	% points present (n = 15)	Mean relative abundance
Calliope Hummingbird	*Stellula calliope*	13%	0.04	0%	0.00
Belted Kingfisher	*Ceryle alcyon*	0%	0.00	7%	0.02
Williamson's Sapsucker	*Sphyrapicus thyroideus*	7%	0.02	13%	0.04
Red-breasted Sapsucker	*Sphyrapicus ruber*	7%	0.02	20%	0.07
Hairy Woodpecker	*Picoides villosus*	7%	0.02	13%	0.07
Olive-sided Flycatcher	*Contopus cooperi*	7%	0.02	0%	0.00
Western Wood-Pewee	*Contopus sordidulus*	33%	0.22	27%	0.16
Dusky Flycatcher	*Empidonax oberholseri*	7%	0.02	13%	0.04
Warbling Vireo	*Vireo gilvus*	53%	0.38	20%	0.16
Steller's Jay	*Cyanocitta stelleri*	33%	0.20	47%	0.33
Mountain Chickadee	*Poecile gambeli*	40%	0.16	27%	0.11
White-breasted Nuthatch	*Sitta carolinensis*	0%	0.00	7%	0.02
Brown Creeper	*Certhia americana*	20%	0.09	20%	0.11
House Wren	*Troglodytes aedon*	7%	0.02	0%	0.00
American Dipper	*Cinclus mexicanus*	13%	0.07	7%	0.02
Golden-crowned Kinglet	*Regulus satrapa*	20%	0.07	0%	0.00
Mountain Bluebird	*Sialia currucoides*	0%	0.00	7%	0.02
American Robin	*Turdus migratorius*	60%	0.42	40%	0.22
Yellow Warbler	*Dendroica petechia*	13%	0.07	7%	0.02
Townsend's Solitaire	*Myadestes townsendi*	7%	0.02	13%	0.07
Audubon's Warbler	*Dendroica coronata auduboni*	40%	0.18	33%	0.16
Mac Gillivray's Warbler	*Oporornis tolmei*	20%	0.07	33%	0.18
Wilson's Warbler	*Wilsonia pusilla*	20%	0.16	20%	0.09
Western Tanager	*Piranga ludoviciana*	20%	0.11	13%	0.04
Chipping Sparrow	*Spizella passerina*	13%	0.04	0%	0.00
Fox Sparrow	*Passerella iliaca*	7%	0.02	0%	0.00
Song Sparrow	*Melospiza melodia*	47%	0.27	33%	0.13
Mountain White-crowned Sparrow	*Zonotrichia leucophrys oriantha*	7%	0.02	0%	0.00
Oregon Junco	*Junco hyemalis thurberi*	100%	0.71	60%	0.36
Brewer's Blackbird	*Euphagus cyanocephalus*	20%	0.29	13%	0.18
Brown-headed Cowbird	*Molothrus ater*	13%	0.16	0%	0.00
Cassin's Finch	*Carpodacus cassinii*	13%	0.04	13%	0.04
Pine Siskin	*Carduelis pinus*	27%	0.24	0%	0.00

[1]To caluculate number of individuals per hectare, multiply abundance by 1.27. To calculate number of individuals detected across entire study area (averaged over three visits), multiply abundance by number of points (15). Because so few species are 100% detectable, such calculations probably underestimate absolute density. Therefore results should be considered a minimum index of abundance, or relative abundance.

Breeding Bird Survey results, interpreted for the Draft Avian Conservation Plan for the Sierra Nevada Bioregion, suggest that several species detected at DEPO are experiencing significant ($P < 0.05$) Sierra Nevada-wide population declines. These include Belted Kingfisher, Olive-sided Flycatcher, Western Wood-Pewee, Steller's Jay, Mountain Chickadee, American Robin, Green-tailed Towhee, Chipping Sparrow, Mountain White-crowned Sparrow, Oregon Junco, Brown-headed Cowbird and Lesser Goldfinch. Cassin's Vireo, Anna's Hummingbird and Tree Swallows are experiencing significantly increasing trends (Siegel and DeSante 1999).

Breeding total individuals, species richness and species diversity

By point summaries of breeding species diversity ranged from 2.59 to 10.21 in 2002 and 1 to 7.85 in 2003 (Table 3). Overall, breeding bird indices at DEPO sites fall within range of bird indices among other eastern Sierra riparian sites, where species diversity ranged from 0.0 to 13.24. In 2002, breeding bird diversity at site 3, located in the Soda Springs Meadow, was among the highest of other eastern Sierra riparian sites (10.21, Heath et al. 2001, Heath and Gates 2002).

Table 3. Indices of total individuals, species richness and Shannon-Weiner index of species diversity by point for breeding species detected on 5-minute fixed-radius riparian point counts, summed over 3 visits at Devils Postpile National Monument, 2002 and 2003.

Site	2002			2003		
	Total Individuals	Spp. Richness	Spp. Diversity	Total Individuals	Spp. Richness	Spp. Diversity
1	14	9	7.44	7	5	4.71
2	14	5	3.96	7	5	4.37
3	28	12	10.21	19	9	6.44
4	16	10	8.44	5	3	2.59
5	8	6	5.66	5	4	3.79
6	8	7	6.73	2	2	2
7	9	6	5.67	6	4	3.46
8	19	9	7.6	15	8	7.32
9	5	3	2.59	2	2	2
10	7	5	4.71	3	1	1
11	6	5	4.76	6	4	3.78
12	14	8	7.17	14	7	6.26
13	20	8	6.18	15	9	7.85
14	11	7	6.04	7	6	5.74
15	9	4	3.71	7	7	7

In 2002, 188 breeding individuals and 30 breeding species were detected across three visits and within 50m during riparian point counts at DEPO (Table 4). In 2003, 120 breeding individuals and 24 species were detected. Species diversity was not significantly different between years ($P= .085$, $\chi^2 = 2.97$, $df =1$). Total transect breeding bird diversity and species richness was high at DEPO as compared to other riparian sites of similar elevation and with the same number of points in the eastern Sierra (Heath and Ballard 2002, Heath et al. 2002a, Heath 2003).

Table 4. 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 and 2003.

	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	1.35	24	5.07	0.66	17.65	4.55	0.55

Mist netting capture rates provided us with another measure of indices for species richness and abundance specific to DEPO's Soda Springs Meadow site (Table 5), and augmented results derived from point counts.

Table 5. Summary of mist netting effort during the breeding season at Soda Springs Meadow, Devils Postpile National Monument, 2002 and 2003.

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

The total number of individuals (migrants and breeders) captured per 100 net hours was higher than those at other PRBO eastern Sierra riparian banding sites (Heath et al. 2001, Heath et al. 2002a) with the exception of Lee Vining Creek, which in 2002 had an exceptionally high capture rate). DEPO captures per 100 net hours were higher than the 1996 national average of 37.2 for 410 MAPS stations across the U.S. (DeSante et al. 1998). Species richness at Soda Springs Meadow (based on capture rates) was average compared to PRBO eastern Sierra riparian banding sites in previous years (Heath et al. 2001, Heath et al. 2002b).

Riparian habitat characteristics in relation to breeding bird indices

Sawyer and Keeler-Wolf habitat types

Table 6. 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 2002.

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

Four Sawyer and Keeler-Wolf riparian habitat types and two upland habitat types were assigned to DEPO sites (Table 6). All points encompassed two distinct habitat types (riparian and upland). Most sites were characterized by Black Cottonwood / Lodgepole Pine and Mixed Willow / Lodgepole Pine.

Bird and habitat correlations

Despite small sample sizes (15 points), a few vegetative features significantly influenced bird numbers (Table 7). Olive-sided Flycatcher detections were correlated with White Fir tree cover, and Brown-headed Cowbirds were correlated with percent of grass cover in the herb (< 50cm) and shrub (50 cm – 5 m) layer.

Table 7. Breeding bird diversity and number of individuals detected within 50m (mean by point by transect, for 3 visits, for CPIF Riparian and Coniferous Forest Focal Species and Brown-headed Cowbirds) in relation to habitat features within 50m of point count stations, Devils Postpile National Monument, 2002. Coefficients and significance levels displayed, Bonferroni adjusted.

	Breeding bird species diversity	Yellow Warbler	Song Sparrow	Wilson's Warbler	Warbling Vireo	Oregon Junco	Brown Creeper	Golden-crowned Kinglet	Fox Sparrow	MacGillivray's Warbler	Western Tanager	Olive-sided Flycatcher	Brown-headed Cowbird
herbaceous cover	--	--	--	--	--	--	--	--	--	--	--	--	--
shrub cover	--	--	--	--	--	--	--	--	--	--	--	--	--
tree cover	--	--	--	--	--	--	--	--	--	--	--	--	--
white fir tree cover	--	--	--	--	--	--	--	--	--	--	--	0.834*	--
mugwort cover	--	--	--	--	--	--	--	--	--	--	--	--	--
grass herb cover	--	--	--	--	--	--	--	--	--	--	--	--	0.897***
grass shrub cover	--	--	--	--	--	--	--	--	--	--	--	--	0.962***
juncus shrub cover	--	--	--	--	--	--	--	--	--	--	--	--	--
lodgepole tree cover	--	--	--	--	--	--	--	--	--	--	--	--	--
black cottonwood tree cover	--	--	--	--	--	--	--	--	--	--	--	--	--
Jeffrey pine cover	--	--	--	--	--	--	--	--	--	--	--	--	--
aspen tree cover	--	--	--	--	--	--	--	--	--	--	--	--	--
willow shrub cover	--	--	--	--	--	--	--	--	---	--	--	--	--
riparian width	--	--	--	--	--	--	--	--	--	--	--	--	--
percent riparian	--	--	--	--	--	--	--	--	--	--	--	--	--
maximum tree DBH	--	--	--	--	--	--	--	--	--	--	--	--	--

P < 0.05 = *; P<0.01 = **, P < 0.001 = ***, -- = no significant correlation

Estimates of productivity

Soda Springs Meadow exhibited high young (Hatch Year) to adult ratios, suggesting good productivity overall (defined here as ratios over 0.30, Table 8). Species with exceptionally high productivity indices include Calliope Hummingbirds, Red-breasted Sapsuckers, Audubon's Warblers, and Mountain White-crowned Sparrows in 2002. In 2003, Calliope Hummingbirds, Red-breasted Sapsuckers, Mac Gillivray's Warblers and Wilson's Warblers demonstrated exceptionally high productivity (Table 9).

Table 8. Species and age class of all birds banded at Soda Springs Meadow, Devils Postpile National Monument during constant effort mist netting during the 2002 breeding season. Solely migrant, transient and dispersing species in *italics*. Total = all birds captured combined, Adjusted Total = breeding species only.

Common Name	Latin Name	Adult	Hatch Year	Hatch Year / Adult ratio
Calliope Hummingbird	*Stellula calliope*	3	4	1.33
Rufous Hummingbird	*Selasphorus rufus*	*3*	*9*	*3.00*
Red-breasted Sapsucker	*Sphyrapicus ruber*	5	5	1.00
Willow Flycatcher	*Empidonax traillii*	*1*	*0*	*0*
Dusky Flycatcher	*Empidonax oberholseri*	2	1	0.50
Cassin's Vireo	*Vireo cassinii*	*1*	*0*	*0*
Warbling Vireo	*Vireo gilvus*	13	1	0.08
Steller's Jay	*Cyanocitta stelleri*	0	1	~
Brown Creeper	*Certhia americana*	0	1	~
House Wren	*Troglodytes aedon*	0	1	~
Golden-crowned Kinglet	*Regulus satrapa*	1	0	0
American Robin	*Turdus migratorius*	8	0	0
Orange-crowned Warbler	*Vermivora celata*	*17*	*15*	*0.88*
Nashville Warbler	*Vermivora ruficapilla*	1	1	1.00
Yellow Warbler	*Dendroica petechia*	4	0	0
Audubon's Warbler	*Dendroica coronata auduboni*	10	12	1.20
Hermit Warbler	*Dendroica occidentalis*	*1*	*0*	*0*
Mac Gillivray's Warbler	*Oporornis tolmei*	0	2	~
Wilson's Warbler	*Wilsonia pusilla*	10	2	0.20
Spotted Towhee	*Pipilo maculatus*	0	2	~
Brewer's Sparrow	*Spizella breweri*	1	1	1.00
Black-throated Sparrow	*Amphispiza bilineata*	*0*	*1*	~
Fox Sparrow	*Passerella iliaca*	0	1	~
Song Sparrow	*Melospiza melodia*	13	11	0.85
Mountain White-crowned Sparrow	*Zonotrichia leucophrys oriantha*	2	8	4.00
Oregon Junco	*Junco hyemalis thurberi*	10	4	0.40
Lazuli Bunting	*Passerina amoena*	1	0	0
Brown-headed Cowbird	*Molothrus ater*	1	0	0
Cassin's Finch	*Carpodacus cassinii*	3	0	0
Pine Siskin	*Carduelis pinus*	7	0	0
Total		118	83	0.70
Adjusted Total		96	58	0.60

Table 9. Species and age class of all birds banded at Soda Springs Meadow, Devils Postpile National Monument during constant effort mist netting during the 2003 breeding season. Solely migrant, transient and dispersing species in *italics*. Total = all birds captured combined, Adjusted Total = breeding species only.

Common Name	Latin Name	Adult	Hatch Year	Hatch Year / Adult ratio
Spotted Sandpiper	*Actitis macularia*	0	1	~
Calliope Hummingbird	*Stellula calliope*	2	3	1.5
Rufous Hummingbird	*Selasphorus rufus*	2	3	1.5
Red-breasted Sapsucker	*Sphyrapicus ruber*	4	5	1.25
Warbling Vireo	*Vireo gilvus*	4	0	0
Steller's Jay	*Cyanocitta stelleri*	2	0	0
Mountain Chickadee	*Poecile gambeli*	3	0	0
American Robin	*Turdus migratorius*	8	0	0
Orange-crowned Warbler	*Vermivora celata*	9	27	3
Nashville Warbler	*Vermivora ruficapilla*	1	1	1
Yellow Warbler	*Dendroica petechia*	3	0	0
Audubon's Warbler	*Dendroica coronata auduboni*	23	5	0.22
Mac Gillivray's Warbler	*Oporornis tolmei*	4	6	1.5
Wilson's Warbler	*Wilsonia pusilla*	5	11	2.2
Western Tanager	*Piranga ludoviciana*	3	0	0
Song Sparrow	*Melospiza melodia*	12	8	0.67
Mountain White-crowned Sparrow	*Zonotrichia leucophrys oriantha*	2	0	0
Oregon Junco	*Junco hyemalis thurberi*	10	2	0.2
Brewer's Blackbird	*Euphagus cyanocephalus*	3	1	0.33
Lazuli Bunting	*Passerina amoena*	1	1	1
Brown-headed Cowbird	*Molothrus ater*	1	0	0
Pine Grosbeak	*Pinicola enucleator*	1	0	0
Pine Siskin	*Carduelis pinus*	1	0	0
Total		104	74	0.65
Adjusted Total		93	44	0.49

Site fidelity and recruitment

In 2003, 9 individuals of 6 species that were originally banded in 2002 were recaptured in mist nets at Soda Springs Meadow (Table 10). All individuals were breeders in both years, with the exception of a Mountain White–crowned Sparrow, which was captured as a juvenile in 2002 and returned to breed as an adult in 2003.

Table 10. Individuals banded in 2002 and recaptured in 2003, and age of first capture at the Soda Springs Meadow, Devils Postpile National Monument.

	Age in 2002	
Species	Adult	Hatch year
Red-breasted Sapsucker	1	0
American Robin	1	0
Audubon's Warbler	1	0
Song Sparrow	3	0
Mountain White-crowned Sparrow	1	1
Oregon Junco	1	0
Total individuals	8	1

Timing

In both years, hatching year birds of several species began to appear in mist nets in early July, indicating that nest initiation began late May through early June in that year (Figure 2). In 2003, no hatching year Warbling Vireos or Mountain White-crowned Sparrows were captured (Table 9, Figure 3).

Figure 2. Timing and number of captures for seven breeding species at Soda Springs Meadow, Devils Postpile National Monument, 2002. Number of captures on Y axis, ten day period date on X axis.

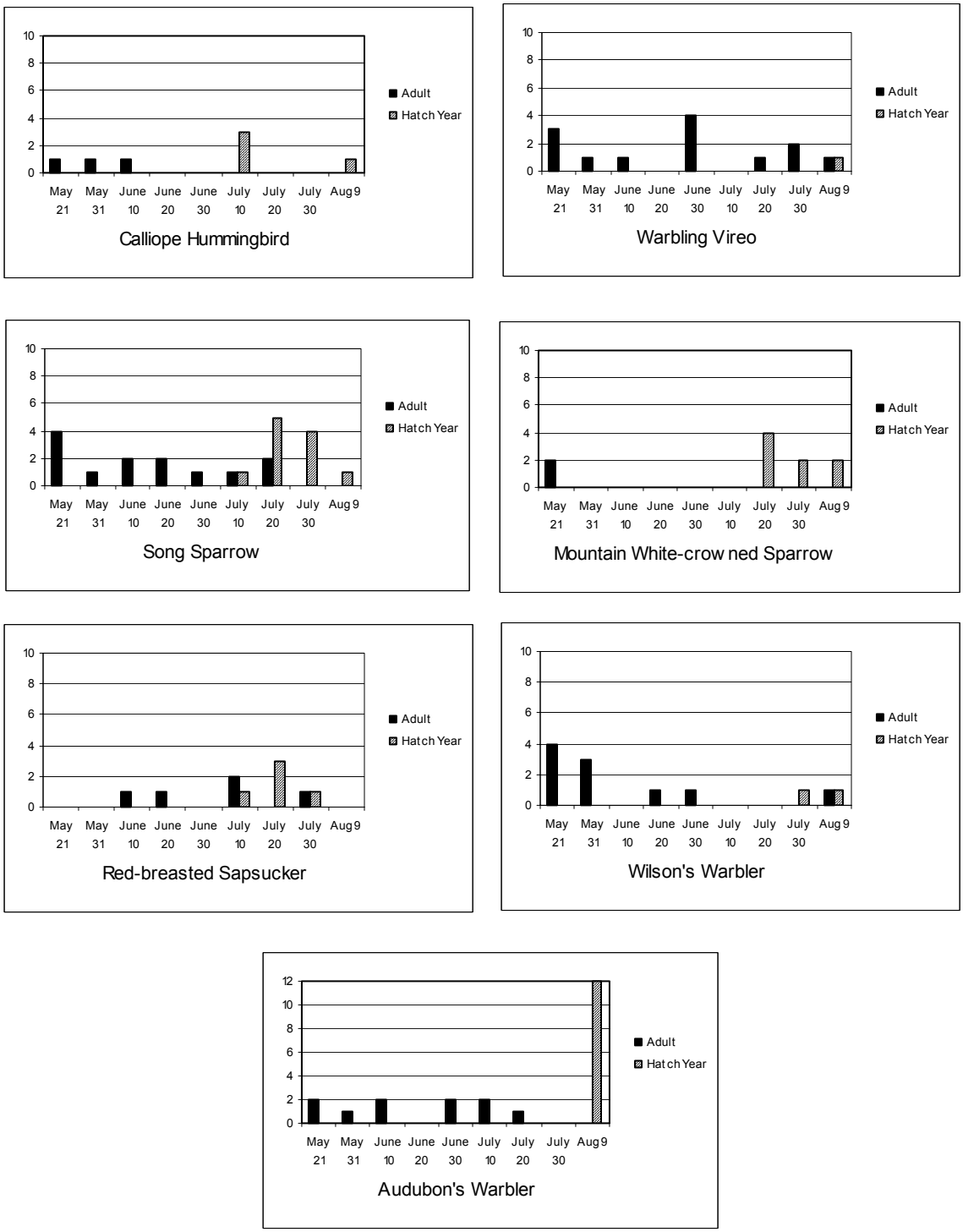
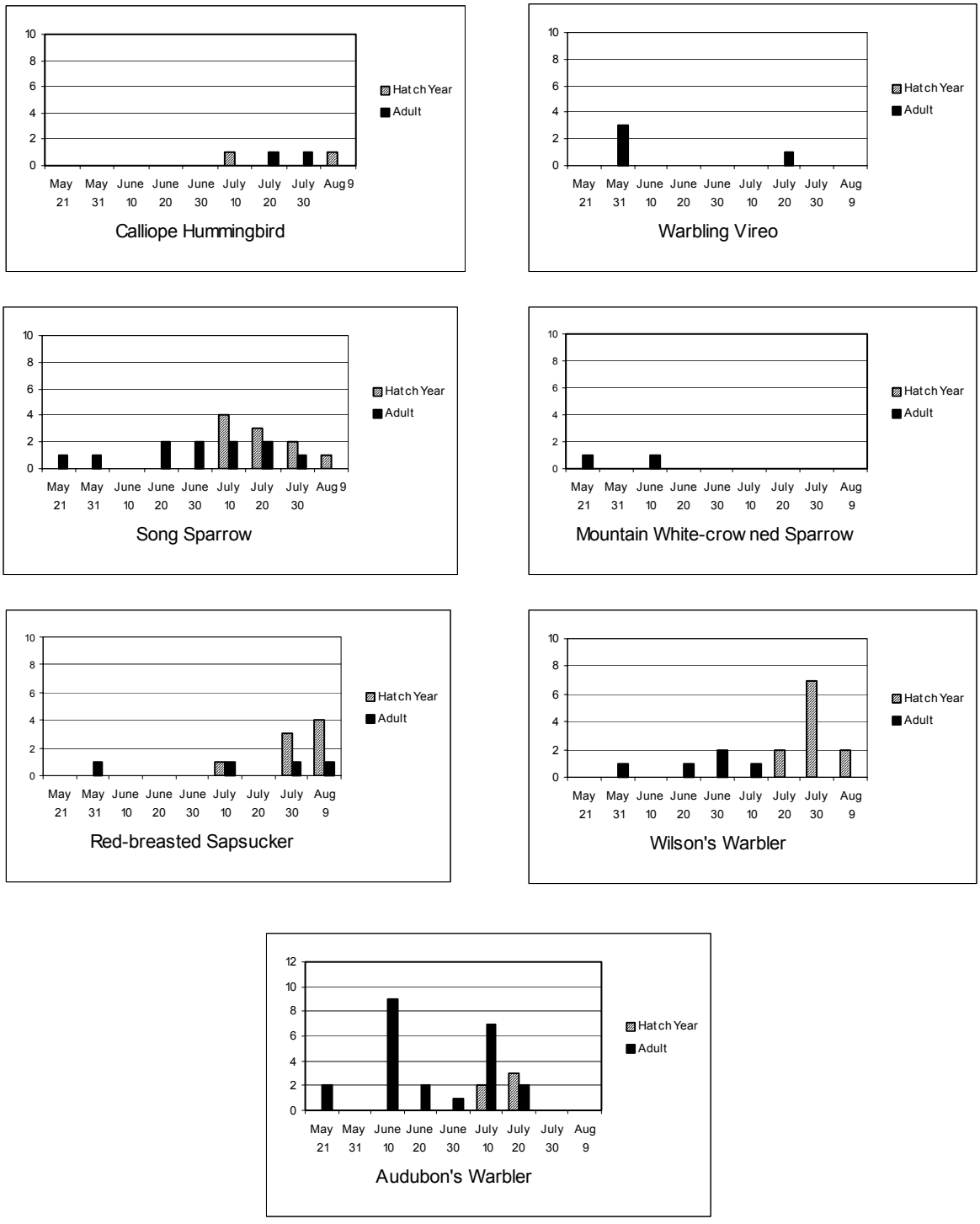


Figure 3. Timing and number of captures for seven breeding species at Soda Springs Meadow, Devils Postpile National Monument, 2003. Number of captures on Y axis, ten day period date on X axis.

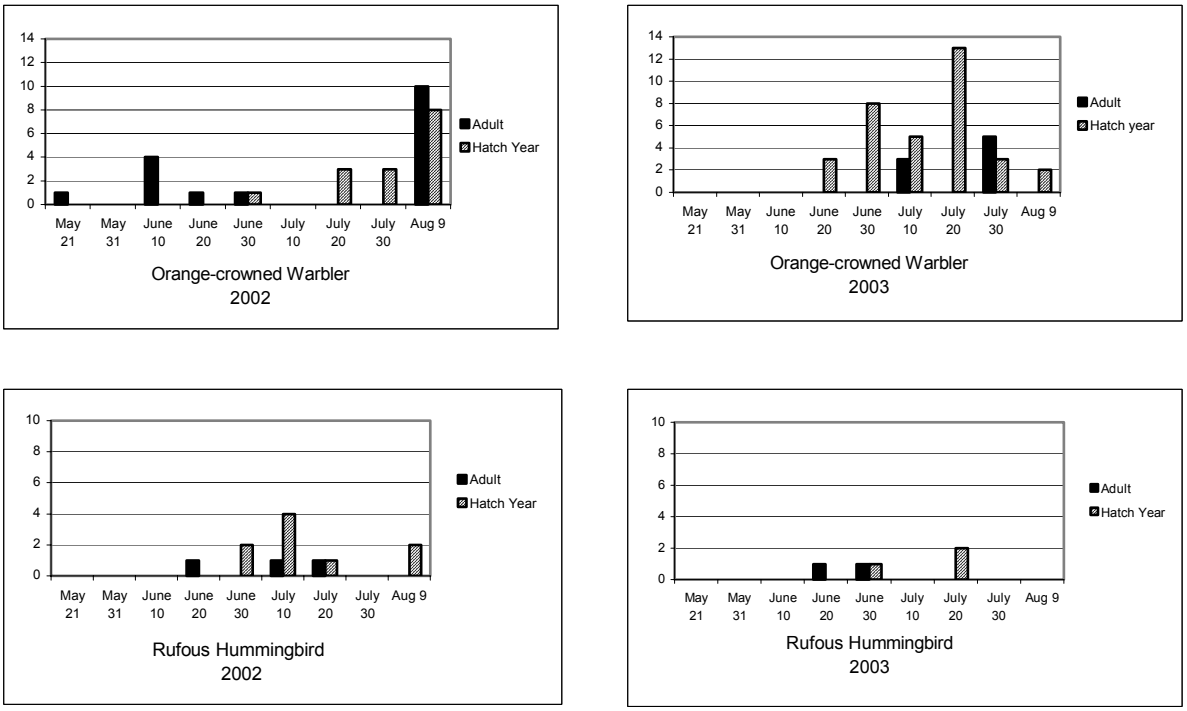


Even though Orange-crowned Warblers were captured throughout the breeding season in 2002 and 2003 (Figure 4), we believe that they utilized Soda Springs Meadow during post breeding dispersal as opposed to breeding. We did not detect singing individuals during any of our point counts, nor did we capture any adult females or males in breeding condition. Orange-crowned

Warblers are one of the earliest breeders at lower elevations and have been documented to disperse to higher elevation meadows during post breeding dispersal at other California locations (Sogge et al. 1994). The confounding factor in this idea, however, is the captures of young birds with no skull ossification in July, indicating that they either dispersed very quickly after fledging, bred very near by, or possibly at DEPO.

In 2003, hatch year Orange- crowned Warblers arrived in large numbers in mid June (whereas most were captured in late July in 2002) potentially indicating an earlier breeding season for Orange-crowned Warblers at lower elevations in 2003. Adult capture patterns were also different between years. Long- term data sets of this nature will further elucidate fluctuations in timing of captures.

Figure 4. Timing and number of captures for two species using Soda Springs Meadow for post-breeding dispersal and migration, Devils Postpile National Monument, 2002 and 2003. Number of captures on Y axis, ten day period date on X axis.



Rufous Hummingbirds breed from very northern California north to Alaska (Calder 1993), but utilize Soda Springs Meadow during their southerly migration (Figure 3). Juvenile Rufous Hummingbirds accounted for 11% of all hatch year captures in 2002 and 4% of all hatch year captures in 2003.

VISITOR EDUCATION AND OUTREACH

We tallied 283 (2002) and 362 (2003) visitors at mist netting demonstrations during 9 days at the Soda Springs Meadow site (Figure 5). Mist netting demonstrations were either attended voluntarily by visitors, or were incorporated into ranger walks led by DEPO Park Rangers. Avian ecology and identification, meadow restoration and management, bird and habitat conservation, and avian monitoring methods were interpreted to visitors during the 5 hour mist netting sessions. Visitors of all ages viewed live birds in the hand and witnessed the biological monitoring method first hand (Figures 6-10).

Figure 5. Visitors of the Soda Spring Meadow Banding Station, Devils Postpile National Monument, by banding period. May 30 – August 15, 2002 and 2003.

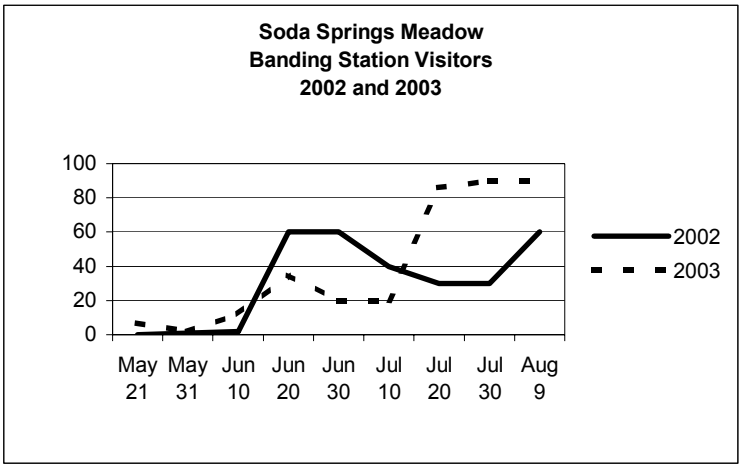


Figure 6. PRBO Biologist Gernot Huber shows visitors the variety of band sizes that biologists use. Photo by Linda Mutch, NPS, 2002.

Figure 7. PRBO Biologists demonstrate bird banding to Park Service employees and Monument visitors. Photo by Linda Mutch, NPS, 2002.

Figure 8. PRBO Biologist Yen Luc shows a visitor a migrant Orange-crowned Warbler. Photo by Linda Mutch, NPS 2002.

Figure 9. PRBO Biologist River Gates shows a visitor an Orange-crowned Warbler. Photo by Sacha Heath, PRBO, 2003.

Figure 10. PRBO Biologists Grant Ballard, River Gates, and Gernot Huber record banding data with visitors' assistance.

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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.

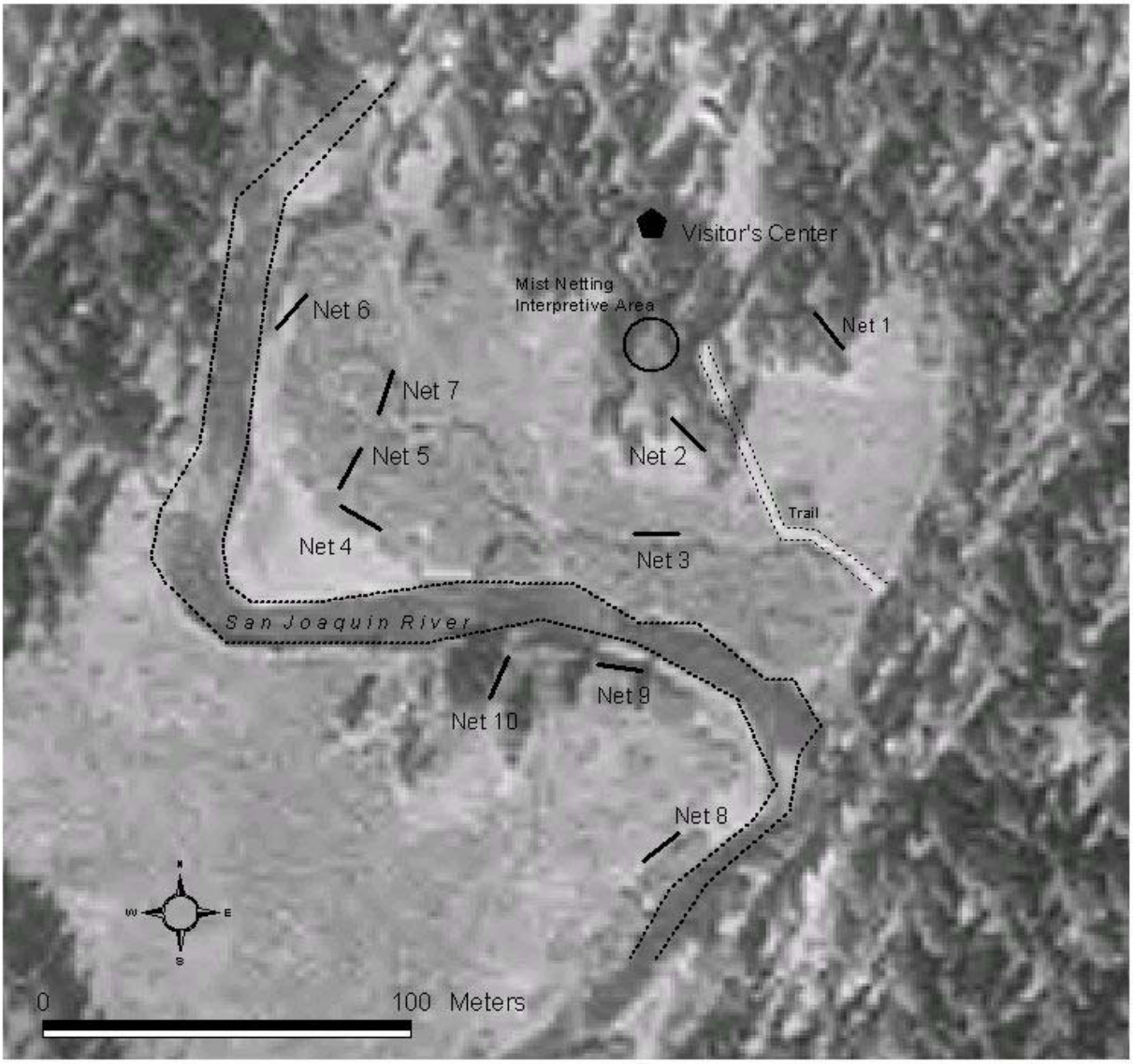
Appendix 1 – Table A. Mist netting census dates at Devils Postpile National Monument, 2002 and 2003.

	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	August 3	August 13
2003	May 30	June 7	June 13	June 25	July 3	July 15	July 24	August 4	August 13

Appendix 1 – Table B. GPS locations of mist net locations at Devils Postpile National Monument, 2002 and 2003 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 and 2003.



Appendix 2. Point count transect census dates, GPS locations, point count locations and point count description for Devils Postpile National Monument, 2002 and 2003.

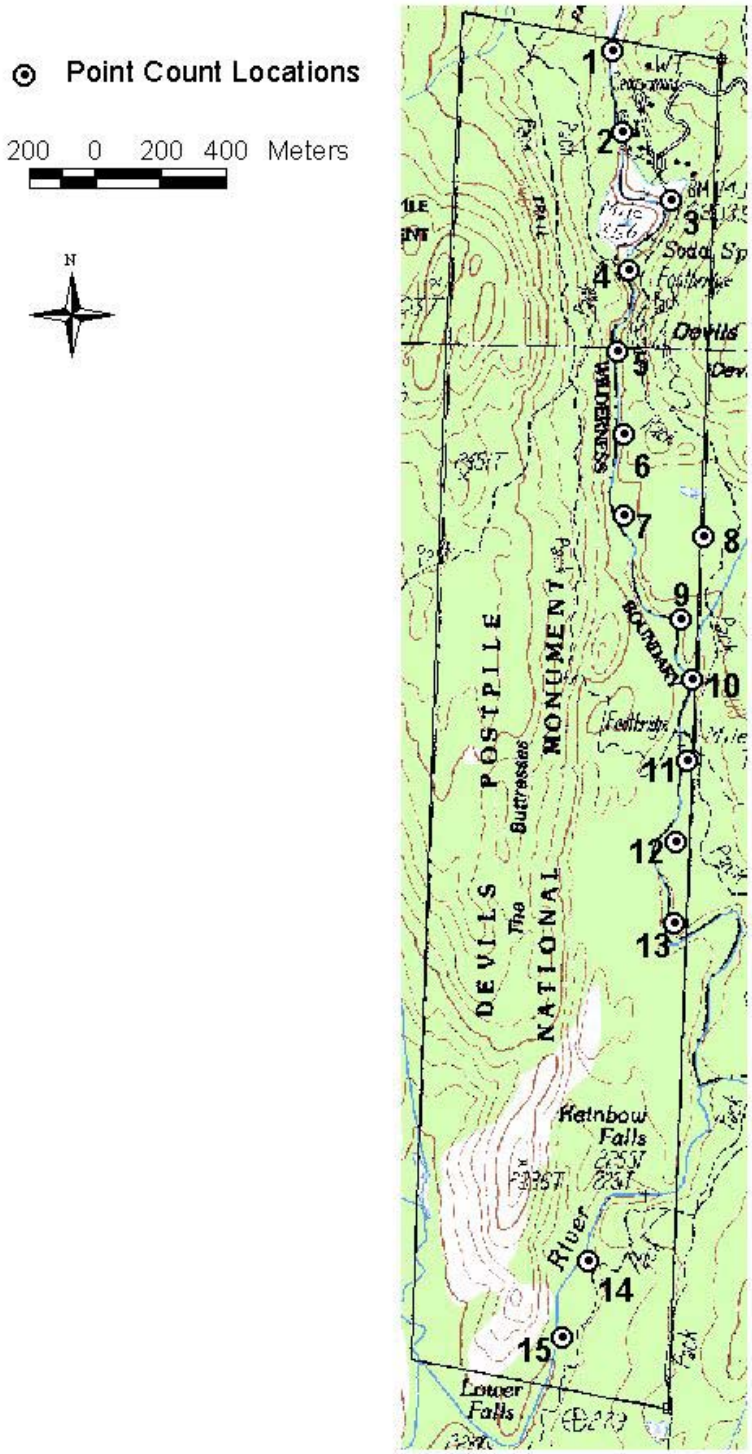
Appendix 2 – Table A. Point count transect, 4-letter code, year, number of points, and census dates in 2002 and 2003.

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

Appendix 2 - Table B. GPS locations of all point count stations established in 2002 and 2003, 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 and 2003.



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 and 2003.

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 Devils Postpile National Monument, May 29 – August 13, 2002 and 2003, including Parker and Parker (2001), and Institute of Bird Populations surveys (IBP data 2003).

Common name	Latin name	Breeding status	Common name	Latin name	Breeding status
Mallard	*Anas platyrhynchos*	1	Red-shafted Flicker	*Colaptes auratus*	1
Bufflehead	*Bucephala albeola*	2***	Olive-sided Flycatcher	*Contopus cooperi*	2
Common Merganser	*Mergus merganser*	3	Western Wood-pewee	*Contopus sordidulus*	1
Bald Eagle	*Haliaeetus leucocephalus*	0	Willow Flycatcher	*Empidonax traillii*	0
Cooper's Hawk	*Accipiter cooperii*	2*	Hammond's Flycatcher	*Empidonax hammondii*	2
Northern Goshawk	*Accipiter gentilis*	2	Gray Flycatcher	*Empidonax wrightii*	0*
Red-tailed Hawk	*Buteo jamaicensis*	2	Dusky Flycatcher	*Empidonax oberholseri*	3
Golden Eagle	*Aquila chrysaetos*	0	Cassin's Vireo	*Vireo cassinii*	2
American Kestrel	*Falco sparverius*	2**	Warbling Vireo	*Vireo gilvus*	3
Mountain Quail	*Oreortyx pictus*	2	Steller's Jay	*Cyanocitta stelleri*	1
Virginia Rail	*Rallus limicola*	2**	Clark's Nutcracker	*Nucifraga columbiana*	2
Spotted Sandpiper	*Actitis macularia*	1	Common Raven	*Corvus corax*	1
California Gull	*Larus californicus*	0	Tree Swallow	*Tachycineta bicolor*	2
Mourning Dove	*Zenaida macroura*	2	Violet-green Swallow	*Tachycineta thalassina*	2
Great Horned Owl	*Bubo virginianus*	0	Cliff Swallow	*Petrochelidon pyrrhonota*	2
Black Swift	*Cypseloides niger*	1	Mountain Chickadee	*Poecile gambeli*	3
Vaux's Swift	*Chaetura vauxi*	0**	Red-breasted Nuthatch	*Sitta canadensis*	2
White-throated Swift	*Aeronautes saxatalis*	2**	White-breasted Nuthatch	*Sitta carolinensis*	2
Anna's Hummingbird	*Calypte anna*	2**	Brown Creeper	*Certhia americana*	1
Calliope Hummingbird	*Stellula calliope*	1	Rock Wren	*Salpinctes obsoletus*	2**
Rufous Hummingbird	*Selasphorus rufus*	0	House Wren	*Troglodytes aedon*	1
Belted Kingfisher	*Ceryle alcyon*	2	American Dipper	*Cinclus mexicanus*	1
Lewis' Woodpecker	*Melanerpes lewis*	0*	Golden-crowned Kinglet	*Regulus satrapa*	3
Williamson's Sapsucker	*Sphyrapicus thyroideus*	2	Ruby-crowned Kinglet	*Regulus calendula*	2***
Red-breasted Sapsucker	*Sphyrapicus ruber*	1	Mountain Bluebird	*Sialia currucoides*	2
Downy Woodpecker	*Picoides pubescens*	2	Townsend's Solitaire	*Myadestes townsendii*	1
Hairy Woodpecker	*Picoides villosus*	2	Hermit Thrush	*Catharus guttatus*	3
White-headed Woodpecker	*Picoides albolarvatus*	2	American Robin	*Tudus migratorius*	1
Black-backed Woodpecker	*Picoides arcticus*	3	Orange-crowned Warbler	*Vermivora celata*	1

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 (IBP data 2003), *** observed only by Parker and Parker (2003) outside of DEPO boundaries

Appendix 5.Continued. Breeding status of all bird species observed at Devils Postpile National Monument, May 29 – August 13, 2002 and 2003, including Parker and Parker (2001), and Institute of Bird Populations surveys (IBP data 2003).

Common name	Latin name	Breeding status	Common name	Latin name	Breeding status
Nashville Warbler	*Vermivora ruficapilla*	3	Mtn. White-crowned Sparrow	*Zonotrichia leucophrys oriantha*	1
Yellow Warbler	*Dendroica petechia*	3	Oregon Junco	*Junco hyemalis thurberi*	1
Audubon's Warbler	*Dendroica coronata auduboni*	3	Black-headed Grosbeak	*Pheucticus melanocephalus*	2
Hermit Warbler	*Dendroica occidentalis*	0	Lazuli Bunting	*Passerina amoena*	1
Mac Gillivray's Warbler	*Oporornis tolmei*	1	Red-winged Blackbird	*Agelaius phoeniceus*	0**
Common Yellowthroat	*Geothlypis trichas*	2**	Western Meadowlark	*Sturnella neglecta*	2***
Wilson's Warbler	*Wilsonia pusilla*	1	Brewer's Blackbird	*Euphagus cyanocephalus*	1
Western Tanager	*Piranga ludoviciana*	1	Brown-headed Cowbird	*Molothrus ater*	3
Green-tailed Towhee	*Pipilo chlorurus*	2	Pine Grosbeak	*Pinicola enucleator*	2
Spotted Towhee	*Pipilo maculatus*	3	Cassin's Finch	*Carpodacus cassinii*	1
Chipping Sparrow	*Spizella passerina*	2	Purple Finch	*Carpodacus purpureus*	0
Brewer's Sparrow	*Spizella breweri*	2	Red Crossbill	*Loxia curvirostra*	2
Black-throated Sparrow	*Amphispiza bilineata*	0	Pine Siskin	*Carduelis pinus*	3
Fox Sparrow	*Passerella iliaca*	3	Lesser Goldfinch	*Carduelis psaltria*	2
Song Sparrow	*Melospiza melodia*	1	Evening Grosbeak	*Coccothraustes vespertinus*	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 (IBP data 2003), *** observed only by Parker and Parker (2003) outside of DEPO boundaries