Appendix D

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Plumas-Lassen Area Study Module on Landbird Abundance, Distribution, and Habitat Relationships

2003 Annual Report

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BACKGROUND and INTRODUCTION

Coniferous forest is one of the most important habitat types for birds in California (CalPIF 2002). In the Sierra Nevada, a century of intensive resource extraction and forest management has led to major changes in the amount and quality of coniferous forest habitat. Problems that the forests have faced include loss of habitat to intensive logging operations; lack of replacement of old-growth stands due to harvest rotations of insufficient length in time; changes in forest structure due to fire suppression; elimination of snags and dead trees; and fragmentation (SNEP 1996, CalPIF 2002). Bird and other wildlife populations have subsequently been altered by such changes; declines and extirpations have been observed in a number of species, some of which are now afforded special status at the federal or state level.

The Record of Decision for the Sierra Nevada Forest Plan Amendment (SNFPAA 2001) directs the Forest Service to maintain and restore old forest conditions that provide crucial habitat for a number of plant and animal species. Certain taxa are emphasized in this strategy because of their dependence on old forest habitat attributes. Simultaneously, the Forest Service is taking steps to reduce risks of catastrophic fire by removing vegetation and reducing fuel loads in overstocked forests. Achieving all of these potentially competing goals as well as meeting other demands placed on Sierra Nevada forests is a challenging task.

The SNFPAA Record of Decision called for an administrative study to test the effects of various forest management actions, intended to reduce fuels and re-introduce natural fire regimes, on California Spotted Owl populations and other components of old forests. In investigating this issue, valuable feedback can be gained by determining how the full complement of the avian community will respond to different forest management regimes, particularly at the landscape scale. If forest management practices encourage old forest development and forests across landscapes trend towards larger trees and higher canopy cover, how will birds other than the Spotted Owl respond to these conditions?

Here we report on the progress of the landbird study module, one of an integrated series of studies intended to evaluate land management strategies designed to reduce wildland fire hazard, promote forest health, and provide economic benefits within the area covered by the Herger-Feinstein Quincy Library Group Forest Recovery Act Pilot Project (HFQLG Pilot Project).

In addition to this study PRBO has been monitoring songbird populations in the Northern Sierra since 1997. In the last three years these efforts have focused on assessing the importance of mountain meadows and montane shrub habitats to the bird community (Burnett and Humple 2003, Humple and Burnett 2004). In particular our efforts have focused on bird response to meadow restoration and removal of grazing, as well as assessing the value of clear-cut regenerations, basically large groups, to shrub dependent bird species. In 2004, we will commence two new monitoring efforts assessing bird response to hardwood enhancement projects. In the Eagle Lake Ranger District we will be monitoring the effects of Aspen enhancement through removal of encroaching conifers and fencing to eliminate grazing pressure. In the Almanor Ranger District we are assessing the effectiveness of forest thinning to promote regeneration of Black Oak and other shade intolerant forest tree and shrub species. Working closely with the project planners from both of these Ranger Districts these projects, along with

the Plumas-Lassen administrative study, are being implemented as adaptive management experiments and will ideally act as effective models of collaboration between science and managers in administering public lands in the Sierra Nevada.

OBJECTIVES

The primary objective of our module is to assess the effectiveness of forest management practices in sustaining a long-term ecologically stable forest ecosystem by using songbirds as management indicators. We intend to monitor the distribution and abundance of birds across the landscape in response to changes in forest structure and composition as determined by vegetation growth/succession and by human-induced treatments. Will forest structure and composition resulting from a combination of continuous vegetative growth and specific management regimes create conditions capable of sustaining stable avian communities?

We are principally interested in measuring the response of variables over large geographic areas and over relatively long time periods. The reason for this is rooted in the rate and extent of treatments combined with the rate and extent of vegetation growth. This landscape-scale study endeavors to determine the impact to the bird community of forest treatments at various temporal and spatial scales.

In order to meet these objectives we will measure population trends at several different scales, including the watershed and treatment unit scale, to determine change in abundance and presence/absence of a suite of species. In addition we will build predictive models that can associate habitat conditions with expected avian species abundance. In addition to assessing population trends and determining habitat associations of landbirds at various scales within the study area, we will determine the influence of current forest management and succession in these observed trends. What are the site-specific changes in bird community composition and abundance in response to treatments over time, and are these changes those predicted by our habitat association models?

Our approach allows us to determine the trajectory, or trend, of the populations of many of the bird species within the study area over time, predict the habitat associations most important to those species, and determine the impact of forest treatments in the observed trends. By monitoring a suite of species our results are likely to provide information on the state of the overall system as apposed to one particular aspect, such as old growth. When interpreted properly this information will provide the Forest Service with a key tool for assessing the efficacy of proposed management actions across the northern Sierra forests, providing the information necessary to assess current management and provide ways to improve it in the future.

METHODS

General sampling method

We are using standardized five-minute variable circular plot (VCP) point count censuses (Buckland 1993, Ralph et al. 1993) to sample the avian community in the study area. In this method, points are clustered in transects, but data is only collected from fixed stations, not along the entire transect.

Point count data allow us to measure secondary population parameters such as relative abundance of individual bird species, species richness, and species diversity. This method is useful for making comparisons of bird communities across time, locations, habitats, and land-use treatments.

All birds detected at each station during the five-minute survey are recorded according to their initial distance from the observer. These detections are placed within one of six categories: within 10 meters, 10-20 meters, 20-30 meters, 30-50 meters, 50-100 meters, and greater than 100 meters. The method of initial detection (song, visual, or call) for each individual is also recorded. Using a variable radius point count allows us to conduct distance sampling. Distance sampling should enable us to provide more precise estimates of density and detectability of individual birds as well as account for some of the observer variability inherent in the point count sampling method (Buckland et al. 1993).

Counts begin around local sunrise and are completed within four hours. Each transect is visited twice during the peak of the breeding season.

Field Crew Training

Field crew members all have previous experience conducting avian fieldwork and undergo extensive training onsite for three weeks prior to conducting surveys. Training consists of long hours in the field birding and conducting double observer practice point counts with expert observers. Each crew member is given an audio compact disc with the songs and calls of all of the local avifauna, prior to their arrival at the study site. Each person uses the compact disc to study the local birds and is then given quizzes each evening designed to test their knowledge of the songs and calls of the local birds. Significant time is also given to calibrating each person in distance estimation. In addition each observer uses a range finder to calibrate distances at each point before starting a survey.

Vegetation sampling methods

Vegetation will be assessed once every 3 years at untreated sites and once before and after treatment at treated sites and then every 3 years the initial post treatment assessment. Vegetation is assessed using the relevé method, following procedures outlined in Ralph et al. (1993). In summary this method uses a 50-meter radius plot centered on each census station where general habitat characteristics of the site are recorded (canopy cover, slope, aspect, etc.) and the cover, abundance, and height of each vegetation stratum (tree, shrub, herb, and ground) are determined through ocular estimation. Within each vegetation stratum, the species composition is determined and each species' relative cover recorded, as a percentage of total cover for that stratum (see Ralph et al. 1993 for complete description).

Statistical Analyses

We analyzed point count data in order to create preliminary by-point community indices for each transect. Community indices were created using a restricted list of species that excluded those that do not breed in the study area (Rufous Hummingbird, House Wren, Orange-crowned Warbler) or are not accurately surveyed using the point count method (e.g., such as raptors, waterfowl, grouse, nightjars, swallows, crows, ravens, Band-tailed Pigeon, Belted Kingfisher, American Dipper). It is important to bear in mind that this data should be considered a preliminary result. It would be inappropriate to use one year of data to rank the importance or quality of any individual site over another. With future years of data collection and more complex analysis techniques we will be better able to assess the importance of particular sites as well as habitat types and features for songbird populations in the study area.

We present the mean by point (average per point per visit by transect) for the following three indices. This method allows for using the point as the individual sampling unit and therefore makes possible the stratification of points for analysis based on attributes other than the transect and comparison of uneven sample sizes.

Species Richness

Species richness is defined as the mean number of species detected within 50 meters of each point per visit.

Diversity

Species diversity is defined as the mean number of species detected within 50 m (species richness) weighted by the mean number of individuals of each species. A high diversity score indicates high ecological (species) diversity, or a more equal representation of the species. Species diversity was measured using a modification of the Shannon-Wiener index (Krebs 1989). We used a transformation of the usual Shannon-Weiner index (symbolized H′), which reflects species richness and equal distribution of the species. This transformed index, introduced by MacArthur (1965), is N_1, where $N_1 = 2^{H'}$. The advantage of N_1 over the original Shannon-Wiener metric (H′) is that N_1 is measured in terms of species instead of bits of information, and thus is more easily interpretable (Nur et al. 1999).

Abundance

The index of abundance is the mean number of individuals detected per station per visit. This number is obtained by dividing the total number of detections within 50 meters by the number of stations and the number of visits.

GIS Project for Creating Species Maps

We created a GIS project incorporating all the bird data from this project collected in 2003 (CD Supplement A). This tool can be used by land managers to generate distribution maps for all species breeding within the ARD (see Appendices 5 and 6 for examples), identify birds species present at specific sites of management interest, present detection information for species of management interest, and present community indices (e.g., species richness) as determined by point count analysis. Appendix 3 outlines directions for creating additional maps for any species of interest or for bird community indices, and describes all aspects of this ArcView project and associated database tables. In future years we will update the bird data for this project to

incorporate the most up to date information on the distribution and abundance of birds in the study area.

RESULTS and DISCUSSION

In 2003 we established 33 new transects and continued surveys on 46 transects that had been established in 2002 (Table 1, Appendix 1). These 79 transects consist of 12 points each for a total of 948 point count locations surveyed in 2003 in the study area (treatment units 2-5). Of these 948 points, 840 are located in areas not-currently slated for DFPZ treatment; the remaining 108 are located within areas scheduled for treatment. The majority of DFPZ transects are located in treatment unit 4 with the remainder in treatment unit 1. As the location of additional DFPZ networks is solidified in treatment units 2, 3, and 5, and potentially elsewhere, we will add additionally transects to those sites.

Table 1. Point count transects censused by PRBO in the 2003 breeding season in the PLAS study area, by treatment unit, watershed, and treatment type (Landscape or DFPZ).

Treatment Unit	Watershed	Number of Points	Transects (by Code)	DFPZ Points	DFPZ Transects
7	Taylor Creek	24	714, 722	0	-
7	**Total**	**24**		**0**	
5	Grizzly Forebay	39	GRZ1, GRZ2, GRZ3, 522	0	-
5	Frazier Creek	45	524, 522, 513, FRC1	0	-
5	China Gulch	36	CHG1,CHG2, CHG3	0	-
5	Bear Gulch	36	BEG1,523,514	0	-
5	Haskins Valley	36	D501, HAV1, HAV2	0	-
5	Red Ridge	36	RED1, RED2, RED3	0	-
5	**Total**	**228**			
4	Silver Lake	41	SIL1, SIL2, SIL3, D405	24	D407, D409
4	Meadow Valley Creek	51	414, MVY1, MVY2, D404	0	-
4	Deanes Valley	36	424, 413, 422,	0	-
4	Snake Lake	36	SNK1,SNK2,SNK3	12	D403
4	Miller Fork	36	MIF1, MIF2, MIF3	24	D408, D401
4	Pineleaf Creek	19	423, D405	12	D402
4	**Total**	**219**		**72**	
3	Rush Creek	64	313,322,324,RUS1,314,222	0	-
3	Soda Creek	0		0	-
3	Halsted Flat	36	HAL1, HAL2, HAL3	0	-
3	Lower Spanish Creek	36	323, SPC1, SPC2	0	-
3	Indian Falls	12	IND1	0	-
3	Black Hawk Creek	12	BLH1	0	-
3	**Total**	**160**		**0**	**-**
2	Mosquito Creek	36	MSQ1, MSQ2, 214	0	-

Treatment Unit	Watershed	Number of Points	Transects (by Code)	DFPZ Points	DFPZ Transects
2	Butt Valley Reservoir	36	BVR1, BVR2, BVR3	0	-
2	Ohio Creek	41	OHC1, OHC2, 223, 213	0	-
2	Seneca	45	224, SEN1, 222,314, 213	0	-
2	Caribou	24	CAR1, CAR2	0	-
2	**Total**	**182**		**0**	**-**
1	Coon Hollow	6	122	0	-
1	Philbrook	6	122	0	-
1	Upper Butte Creek	0	114,122	6	D109, HUSU
1	Grizzly Creek	2	214	9	D109, HUSU
1	Upper Yellow Creek	12	114	19	D107, D102
1	Soda Creek	0		2	HUSU
1	**Total**	**27**		**36**	
	Grand Total	**840**		**108**	

A total of 92 species were detected during point count surveys within the study area in 2003 (Appendix 2). We determined breeding bird diversity, richness, and abundance at all sites surveyed in 2003 (Table 2). Additionally, we included indices for transects that were surveyed in both years. All three of the population indices were lowest at the 214 transect and highest at the 313 transect. Abundance (the average number of individuals detected within 50 meters from each point in the transect on a given visit) ranged from a 1.63 to 7.58. Species richness ranged from 2.25 to 10, and ecological diversity ranged from 2.07 to 9.14.

Table 2. Mean abundance, ecological diversity, and species richness for all point count transects surveyed by PRBO in the Plumas/Lassen area study in 2003.

	Treatment	Abundance		Diversity		Richness	
Transect	Unit	2003	2002	2003	2002	2003	2002
114	1	3.58	7.63	4.15	7.41	4.58	8.42
122	1	4.17	3.33	3.26	3.88	3.42	4.17
Total	**1**	**3.88**	**5.48**	**3.71**	**5.65**	**4.00**	**6.30**
213	2	5.13	1.89	5.49	2.17	6.17	2.29
214	2	1.63	3.92	2.07	5.13	2.25	5.58
222	2	5.25	4.46	7.06	5.52	7.58	6.08
223	2	6.29	6.04	6.47	7.77	7.33	8.58
224	2	3.21	4.50	4.02	5.63	4.33	6.08
MSQ1	2	2.79	NS	3.79	NS	4.08	NS
MSQ2	2	2.75	NS	3.21	NS	3.50	NS
BVR1	2	5.17	NS	4.69	NS	5.42	NS
BVR2	2	3.63	NS	5.00	NS	5.33	NS
BVR3	2	4.67	NS	5.70	NS	6.25	NS
OHC1	2	3.00	NS	4.00	NS	4.33	NS
OHC2	2	4.08	NS	5.06	NS	5.58	NS
SEN1	2	3.00	NS	3.76	NS	4.08	NS
CAR1	2	3.42	NS	4.04	NS	4.42	NS

Transect	Treatment Unit	Abundance		Diversity		Richness	
		2003	2002	2003	2002	2003	2002
CAR2	2	2.50	NS	3.66	NS	3.83	NS
Total	**2**	**3.77**		**4.53**		**4.97**	
313	3	7.58	3.67	9.14	4.65	10.00	5.08
314	3	4.42	4.08	5.89	3.70	6.42	3.75
322	3	3.38	4.63	4.88	6.02	5.17	6.58
323	3	2.79	5.33	4.52	7.28	4.67	7.92
324	3	3.83	4.54	4.69	6.45	5.17	6.83
BLH1	3	2.42	NS	3.00	NS	3.25	NS
HAL1	3	3.46	NS	5.32	NS	5.58	NS
HAL2	3	3.92	NS	4.68	NS	5.17	NS
HAL3	3	6.96	NS	6.75	NS	7.67	NS
IND1	3	4.13	NS	5.06	NS	5.50	NS
RUS1	3	5.83	NS	6.94	NS	7.75	NS
SPC1	3	3.29	NS	4.48	NS	4.75	NS
SPC2	3	4.25	NS	5.18	NS	5.75	NS
Total	**3**	**4.33**		**5.43**		**5.91**	
413	4	2.83	5.83	2.53	7.15	2.58	7.83
414	4	4.38	6.79	6.13	7.87	6.50	8.58
422	4	4.54	4.29	4.82	5.49	5.42	5.92
423	4	3.29	4.58	4.11	6.38	4.50	6.75
424	4	5.46	5.75	6.80	7.22	7.42	8.00
MIF1	4	4.00	NS	5.08	NS	5.50	NS
D404	4	6.50	4.96	7.42	6.65	8.33	7.08
D405	4	4.79	4.46	6.44	5.97	7.00	6.50
MIF2	4	5.67	NS	6.76	NS	7.42	NS
MIF3	4	5.21	NS	5.25	NS	6.17	NS
MVY1	4	4.75	NS	6.38	NS	6.92	NS
MVY2	4	5.58	NS	6.42	NS	7.08	NS
SIL1	4	5.17	NS	5.91	NS	6.67	NS
SIL2	4	5.13	NS	6.54	NS	7.17	NS
SIL3	4	2.29	NS	3.63	NS	3.75	NS
SNK1	4	4.25	NS	4.91	NS	5.50	NS
SNK2	4	4.54	NS	5.79	NS	6.33	NS
Total	**4**	**4.61**	**-**	**5.58**	**-**	**6.13**	**-**
513	5	3.00	5.38	4.09	6.33	4.33	6.92
514	5	5.75	2.46	5.04	4.11	5.17	4.25
522	5	5.63	5.50	6.70	6.89	7.25	7.67
523	5	3.33	3.54	5.51	4.94	5.75	5.25
524	5	2.79	4.42	3.86	5.95	4.08	6.42
BEG1	5	3.42	NS	4.15	NS	4.42	NS
CHG1	5	3.46	NS	4.63	NS	5.08	NS

Transect	Treatment Unit	Abundance		Diversity		Richness	
		2003	2002	2003	2002	2003	2002
CHG2	5	6.67	NS	7.46	NS	8.25	NS
CHG3	5	3.54	NS	4.79	NS	5.17	NS
FRC1	5	5.25	NS	6.42	NS	7.08	NS
GRZ1	5	3.92	NS	4.61	NS	4.92	NS
GRZ2	5	3.58	NS	5.34	NS	5.67	NS
GRZ3	5	4.71	NS	6.58	NS	7.08	NS
RED1	5	4.75	NS	5.43	NS	5.92	NS
RED2	5	3.00	NS	4.85	NS	5.08	NS
RED3	5	4.13	NS	5.88	NS	6.25	NS
D501	5	4.21	NS	5.18	NS	5.75	NS
HAV1	5	5.75	NS	6.88	NS	7.67	NS
HAV2	5	4.92	NS	6.73	NS	7.25	NS
Total	**5**	**4.31**		**5.48**		**5.90**	
722	7	2.92	2.33	3.69	3.47	4.00	3.58
714	7	3.54	3.79	4.57	5.17	4.83	5.58
Total	**7**	**3.23**	**3.06**	**4.13**	**4.32**	**4.42**	**4.58**
DFPZ							
D102	1	3.54	5.29	4.70	5.20	5.00	5.92
D107	1	3.50	4.25	4.89	5.80	5.25	6.17
D109	1	5.71	6.13	6.43	7.96	7.08	8.67
HUSU	1	5.58	5.00	7.24	6.36	7.83	6.83
Total	**1**	**4.58**	**5.17**	**5.82**	**6.33**	**6.29**	**6.90**
D401	4	4.21	6.79	4.52	8.01	5.00	8.75
D402	4	4.13	4.71	5.15	6.24	5.58	6.75
D403	4	3.79	3.71	5.23	5.09	5.58	5.42
D407	4	3.46	4.42	5.08	5.90	5.33	6.33
D408	4	5.88	4.50	6.95	6.20	7.58	6.75
D409	4	1.92	NS	2.85	NS	3.00	NS
Total	**4**	**3.90**		**4.96**		**5.35**	

Species Abundance by Treatment Unit

We compared species abundance between treatment units (Table 3), and found that in 2003, Hermit Warbler was the most abundant species in treatment units two, four, and five reaching its highest abundance in unit four. Audubon's Warbler was the most abundant species in unit three. A total of thirteen species comprised the ten most abundant species in these four units. Two, three, and five each had one unique species among their ten most abundant species, while unit four did not have any unique species. The three unique species to a unit were Hammond's Flycatcher in unit two, MacGillivray's Warbler in unit three, and Spotted Towhee in unit five. It should be noted that these are data from one year of surveys and indices may vary annually.

Though little if any treatment has been implemented within the study area to date, the data collected in 2002 and 2003 is valuable for assessing pre-existing conditions and honing our study design in order to meet our objectives, thus forming the baseline for this long-term study.

With additional years of data collection we will build habitat association models to determine the factors influencing the abundance and distribution of a suite of forest songbird species in the study area. Following implementation of treatments we will assess the impact on the avian community.

Table 3. The mean abundance per point of the ten most abundant species in each treatment unit. Mean abundance is the average number of individuals per point per visit in 2003.

Treatment Unit 2 Species	Mean Abundance	Treatment Unit 3 Species	Mean Abundance
Hermit Warbler	0.60	Audubon's Warbler	0.44
Nashville Warbler	0.41	Oregon Junco	0.40
Oregon Junco	0.33	Golden-crowned Kinglet	0.37
Fox Sparrow	0.27	Hermit Warbler	0.32
Mountain Chickadee	0.27	Mountain Chickadee	0.32
Audubon's Warbler	0.27	Red-breasted Nuthatch	0.23
Hammond's Flycatcher	0.22	Fox Sparrow	0.22
Dusky Flycatcher	0.21	Dusky Flycatcher	0.20
Golden-crowned Kinglet	0.21	MacGillivray's Warbler	0.16
Western Tanager	0.19	Western Tanager	0.16
Treatment Unit 4 Species	**Mean Abundance**	**Treatment Unit 5 Species**	**Mean Abundance**
Hermit Warbler	0.64	Hermit Warbler	0.50
Audubon's Warbler	0.39	Nashville Warbler	0.48
Oregon Junco	0.30	Mountain Chickadee	0.32
Mountain Chickadee	0.30	Oregon Junco	0.29
Nashville Warbler	0.25	Western Tanager	0.24
Western Tanager	0.24	Audubon's Warbler	0.23
Golden-crowned Kinglet	0.19	Fox Sparrow	0.21
Red-breasted Nuthatch	0.19	Spotted Towhee	0.21
Fox Sparrow	0.17	Golden-crowned Kinglet	0.19
Dusky Flycatcher	0.14	Red-breasted Nuthatch	0.18

GIS Project for Creating Bird Abundance and Distribution Maps

We have created a GIS project that can be used to generate maps of site-specific avian community indices as well as the abundance of every species detected within the study area. These data are a valuable resource that can be used by project planners on the location of species of interest, including sensitive species and management indicators.

Appendix 3 provides directions in how to create GIS maps based on the bird data. We created two sample maps that are presented in Appendices 4 and 5, for overall species richness in treatment unit 4, and for Olive-sided Flycatcher abundance in units 4 and 5. Similar maps for any other species detected, as well as for all community indices (species richness, ecological diversity, and bird abundance), can be created following our directions and using the ArcView project located in CD Supplement A.

PERSONNEL

This project is coordinated and supervised by PRBO staff biologist Ryan Burnett. Field work in 2003 was conducted by Ryan Burnett, Jim Destaebler, Eric Leibgold, Kim Maute, Tami Ransom, Chris Rintoul, Andrew Rothman, and Doug Zimmerman. PRBO staff biologists Diana Stralberg and Lazarus Pomara organized GIS resources. Computer programs used to manage and summarize data were created by PRBO staff biologists Grant Ballard, Dan Barton, and Mike Lynes. The study was carried out under the guidance of PRBO Terrestrial Program Director Geoffrey R. Geupel, PRBO Population Ecologist Nadav Nur, and Peter Stine of the PSW Sierra Nevada Research Center.

ACKNOWLEDGEMENTS

Funding for this project is provided by the Pacific Southwest Research Station and Region 5 of the U.S. Forest Service, and the National Fire Plan. We are grateful to Jim Schaber of the University of California Meadow Valley Field Camp for his kindness and generosity in providing housing and logistical support. This is PRBO contribution 1178.

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Appendix 1. Transects point counted by PRBO in the Plumas-Lassen Study Area in 2003 (the first digit in the numbered transect refers to treatment unit, the other transects are abbreviations of the watershed they are in, e.g. HAL1 is in the Halsted Flat watershed).

Transect	First Visit	Second Visit	Transect	First Visit	Second Visit
114	6/12/2003	6/28/2003	D404	5/26/2003	6/25/2003
122	6/14/2003	1 visit only	D405	5/27/2003	6/21/2003
213	6/1/2003	6/21/2003	D407	5/31/2003	6/16/2003
214	6/2/2003	6/15/2003	D408	5/30/2003	6/21/2003
222	5/29/2003	6/20/2003	D409	6/4/2003	6/16/2003
223	5/27/2003	6/19/2003	D501	6/6/2003	6/24/2003
224	5/28/2003	6/18/2003	FRC1	6/11/2003	6/26/2003
313	5/28/2003	6/20/2003	GRZ1	6/7/2003	6/23/2003
314	5/29/2003	6/20/2003	GRZ2	6/7/2003	6/23/2003
322	5/28/2003	6/20/2003	GRZ3	6/7/2003	6/23/2003
323	5/30/2003	6/22/2003	HAL1	5/27/2003	6/16/2003
324	6/2/2003	6/27/2003	HAL2	5/27/2003	6/18/2003
413	5/30/2003	1 visit only	HAL3	5/27/2003	6/18/2003
414	5/25/2003	6/29/2003	HAV1	6/6/2003	6/24/2003
422	6/7/2003	6/22/2003	HAV2	6/10/2003	6/24/2003
423	5/25/2003	6/13/2003	HUSU	6/14/2003	6/30/2003
424	5/25/2003	6/25/2003	IND1	5/29/2003	6/24/2003
513	6/10/2003	6/25/2003	MIF1	6/4/2003	6/19/2003
514	7/2/2003	1 visit only	MIF2	6/5/2003	6/26/2003
522	6/12/2003	6/28/2003	MIF3	6/4/2003	6/19/2003
523	6/19/2003	6/29/2003	MSQ1	5/28/2003	6/17/2003
524	6/10/2003	6/25/2003	MSQ2	6/2/2003	6/17/2003
714	6/11/2003	6/29/2003	MVY1	6/5/2003	6/18/2003
722	6/11/2003	6/27/2003	MVY2	6/8/2003	6/25/2003
BEG1	6/11/2003	6/23/2003	OHC1	5/27/2003	6/19/2003
BLH1	5/25/2003	6/16/2003	OHC2	6/1/2003	6/20/2003
BVR1	5/28/2003	6/27/2003	RED1	6/11/2003	6/23/2003
BVR2	5/29/2003	6/16/2003	RED2	6/6/2003	6/26/2003
BVR3	6/9/2003	6/27/2003	RED3	6/15/2003	6/27/2003
CAR1	5/28/2003	6/16/2003	RUS1	5/29/2003	6/27/2003
CAR2	6/2/2003	6/20/2003	SEN1	5/28/2003	6/18/2003
CHG1	6/15/2003	6/27/2003	SIL1	6/8/2003	6/21/2003
CHG2	6/10/2003	6/23/2003	SIL2	6/5/2003	6/30/2003
CHG3	6/10/2003	6/25/2003	SIL3	6/8/2003	6/21/2003
D102	6/14/2003	6/30/2003	SNK1	6/4/2003	6/17/2003
D107	6/12/2003	6/28/2003	SNK2	6/4/2003	6/17/2003
D109	6/14/2003	6/30/2003	SNK3	6/4/2003	6/17/2003
D401	5/30/2003, 6/1/2003	6/21/2003	SPC1	5/24/2003	6/16/2003
D402	5/25/2003	6/18/2003	SPC2	5/30/2003	6/24/2003
D403	5/27/2003	6/17/2003			

Appendix 2. List of all bird species detected by PRBO on point count surveys (common, AOU code, scientific name) in the PLAS in 2002 and 2003.

Common Name	AOU Code	Scientific Name
Acorn Woodpecker	ACWO	*Melanerpes formicivorus*
American Crow	AMCR	*Corvus brachyrhynchos*
American Dipper	AMDI	*Cinclus mexicanus*
American Kestrel	MAKE	*Falco sparverius*
American Robin	AMRO	*Turdus migratorius*
Anna's Hummingbird	ANHU	*Calypte anna*
Audubon's Warbler	AUWA	*Dendroica coronata audubonii*
Bald Eagle	BAEA	*Haliaeetus leucocephalus*
Band-tailed Pigeon	BTPI	*Columba fasciata*
Belted Kingfisher	BEKI	*Ceryle alcyon*
Bewick's Wren	BEWR	*Thryomanes bewickii*
Black Phoebe	BLPH	*Sayornis nigricans*
Black-backed Woodpecker	BBWO	*Picoides arcticus*
Black-headed Grosbeak	BHGR	*Pheucticus melanocephalus*
Black-throated Gray Warbler	BTYW	*Dendroica nigrescens*
Blue Grouse	BGSE	*Dendragapus obscurus*
Blue-gray Gnatcatcher	BGGN	*Polioptila caerulea*
Brewer's Sparrow	BRSP	*Spizella breweri*
Brown Creeper	BRCR	*Certhia Americana*
Brown-headed Cowbird	BHCO	*Molothrus ater*
Bushtit	BUSH	*Psaltriparus minimus*
California Quail	CAQU	*Callipepla californica*
Calliope Hummingbird	CAHU	*Stellula calliope*
Canada Goose	CAGO	*Branta Canadensis*
Cassin's Finch	CAFI	*Carpodacus cassinii*
Cassin's Vireo	CAVI	*Vireo casinii*
Cedar Waxwing	CEDW	*Bombycilla cedrorum*
Chipping Sparrow	CHSP	*Spizella passerina*
Clark's Nutcracker	CLNU	*Nucifraga columbiana*
Common Nighthawk	CONI	*Chordeiles minor*
Common Raven	CORA	*Corvus corax*
Cooper's Hawk	COHA	*Accipiter cooperii*
Downy Woodpecker	DOWO	*Picoides pubescens*
Dusky Flycatcher	DUFL	*Empidonax oberholseri*
European Starling	EUST	*Sturns vulgaris*
Evening Grosbeak	EVGR	*Coccothraustes vespertinus*
Fox Sparrow	FOSP	*Passerella iliaca*
Golden-crowned Kinglet	GCKI	*Regulus satrapa*
Gray Flycatcher	GRFL	*Empidonax wrightii*
Gray Jay	GRJA	*Perisoreus canadensis*
Green Heron	GRHE	*Butorides virescens*
Green-tailed Towhee	GTTO	*Pipilo chlorurus*
Hairy Woodpecker	HAWO	*Picoides villosus*

Common Name	AOU Code	Scientific Name
Hammond's Flycatcher	HAFL	*Empidonax hammondii*
Hermit Thrush	HETH	*Catharus guttatus*
Hermit Warbler	HEWA	*Dendroica occidentalis*
House Wren	HOWR	*Troglodytes aedon*
Huttons Vireo	HUVI	*Vireo huttoni*
Lazuli Bunting	LAZB	*Passerina amoena*
Lesser Goldfinch	LEGO	*Carduelis psaltria*
Lewis's Woodpecker	LEWO	*Melanerpes lewis*
Lincoln's Sparrow	LISP	*Melospiza lincolnii*
MacGillivray's Warbler	MGWA	*Oporornis tolmiei*
Mallard	MALL	*Anas platyrhynchos*
Mountain Bluebird	MOBL	*Sialia currucoides*
Mountain Chickadee	MOCH	*Poecile gambeli*
Mountain Quail	MOQU	*Oreotyx pictus*
Mourning Dove	MODO	*Zenaida macroura*
Nashville Warbler	NAWA	*Vermivora ruficapilla*
Northern Goshawk	NOGO	*Accipiter gentiles*
Northern Pygmy-Owl	NPOW	*Glaucidium gnoma*
Olive-sided Flycatcher	OSFL	*Contopus cooperi*
Orange-crowned Warbler	OCWA	*Vermivora celata*
Oregon Junco	ORJU	*Junco hyemalis*
Osprey	OSPR	*Pandion haliaetus*
Pacific-slope Flycatcher	PSFL	*Empidonax difficilis*
Pileated Woodpecker	PIWO	*Dryocopus pileatus*
Pine Siskin	PISI	*Carduelis pinus*
Purple Finch	PUFI	*Carpodacus purpureus*
Red Crossbill	RECR	*Loxia curvirostra*
Red-breasted Nuthatch	RBNU	*Sitta Canadensis*
Red-breasted Sapsucker	RBSA	*Sphyrapicus rubber*
Red-shafted Flicker	RSFL	*Colaptes auratus*
Red-tailed Hawk	RTHA	*Buteo jamaicensis*
Red-winged Blackbird	RWBL	*Agelaius phoeniceus*
Rock Wren	ROWR	*Salpinctes obloletus*
Rufous Hummingbird	RUHU	*Selasphorus rufus*
Sage Thrasher	SATH	*Oreoscoptes montanus*
Sharp-shinned Hawk	SSHA	*Accipiter striatus*
Song Sparrow	SOSP	*Melospiza melodia*
Spotted Owl	SPOW	*Strix occidentalis*
Spotted Towhee	SPTO	*Pipilo maculates*
Stellar's Jay	STJA	*Cyanocitta stelleri*
Swainson's Thrush	SWTH	*Catharus ustulatus*
Townsend's Solitaire	TOSO	*Myadestes townsendi*
Tree Swallow	TRES	*Tachycineta bicolor*
Turkey Vulture	TUVU	*Cathartes aura*
Vaux's Swift	VASW	*Chaetura vauxi*

Common Name	AOU Code	Scientific Name
Violet-green Swallow	VGSW	*Tachycineta thalassina*
Warbling Vireo	WAVI	*Vireo gilvus*
Western Bluebird	WEBL	*Sialia mexicana*
Western Scrub-Jay	WESJ	*Aphelocoma californica*
Western Tanager	WETA	*Piranga ludoviciana*
Western Wood-Pewee	WEWP	*Contopus sordidulus*
White-breasted Nuthatch	WBNU	*Sitta carolinensis*
White-headed Woodpecker	WHWO	*Picoides albolarvatus*
Williamson's Sapsucker	WISA	*Sphyrapicus thyroideus*
Wilson's Warbler	WIWA	*Wilsonia pusilla*
Winter Wren	WIWR	*Troglodytes troglodytes*
Wrentit	WREN	*Chamea fasciata*
Yellow Warbler	YWAR	*Dendroica petechia*

Appendix 3. Details on Supplement A ArcView Project for building species maps

I. PRIMARY ARCVIEW FILES

2003reportsupplement.apr - ArcView project file. Double click this file to open the project.

PLASabsum03l50 - table which contains one line of data per point with all associated bird data, including diversity, species richness, and abundance of all species combined, as well as abundance of individual species. Only includes data within 50m and for restricted species only (breeders in area and species well surveyed by the point count method; see *Methods: Statistical Analysis*). This has been imported into an ArcView project file. It means "Point count abundance summary for birds less than 50 m from the observer".

PLASabsum03all - table which contains one line of data per point with all associated bird data, includes ALL data (birds within 50m, birds greater than 50m, and flyovers, combined) and is for all species, including non-breeders as well as species not well surveyed with the point count method. Has been imported into ArcView project file. It means "Point count abundance summary for birds of all detections."

With this project and these tables, additional maps can be generated (e.g., abundance maps for individual species showing where they are most and least common; maps showing differences in diversity, richness or overall abundance; and maps showing presence/absence of species of interest that are not well surveyed with this method, but encountered during point counts).

II. GIS DATABASE FIELDS EXPLAINED

Below are the definitions for each field within the pcabsuml50.dbf and pcabsumall.dbf (see above) tables.

YEAR = year that data was collected

STATION = abbreviated point count transect name (4-letters)

SITE = point count station number within a given transect

X_COORD = latitude in UTMs for the point

Y_COORD = longitude in UTMs for the point

VISITS = number of total point count visits done at that point; in 2003 all sites were visited 2 times.

SW = bird diversity at that point (see *Methods: Statistical Analysis*)

SPECRICH = bird species richness at that point (see *Methods: Statistical Analysis*)

ABUNDANCE = average number of individuals detected at that point per visit (total individuals/number of visits; see *Methods: Statistical Analysis*)

"SPEC"AB = multiple fields, detailing number of individuals of each species at each point (averaged across visits). Uses AOU 4-letter codes for each bird species, combined with "AB" for abundance (e.g., Audubon's Warbler abundance is delineated as *AUWAAB*). See Appendix 2 for explanation of all 4-letter bird species codes. This is done for 61 species within 50 meters (PLASabsum03L50.dbf) and 92 species when including all detections (PLASabsum03all.dbf).

Appendix 3, continued

III. HOW TO GENERATE ABUNDANCE MAPS BY SPECIES

1. Save all files on the CD onto hard drive

2. Open **2003reportsupplement.apr** in ArcView

3. Since it has been moved, you will have to direct ArcView to each file location (all wherever you have saved them) for the first time, and then save the project so you won't need to do so again.

4. Open view 1.

5. Once inside view 1 click on view on the pull down menu and choose "add event theme"

6. Choose table you want to take data from (PLASabsum03L50.dbf or PLASabsum03all.dbf); click OK.

7. Double click on the newly created event theme in left margin

8. Under legend subfolder inside the project folder choose ***speciesabundance.avl*** if you are going to create a map for individual species abundance; or **choose richdivab_legend.avl** if you are going to create a map of community indices. This way all the legends for all species are identical, and done to the same scale.

9. Then under *load legend: field* pick the species abundance you wish to map (i.e., choose *wiwrab* if making a map of Winter Wren abundance based on point count stations) and click OK.

10. Hit APPLY (and close legend window).

11. While that event theme is still selected, under *theme,* click on *properties.* You can then modify the theme name here (e.g., *Winter Wren <50 m*)

12. You will likely choose to make each species map a *layout* if you wish to print them out with a legend (View → layout)

Appendix 4. Sample ArcView Project Map of bird species richness in treatment unit 4 of the PLAS study area in 2003.