Yosemite National Park

Division of Resources
Management and Science

Looking Downstream

FINAL 2014 Update

Physical and Ecological Responses to River Flow Downstream of Hetch Hetchy Reservoir, Yosemite National Park

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Summary

The Looking Downstream project is an interdisciplinary study designed to better understand the physical processes and ecology of the mainstem Tuolumne River corridor between O'Shaughnessy Dam and the western boundary of Yosemite National Park. The project consists of hydrology, vegetation, and wildlife (bird, bat, and benthic macroinvertebrate) study components. An overarching goal of the Looking Downstream project is to provide information that water managers can use to manage environmental water releases from O'Shaughnessy Dam in ways that will more closely replicate natural physical processes and benefit water-dependent ecosystems downstream of the dam.

2014 was the first full field season following the Rim Fire, which began on 17 August 2013 and burned over 257,000 acres in Stanislaus National Forest and Yosemite National Park, including Poopenaut Valley. Within the context of our normal investigations in Poopenaut Valley, we were able to evaluate some of the effects of the Rim Fire on ecosystems within Poopenaut Valley.

The 2013-2014 water year was exceptionally dry, with 1 April and 1 May snow water equivalent measured at only 36% and 19% of the 1 April average, respectively. Water year 2013-2014 also followed dry years in 2011-2012 and 2012-2013, leading to a historically unprecedented drought in central California. Thus, hydrology studies in spring 2014 focused on monitoring low flow conditions; these low flows precluded any experimental flows, as well as filling the seasonal pond on the north side of Poopenaut Valley.

We resampled vegetation transects and also added a metric to quantify soil surface cover so that basal cover of litter, bare ground and vegetation—important indicators of meadow condition—could be evaluated. For this year's analysis, we developed a wetland species prevalence index, which synthesizes the prevalence of each category into one metric. There was a statistically significant change in the wetland index between 2008 and 2014. Plant species richness varied significantly over this time period, with species richness in 2014 being the lowest documented. There was also a significant change in native plant species cover between 2008 and 2014. The lowest mean cover of native species was in 2014 and the highest cover was in 2011. Low precipitation amounts in 2012, 2013, and 2014 led to low river discharges, and precluded large water releases from O'Shaughnessy Dam. Although the increase in the wetland index values, which indicates a trend towards more upland plant communities, was statistically significant, it was of small magnitude. Environmental conditions in Poopenaut Valley do not yet appear to be fully supporting wetlands.

While the Rim Fire changed the habitat and made it no longer suitable for some birds (e.g., riparian focal species), it may have actually provided habitat for other, more fire-adapted species, such as Lawrence's Goldfinch and Lazuli Bunting, which were observed this year in larger numbers than in past years. We found that Search Area 1 had the lowest species richness, diversity, and evenness. Species richness in Area 1 continued its disturbing decline with this year's species richness being 41.6% lower than in 2013, 53% lower than in 2012, and 55% lower than the pre-drought species richness average from 2007-2011. While the Rim Fire certainly had some effect on the birds of Poopenaut Valley, these results might be more

indicative of the drought conditions that are further exacerbated by the lack of water in the seasonal pond.

Species richness and relative abundance were lower in 4 out of 5 search areas when compared to 2013 results. In general, bird abundance and diversity were both well below average numbers. We detected two Riparian Focal Species (RFS), a male Song Sparrow and a male Yellow Warbler, in North Poopenaut adjacent to the seasonal pond. We did not detect any females in these areas and while males were detected on multiple visits, we saw no indication that these species were using this area as nesting habitat. Additionally, the willows surrounding the seasonal pond were killed in the Rim Fire, making this area even less suitable for riparian birds.

Using the spot mapping technique, we closely monitored the populations of Riparian Focal Species in Poopenaut Valley and quantified the number of breeding pairs and nest locations. We found that Black-headed Grosbeaks did not have any territories within the willows along the Tuolumne River in 2014, a noticeable change from results of past years. This is likely linked to the large die-off of willows caused by the Rim Fire. We also noticed that there were fewer Song Sparrow and Yellow Warbler territories along the Tuolumne River and these territories were larger.

Nest searching continued to provide insight on both habitat use and reproductive success of bird species in Poopenaut Valley. We found several nests within the flood plain of the Tuolumne River, including a Song Sparrow nest within flood debris five feet off the ground in a small willow. We detected two Song Sparrow nests, one Northern Rough-winged Swallow nest, and one Hairy Woodpecker nest less than ten feet above the surface of the river. These nests would be highly susceptible to increases in water flow, especially later in the breeding season.

Color-banding individual Warbling Vireos, Yellow Warblers, and Song Sparrows was integral in determining territory size and tracking individuals throughout the field season. Color-banding allowed us to attribute nest success to a specific individual in five cases. We found that one male Song Sparrow had likely successfully fledged five young; one male Song Sparrow held a territory with a nest that had an unknown fate; a male Warbling Vireo defended a territory where his nest failed; a male Yellow Warbler was seen feeding a fledgling; and a male Yellow Warbler was seen feeding a female on her nest, however the fate of this nest is unknown.

Acoustic detection has identified an impressive biodiversity of bat species inhabiting Poopenaut Valley, with at least one species, the Mexican free-tailed bat, present year-round. We documented five special status species, two of which were the first (spotted bat) and fourth (western mastiff bat) most frequently detected species during 2014. The considerable jump in spotted bat and western mastiff bat detections at the south site in summer 2014 requires further study; however, habitat effects from the Rim Fire in 2013, water level, and prey availability and abundance may be factors.

Chapter 1. Introduction

The primary goals of the Looking Downstream project are 1) to fill in first-order information gaps by collecting baseline information on the hydrology, vegetation, birds, and bats. and benthic macroinvertebrates tied to river flow downstream of O'Shaughnessy Dam, 2) provide a general characterization of the river reach, and 3) assess its overall hydrological and ecological condition. An important overarching goal of these studies is to work collaboratively to produce science-based information and recommendations that the San Francisco Public Utilities Commission (SFPUC) can use to design environmental water releases that will be most beneficial to maintaining and enhancing ecosystems downstream of the dam.

Poopenaut Valley, a broad, low gradient valley located approximately 5.5 km (3.5 miles) downstream of O'Shaughnessy Dam, is one of the most ecologically diverse and productive areas in the river reach between the dam and the western boundary of Yosemite National Park. As a result, we consider Poopenaut Valley to be the location most sensitive to habitat disruption resulting from an altered hydrologic regime (National Park Service, 2009). For these reasons, we have focused our research efforts primarily in Poopenaut Valley, specifically on the meadow, wetland, and riparian ecosystems found there (National Park Service, 2009, 2010, 2011, 2012a, 2012b, 2014).

Our 2014 research in Poopenaut Valley consisted of five main subject areas: (1) surface and ground water hydrology, (2) upland, meadow, wetland, and riparian vegetation, (3) riparian-dependent bird species, (4) bats, and (5) benthic macroinvertebrate assemblages. Results from benthic macroinvertebrate research are reported separately by researcher Jeff Holmquist of the University of California White Mountain Research Station (Holmquist and Schmidt-Gengenbach, 2013). This status report presents the other subjects in Chapters 2 through 5. This report details findings from the 2013-2014 field season in Poopenaut Valley, specifically the period from September 2013 to September 2014.

Chapter 2. 2014 Hydrology Studies in Poopenaut Valley

2.1 Introduction

Hydrology studies in 2014 primarily consisted of continued monitoring of water levels in the Tuolumne River, tributary streams, Poopenaut Valley seasonal pond, and groundwater within the meadows adjacent to the river. Due to low water conditions, there was no flow experiment in 2014.

2.2 Overview of the 2013-2014 water year

The 2013-2014 water year was exceptionally dry with April 1st and May 1st snow water equivalent measured at 36% and 19% of the April 1st average respectively (Table 1). Precipitation at O'Shaughnessy Dam for WY2014 (California Data Exchange Commission site HEM) was 21.2 inches (51.8 cm). Spring runoff onset was March 17th as determined using the maximum negative cumulative deviation from annual average flows at the USGS gage in the Grand Canyon of the Tuolumne River upstream of Hetch Hetchy Reservoir. The spring runoff peak on the Tuolumne River immediately upstream of Hetch Hetchy reservoir at USGS Gage 11274790 occurred on May 26, 2014 (1,450 cubic feet per second, cfs). Water year 2013-2014 followed dry years in 2011-2012 and 2012-2013, leading to a historically unprecedented drought in central California.

The seasonal pond in Poopenaut Valley contained small amounts of water from mid-winter through early June; this water was derived from locally derived rain and melting snow, with no apparent contributions from the Tuolumne River.

Table 2-1. Summary snow water content for snow courses in the Tuolumne River watershed upstream of Hetch Hetchy Reservoir, 2013.

Snow Course	Course #	Elevation (m)	Apr 1st Average (cm)	April 1 2014 (cm)	May 1 2014 (cm)
Dana	157	2987	79.0	40.6	30.5
Rafferty	158	2865	83.3	38.1	--
New Grace	368	2713	121.9	57.2	47.0
Tuolumne	161	2621	57.7	15.2	0
Wilma	163	2438	109.7	54.6	35.6
Paradise	167	2332	101.3	44.4	22.9
Vernon	169	2042	56.9	8.9	1.3
Beehive	171	1981	59.7	3.8	0
Lower Kibbie	173	2042	66.0	0	3.8
			% April 1st Average	**36%**	**19%**

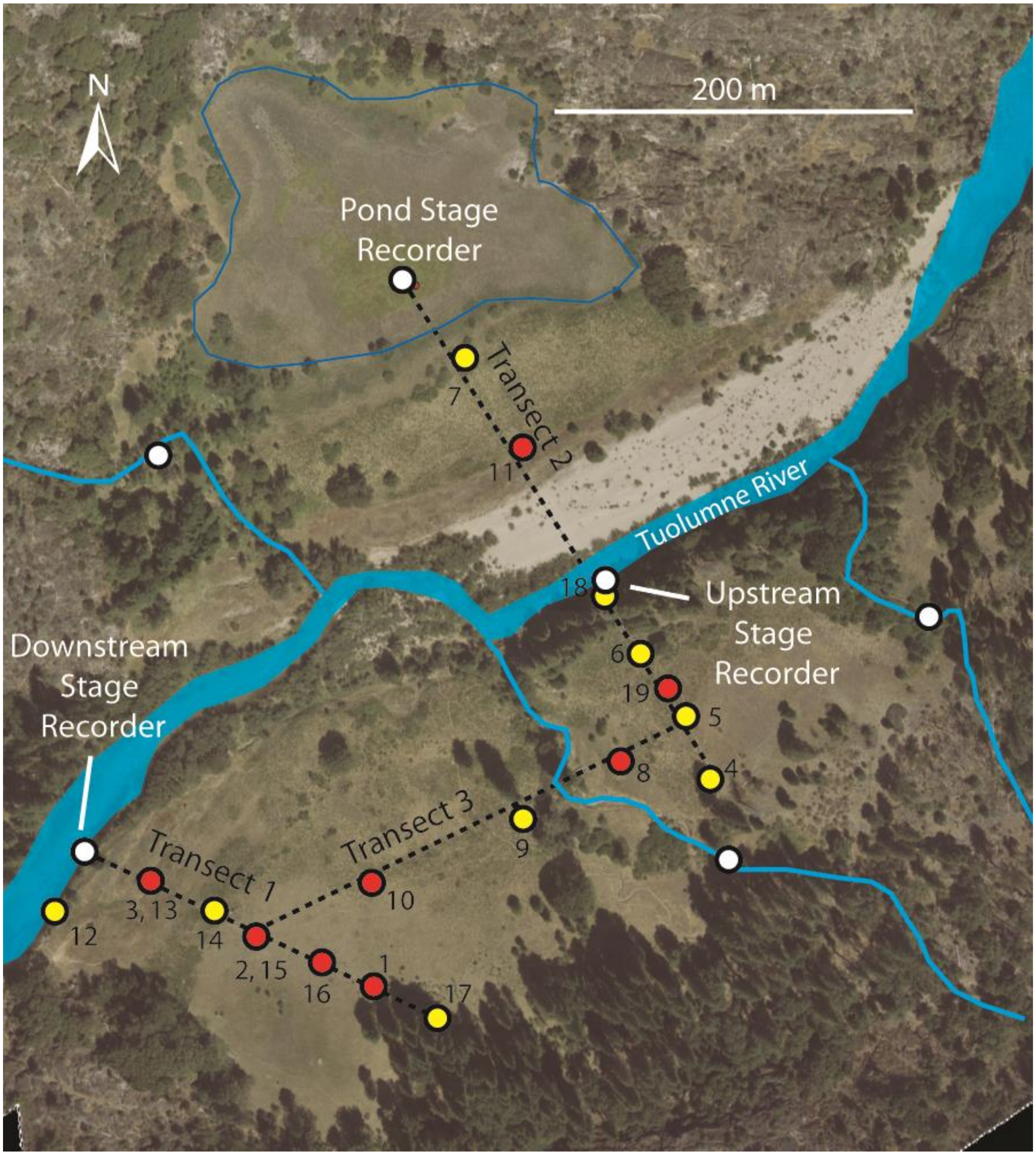


Figure 2-1. Poopenaut Valley water level monitoring locations. White dots indicate stage recorders in surface waters (Tuolumne River, tributaries, and seasonal pond). Red dots indicate existing groundwater monitoring wells. Yellow dots indicate former groundwater monitoring wells removed in October 2011.

Following the Rim Fire, we replaced and resurveyed sensors in the pond and north stage recorders and well 10. Figure 1 reflects a new sensor elevation for the pond record, one that is approximately 40 cm higher than the previous sensor. The pond sensor location is toward the southern edge of the pond and it may be better positioned in future at the lowest point to better record the wetted period.

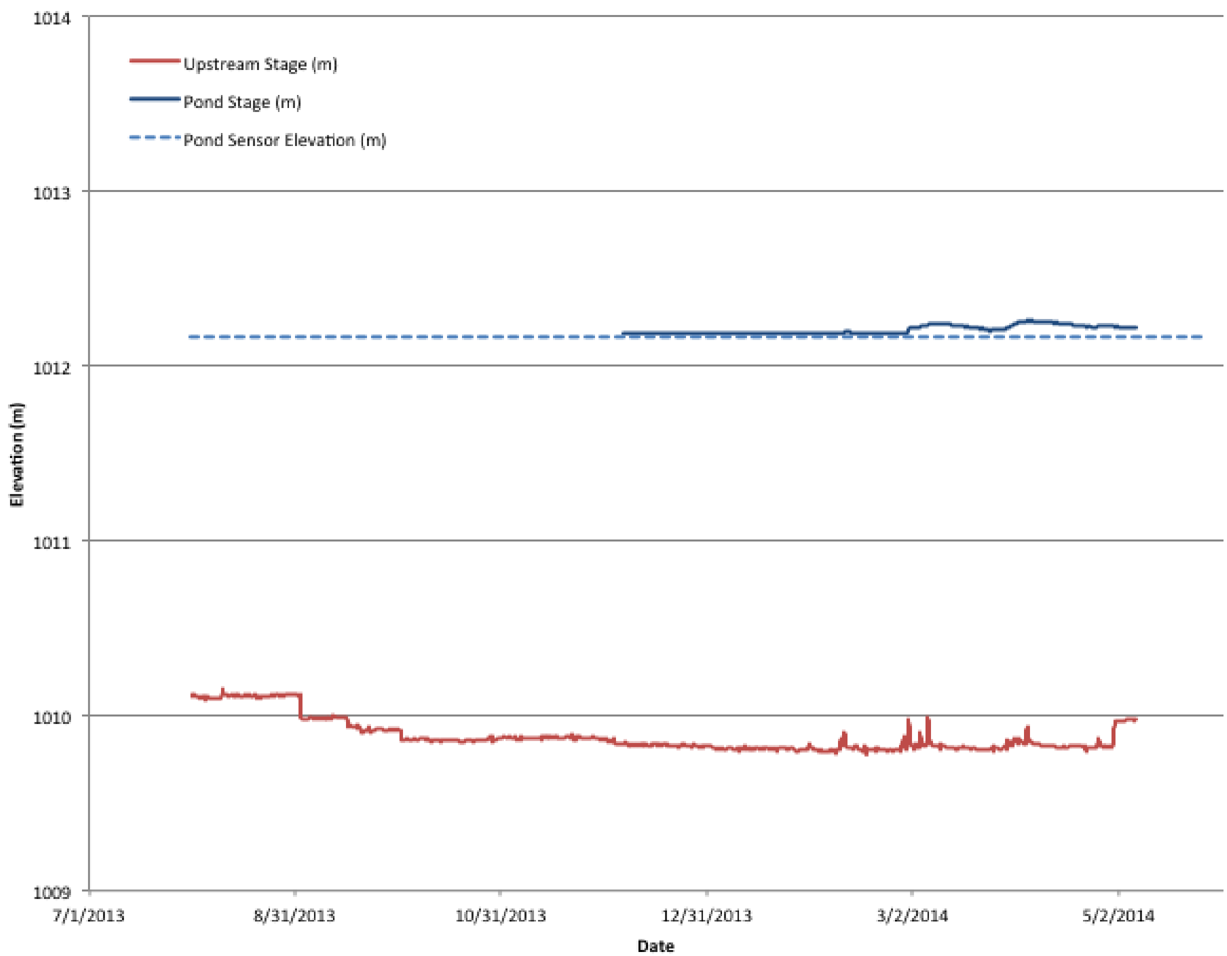


Figure 2-2. Tuolumne River and seasonal pond stage data for Transect 2 (upstream transect) in 2013-2014. The pond recorder was replaced in fall 2013 following damage related to the Rim Fire.

Chapter 3. 2014 Vegetation Studies in Poopenaut Valley

3. 1 Introduction

Herbaceous wetland and upland meadows intermixed with dense riparian trees and shrubs comprise the vegetation in Poopenaut Valley. The maintenance and enhancement of the ecological integrity of these communities requires flow magnitude, timing, frequency and duration sufficient to inundate wetlands and maintain the water table and soil moisture required for plants to establish and persist. The minimum hydrologic requirements for a jurisdictional wetland in the western mountain region is defined by the US Army Corps of Engineers to have soil saturation within 30 cm (12-inches) of the ground surface for a period of 14 consecutive days during the growing season 5 out of every 10 years (U.S. Army Corps of Engineers 2012). Through hydrologic assessments and modeling, hydrologists have recommended flow models and have a good sense of the physical response (e.g. soil saturation, water table level, soil moisture retention) to different flow magnitudes and durations. For example, Russo et al. (2012) suggested that surface soil inundation was the most effective method, in terms of minimizing the volume of flow releases, for saturating soils and supporting wetland hydrology. While soil physical and chemical properties may have change quickly under an altered flow regime, measurable vegetation responses may take much longer before they reflect the effects of such restored hydrology. Therefore, assessment of the biological response through monitoring requires a longer time period.

We developed a two-fold approach to monitoring vegetation changes in Poopenaut Valley. We delineated wetlands in 2007, with refinement to the boundaries in 2008 and 2009. Comparison of future repeat wetland delineations to the 2009 delineation could illustrate broad-scale changes throughout the delineated area, if present. In 2008, we developed and implemented a monitoring component that consistent of sampling plant communities. This allowed for examining finer changes in plant composition.

For 2014, we resampled vegetation transects and also added a metric to quantify soil surface cover so that basal cover of litter, bare ground and vegetation—important indicators of meadow condition—could be evaluated. We did not evaluate the basal cover in this report but have the data available for future comparison. Also for 2014, we approached the analysis of wetland plant communities differently. Plant species that inhabit wetlands have been assigned wetland indicator rating categories that correspond with their rate of occurrence in wetland versus upland habitat (Lichvar 2014). Previously, we had examined the change in each such category separately. For this year's analysis, we developed a wetland species prevalence index, which synthesizes the prevalence of each category into one metric. This approach has been used to assess differences among or changes in plant communities such as examining environmental gradients, evaluating wetland restoration or creation success, or monitoring potential groundwater impacts (e.g., Stromberg et al. 1996, Campbell et al. 2002, Dwire et al. 2004, Spieles 2005).

The monitoring plan calls for resampling every other year. Due to the uncommon fire event from the Rim Fire, we chose to sample this year in order to quantify short-term effects of the fire on vegetation. To evaluate potential changes in plant community due to a change in hydrology or due to fire effects, we focused this year's analysis on metrics that would most likely reflect these changes. We therefore examined changes in the prevalence of wetland indicator species, species richness, and native species cover.

3.2 Methods

3.2.1 Field Data Collection

We established nine permanent transects of lengths between 46 and 91 m in 2008 and marked each end with rebar (Figure 3-1). We subjectively located these transects either to coincide with ground water monitoring wells or to capture particular vegetation types. To estimate vegetation cover, we used the point-intercept method, collecting points at each meter along the transect. For each point intercept, we measured and recorded the height and species of the tallest plant intercepted and recorded any other plant species below. Each plant species was only counted once. In addition, in 2014 we began to also record ground cover. Thus, we noted basal cover as the vegetation or substrate "hit" at the ground surface. To monitor the change in distribution in plant types, we randomly placed nested frequency quadrats of sizes 1 m^2, 0.5 m^2, and 0.25 m^2 along the transects. We recorded the presence of all species in these quadrats.

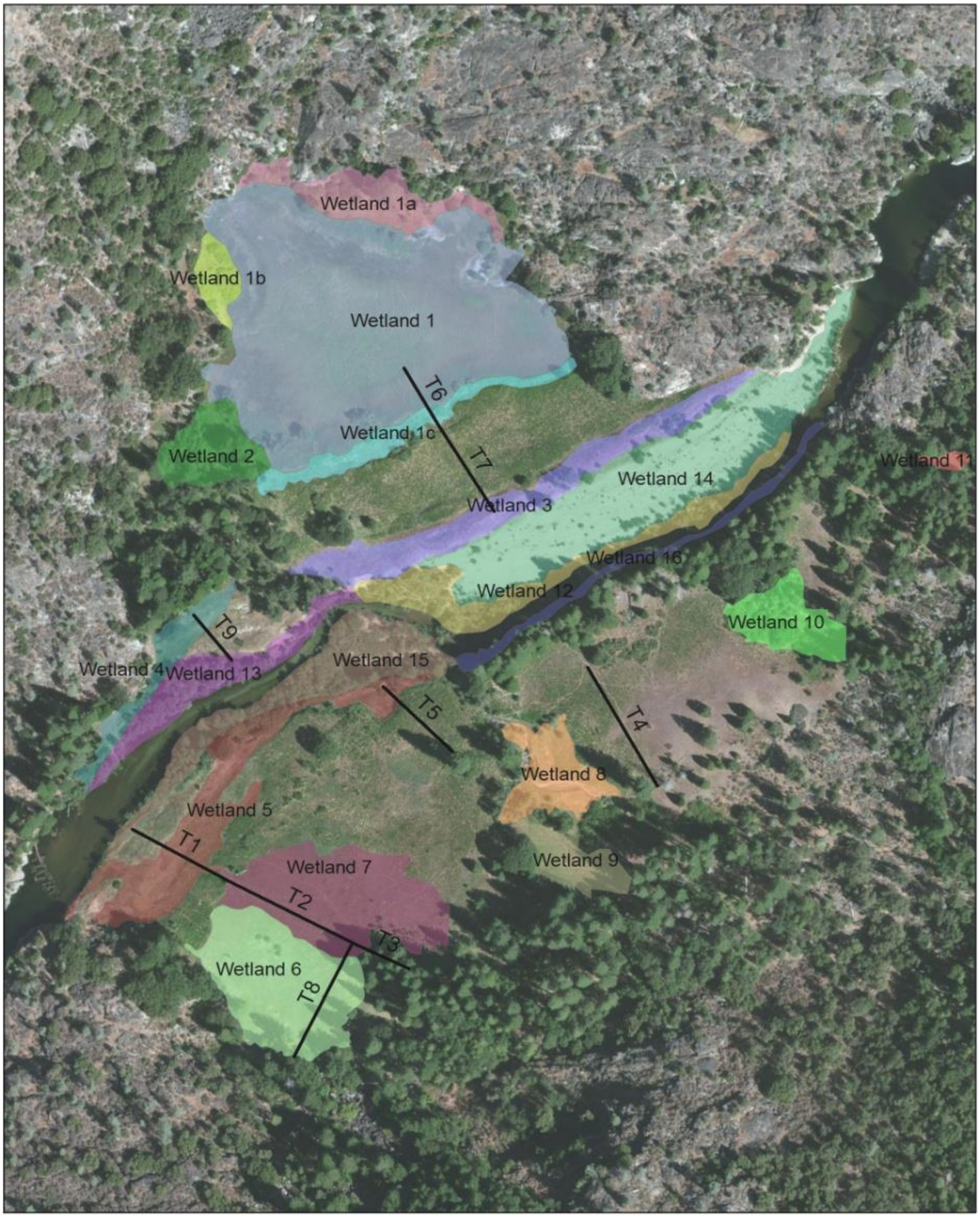


Figure 3-1. Wetlands delineated in 2007 in Poopenaut Valley and transects established for plant community monitoring.

3.3 Data Analysis

To apply repeated-measures analyses, we eliminated samples that were not repeated at each sampling event. Species names follow the Jepson Manual (2012). Wetland indicator status values were determined from the National Wetland Plant List (Lichvar 2014) using the western valleys, mountain and coast region. Species not listed in that publication were rated as “upland”. Plants that were not identified to species could not be assigned an indicator status value and were eliminated from the wetland analysis.

We calculated a wetland index (WI) as a weighted average of species cover in each transect following weighting methods developed in Wentworth et al. (1988) and Atkinson et al. (1993). We assigned a score to wetland status categories as follows: 1 = obligate (OBL), 2 = facultative wetland (FACW), 3 = facultative (FAC), 4 = facultative upland (FACU) and 5 = upland (UPL). We calculated the relative contribution of each wetland category and multiplied it by its respective score by summing the number of intercepts of each category divided by the total number of intercepts in the transect:

$$WI = (P_{OBL} * 1 + P_{FACW} * 2 + P_{FAC} * 3 + P_{FACU} * 4 + P_{UPL} * 5)/ P_{transect}$$

Where: WI = wetland index

P = number of point intercepts

Wetland index values were then averaged across transects.

To evaluate if native species cover was changing, we calculated the mean percent cover of native species by transect:

$$\% \text{ cover native species} = P_{native}/P_{total}$$

We calculated species richness as the mean number of species per quadrat. To detect changes in non-native species cover we calculated the mean percent cover by non-native species.

To test for changes in wetland index, species richness, and non-native species cover over time, we used a repeated-measures ANOVA to test for differences among years and post-hoc pairwise comparisons with an alpha value of 0.1. We did not apply a correction for multiple tests. All statistical tests were performed using Systat statistical software (SYSTAT Software Inc. 2009).

3.4 Results

3.4.1 Vegetation changes

For metrics using the transect as the sampling unit, we excluded transect 9, which was only sampled in 2008 and 2014. All other transects were sampled during each field visit (n = 8). For metrics using quadrats as the sampling unit, we eliminated quadrats that were missing cases, including all quadrats on transect 9 for these analyses. We retained all quadrats sampled in each field visit (n = 46).

For the 2014 cover estimation, we identified 60 species and an additional four plants identified to genera only *(Juncus, Carex, Monderella*, and *Polygonum,* Table 3-2). As in previous years, a few species dominated the vegetation. These include *Poa pratensis, Elymus triticoides,* and *Pteridium aquilinum*. The plants identified only to "*Carex sp."* constituted a large percentage of the vegetation cover in 2013 and 2014 (10.2% and 10.7%, respectively) compared with previous years in which presumably all or nearly all *Carex* were identified to species level. Most often these plants contained no reproductive structures, precluding positive identification. We included 38 plant groups (34 species and 4 genera) in the frequency sampling. Similarly, *Carex sp.* had high representation in 2013 and 2014 compared with previous years.

Table 3-1. Mean percent cover of each species found in sample transects, ordered from highest to lowest cover observed in 2008, and the number of plots in which each species occurred each year. Plants identified to genus only are highlighted in gray.

	Mean Percent Cover					# Plots				
Species	**2008**	**2009**	**2011**	**2013**	**2014**	**2008**	**2010**	**2011**	**2013**	**2014**
Poa pratensis	30.9	28.3	27.3	31.7	32.4	42	35	37	36	37
Elymus triticoides	18.6	15.4	16.0	19.3	18.7	43	34	35	39	37
Pteridium aquilinum	7.0	8.2	7.3	6.8	7.6	15	15	13	19	17
Artemisia douglasiana	5.5	6.2	6.7	2.8	3.5	23	17	18	16	19
Elymus glaucus	4.7	7.5	4.3	1.6	3.4	12	10	13	3	11
Bromus tectorum	4.3	2.7	1.4	4.8	3.1	12	7	9	12	8
Carex athrostachya	4.1	3.5	7.1	2.0	0.2	22	15	16	10	3
Schoenoplectus acutus var. occidentalis	3.4	4.1	3.6	1.6	1.3	5	5	5	5	4
Chlorogalum pomeridianum	3.0	1.7	2.9	3.2	2.3	6	8	8	7	6
Carex vesicaria	2.6	1.5	0.7	2.2	0.4	8	3	2	2	2
Rumex acetosella	2.4	2.0	1.4	0.6	2.5	10	4	5	2	11
Euthamia occidentalis	1.6	0.0	2.0	0.4	0.1	10	6	6	7	5
Apocynum cannabinum	1.2	2.0	2.9	2.2	1.0	15	12	14	13	10
Prunus virginiana var. demissa	1.0	0.8	0.8	0.8	0.8		2			
Agastache urticifolia	1.0	0.5	0.9	0.6	0.3	1		1		
Equisetum laevigatum	1.0	0.6	1.1	1.5	1.1	31	23	26	26	28
Carex pellita	0.8	1.6	0.0	0.0	0.0	18	14			
Chamaesyce serpyllifolia ssp. serpyllifolia	0.7	0.0	0.0	0.0	0.0	4	1	1		
Carex praegracilis	0.6	0.8	0.5	1.7	0.1	3	3	3	2	
Lupinus albicaulis	0.5	0.2	0.4	0.6	0.4	6	4	8	6	3
Festuca myuros	0.5	0.9	0.2	0.4	1.1	4	3	2	3	2
Bromus carinatus	0.4	1.2	0.5	0.3	0.2	5	4	4	1	1
Achillea millefolium	0.4	0.2	0.5	0.1	0.4	2	1	2	2	2
Carex senta	0.3	0.3	0.0	0.0	0.0	2	1			
Vicia americana	0.3	1.1	0.7	0.5	0.8	10	11	8	8	5
Gilia capitata	0.3	0.7	0.2	0.6	2.3	3	6	3	11	10
Stipa lemmonii	0.3	0.2	0.9	0.1	0.1	1		1	1	
Carex feta	0.3	0.0	0.0	0.0	0.0	2				
Panicum acuminatum	0.3	0.5	0.4	0.1	0.0	2	1	1	1	
Agrostis humilis	0.2	0.0	0.0	0.0	0.0					
Polygonum sp.	0.2	0.0	1.1	0.0	0.0	5				
Agrostis scabra	0.2	0.0	0.0	0.0	0.2	2				
Tragopogon dubius	0.2	0.0	0.3	0.0	0.3	2	3	3	1	1
Bromus diandrus	0.2	0.3	0.1	0.7	0.2	2				
Erodium cicutarium	0.1	0.0	0.0	0.0	0.0	1	1		2	4
Stellaria longipes ssp. longipes	0.1	0.0	0.0	0.0	0.0	2	1			
Prunella vulgaris	0.1	0.1	0.1	0.0	0.0		1	2	1	
Carex fracta	0.1	3.2	0.0	0.0	0.0	2	10			
Solidago velutina ssp. californica	0.1	0.6	0.3	0.1	0.4	10	5	6	8	9
Acmispon americanus	0.1	0.7	0.4	0.3	0.3	4	5	5	3	14
Persicaria amphibia	0.0	0.0	0.0	0.4	0.0		5	5	4	
Erigeron canadensis	0.0	0.0	0.1	0.0	0.2	1	5	3		2
Clarkia williamsonii	0.0	0.3	0.5	0.1	0.1		4	5	1	2

Sonchus asper	0.0	0.2	0.5	0.0	0.2	1	3	5	1	
Bromus hordeaceus	0.0	0.1	0.2	0.3	0.2	4	1	3	4	1
Monardella sp.	0.0	0.4	0.5	0.2	0.0		1	2	3	1
Equisetum arvense	0.0	0.4	1.4	0.3	0.4	1	1	2	1	5
Madia elegans	0.0	0.3	0.0	0.1	0.1		1	1	2	1
Rorippa curvisiliqua	0.0	0.0	0.2	0.0	0.0		1	1		
Eriogonum nudum	0.0	0.3	0.0	0.0	0.0	1	1			
Carex sp.	0.0	0.0	2.9	10.2	10.7	1		8	21	24
Asclepias speciosa	0.0	0.0	0.0	0.4	0.0			2	1	
Lessingia leptoclada	0.0	0.0	0.0	0.1	0.0			1		
Lupinus nanus	0.0	0.0	0.0	0.0	0.2				1	
Solidago canadensis	0.0	0.0	0.4	0.0	0.5					4
Verbascum thapsus	0.0	0.0	0.0	0.0	1.3					3
Artemisia dracunculus	0.0	0.0	0.0	0.3	0.0					
Carex whitneyi	0.0	0.1	0.0	0.0	0.0					
Juncus sp.	0.0	0.1	0.5	0.0	0.0					
Persicaria maculosa	0.0	0.0	0.0	0.0	0.5					
Quercus kelloggii	0.0	0.0	0.0	0.1	0.0					
Rumex crispus	0.0	0.0	0.0	0.0	0.2					
Veratrum californicum	0.0	0.0	0.0	0.0	0.2					
Wyethia elata	0.0	0.0	0.1	0.0	0.0					
Potentilla gracilis							3	3	1	
Lupinus sp.							1	1	1	1
Oxypolis occidentalis							1	1		
Bromus arenarius							1			
Hypericum scouleri							1			
Mollugo verticillata							1			
Oenothera elata						1	1			
Polygonum douglasii							1			
							1			
Helenium bigelovii								1	1	
Eriogonum sp.								1		
Galium trifidum								1		
Pinus ponderosa									1	2
Collomia grandiflora									1	
Mentha arvensis									1	
Agrostis sp.										1
Calocedrus decurrens										1
Lactuca tatarica ssp. Pulchella										1
Hordeum brachyantherum						1				
Phleum pratense						1				
Populus trichocarpa						2				
Sisymbrium officinale						1				
Sisyrinchium bellum						1				
Thalictrum fendleri var. fendleri						1				
Trifolium sp.						1				

There was a statistically significant change in the wetland index between 2008 and 2014 (*df* = 4, *F* = 4.063, p = 0.01, Figure 3-2). Wetland index values ranged from a low of 3.08 in 2011 to a high of 3.33 in 2014. Post-hoc testing indicated that there was an increase in the wetland index between 2008 and 2011 and between 2014 and all other years (Table 3-2).

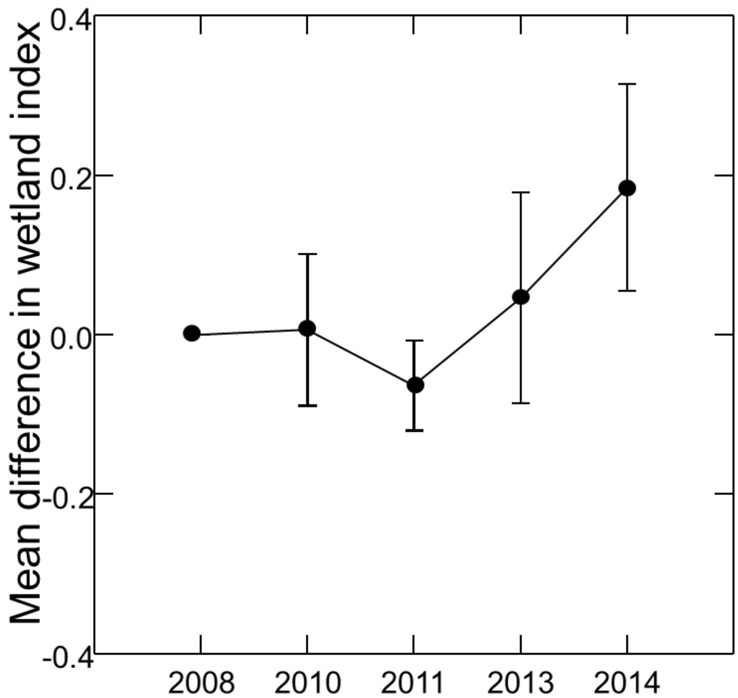


Figure 3-2. Mean difference in wetland index between the baseline year, 2008, and subsequent readings. Error bars represent 90% CI.

Table 3-2. Wetland index score post-hoc pairwise comparisons. Significant differences at the alpha level of 0.1 are shown in bold.

Within Subjects Factor Comparing Levels		Mean Difference Between Levels	Standard Error of Difference	p-Value	95% Confidence Interval Lower	95% Confidence Interval Upper
1	2	-0.007	0.050	0.884	-0.125	0.110
1	3	0.065	0.030	**0.070**	-0.007	0.137
1	4	-0.045	0.069	0.537	-0.209	0.119
1	5	-0.185	0.069	**0.032**	-0.349	-0.021
2	3	0.072	0.062	0.281	-0.074	0.219
2	4	-0.038	0.098	0.712	-0.268	0.193
2	5	-0.177	0.087	**0.081**	-0.384	0.029
3	4	-0.110	0.052	**0.071**	-0.232	0.012
3	5	-0.250	0.064	**0.006**	-0.400	-0.100
4	5	-0.140	0.043	**0.014**	-0.242	-0.038

Species richness varied significantly over time (*df* = 4, *F* = 7.078, p <0.0001, Figure 3-3). Species richness in 2014 was the lowest documented at 4.9 species/plot, which was statistically different from all previous years. This represents a decrease of 1.3 species/plot (90% CI = 0.1 – 1.9) from 2008. Additionally, 2013 was statistically significant from 2008 (Table 3-3).

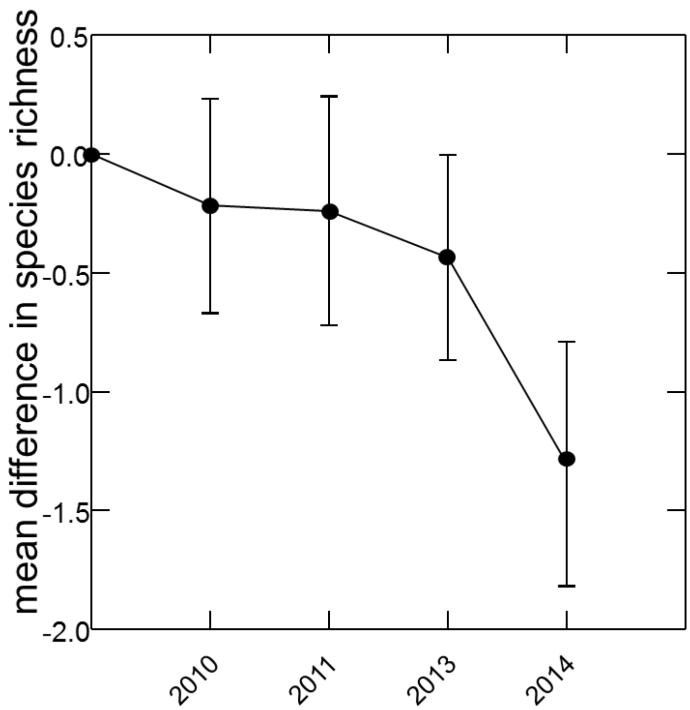


Figure 3-3. Mean difference in species richness between each sampled year and 2008. Error bars represent 90% CI.

Table 3-3. Species richness post-hoc pairwise comparisons. Significant differences at the alpha level of 0.1 are shown in bold.

Within Subjects Factor		Mean Difference Between Levels	Standard Error of Difference	p-Value	95% Confidence Interval	
Comparing Levels					Lower	Upper
1	2	0.217	0.269	0.423	-0.324	0.759
1	3	0.239	0.287	0.409	-0.339	0.817
1	4	0.435	0.258	**0.098**	-0.084	0.954
1	5	1.304	0.306	**0.000**	0.688	1.921
2	3	0.022	0.274	0.937	-0.529	0.573
2	4	0.217	0.252	0.394	-0.291	0.726
2	5	1.087	0.303	**0.001**	0.477	1.697
3	4	0.196	0.196	0.323	-0.198	0.590
3	5	1.065	0.286	**0.001**	0.490	1.640
4	5	0.870	0.252	**0.001**	0.362	1.377

The lowest mean cover of native species was 57% in 2014 and with a high of 69% cover in 2011 (Figure 3-4). There was significant change in native species cover among years (*df* = 4, *F* = 2.780, *p* = 0.046). Post-hoc pairwise comparisons suggested a significant increase in 2011 compared with the baseline and a decrease in 2014 compared with 2010 and 2011 (Table 3-4).

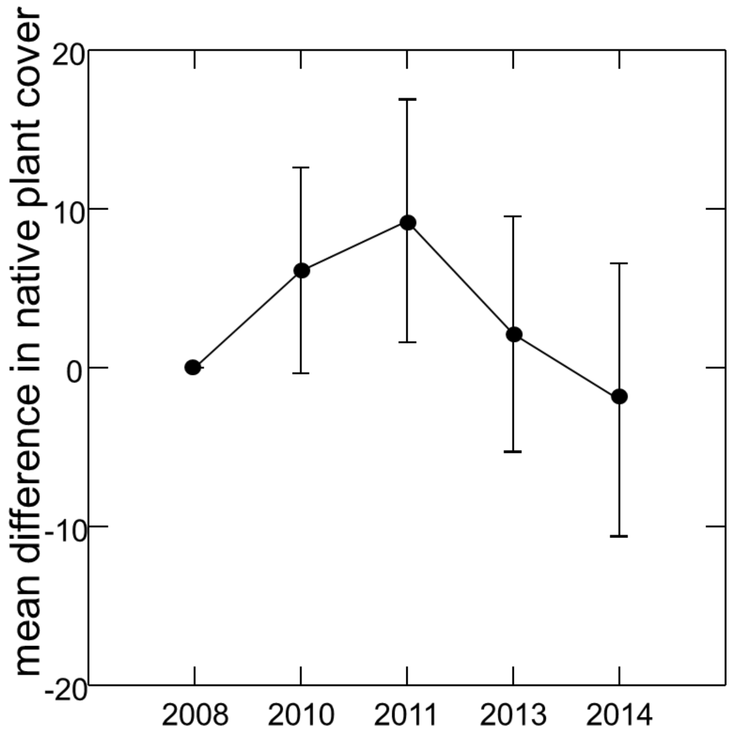


Figure 3-4. Mean difference in percent native plant cover between each sampled year and 2008. Error bars represent 90% CI.

Table 3-4. Native species cover post-hoc pairwise comparisons. Significant differences at the alpha level of 0.1 are shown in bold.

Within Subjects Factor		Mean Difference Between Levels	Standard Error of Difference	p-Value	95% Confidence Interval	
Comparing Levels					Lower	Upper
1	2	-6.125	3.420	0.116	-14.211	1.961
1	3	-9.250	4.039	**0.056**	-18.800	0.300
1	4	-2.125	3.907	0.603	-11.364	7.114
1	5	2.000	4.536	0.673	-8.725	12.725
2	3	-3.125	3.975	0.458	-12.525	6.275
2	4	4.000	2.777	0.193	-2.568	10.568
2	5	8.125	2.263	**0.009**	2.773	13.477
3	4	7.125	4.011	0.119	-2.359	16.609
3	5	11.250	4.570	**0.043**	0.444	22.056
4	5	4.125	4.561	0.396	-6.660	14.910

3.4.2 Rim Fire Effects

We also made some general site observations in this first season post-fire. The 2013 Rim Fire killed some large Ponderosa pines in the upland and some saplings at the meadow-upland interface (Figure 3-5). However, our observations suggest that many of these saplings will survive.

Figure 3-5. Ponderosa pine burned in the 2013 Rim Fire. While some conifer saplings at the meadow boundary burned, others were only partially consumed and may survive.

3.5 Discussion

3.5.1 Vegetation changes

Several changes were observed in 2014. However, we must look at potential sampling artifacts that could influence some of these observed patterns. Because *Carex* species were largely lumped in 2013 and 2014 compared with previous years in which several different *Carex* species were listed and few (2012) or none (2008, 2010) were lumped into genera. For the wetland index and native cover analyses, these were excluded. For the richness calculation, lumping could reduce the number of species observed for some quadrats. These analyses could be performed again by lumping previously identified *Carex* into one generic category to see if outcomes changed.

Wetland plant communities are affected by soil inundation and moisture levels. These can be influenced by river inundation, precipitation and run-off patterns, and temperature (i.e., high temperatures contributing to water stress). Low precipitation in the Sierra Nevada in 2012, 2013, and 2014 precluded large water releases from O'Shaughnessy Dam and therefore soils would not have been saturated from flood events in those years. Additionally, there would not have been heavy precipitation and runoff to recharge ground-water tables. The increase in the wetland index values, indicating a trend towards more upland plant communities, although statistically significant, was of small magnitude (3.08 to 3.33). Following previous work, vegetation would be defined as hydrophytic if its wetland index were < 3.0 (U.S. Army Corps of

Engineers 2012). Thus, the environmental conditions in Poopenaut Valley do not yet appear to be fully supporting wetlands, suggesting the need for more soil saturation.

These sample units are dominated by perennial vegetation—86% cover (sd = 1.7) in 2008 and 82% cover (sd = 22) in 2014. Thus, this vegetation would not be expected to change quickly year-to-year unless mortality were inflicted upon the plants such as by flooding they could not tolerate or fire that caused below-ground damage.

3.5.2 Rim Fire effects

The decline in species richness in 2014 could be an effect of the Rim Fire. However, there also appeared to be a slight decrease in 2013—prior to the fire—compared with 2008 baseline conditions. We did not find such drastic changes in other metrics or particular dominant plants to suggest that the fire was severe enough to change the plant community to a large magnitude. Fire is of interest in its potential to reduce conifer encroachment. Our sampling data did not encompass the meadow edge—the habitat in which Ponderosa pine saplings burned. Although some of these individuals were burned enough to cause mortality, it was unclear if the majority of those surviving the fire in the short-term will succumb in later years. If so, then the fire will help perpetuate dominance by herbaceous species. However, if these saplings survive, they could be more resistant to future fires because their lower branches burned. Thus, if fire doesn't kill them, the argument to support flooding to suppress conifer encroachment is all the more compelling.

3.6 Conclusions and Future Directions

There is evidence that plant communities are changing. However, statistically significant changes need to be taken cautiously. We chose to not correct for multiple tests thus the probability of committing a type I error is fair. Thus far, few of the changes are of high magnitude. As suggested in previous reports, the time scale in which greater change could occur may be longer than our current monitoring frequency. Another caution is that because these transects were not randomly placed, inference cannot be made to the meadow as whole. The design will still allow for assessment of change along those transects, which could be suggestive of change on a broader scale, but that cannot be asserted. The design has the merit of permanent sampling units, which has shown in these analyses to provide sufficient power to detect biologically significant change.

The pace of vegetation change in systems dominated by perennial species is slow, unless there is a catalyst such as fire or flooding. For Poopenaut Valley, annual sampling is not necessary and even bi-annual sampling may be more than needed if the objective is to make a long-term change to flow regime and the monitoring will continue in the long-term as well. The monitoring program must weigh the needs of field data collection (new data) against the need to expend resources properly analyzing the data to understand needed changes in management or monitoring.

Chapter 4. 2014 Bird Studies in Poopenaut Valley

4.1 Introduction

The sensitivity of bird populations to changes in the ecosystem makes them an important indicator of overall habitat quality (Marzluff and Sallabanks, 1998). Long-term monitoring of birds, particularly during the breeding season, can be used to effectively assess habitat health (Ralph et al., 1993). Bird population dynamics have been used as scientifically viable surrogates for evaluation of ecosystem condition because (1) birds are conspicuous, easily observable, and monitoring and analysis are cost effective; (2) as secondary consumers (i.e. insectivores), birds are sensitive indicators of environmental change; and (3) knowledge of the natural history of many bird species has a rich basis in literature. In human-altered riparian areas, bird monitoring can be a valuable tool for assessing changes in habitat quality incurred from restoration efforts, river diversion and channelization projects, water impoundment, and flooding events.

One of the main objectives of bird studies in Poopenaut Valley is to gain a better understanding of how altered hydrology below O'Shaughnessy Dam affects breeding birds. We began investigations in 2007 by completing a California Wildlife Habitat Relationships (CWHR) model that predicts occurrence of vertebrate species (amphibians, reptiles, birds, and mammals) between O'Shaughnessy Dam and the park boundary and in Poopenaut Valley (National Park Service, 2009). Also in 2007, we began ground-truthing the model by conducting area search surveys with the goal of characterizing the breeding bird community in Poopenaut Valley (National Park Service, 2009, 2010, 2012a, 2012b, 2014). Since 2007, we have continued to augment our survey methods in order to delve deeper into the breeding ecology of the bird community in Poopenaut Valley, with emphasis on four riparian focal species (RHJV, 2004). These focal species [Warbling Vireo (*Vireo gilvus*), Yellow Warbler (*Setophaga petechia*), Song Sparrow (*Melospiza melodia*), and Black-headed Grosbeak (*Pheucticus melanocephalus*)] play a central role in relating seasonal population trends of breeding birds in Poopenaut Valley to water availability.

After initiating bird studies in 2007 with search area surveys, beginning in 2008 we conducted point counts surveys; beginning in 2010 we conducted spot mapping surveys, nest searching, and territory mapping; beginning in 2012 we captured and banded birds; beginning in 2013 we color-banded Song Sparrows and Yellow Warblers; and beginning in 2014 we color-banded Warbling Vireos, Black-headed Grosbeaks, and Western Wood-Pewees. We continue to more closely monitor Song Sparrows and Yellow Warblers because they have special sensitivity to different aspects of the riparian system: Yellow Warblers are listed as a California Species of Special Concern, and Song Sparrows typically nest in the lowest vegetation strata, so their nests may be particularly prone to flooding in a managed hydrological regime.

Color-banding serves two primary functions in our survey efforts. First, it increases the accuracy of territory mapping because we are able to positively identify and track color-banded individuals. As our knowledge of territories becomes more accurate and reliable, this enables us to investigate potential correlations between territory size and other ecological attributes associated with quality of available habitat. Second, color-banding provides an opportunity to measure multiple indices of avian population health, e.g., productivity, juvenile survival, adult survival, and recruitment. Color-banding can also reduce the amount of time and effort needed to locate an individual's nest and determine an individual's breeding status (Anders and Marshall 2005). Incorporating color-banding into the suite of avian survey techniques utilized in Poopenaut Valley results in a more thorough and comprehensive assessment of ways in which the altered flow regime might be influencing avian population dynamics. This information on breeding bird populations will feed into recommendations to the San Francisco Public Utilities Commission on timing water releases from O'Shaughnessy Dam in order to benefit breeding birds.

4.2 Methods

4.2.1 Bird Area Search and Point Count Surveys

We conducted the eighth year of standardized area search surveys (2007-2014) and the seventh year of point count surveys (2008-2014) to estimate bird community species abundance, composition, and habitat use in Poopenaut Valley wet meadow and montane riparian habitats. We conducted area searches in five distinct areas, each comprising approximately 0.03 km^2 (3 hectares) (Figure 4-1); see the 2007 Looking Downstream Report (National Park Service, 2009) for a thorough description of protocols and search areas.

In 2008 we established two point count locations, one on either side of the river in Poopenaut Valley at locations intersecting Areas 1 and 2; and Areas 3 and 4 (Figure 4-1) (South UTM- 11 S 0252165 4200535, North UTM- 11S 0252076 4200794). We used the standardized point count protocol for monitoring landbirds (Ralph et al., 1993, Nur et al., 1999), including the use of a standardized datasheet. Use of standardized survey methods allows data to be compared among years, and compared with areas outside of Poopenaut Valley. Each set of surveys were spaced at least 10 days apart and were completed by 10 am. Point counts were conducted for 5-minutes each, during each of the three visits, following the area searches. For both survey methods, the observer recorded observed species, method of detection (visual, song, or call), and indications of breeding status, such as copulation, courtship or territorial display, food carrying, and any observed fledglings. Data analysis of area searches and point counts included relative abundance, species richness, species diversity index, evenness, and dissimilarity (see National Park Service, 2009, for description of data analysis methods and examples of standardized datasheets). Species dissimilarity was calculated using different statistical software in 2014. Instead of using SYSTAT, we used program R (R Statistical Computing Software, Vienna, Austria), which proved to be a more powerful analysis tool. We used the *vegdist* function with the *vegan* package to complete the Bray-Curtis dissimilarity measure.

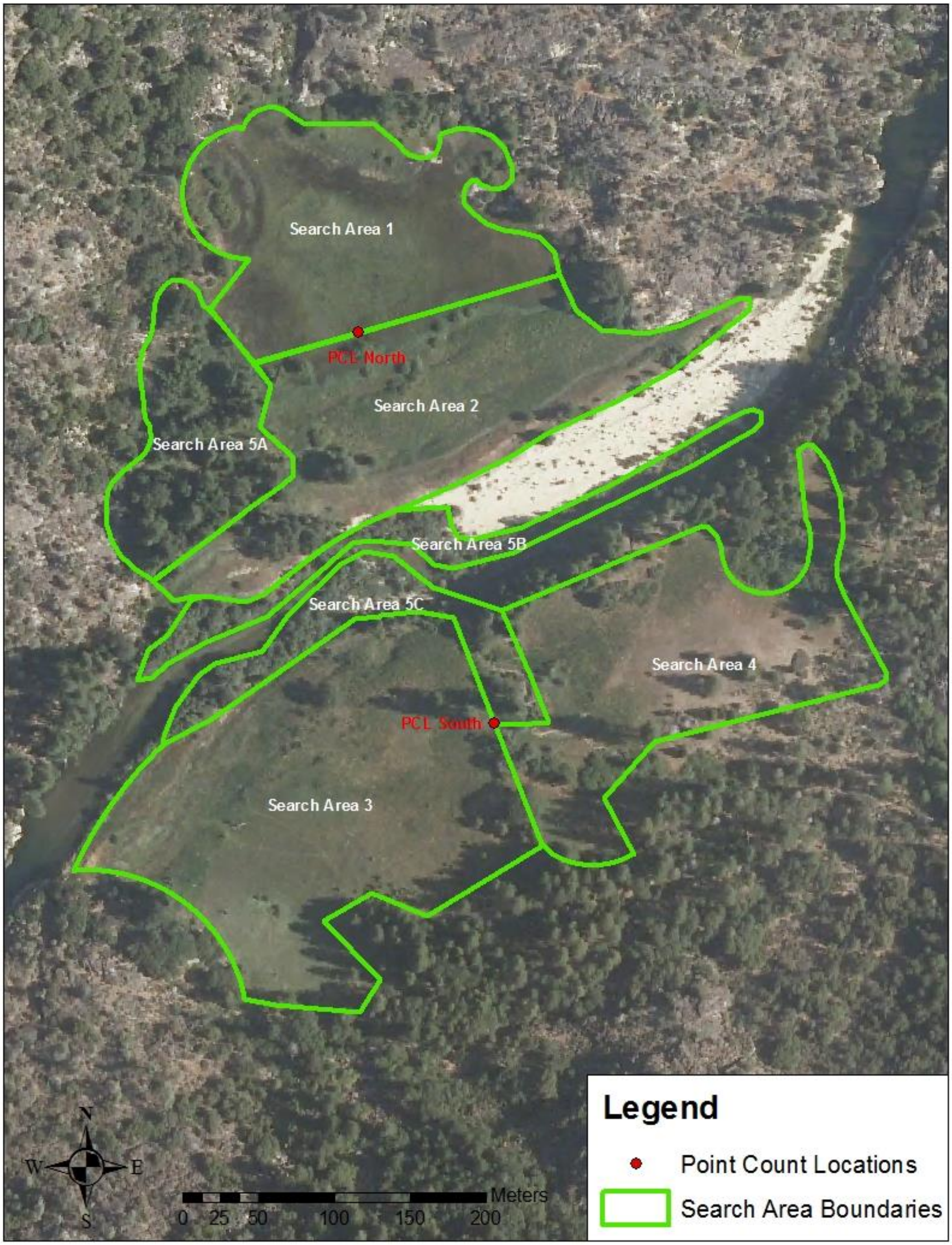


Figure 4-1. Bird search areas (same as spot map and nest search areas) and point count locations (PCL) in Poopenaut Valley.

4.2.2 Bird Spot Map Surveys

In 2010, we began conducting spot map surveys in the same avian search areas (Areas 1-5) as the area searches (Figure 4-1). We completed 5 visits in 2014. Because of comparatively low water flows in 2014, we did not encounter difficulty crossing the river, and were able to conduct a comprehensive survey of all five areas during each visit. During a single visit, we spent 40 to 90 minutes spot mapping each area, and finished by 12:00 pm (noon). We adapted spot mapping methods from the standardized spot mapping protocol described by Bibby et al., (1992) and Ralph et al. (1993). The observer walked the area slowly, stopping for as long as necessary to mark every bird detected in its exact location on a map of the area. We recorded birds inside each area, and within 10 meters outside the area boundary, unless the boundary was the dividing line between areas. The observer distinguished males from females if possible, and marked their locations on the map using a different symbol. The observer also noted if males were singing (denoted by circling the male), recorded any and all territorial behavior including chasing or counter-singing (denoted by drawing dotted lines between individuals), and noted the direction of movement of individuals using arrows. During each visit, the observer recorded data on a new map.

At the end of the season, we prepared cumulative maps for the four focal species: Warbling Vireo, Yellow Warbler, Song Sparrow, and Black-headed Grosbeak in order to determine number of breeding pairs, territory sizes, and distribution. We digitized these maps and analyzed the detection data using geographic information system (ArcGIS) software. We mapped locations of individuals, pairs, and territorial behavior such as counter-singing and chasing. Measuring the size of bird territories has been done using various methods in the past (Hayne, 1949; Odun and Kuenzler, 1955; Suthers, 1960; Wiens et al., 1985). Traditionally, bird detections were marked on a map, and then clusters of detections were grouped into the smallest polygon in which no internal angle exceeded 180 degrees (Burgman and Fox, 2003). This method is known as minimum convex polygons (Mohr, 1947). While this method provides useful insight into potential territories, it is susceptible to a lot of observer bias (Laver and Kelly, 2008; Nilsen et al., 2008; Worton, 1995). For each species, we plotted each pair's territory location and size using kernel density estimation which has been claimed to be a more rigorous method of mapping home ranges (Borger et al., 2006; Naef-Daenzer, 1993; Seaman and Powell, 1996) than the minimum convex polygon method (Mohr, 1947; Silverman, 1986). The kernel density estimation produced a raster layer depicting detection densities. This layer estimated a probability density for the entire study area. To identify each territory belonging to a pair of birds, we used the kernel raster layer as a visual guide for creating a convex hull around groups of points. We used minimum registration number guidelines from I.B.C.C., (1970) to avoid selecting clusters with not enough detections. Each resulting convex hull represented an independent territory.

4.2.3 Bird Nest Search Surveys

Since 2010, we have conducted nest search surveys simultaneously with spot map surveys, and have used a standardized nest searching protocol (PRBO, 2001). Birds exhibiting probable or confirmed breeding activity such as foraging in pairs, carrying nesting material, or carrying food were followed as closely as possible in order to find nests, and their movements and behaviors were mapped onto the spot maps. For each nest, we recorded the nest location using a Global Positioning System (GPS) unit and recorded information about the status and location of the nest onto a nest card. During every subsequent site visit, we checked each nest and recorded the observed nesting activity onto the nest card. At the end of the season, we transferred nest card information onto a nest record sheet and coded nest results.

4.2.4 Bird Mist-netting and Color-banding

Beginning in 2012, we captured birds using mist-nets, and in 2013 began color-banding captured Song Sparrows and Yellow Warblers, and in 2014 began color-banding Warbling Vireos, Black-headed Grosbeaks, and Western Wood-Pewees. With few exceptions, we identified all captured birds to species, age, and sex; and banded them with USGS/BRD numbered aluminum bands. We collected the following data from all birds captured, including recaptures:

- capture code (newly banded, recaptured, band changed, unbanded)
- band number
- species
- age and how aged
- sex (if possible) and how sexed (if applicable)
- extent of skull pneumaticization
- breeding condition of adults (i.e., extent of cloacal protuberance or brood patch)
- extent of juvenal plumage in young birds
- extent of body and flight-feather molt
- extent of primary-feather wear
- presence of molt limits and plumage characteristics
- wing chord
- fat class and body mass
- date and time of capture
- station and net site where captured
- any pertinent notes

Our efforts were restricted to early morning hours, from local sunrise to approximately 0930. To capture the birds, we identified important movement corridors in each of the birds' territories and erected a 6-meter, 32 mm mesh mist net. Beneath the net, we hid an iPod equipped with a portable speaker and played a recording of the male song for up to approximately 20 minutes in order to attract the target species. We actively watched the mist-nets, and extracted any birds immediately after capture. We banded each individual with a USGS-issued silver aluminum band with a unique 9-digit identification number and a unique combination of color bands to allow individual identification during subsequent field observations. We also collected data following the Institute for Bird Populations' MAPS (Monitoring Avian Productivity and Survivorship) protocol, including age, sex, breeding status, extent of body and flight feather molt, fat, wing chord length, and weight. Birds were released early with minimal data taken if they exhibited signs of stress.

In the event that birds other than targeted focal species flew into the net, we extracted and processed them as above, and banded them with a USGS silver aluminum band (if we had the proper size), but did not apply color-bands. All banding data were collected under permit no. 22423, administered by The Institute for Bird Populations (IBP). In accordance with the permitting requirements, IBP will send all electronically entered and proofed banding data to the USGS Bird Banding Laboratory at the Patuxent Wildlife Research Center, thereby contributing to a national long-term monitoring effort of birds.

4.3 Results

4.3.1 2014 Bird Area Searches

The eighth consecutive year of area search surveys in Poopenaut Valley took place during the summer of 2014 and was comprised of three separate visits (23 May 2014, 3 June 2014, and 18 June 2014). Due to low water flow, all five search areas were accessible on each survey date. During the three visits, flow rates just below the O'Shaughnessy Dam were 2.3, 2.3, and 2.2 cms (82, 80, 76 cfs), respectively (http://waterdata.usgs.gov).

During area searches, we observed a cumulative total of 249 individual birds of 29 species in Poopenaut Valley in 2014. To account for the likelihood of duplicate observations of individual birds among visits, we estimated relative abundance to be 169 individual birds using the highest count from the three visits for each species (Table 4-1). The five most frequently detected bird species, based on high counts, were Lawrence's Goldfinch (*Spinus lawrencei)* (29 individuals), Red-winged Blackbird *(Agelaius phoeniceus)* (12 individuals), American Robin *(Turdus migratorius)* (11 individuals), Anna's Hummingbird (*Calypte anna)* (10 individuals), and Western Wood-Pewee *(Contopus sordidulus)* (10 individuals) (Table 4-1). The six most frequently encountered species based on gross totals were Lawrence's Goldfinch (32 detections), American Robin (17 detections), Anna's Hummingbird and Lazuli Bunting *(Passerina amoena)* (16 detections), and Red-winged Blackbird and Western Wood-Pewee (15 detections).

Table 4-1. Relative abundance of bird species detected during area searches (1-5) in Poopenaut Valley, Yosemite National Park, in May – June 2014. Values reported are high counts for each species in each area across all three visits.

Species	Status	1	2	3	4	5	Relative Abundance
American Robin			4	1	2	4	**11**
Anna's Hummingbird		2	2	3	1	2	**10**
Brown-headed Cowbird			1			2	**3**
Black-headed Grosbeak	RFS		2	2		4	**8**
Black Phoebe				1			**1**
Brewer's Blackbird				3		2	**5**
Black-throated Gray Warbler				1		1	**2**
Bullock's Oriole			1	3	1	2	**7**
Cassin's Vireo				2		1	**3**
House Wren		1		1	1	2	**5**
Lawrence's Goldfinch		20		4	2	3	**29**
Lazuli Bunting			2	4	2	1	**9**
Lesser Goldfinch				1			**1**
Mallard		2					**2**
MacGillivray's Warbler					3		**3**
Mourning Dove		2	2		2	2	**8**
Orange-crowned Warbler						1	**1**
Pacific-slope Flycatcher						1	**1**
Red-shafted Flicker			1	1			**2**
Red-winged Blackbird		9			1	2	**12**
Song Sparrow	RFS	1			1	3	**5**
Spotted Sandpiper						3	**3**
Spotted Towhee			1	1	1	3	**6**
Steller's Jay			3	2		1	**6**
Unidentified Flycatcher					1		**1**
Warbling Vireo	RFS		1	1	1	4	**7**
Western Wood Pewee			1	3	3	3	**10**
Willow Flycatcher						1	**1**
Yellow Warbler	CSC, SSC, RFS		1	1	2	3	**7**
Combined species totals		**37**	**22**	**35**	**24**	**51**	**169**

The montane riparian habitat in Search Area 5 had the highest species richness (23 species), abundance estimate (51 detections), diversity index (*H* = 3.028), and evenness (*J* = 0.966). Search Area 1 exhibited the lowest species richness (7 species), diversity index (*H* = 1.345), and evenness (*J* = 0.691). On average, wet meadow habitat averaged 29.5 detections of 13.25 species, which was much lower compared with 51 detections of 23 species in the montane riparian habitat (Table 4-2).

Table 4-2. Species richness, relative abundance, bird diversity, and evenness from area searches, by study area in Poopenaut Valley, Yosemite National Park, May - June 2014.

	Species Richness+	Abundance Estimate*	Species Diversity Index*	Evenness*
Search Area 1 Wet Meadow	7	37	1.345	0.691
Search Area 2 Wet Meadow	13	22	2.437	0.950
Search Area 3 Wet Meadow	18	35	2.743	0.949
Search Area 4 Wet Meadow	15	24	2.615	0.965
Search Area 5 Montane Riparian	23	51	3.028	0.966

+For each area, the total number of species detected in all three area search visits is reported.

*For each species in a given area, the highest number of individuals for each species detected in the three visits is reported.

Analysis of area search data from Search Areas 1-5 using the Bray-Curtis Dissimilarity Measure, revealed that Areas 1 and 4 differed the most in community assemblage (I_{BC} = 0.625, Table 4-3), meaning they shared the least number of species in common. Areas 1 and 2 shared the highest degree of community similarity (I_{BC} = 0.091, Table 4-3), meaning they shared the most similar species composition.

Table 4-3. Bray-Curtis Dissimilarity Matrix for bird assemblages by search area in Poopenaut Valley, Yosemite National Park, May - June 2014. Numbers enclosed in boxes indicate the least and most similar sites.

	Area 1	*Area 2*	*Area 3*	*Area 4*	*Area 5*
Area 1	0				
Area 2	0.091	0			
Area 3	0.543	0.261	0		
Area 4	0.625	0.222	0.244	0	
Area 5	0.563	0.322	0.316	0.270	0

4.3.2 2014 Bird Point Counts

The seventh year of point count surveys in Poopenaut Valley took place during 2014 and comprised three separate visits (23 May 2014, 3 June 2014, and 18 June 2014). We were able to survey at both point count locations for all three visits due to low river flow. At North Poopenaut, we detected an average of 14.33 individuals of 20 species, while at South Poopenaut we detected an average of 16.00 individuals of 20 species (Table 4-4). In total 24 species were detected during point counts across all three visits.

Table 4-4. Raw abundance (total number of detections), relative abundance (mean individual detections), and species richness from point counts in Poopenaut Valley, Yosemite National Park, May-June 2014. Data include all detections, excluding flyovers.

	North Poopenaut		South Poopenaut	
Species	**Total Individuals Detected**	**Relative Abundance**	**Total Individuals Detected**	**Relative Abundance**
American Robin	2	0.67	2	0.67
Anna's Hummingbird	-		1	0.33
Brown-headed Cowbird	1	0.33	-	
Black-headed Grosbeak	-		1	0.33
Black-throated Gray Warbler	1	0.33	-	
Bullock's Oriole	2	0.67	1	0.33
Cassin's Vireo	3	1.00	1	0.33
Downy Woodpecker	1	0.33	-	
House Wren	1	0.33	2	0.67
Lawrence's Goldfinch	1	0.33	3	1.00
Lazuli Bunting	2	0.67	4	1.33
Lesser Goldfinch	-		1	0.33
MacGillivray's Warbler	-		1	0.33
Mourning Dove	3	1.00	3	1.00
Mountain Quail	3	1.00	5	1.67
Red-shafted Flicker	1	0.33	-	
Red-winged Blackbird	4	1.33	4	1.33
Song Sparrow	3	1.00	5	1.67
Spotted Towhee	1	0.33	1	0.33
Steller's Jay	1	0.33	3	1.00
Warbling Vireo	4	1.33	2	0.67
Western Tanager	1	0.33	2	0.67
Western Wood-Pewee	4	1.33	4	1.33
Yellow Warbler	4	1.33	2	0.67
Abundance	43	14.33	48	16.00
Species Richness	20		20	

4.3.3 2014 Bird Spot Mapping

In 2014, we conducted the fifth consecutive year of spot mapping in Poopenaut Valley. We conducted five spot mapping visits: 24 April, 30 April and 1 May, 13 and 14 May, 28 and 29 May, and 16 and 17 June. Additional spot mapping, focused on only color banded birds, occurred on 19 May, 28 May, 17 June, and 30 June. Spot mapping yielded detailed results on the breeding biology of four riparian focal species: Warbling Vireo, Yellow Warbler, Song Sparrow, and Black-headed Grosbeak (Figure 4-2).

Warbling Vireo: At least five male Warbling Vireos were observed singing during the first spot mapping visit on 24 April. Females were first observed on 7 May. We identified a total of six Warbling Vireo territories in Poopenaut Valley during the 2014 field season (Figure 4-3). A female was observed nest building on 7 May in a small black oak, where Area 2 meets Area 5A, however on 19 May this nest was gone, presumably destroyed by a predator.

Yellow Warbler: Yellow Warblers arrived later in Poopenaut Valley than the other focal species, consistent with observations in previous years. The first male was detected on 30 April and the first female was detected on 9 May. We detected three territories within Poopenaut Valley (Figure 4-4). Most activity was concentrated around the riparian corridor however a singing Yellow Warbler was observed in Area 1 on 14 May and a singing male was also observed in Area 4 with a female nearby on 29 May. On 14 May a female was observed feeding nestlings in Area 5C, however during a follow-up visit on 28 May, the female was observed on nest again. The color-banded male Yellow Warbler (YT/TS) was observed bringing food to the female and/or nestlings on 3 June. On 18 June there was no activity observed at the nest, leaving the fate of this nest unknown. On 30 June a color-banded Yellow Warbler (GG/TS) was observed feeding a fledgling in the upstream part of Area 5C.

Song Sparrow: We detected two territorial male Song Sparrows during the first survey on April 24. A third singing male Song Sparrow was observed on 14 May. Females were also first observed on 24 April. All territorial males were observed along the riparian corridor. A total of three territories were identified in Poopenaut Valley during 2014 spot mapping (Figure 4-5). Two of the territories belonged to color-banded Song Sparrows. A singing, unpaired Song Sparrow was observed throughout Area 1 during several spot mapping visits, however no evidence of breeding was found in this area. Two Song Sparrow nests were found this year, both on 13 May. One nest probably fledged young while the fate of the second nest was unknown. A juvenile Song Sparrow was observed foraging in Area 5C on 30 June. A juvenile bird observed on such an early date indicates that it was likely local to the area.

Black-headed Grosbeak: We detected several territorial male Black-headed Grosbeaks in Poopenaut Valley during the first survey on 24 April 2014. Females first arrived on 1 May. Through spot-mapping, we identified four territories in Poopenaut Valley (Figure 4-6). Territory sizes were difficult to determine because the birds often engaged in long flights across multiple survey areas. This year, no nests were found in the riparian corridor along the Tuolumne River, possibly due to the change in vegetation structure after the Rim Fire. On 13 May a female was observed on nest, with a male singing next to the nest. The nest was located in the western edge of Area 3 but the nest was found destroyed on 28 May.

We mapped breeding territories of Warbling Vireo, Yellow Warbler, Song Sparrow, and Black-headed Grosbeak using spot-mapping data (Figure 4-2). Most of the territories were located along meadow edges, especially where willows were present.

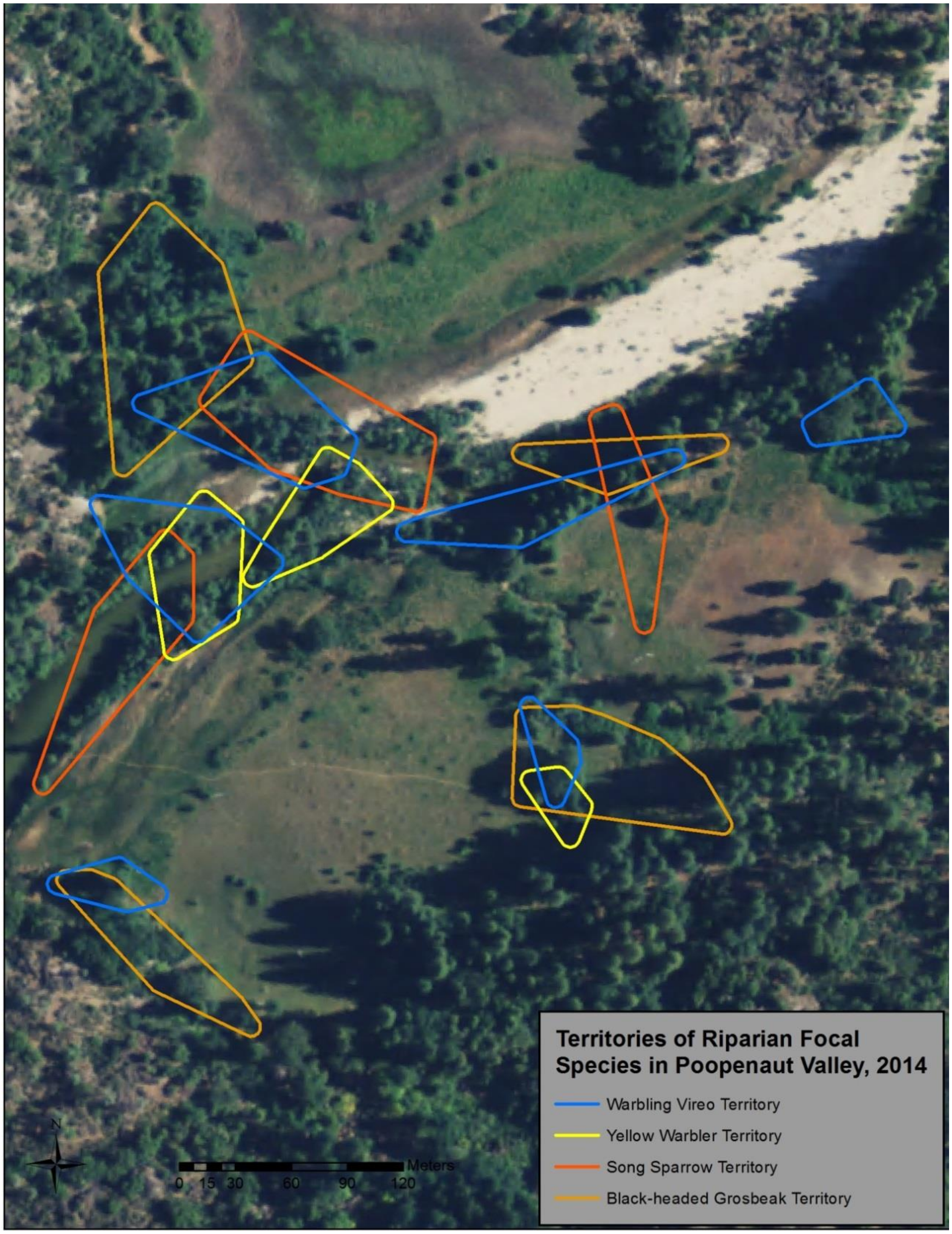


Figure 4-2. Warbling Vireo, Yellow Warbler, Song Sparrow, and Black-headed Grosbeak breeding territories in Poopenaut Valley, Yosemite National Park, 2014.

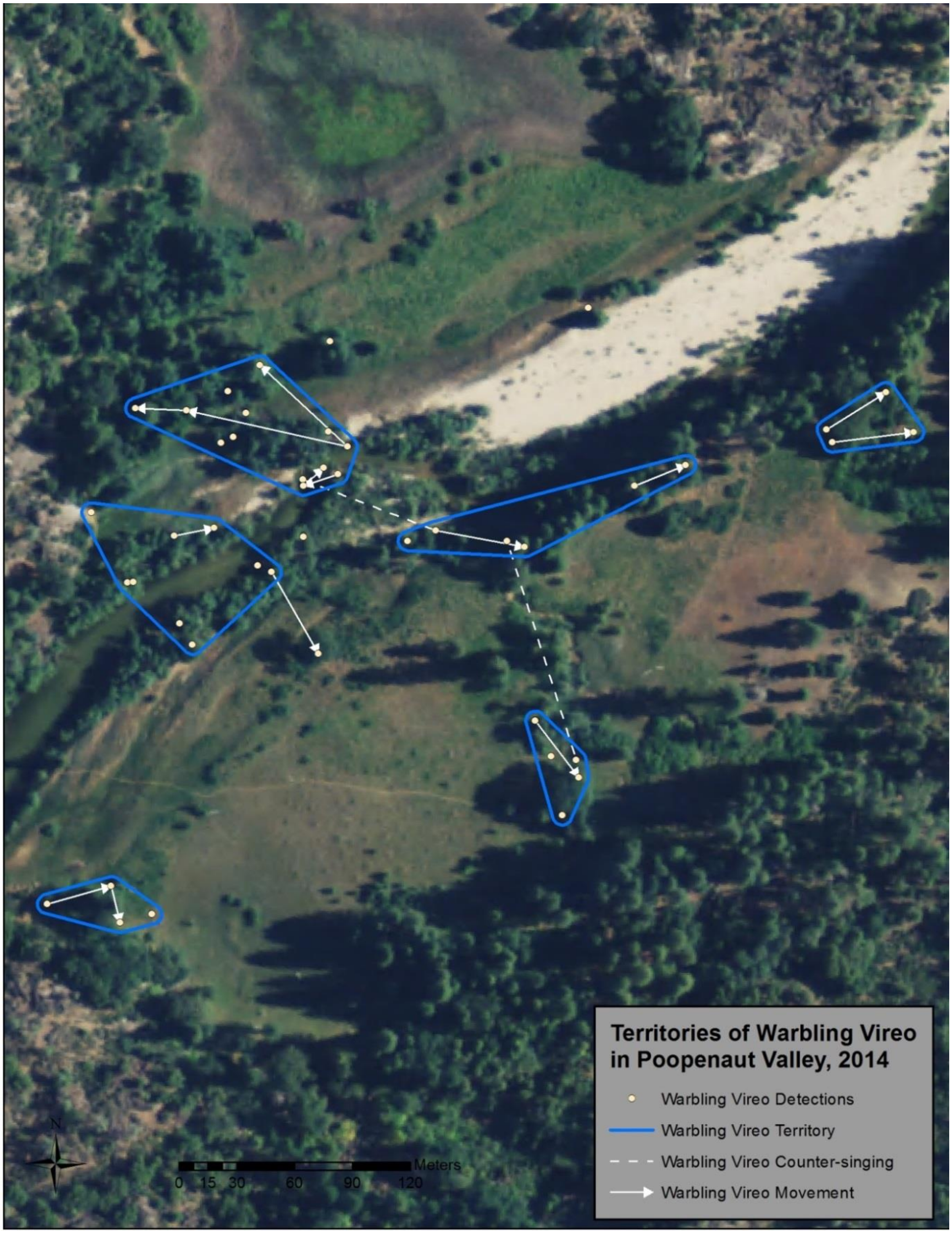


Figure 4-3. Warbling Vireo detections, territories, counter-singing between males, and individual movement within Poopenaut Valley, Yosemite National Park, 2014.

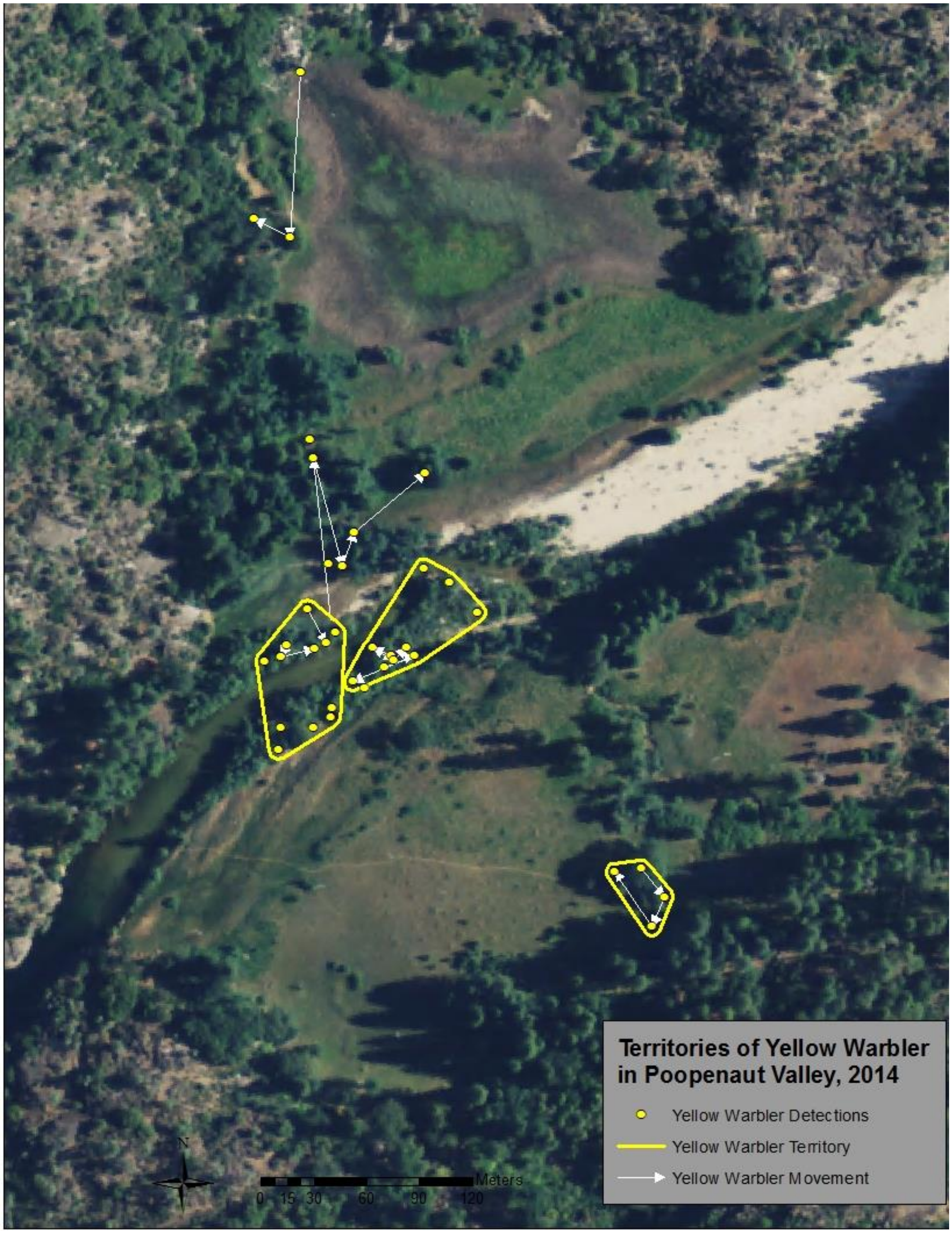


Figure 4-4. Yellow Warbler detections, territories, and individual movement within Poopenaut Valley, Yosemite National Park, 2014. No counter-singing was observed.

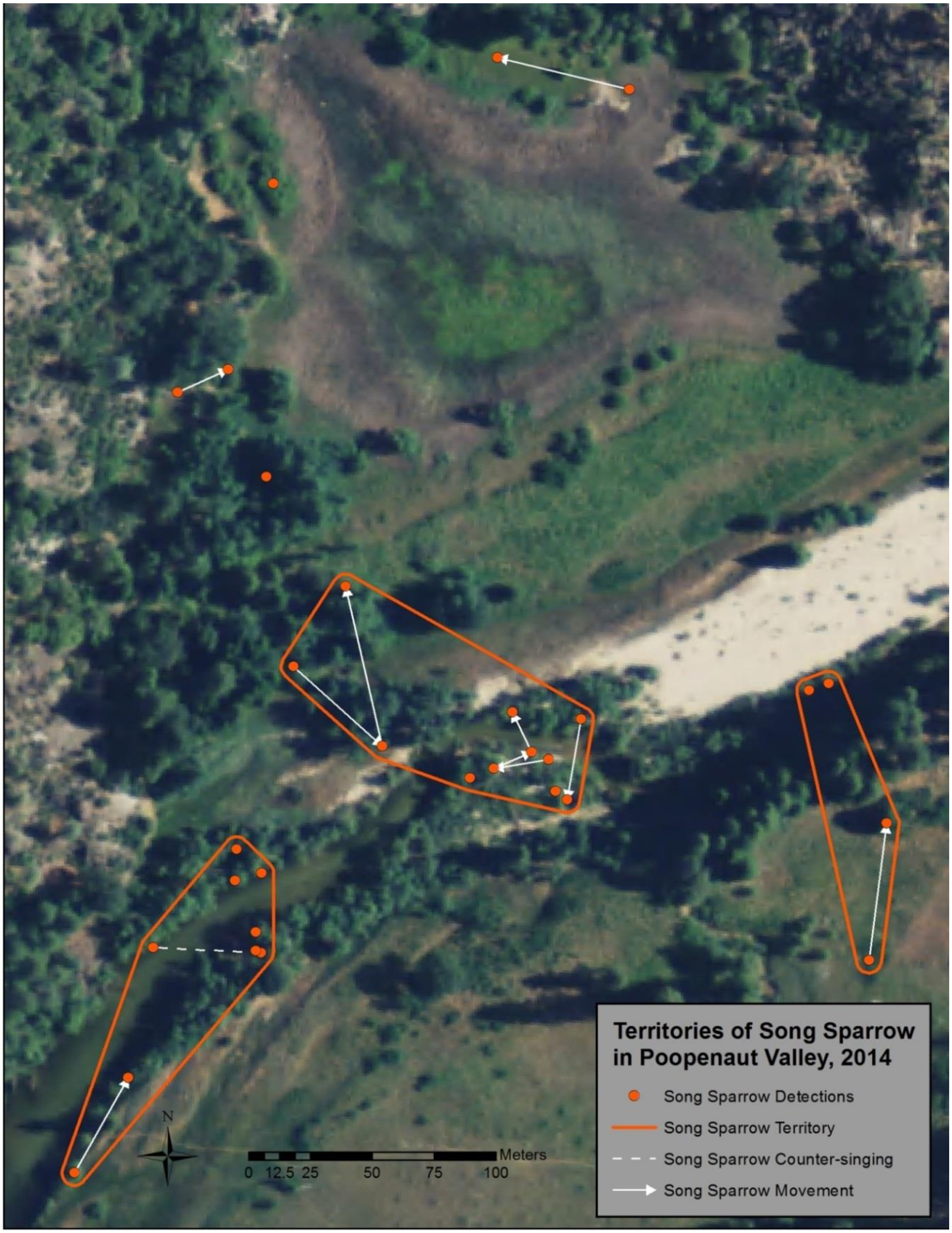


Figure 4-5. Song Sparrow detections, territories, counter-singing between males, and individual movement within Poopenaut Valley, Yosemite National Park, 2014.

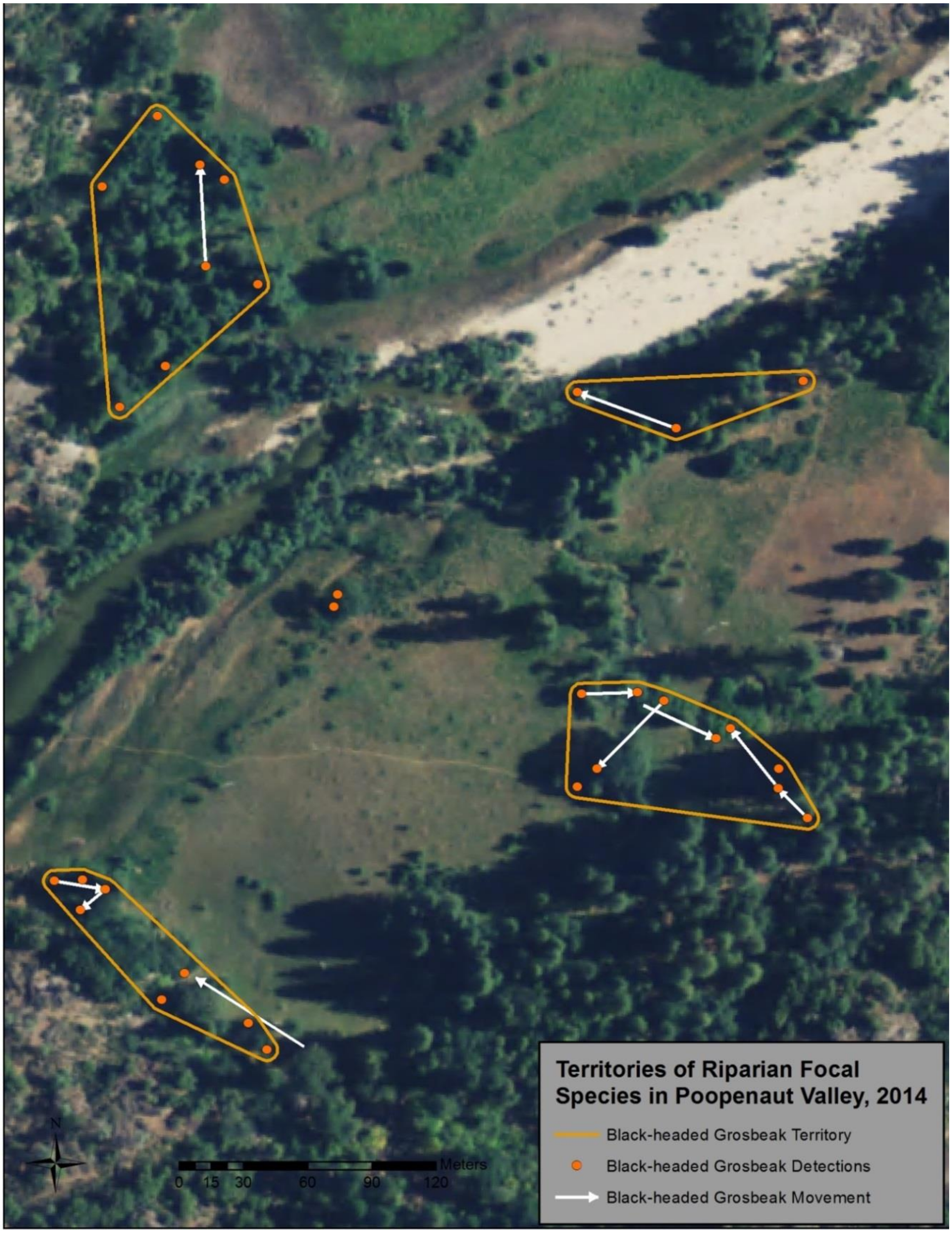


Figure 4-6. Black-headed Grosbeak territories, detections, and individual movement within Poopenaut Valley, Yosemite National Park, 2014. No counter-singing was observed.

4.3.4 2014 Bird Nest Searching

In 2014, we conducted the fifth consecutive year of nest searching in Poopenaut Valley. Concerted nest searching visits were made to Poopenaut on 13, 14, 19, 23, 28, 29 May and 3, 18, 30 June; and opportunistic nest searches (while conducting other surveys) took place on 24, 30 April and 1 May. We nest searched most often in the morning or evening when bird activity was at its highest.

We located 14 nests of 11 different species (Table 4-5) and plotted their locations using ArcGIS (Figure 4-7). We located five nests belonging to focal species: one Warbling Vireo, one Yellow Warbler, two Song Sparrow, and one Back-headed Grosbeak nest(s). We also observed nesting behavior (nest-material carries, parental visits to fledglings) but did not confirm nest locations for the following species: American Dipper *(Cinclus mexicanus)*, American Robin, Common Merganser *(Mergus merganser)*, Spotted Towhee *(Pipilo maculatus)*, Steller's Jay *(Cyanocitta stelleri)*, and Western Tanager *(Piranga ludoviciana)*.

Table 4-5. Nests and breeding confirmed during 2014 nest searching in Poopenaut Valley, Yosemite National Park.

Species	Nest Located	Breeding confirmed
American Dipper		1
American Robin		1
Black-headed Grosbeak[1]	1	
Black Phoebe	1	
Bullock's Oriole	1	
Common Merganser		1
Hairy Woodpecker	1	
House Wren	1	
Lesser Goldfinch	1	
Northern Rough-winged Swallow	1	
Song Sparrow[1]	2	
Spotted Towhee		1
Steller's Jay		1
Warbling Vireo[1]	1	
Western Tanager		1
Western Wood-Pewee	3	
Yellow Warbler[1]	1	

[1]Riparian Focal Species

Figure 4-7. Locations of 14 bird nests in Poopenaut Valley, Yosemite National Park, May-July 2014. Each nest is marked with the species alpha code followed by that species nest number. Alpha codes represent the following species common names: AMRO=American Robin, BHGR=Black-headed Grosbeak, BLPH=Black Phoebe, BUOR=Bullock's Oriole, HAWO=Hairy Woodpecker, HOWR=House Wren, LEGO=Lesser Goldfinch, NRWS=Northern Rough-winged Swallow, SOSP=Song Sparrow, WAVI=Warbling Vireo, WEWP=Western Wood-Pewee, YEWA=Yellow Warbler.

In 2014, all 14 nests were discovered between 1 May and 30 June, with the first three weeks of May being the most active nest-building period.

Black-headed Grosbeak: Found 13 May in the early afternoon by watching the male Black-headed Grosbeak singing near the nest, then move directly next to the nest. The nest was in a large incense cedar on the north-western edge of Area 3. We observed the female incubating eggs on 13 May and 23 May but during a return visit on 28 May the nest appeared to be damaged and no further activity was observed. **Fate: Fail** UTM: 11S 0251941 4200440

Black Phoebe: Found 1 May in eastern-most edge of Area 2 during spot mapping. The nest was built on a large rock wall with a small but deep pool of water underneath it. Nestlings observed on 14 May, however, on 23 May visit the young were gone and nest was destroyed. **Fate: Fail** UTM 11S 0252367 4200842

Bullock's Oriole: Found 1 May, about 30 feet off the ground in a large cottonwood in Area 2. A Western Scrub-Jay was observed destroying nest. Contents of the nest are unknown. **Fate: Fail** UTM 11S 0252029 4200651

Hairy Woodpecker: Found 1 May. Male was feeding young at nest. The nest was located in a snag that extended out of the river. Nest was approximately 10 feet above water level. Both parents were seen feeding nestlings 7 May, 12 May, and 19 May. On 28 May there was no activity at nest but at least 4 Hairy Woodpeckers were in willows and cottonwoods surrounding nest. **Fate: Fledge** UTM 11S 0252026 4200624

House Wren: Found 18 June. Nest located where bark peeled away from tree in dead, burnt willow in western part of riparian area of Area 5C. Contents of nest were unknown. **Fate: Unknown** UTM 11S 0251968 4200541

Lesser Goldfinch: Found 30 June. Nest located at top of closest willow to west of large live oak in Area 5C. On 30 June the female Lesser Goldfinch was observed landing on the nest and then incubating eggs. No activity was seen on follow up visits. **Fate: Unknown** UTM 11S 0251982 4200565

Northern Rough-winged Swallow: Found 28 May. Nest located in bare river bank near where Area 5C meets Areas 3 and 4. On 18 June an adult appeared to be carrying food but the bird was not seen entering the nest. No activity was seen on follow up visits on 30 June and 9 July. **Fate: Unknown** UTM 11S 0252137 4200627

Song Sparrow:

Nest 1: Found 13 May while spot mapping. Grassy nest was located about one foot off ground and was attached to small stick lying over a dead log in Area 5B (Figure 4-8). On 23 May, five nestlings were first observed in nest and on 28 May nestlings were again observed in nest. On evening of 28 May, young were gone from nest but female Song Sparrow could be seen giving contact calls and looking towards ground, indicating that the young had fledged. **Fate: Probable fledge** UTM 11S 0251954 4200596

Figure 4-8. Song Sparrow nest discovered in Area 5B during nest searching in 2014.

Nest 2: Found 13 May in grassy clump of flood debris stuck in small willow about five feet off the ground. On 13 May female observed carrying food to three nestlings. Six days later the nest was empty and the nest appeared to be destroyed. However, young were approximately 8 days old and may have fledged. **Fate: Unknown** UTM 11S 0252089 4200642

Warbling Vireo: Found 7 May. Female was observed building with spider webs in small black oak while male sang nearby. On 19 May the nest was gone. **Fate: Fail** UTM 11S 0251996 4200674

Western Wood-Pewee:

Nest 1: Found 7 May. Female observed building nest in dead willow in Area 5C while male sang nearby. On 12 May and 13 May there was no activity and the nest appeared to be abandoned. **Fate: Fail** UTM 11S 0251979 4200547

Nest 2: Found 13 May. Individual seen nest building, this is believed to be the same pair that abandoned Nest 1. On 19 May visit the nest appeared to be destroyed. **Fate: Fail** UTM 11S 0251965 4200596

Nest 3: Found 28 May. Nest was located at the top of a dead willow in Area 5C. Female nest building on 28 May and on 3 June female observed on nest. On 18 June the nest was gone. **Fate: Fail** UTM 11S 0251966 4200575

Yellow Warbler: Found 14 May. Nest located in crotch of dead willow. Female observed carrying food to nest but number of nestlings unknown. On 28 May the female was observed on nest again, possible failure of first clutch. On 18 June no activity was observed at nest. **Fate: Unknown** UTM 11S 0251976 420055

4.3.5 2014 Riparian Focal Species (RFS) Color-banding

Soon after locating their respective territories in 2014, we began target-netting and color-banding individual Warbling Vireos, Yellow Warblers, and Song Sparrows. We did not capture any Black-headed Grosbeaks or Western Wood-Pewees, even though we were prepared to color-band them. We set up nets opportunistically where we had observed pairs of Warbling Vireos, Yellow Warblers, and Song Sparrows (Figure 4-9, Table 4-6). Target-netting occurred during 4 visits on 30 April, 1 May, 13 May, and 14 May.

Table 4-6. Target-netting locations in Poopenaut Valley during 2014 color-banding.

Date	Net	UTM Easting	UTM Northing	Date	Net	UTM Easting	UTM Northing
30 April	1	252095	4200638	13 May	1	252097	4200627
30 April	2	-	-	13 May	2	252081	4200645
1 May	3	252005	4200577	14 May	1	251963	4200559
1 May	4	252120	4200661	14 May	2	251918	4200605
1 May	5	252132	4200664	14 May	3	251976	4200605

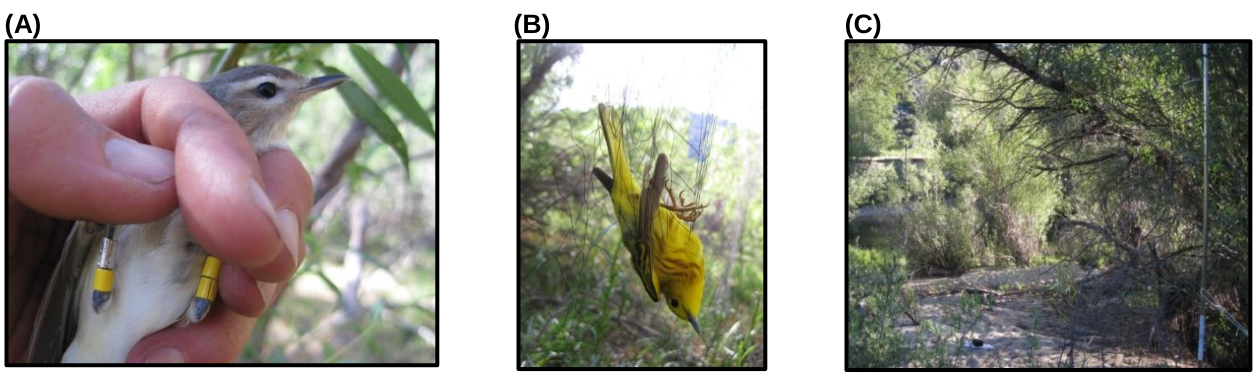


Figure 4-9. (A) Color-banded Warbling Vireo (Yellow-Yellow/Yellow-Silver); (B) Yellow Warbler captured in a mist-net; (C) Mist-net set up adjacent to river, with audio-lure on ground beneath net.

In total, we color-banded 2 Warbling Vireos, 2 Yellow Warblers, and 3 Song Sparrows during the 2014 color-banding effort in Poopenaut Valley. We also recaptured two previously color-banded birds: Yellow Warbler originally banded in 2012 and Song Sparrow originally banded in 2013. With the exception of the recaptured Yellow Warbler from 2012, all individuals exhibited active breeding condition, showing the presence of a cloacal protuberance for males and brood patch in females. The recapture of the Song Sparrow, a year-round resident, indicates breeding site fidelity in Poopenaut Valley. The recaptured Yellow Warbler was not re-sighted, which indicates that the bird continued its migration. Poopenaut Valley plays an important role in Neotropical migrant stopover habitat. Some color-banded birds were observed several times after banding, identified by their color band combination, and showed no sign of lasting stress. We were able to assign territories to several color-banded individuals and track reproductive success and failure.

In addition to target species, we captured 1 Spotted Towhee and 1 Bullock's Oriole (*Icterus bullockii*) on 13 May and 14 May, respectively. Both birds were females and exhibited a brood patch, indicating that they are breeding within Poopenaut Valley (Table 4-7).

Table 4-7. Banding summary of target-netting in Poopenaut Valley, 2012-2014.

Date	Capture Time	Net	New/Recap	Band Number	Species	Age d	Se x	Color-bands
7/10/2012	915	-	N	269082303	Black-throated Gray Warbler	AHY	F	-
7/10/2012	630	-	N	269082295	House Wren	AHY	U	-
7/10/2012	550	-	N	255126272	Song Sparrow	AHY	M	-
7/10/2012	550	-	N	255126273	Song Sparrow	AHY	M	-
7/10/2012	630	-	N	255126274	Song Sparrow	AHY	M	-
7/10/2012	720	-	N	255126275	Song Sparrow	AHY	M	-
7/10/2012	610	-	N	269082294	Western Wood-Pewee	AHY	M	-
7/10/2012	730	-	N	269082300	Western Wood-Pewee	AHY	U	-
7/10/2012	750	-	N	269082302	Western Wood-Pewee	AHY	F	-
7/10/2012	630	-	N	269082296	Yellow Warbler	SY	F	-
7/10/2012	630	-	N	269082297	Yellow Warbler	ASY	M	-
7/10/2012	700	-	N	269082298	Yellow Warbler	ASY	M	-
7/10/2012	720	-	N	269082299	Yellow Warbler	SY	F	-
7/10/2012	740	-	N	269082301	Yellow Warbler	AHY	M	-
4/26/2013	820	1	R	255126275	Song Sparrow	AHY	M	YY/SG
4/26/2013	950	2	R	255126274	Song Sparrow	AHY	M	GG/YS
5/2/2013	710	3	N	225130775	Song Sparrow	AHY	F	GR/TS
5/2/2013	710	3	N	225130776	Song Sparrow	AHY	M	RY/ST
6/13/2013	920	7	R	Unbanded	Black-headed Grosbeak	AHY	F	-
6/13/2013	940	7	N	185128983	Lazuli Bunting	ASY	M	-
6/13/2013	630	5	N	263019801	Yellow Warbler	AHY	F	TT/YS
6/13/2013	820	6	R	269082298	Yellow Warbler	ASY	M	RR/GS
6/14/2013	940	7	N	Unbanded	Black-headed Grosbeak	AHY	F	-
6/15/2013	940	7	N	Unbanded	Black-headed Grosbeak	ASY	M	-
6/16/2013	940	7	N	Unbanded	Black-headed Grosbeak	HY	U	-
6/18/2013	640	8	R	269082301	Yellow Warbler	AHY	M	YY/GS
6/19/2013	710	9	N	263019802	Yellow Warbler	AHY	M	YT/YS
5/13/2014	630	1	N	254048301	Warbling Vireo	AHY	M	GR/GS
5/14/2014	850	3	N	254048302	Warbling Vireo	AHY	M	YY/YS
4/30/2014	1820	1	N	263019803	Yellow Warbler	ASY	M	RS/RT
5/14/2014	820	3	N	263019804	Yellow Warbler	ASY	M	GG/TS
5/1/2014	700	1	N	225130777	Song Sparrow	AHY	M	RR/RS
5/13/2014	1910	1	N	225130778	Song Sparrow	AHY	F	RR/GS
5/14/2014	630	1	N	225130779	Song Sparrow	AHY	M	TT/TS
4/30/2014	1800	1	R	255126274	Song Sparrow	AHY	M	GG/YS
5/13/2014	1820	1	R	255126274	Song Sparrow	AHY	M	GG/YS
5/13/2014	1850	1	R	269082299	Yellow Warbler	ASY	F	RG/RS
5/14/2014	700	1	R	225130777	Song Sparrow	AHY	M	RR/RS
5/14/2014	900	3	R	254048301	Warbling Vireo	AHY	M	GR/GS

5/13/2014	1840	1	N	Unbanded	Spotted Towhee	ASY	F	-
5/14/2014	810	3	N	Unbanded	Bullock's Oriole	AHY	F	-

Age Code Key: AHY= After Hatching Year, ASY= After Second Year
Color Band Key: G=Green, R=Red, S=Silver, T=Turquoise, Y=Yellow

We mapped several color-banded songbird territories during 2014. While we did not record any color-banded females during color-band resighting, we were able to identify the nests and sometimes unbanded females within the territories that belonged to the color-banded males. Two color-banded male Song Sparrows, band combinations RR/RS and GG/YS, occupied territories with nesting females (Figure 4-10). Both territories were located within the riparian corridor of Search Area 5. Color-banded Song Sparrow, RR/RS, likely successfully fledged young while the fate of color-banded Song Sparrow, GG/YS, is unknown. We also identified the territories of two color-banded Yellow Warblers, band combinations YT/YS and GG/TS, within the riparian corridor of Search Area 5 (Figure 4-10). The nesting success of YT/YS is unknown but GG/TS was seen feeding a fully-feathered fledgling. The territories in Figure 4-10 were mapped using only observations of the color-banded birds which cause territories to appear differently than depicted in the territory mapping of unmarked individuals in Section 4.3.3.

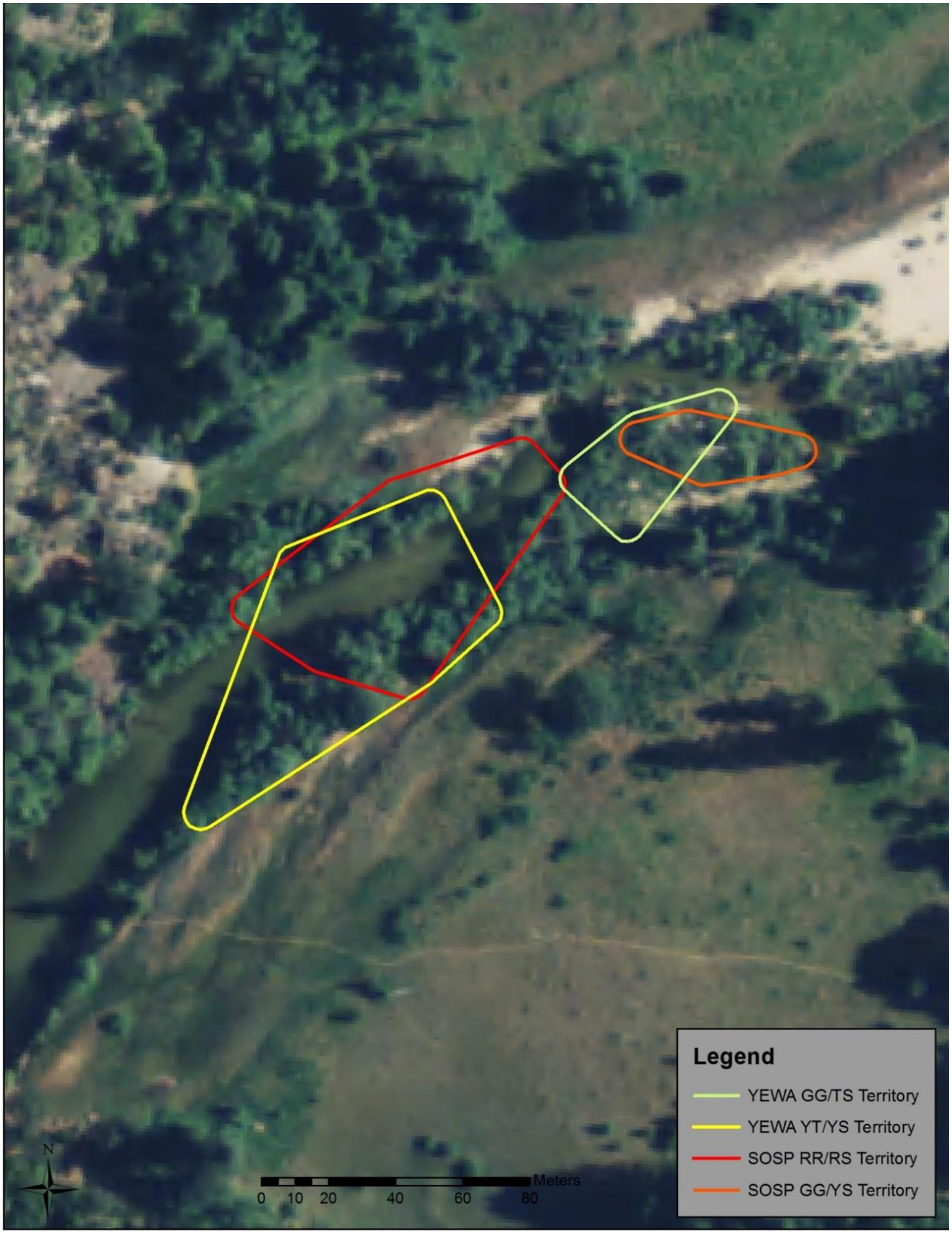


Figure 4-10. Territories of color-banded birds in Poopenaut Valley, 2014. Alpha codes represent the following species common names: SOSP= Song Sparrow and YEWA = Yellow Warbler. Color band codes are as follows: R=Red, G=Green, T=Turquoise, Y=Yellow, and S=Silver.

4.3.6 2014 Breeding Bird Summaries

Data collected during spot mapping and nest searching in 2011-2014 were used to calculate dates pertaining to arrival on the breeding ground, initiation of breeding, and fledging young for Riparian Focal Species (Table 4-8). These data showed that several species initiated breeding in late April or early May, when Tuolumne River levels were still artificially low. In 2014, detailed observations from 5 nests in particular contributed toward refining specific breeding chronology dates (Table 4-9).

Table 4-8. Preliminary life history breeding schedules for four Riparian Focal Species in Poopenaut Valley, Yosemite National Park, 2011-2014. Dates reflect earliest observed behavior pertaining to each activity, except where marked with an asterisk, indicating a hypothetical calculation based on known breeding observations and published life-history information.

YELLOW WARBLER				
Resident/Migratory	Migratory			
Site Fidelity	High			
Feeding type/food source	Insects and other arthropods; gleaning, sallying, hovering			
Nesting strata	Often contains heavy understory brush for nesting and tall trees for foraging and singing			
Nesting location	0.60 to 4.90 m above ground in shrub or deciduous sapling			
Capable of 2+ clutches?	One brood (3-6 eggs) normally reared; second brood rarely attempted			
	2011	**2012**	**2013**	**2014**
Males arrive	2 May	3 May	2 May	30 April
Females arrive	5 May	12 May	9 May	9 May*
Territory establishment	4 May	12 May	9 May	30 April
Females begin nesting	12 May	-	17 May	4-May[1]
Fledglings leave nest	3-10 June	-	12 June* to 11 July	30 June

[1]Back-calculated from active nest 14 May 2014

SONG SPARROW				
Resident/Migratory	Resident			
Site fidelity	High			
Feeding type/food source	During breeding, primarily insects and other small invertebrates; some seeds and fruit			
Nesting strata	Nests commonly 0–4 m, mostly on ground under grass tuft or shrub; wet meadows and margins of ponds, lake and slow-moving streams			
Nesting location	Ground cover, low in grass and shrubs			
Capable of two clutches?	Yes			
	2011	**2012**	**2013**	**2014**
Males arrive	28 April	27 April	26 April	24 April
Females arrive	28 April	27 April	26 April	24 April
Territory establishment	28 April	27 April	26 April	24 April
Females begin nesting	-	27 April	26 April	30 April[1]
Fledglings leave nest	-	20 May to 26 May	24 May	28 May

[1]Young discovered in nest on 13 May and "Females begin nesting" data back calculated from this

BLACK-HEADED GROSBEAK				
Resident/Migratory	Migratory			
Site fidelity	Unknown			
Feeding type/food source	Gleans animal matter, primarily insects and spiders, and vegetable matter, including cultivated fruit and weed seeds. Most forage on foliage, twigs, branches, and in the air			
Nesting strata	In outer branches of deciduous trees, cottonwoods, willows, and other hardwoods that margin rivers and streams, also in oak-conifer forest. Occupies diverse habitats			
Nesting location	Shrub, canopy, favors meadows, clearings, and extensive edge			
Capable of two clutches?	No; clutch 2-5 eggs			
	2011	**2012**	**2013**	**2014**
Males Arrive	28 April	27 April	26 April	24 April
Females Arrive	5 May	3 May	26 April	1 May
Males define territories	28 April	3 May	26 April	24 April
Females begin nesting	-	11 May[1]	2 May	13 May
Fledglings leave nest	-	4 June to 13 June	29 May to 13 June	-

[1]Active nest 11 May 2012

WARBLING VIREO				
Resident/Migratory	Migratory			
Site fidelity	Unknown			
Feeding type/food source	Highly plastic, primarily glean from twigs in broad leaf tree-tops for insects throughout the year, some fruit in winter			
Nesting strata	In forked lateral limbs of tree periphery, prefer cottonwood, alders, and aspens that line streams			
Nesting location	Canopy, tall, primarily coniferous trees, 7m or higher			
Capable of two clutches?	Yes, two considered normal; clutch 3-5 eggs			
	2011	2012	2013	2014
Males Arrive	28 April	27 April	26 April	24 April
Females Arrive	28 April	27 April	2 May	7 May
Males define territories	28 April	27 April	26 April	24 April
Females begin nesting	-	11 May[1]	17 May[2], 25 May*	7 May
Fledglings leave nest	-	6 June to 18 June	30 June*	-

[1] Active nest 11 May 2012, two more on 21 May 2012

[2] Female begging behavior to male observed on 17 May 2013, 25 May 2013 back-calculated as likely nest initiation date for Warbling Vireo nest that fledged on 30 June.

Table 4-9. Nesting chronology of active bird nests found in Poopenaut Valley, Yosemite National Park, 2014. Dates of nest building, egg-laying, and fledging are calculated from date of direct observation, and in the absence of multiple visits, the dates are estimated based on observed nesting behavior and marked with an asterisk (*). Fledge date is hypothetical except for confirmed successful nests. U = Unknown, due to not enough information known about status of nest. Highlighted nest names are riparian focal species.

NEST NAME	UTM EASTING	UTM NORTHING	ELEVATION (M)	ESTIMATED NEST HEIGHT FROM GROUND (M)	DATE FOUND	DATE OF BUILDING	DATE OF EGG LAYING	DATE OF HATCHING	DATE OF FLEDGING	FATE
BHGR01	251941	4200440	1014	9	13 May	2 May*	7 May	19 May*	30May*	Fail
BLPH01	252367	4200842	1019	1.5	1 May	7 April*	21 April*	7 May	25 May*	Fail
BUOR01	252029	4200651	1023	9.1	1 May	1 May	2 May*	13 May*	27 May*	Fail
HAWO01	252026	4200624	1021	3.0	1 May	5 April*	19 April*	1 May*	24 April*	Fledge
HOWR01	251968	4200541	1015	2.4	18 June	U	U	U	U	Unknown
LEGO01	251982	4200565	1015	7.6	30 June	24 June*	30 June	12 July*	25 July*	Unknown
NRWS01	252137	4200627	1013	2.4	28 May	U	28 May	13 June*	3 July*	Unknown
SOSP01	251954	4200596	1018	0.30	13 May	30 April*	4 May*	19 May*	28 May	Fledge
SOSP02	252089	4200642	1014	1.5	13 May	21 April*	26 April	11 May*	23 May*	Unknown
WAVI01	251996	4200674	1014	3	7 May	7 May	11 May*	27 May*	15 June*	Fail
WEWP01	251979	4200547	1015	6.1	7 May	7 May	12 May*	25 May*	11 June*	Fail
WEWP02	251965	4200596	1018	4.6	13 May	11 May*	16 May*	29 May*	15 June*	Fail
WEWP03	251966	4200575	1015	6.1	28 May	24 May*	29 May*	12 June*	29 June*	Fail
YEWA01	251976	4200555	1015	4.6	14 May	28 April*	1 May*	14 May*	26 May*	Unknown

4.3.7 2007-2014 Cumulative Breeding Bird Summaries

Out of 105 species detected during 2007-2014 area searches, 2008-2014 point counts, 2010-2014 spot mapping, 2013-14 nest searching, and 2013-14 incidental observations, we have confirmed 27 breeding species, detected 34 probable breeding species, 15 possible breeding species, and 29 unlikely breeding species in all study areas and points combined. Of these, 7 are riparian focal species (Black-headed Grosbeak, Song Sparrow, Spotted Sandpiper (*Actitis macularia*) Warbling Vireo, Wilson's Warbler, Yellow-breasted Chat (*Icteria virens)*, and Yellow Warbler (RHJV, 2004); 2 are California Species of Concern (Yellow Warbler and Yellow-breasted Chat); 2 are nest predators [Steller's Jay (*Cyanocitta stelleri)* and Western Scrub-Jay (*Aphelocoma californica*)], and 1 is an invasive brood-parasite, Brown-headed Cowbird (Table 4-10).

Table 4-10. List of 105 bird species detected and their breeding status from area search (AS), point count (PC), spot map (SM), and nest searching (NS) surveys, or incidental observations (I), in Poopenaut Valley, Yosemite National Park, April – July, 2007 to 2014. Species observed in 2014 are in bold.

Species	Unlikely	Possible	Probable	Confirmed	Survey Type
Acorn Woodpecker				ON, T	SM, AS, PC
American Coot	X				SM
American Crow	X				SM
American Dipper				CF	SM
American Robin				ON, T, CF, S, CN	SM, AS, PC
Anna's Hummingbird				CN, T	SM, AS, PC
Ash-throated Flycatcher		X			SM, AS
Bald Eagle	X				SM
Band-tailed Pigeon		X			SM, AS
Belted Kingfisher				CN, CF	SM, AS
Bewick's Wren			S		SM, AS
Black Phoebe				ON	SM, AS, PC
Black-headed Grosbeak				CF, P, T, CN, ON, F	SM, AS, PC
Black-throated Gray Warbler			S, P, T		SM, AS
Blue-gray Gnatcatcher			S		SM, AS
Brewer's Blackbird			S, P		SM, AS
Brown Creeper			S		SM, AS, PC
Brown-headed Cowbird			S		SM, AS, PC
Bufflehead	X				I, SM
Bullock's Oriole				ON, CN, F, CF	SM, AS, PC
Bushtit			P		SM, AS
California Towhee			S, P		SM, AS

Calliope Hummingbird			T, P		AS
Canada Goose			S, P		SM
Canyon Wren			S, P, T		SM, AS, PC
Cassin's Finch	X				SM
Cassin's Vireo				ON, T, S, P	SM, AS, PC
Cedar Waxwing	X				AS
Chipping Sparrow				S, CN, P, T	SM, AS, PC
Cliff Swallow	X				SM
Common Merganser				F	SM, AS, PC
Common Poorwill		S			I
Common Yellowthroat	X				SM
Dark-eyed Junco			S, P		SM, AS
Downy Woodpecker		X			SM, AS
Dusky Flycatcher			S, P		SM, AS, PC
Eared Grebe	X				
Evening Grosbeak	X				AS
Golden Eagle	X				
Golden-crowned Kinglet			S		SM
Gray Flycatcher	X				SM, AS, PC
Great Egret	X				SM
Great Horned Owl	X				I
Hairy Woodpecker				CF	SM, AS, PC
Hammond's Flycatcher			S		SM
Hermit Warbler	X				SM
House Wren				ON, T, S, P	SM, AS, PC
Hutton's Vireo		X			AS
Indigo Bunting	X				NS
Lark Sparrow	X				SM
Lawrence’s Goldfinch				P, F	NS, I
Lazuli Bunting			S, P, T		SM, AS, PC
Lesser Goldfinch				ON, S, P	SM, AS, PC
Lincoln's Sparrow				CN	PC, AS
MacGillivray's Warbler			S		SM, PC, AS
Mallard				F, ON, P	SM, AS, PC
Marsh Wren	X				SM
Mountain Chickadee			S		SM
Mountain Quail			S		SM, AS, PC
Mourning Dove			P		SM, AS
Nashville Warbler			S, P, T		SM, AS, PC
Northern Flicker				ON	SM, AS, PC
Northern Pygmy-Owl		X			NS

Northern Rough-winged Swallow				CN, ON	SM, AS, PC
Northern Saw-whet Owl		X			I
Nuttall's Woodpecker			S, D		SM, AS
Oak Titmouse		X			SM, PC
Orange-crowned Warbler			S		SM, PC
Osprey		X			SM
Pacific-slope Flycatcher			S		SM, AS
Painted Redstart	X				I
Pine Siskin		X			SM, AS
Purple Finch				CN, S, P	SM, AS, PC
Red-breasted Nuthatch			S		SM, AS, PC
Red-tailed Hawk	X				I
Red-winged Blackbird			S, P, T,C		SM, AS, PC
Ruby-crowned Kinglet	X				SM
Savannah Sparrow	X				SM, AS
Song Sparrow				CN, CF, F, T, S, P, C, ON	SM, AS, PC
Spotted Owl			P, S		I
Spotted Sandpiper			P		SM, AS
Spotted Towhee				ON, S, P, CF, F	SM, AS, PC
Steller's Jay			P, F		SM, AS, PC
Townsend's Warbler	X				SM
Tree Swallow		X			SM
Vaux’s Swift	X				I
Violet-green Swallow				F	SM, AS, PC
Virginia Rail		X			SM
Warbling Vireo				CF, T, S, P, CN, F, ON	SM, AS, PC
Western Bluebird		X			SM
Western Kingbird	X				SM
Western Meadowlark	X				I
Western Scrub-Jay			P		SM, AS, PC
Western Tanager				CN	SM, AS, PC
Western Wood-Pewee				ON, S, P, CN	SM, AS, PC
White-breasted Nuthatch	X				PC
White-crowned Sparrow	X				AS
White-headed Woodpecker	X				PC
White-throated Swift			P, C		SM, AS, PC
Wilson's Warbler		X			SM, AS
Wood Duck			P		SM
Wrentit			S		SM, AS, PC
Yellow Warbler				ON, CN S, P, T, CF, C, F	SM, AS, PC

Yellow-breasted Chat		S			SM, AS, PC
Yellow-rumped Warbler			S		SM, AS, PC

Breeding status for each species reported as unlikely, possible, probable, and confirmed (see National Park Service, 2007) at Poopenaut Valley, summers 2007-2014. Unlikely species represent those species considered transient in Poopenaut Valley. Codes indicating breeding status are: X = detected in study area during the breeding season; P = pair observed during the breeding season; S = more than one singing male in study area or male bird singing during at least 3 visits; D = drumming woodpecker heard; C = courtship behavior or copulation observed; T = Territorial behavior; CN = bird observed carrying nest material or nest building; CF = bird observed carrying food for young; F = recently fledged or downy young observed; ON = occupied nest observed.

4.4 Discussion

This year was the third consecutive extremely dry year in Poopenaut Valley and the third summer in which no substantial spring pulse was released from O'Shaughnessy Dam. This year also marked the first breeding bird season after Poopenaut Valley was burned in the Rim Fire during late summer 2013, which adds a level of difficulty to our investigation of the effects of flow rates of the Tuolumne River on bird breeding ecology in Poopenaut Valley.

The Rim Fire burned North Poopenaut on 23-24 August and South Poopenaut on 10-11 September. The fire caused dramatic changes to the habitat of Poopenaut Valley, most notably the death of many willows throughout the Valley. While the Rim Fire affected the structure and amount of vegetation in Poopenaut Valley, results are not conclusive on how these changes in vegetation affected the breeding birds.

Search Area 5 had the highest species richness, abundance, diversity, and evenness. A rather large swath of willows was burned on the south side of the river. While the fire changed the habitat and made it no longer suitable for some birds (e.g., riparian focal species), it may have actually provided habitat for other, more fire-adapted species, such as Lawrence's Goldfinch and Lazuli Bunting, which were observed this year in larger numbers than in past years. We found that Area 1 had the lowest species richness, diversity, and evenness. Species richness in Area 1 continued its disturbing decline with this year's species richness being 41.6% lower than in 2013, 53% lower than in 2012, and 55% lower than the pre-drought species richness average from 2007-2011. While the Rim Fire certainly had some effect on the birds of Poopenaut Valley, these results might be more indicative of the drought conditions that are further exacerbated by the lack of water in the seasonal pond.

We found that species richness and relative abundance were lower in 4 out of 5 search areas when compared to 2013 results. In Search Area 1, relative abundance was higher than in 2013; however abundance was driven by an unusual sighting of 20 Lawrence's Goldfinches during the third visit. In general, bird abundance and diversity were both well below average numbers.

The seasonal pond dried out in mid-May this year, due to the lack of a spring pulse. The nesting of birds within and around the seasonal pond may rely on the pond containing water. Red-winged Blackbirds were observed on territory until May 28, which is just after the seasonal pond dried out. However, no Red-winged Blackbirds were observed building nests and no fledglings were observed. The lack of water may have an effect on the relative abundance of food and the type of vegetation within the wetland. Rainfall and its effects on vegetation type and insect abundance may control the population size of Red-winged Blackbirds (Brenner 1966).

We detected two Riparian Focal Species (RFS), a male Song Sparrow and a male Yellow Warbler, in North Poopenaut adjacent to the seasonal pond. Both were observed singing throughout Areas 1 and 2, which is consistent with previous observations. We did not detect any females in these areas and while males were detected on multiple visits, we saw no indication that these species were using this area as nesting habitat. Additionally, the willows surrounding the seasonal pond were killed in the Rim Fire, making this area even less suitable for riparian birds. A concerted effort to color-band individuals singing in these areas would allow for the tracking of these birds within their breeding season, which could help explain the relationship between the seasonal pond and riparian bird species.

Using the spot mapping technique, we closely monitored the populations of Riparian Focal Species in Poopenaut Valley and quantified the number of breeding pairs and nest locations. We found that Black-headed Grosbeaks did not have any territories within the willows along the Tuolumne River in 2014, a noticeable change from results of past years. This is likely linked to the large die-off of willows caused by the Rim Fire. We also noticed that there were fewer Song Sparrow and Yellow Warbler territories along the Tuolumne River and these territories were larger. Territory size has been linked to other aspects of the biotic and abiotic community, including avian body size, intraspecific competitive pressure, and resources availability (Peters, 1983; Schoener, 1968; Tompa, 1962; Hixon, 1980). It may be possible to use territory size to develop metrics to study these other variables as an evaluation of the health of bird communities and to gauge the relative habitat quality in Poopenaut Valley, but much more data on individual bird movement will be needed to make inferences pertaining to territory size.

Nest searching continued to provide insight on both habitat use and reproductive success of bird species in Poopenaut Valley. We found several nests within the flood plain of the Tuolumne River, including a Song Sparrow nest within flood debris five feet off the ground in a small willow. We detected two Song Sparrow nests, one Northern Rough-winged Swallow nest, and one Hairy Woodpecker nest less than ten feet above the surface of the river. These nests would be highly susceptible to increases in water flow, especially later in the breeding season. Continued monitoring of the nests is imperative to understand the relationship between habitat quality and reproductive success in Poopenaut Valley.

Color-banding individual Warbling Vireos, Yellow Warblers, and Song Sparrows was integral in determining territory size and tracking individuals throughout the field season. Color-banding allowed us to attribute nest success to a specific individual in five cases. We found that one male Song Sparrow had likely successfully fledged five young; one male Song Sparrow held a territory with a nest that had an unknown fate; a male Warbling Vireo defended a territory where his nest failed; a male Yellow Warbler was seen feeding a fledgling; and a male Yellow

Warbler was seen feeding a female on her nest, however the fate of this nest is unknown. Additional color-banding of Riparian Focal Species will allow us to better understand the reproductive success and habitat use of individual birds in Poopenaut Valley. More frequent visits and more time spent observing color banded birds will also contribute to better understanding bird ecology in Poopenaut Valley.

Heath and Ballard (2003) looked at the relationship between bird communities and habitat characteristics of several riparian drainages in the Eastern Sierra, and found that riparian width had a strong positive correlation with the probability of occurrence of Yellow Warblers and Song Sparrows. The regeneration of cottonwood and willow trees is frequently compromised in riparian systems with altered hydrological regimes such as peaks and timing of flows. Natural hydrological processes are integral to the establishment of willow/alder shrub habitats with dense understory cover, which is critical to many riparian focal species (RHJV 2004). Based on our on-going research, it remains our recommendation to mimic a natural hydrograph as closely as possible in order to fill the ephemeral pond and maximize available nesting habitat and prey availability.

Chapter 5. 2014 Bat Studies in Poopenaut Valley

5.1 Introduction

Bats are essential in maintaining ecosystem health by controlling insect populations through nighttime foraging. Most bat species forage either directly over water or within the adjacent riparian zone, where plant and insect productivity is higher than in seasonally dry upslope areas. The riparian zone of Poopenaut Valley represents important foraging habitat for bat populations. There are 17 bat species known to occur within Yosemite National Park (Pierson et al., 2001), five of which are special status species that have experienced state-wide declines (Table 5-1). While population declines are based largely on issues that affect these species outside park boundaries, they serve to highlight the importance of park land as potential refugia, and signal a potentially heightened sensitivity of these species to management activities within the park.

Table 5-1. Common and scientific names of the seventeen bat species known to occur in Yosemite National Park. Species in bold indicate California species of special concern.

Common Name	*Genus species*
Pallid bat	***Antrozous pallidus***
Townsend's big-eared bat	***Corynorhinus townsendii***
Big brown bat	*Eptesicus fuscus*
Spotted bat	***Euderma maculatum***
Western mastiff bat	***Eumops perotis***
Western red bat	***Lasiurus blossevillii***
Hoary bat	*Lasiurus cinereus*
Silver-haired bat	*Lasionycteris noctivagans*
California myotis	*Myotis californicus*
Small-footed myotis	*Myotis ciliolabrum*
Long-eared myotis	*Myotis evotis*
Little brown bat	*Myotis lucifugus*
Fringed myotis	*Myotis thysanodes*
Long-legged myotis	*Myotis volans*
Yuma myotis	*Myotis yumanensis*
Western pipistrelle	*Parastrellus hesperus*
Mexican free-tailed bat	*Tadarida brasiliensis*

Bat populations in Poopenaut Valley may also serve as an ecological indicator of habitat health by providing information for further refining flow recommendations for the Tuolumne River, particularly the timing of when water should be released from O'Shaughnessy Dam. Past studies suggest that the highest bat species diversity, detection rates, and degree of foraging activity occur in the park's lower elevations (Pierson et al., 2001, Pierson et al., 2006, Pierson and Rainey 2009, Rainey et al., 2009). Most bat species in Yosemite forage for insects over ponds, rivers, meadows, and among riparian vegetation, which are all affected either directly or indirectly by stream flow. Bat species richness and foraging activity can be linked to prey availability which appears to respond to fluctuations in stream flow. This study aims to (1) determine seasonal patterns of bat species present in Poopenaut Valley, (2) quantify bat foraging activity in relation to stream flow, (3) aid in understanding the ecology of the seasonal pond as related to insect availability and stream flow, and most importantly (4) provide recommendations to SFPUC on timing water releases from O'Shaughnessy Dam in order to benefit focal bat species.

A fifth study objective has been added due to wildfire in the study area during August and September 2013The Rim Fire offers a unique opportunity to study the effects of wildfire on the bat assemblages inhabiting Poopenaut Valley, as described below.

5.2 Methods

We conducted acoustic bat surveys at two sites in Poopenaut Valley to determine species presence and activity level. We deployed one bat detector on the south side of the Tuolumne River and operated it on a year-round basis in order to determine seasonal bat patterns in relation to stream flow. We deployed a second bat detector on the north side of the Tuolumne River adjacent to the seasonal pond and, when accessible, operated it to determine the relationship between bat foraging activity and water levels and insect availability in the adjacent seasonal pond (Figure 5-1).

At each site, we secured one detector and external battery in a locked metal box at the base of a 20 foot tall metal pole (Figure 5-2). At the top of the metal pole, we mounted an external microphone in a weather-proof metal casing and positioned it horizontally to face the meadow opening (south site) and seasonal pond (north site) in order to increase the detection probability of foraging bats. We powered each detector with a 6-volt external battery, which was secured in the locked metal box. Each detector recorded sound in the high frequency range continuously during each night between 1900 and 0700 during the first month of survey. For the remaining time period, each detector recorded sound in the high frequency range each night at two different time periods: (1) 1800 - 2300 and (2) 0300 - 0800. Acoustic surveys at the south site occurred from 14 April 2011 to 10 September 2014. Acoustic surveys at the north site occurred from 19 April 2011 to 10 September 2014. Detectors were scheduled to be checked on a monthly basis.

Figure 5- 1. Acoustic monitoring sites targeting bat species in Poopenaut Valley, Yosemite National Park. Monitoring occurred between April 2011 and September 2014 at two sites: (A) north of the Tuolumne River adjacent to the seasonal pond and (B) south of the Tuolumne River.

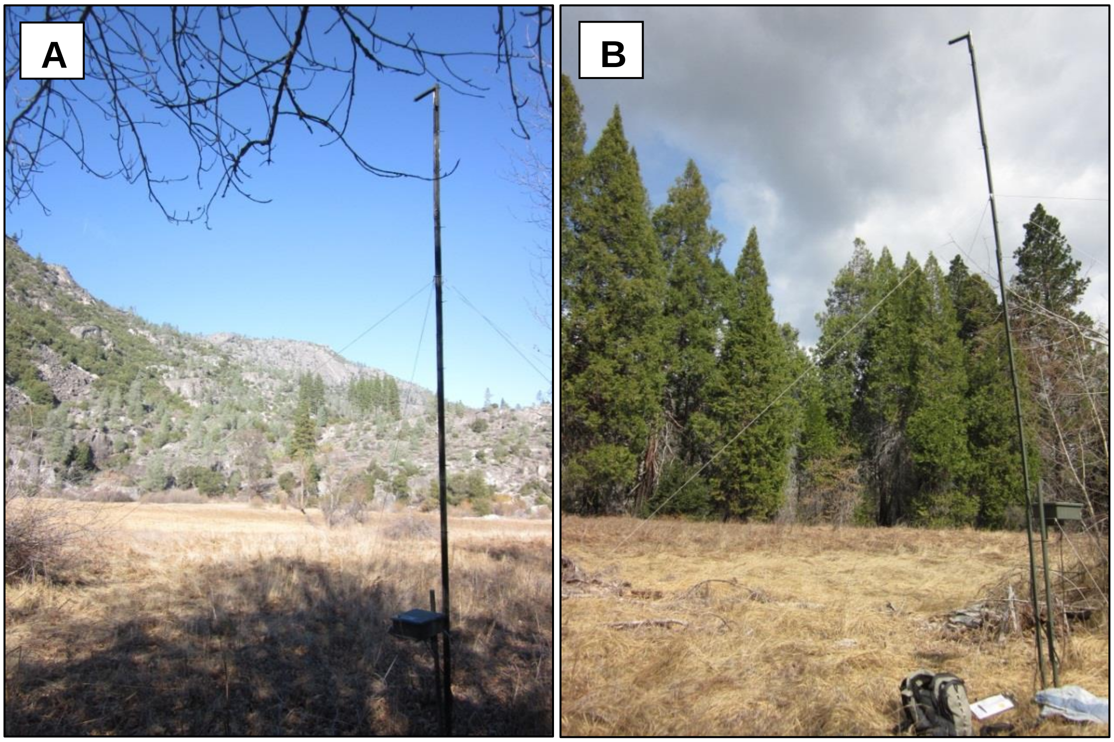


Figure 5-2. Acoustic bat detector set-ups in Poopenaut Valley (A) north of the Tuolumne River adjacent to the seasonal pond, and (B) south of the Tuolumne River.

We used Pettersson D500x ultrasound recording units coupled with SonoBat™ software for full-spectrum acoustic monitoring and bat echolocation call identification. The Pettersson D500x hardware is built specifically for long-term passive monitoring. SonoBat™ software provides a comprehensive tool for analyzing and comparing high-resolution full-spectrum sonograms of bat echolocation calls. SonoBat™ uses a decision engine based on the quantitative analysis of approximately 10,000 species-known recordings from across North America. The software automatically recognizes and sorts calls, then processes the calls to extract six dozen parameters that describe the time-frequency and time-amplitude trends of a call.

SonoBat's call trending algorithm recognizes the end of calls buried in echo and noise as well as establishes trends through noise and from low power signals. SonoBat™ generates high resolution continuous trends of time-frequency and time-amplitude content that enable robust parameter extraction. Inclusion of amplitude parameters increases classification performance above that achieved by using time-frequency parameters alone. We analyzed echolocation call data from each site using the batch process option in SonoBat™. The discriminant probability threshold for each echolocation call was set at 0.90 and the acceptable call quality was set at 0.80. Species were identified by consensus only.

Due to erratic equipment failure (both sites), bear damage (north site only) and accessibility issues (north site only), continuous monitoring was not conducted during 2012 and 2014, with a large data gap during the summers. Additionally, during December 2012, human error resulted in incorrect recording times at the north site, with the detector recording at a less than optimal time period (i.e. during daylight) for one of the daily monitoring sessions during that month. From 7-Dec-12 through 8-Jan-13, the detector at the north site recorded from: (1) 0700 – 1300 and (2) 1700 – 2200, effectively reducing detection probability by half. Although no species were detected at the south site during this same period, the detector appeared to be functioning. Total seasonal monitoring effort for each site is shown in Table 5-2.

The Rim Fire burned the north side of Poopenaut Valley 23-34 August 2013 and the south side 10-11 September 2013 (Figures 5-3, 5-4). Both bat detectors were in burned areas but continued to record when fire swept through the valley. The detector at the south site suffered minimal damage (burnt external microphone cable) whereas the detector at the north side remained undamaged.

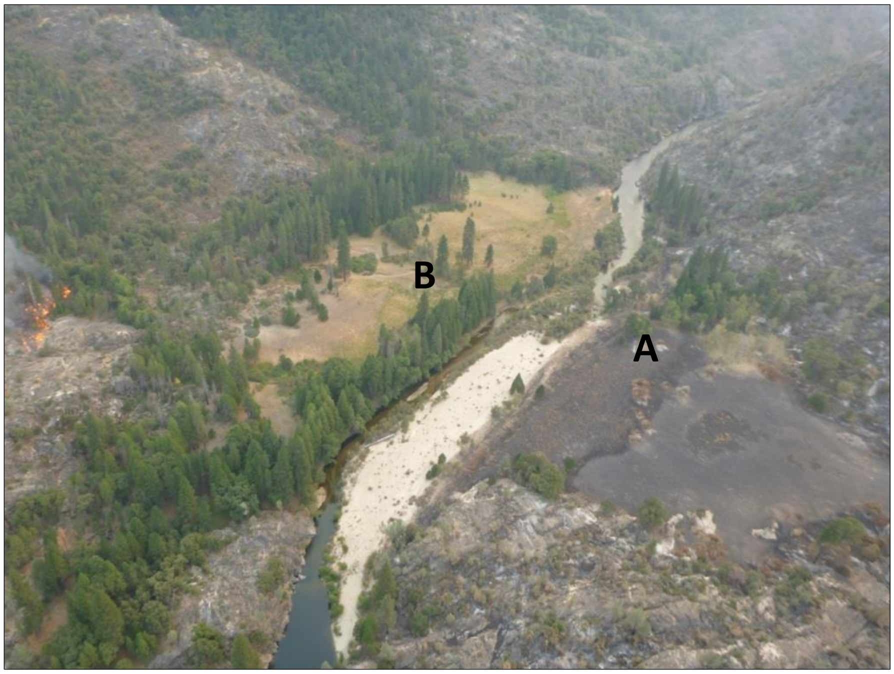


Figure 5-3. Aerial image of Poopenaut Valley taken 10 September 2013 showing active burn front of the Rim Fire on the south side of the valley, and the area on the north side of the valley that burned on 23-24 August 2013. The northern area includes the seasonal pond and site of the north bat detector (A). The active burn front eventually reached the bat detector at the south site (B).

Figure 5-4. Poopenaut Valley post-Rim Fire on 23 September 2013. Bat detectors at the north site (A) and the south site (B) were in burned areas. Both detectors were recording during the Rim Fire.

5.3 Results

We documented a high diversity of bat species in Poopenaut Valley from spring 2011 through late summer 2014. Over this 3.5 year monitoring period, we detected all 17 bat species known to occur within Yosemite National Park (Pierson et al. 2001) in Poopenaut Valley; thus, Poopenaut Valley alone is as diverse as the rest of Yosemite National Park combined. Five of the 17 documented species are California species of special concern (pallid bat, spotted bat, western mastiff bat, Townsend's big-eared bat, and western red bat). Western red bat was detected for the first time at both the north and south sites in August - September 2013, during the period when the Rim Fire burned through the study area. They were again documented in August and September 2014. Similarly, the fringed bat was detected for the first time at both sites during the Rim Fire and has been detected at both sites throughout 2014. Although the pallid bat was detected at the south site in 2011 and at the north site in 2012, it was not detected at either site in 2013. In 2014, pallid bat were again detected at both sites throughout the summer.

Preliminary results show that bat assemblages in Poopenaut Valley varied by year, season (Figures 5-5 to 5-8), and site (Figures 5-9 to 5-12). Whereas the majority of species tended to arrive in late spring/early summer, peak in detection frequency during late summer, and depart sometime during the fall, two species stood out with considerably higher detection frequencies: spotted bat and Mexican free-tailed bat (Figures 5-5 and 5-6). The biggest difference in detection frequency occurred at the south site during spring 2014; the spotted bat had 14 times as many detections as the next most frequently detected species, the Mexican free-tailed bat. Spotted bat detections dropped off slightly, but remained high throughout summer and fall 2014 at the south site. Through summer and fall 2014, detection rates for Mexican free-tailed bats at the north detector were the highest we've documented over the past 3.5 years (Figure 5-5). During this same time period, very high detection rates were also documented for California myotis, western mastiff bat, and western pipistrelle (Figures 5-5 and 5-6). Habitat requirements and arrival/departure dates of the eight most frequently detected bat species in Poopenaut Valley are described in Table 5-3.

Seasonal bat use of Poopenaut Valley varied between species, with Mexican free-tailed bat being the only species that was detected year-round at both sites over the duration of the study period (Figures 5-5 to 5-8). During winter 2013/14, multiple species were detected at the south site, including western mastiff bat, spotted bat, hoary bat, silver-haired bat, and California myotis. North site detections in winter 2013/14 included hoary bat, silver-haired bat, California myotis, and Yuma myotis.

Interestingly, detection frequency increased for the majority of bat species at both sites during the Rim Fire in late summer 2013 (Figures 5-5 to 5-8). During the Rim Fire, the Mexican free-tailed bat had the highest detection frequency at the north site, followed closely by California myotis, and to a lesser extent, canyon bat, hoary bat, and Yuma myotis. At the time, the California myotis had the highest detection frequency ever recorded for this species at the north site during the Rim Fire. At the south site, there were noticeable increases in detection frequencies of the Mexican free-tailed bat, silver-haired bat, California myotis, big brown bat, Yuma myotis, and long-legged myotis during the Rim Fire. In past years at both sites during this time period, in the absence of fire, the majority of species detection frequencies decreased or remained stable.

While detection frequencies increased during the Rim Fire, the largest increases for many species occurred during spring-fall 2014. This increase was pronounced at both sites, though each site had different ratios of species. At the north site, Mexican free-tailed bat, California myotis, western pipistrelle, hoary bat, Yuma myotis, silver-haired bat, big brown bat, and fringed myotis all set record highs (Figures 5-5 and 5-7). Similarly, at the south site, spotted bat, California myotis, western mastiff bat, western pipistrelle, hoary bat, Yuma myotis, big brown bat, fringed myotis, and small-footed myotis saw substantial increases (Figures 5-6 and 5-8). At the south site, 2014 set record highs for total number of bat calls, while the north site also saw some of the highest recorded totals (Figures 5-13 and 5-14).

Species richness increased slightly in 2014 at the south site and was fairly consistent with previous years at the north site (Figures 5-15 and 5-16). Species richness is defined as number of species detected in seasonal time periods. Seasonal patterns in species richness were also consistent with previous years at both sites. Summer has the highest level of species diversity while winter has the lowest. Averaged over the length of the monitoring period, the north site had slightly higher species richness than the south site in every season (Figure 5-17).

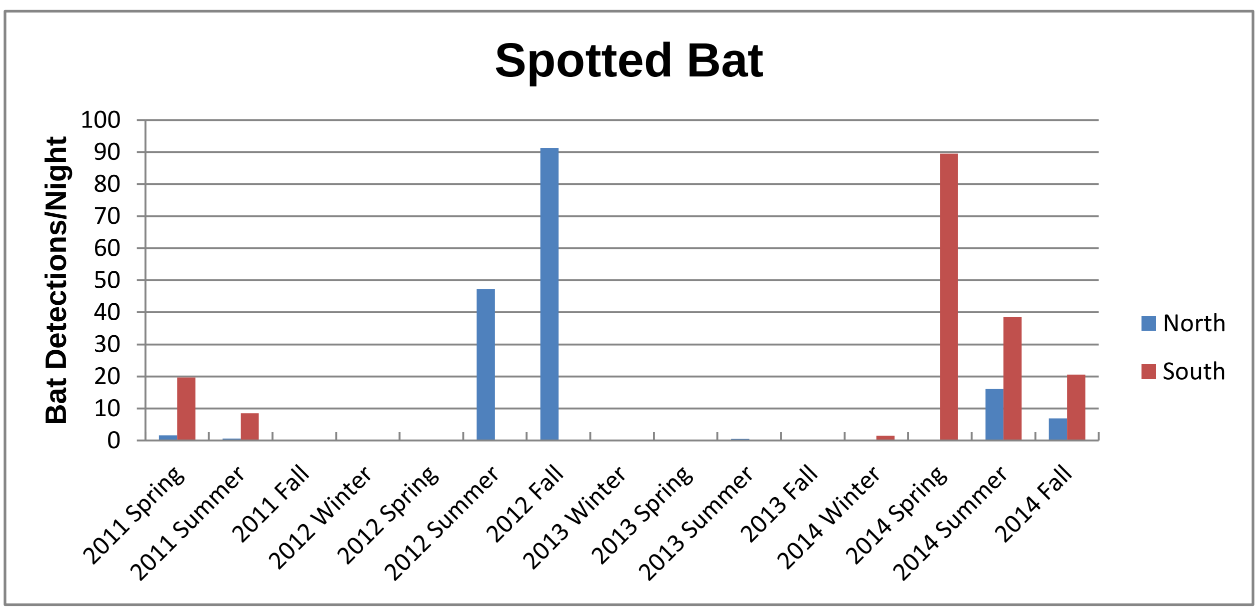
Accessibility issues at the north site and equipment failure at both sites prevented continuous monitoring over the 3.5 year survey period, which had negative effects on the detection probability of each species. While the detection rates take effort into account, we collected much less data over certain periods of time. For example, at the north site during summer 2011, the detector operated only five days during June, July, and August (Table 5-2). As a result, seasonal comparisons between years and sites will become more meaningful when additional data are collected over the coming years.

Table 5-2. Total seasonal monitoring effort from acoustic bat detectors at two sites in Poopenaut Valley, Yosemite National Park from 14 April 2011 to 10 September 2014. Spring is March-May, Summer is June-August, Fall is September-November, and Winter is December-February. For each season and site, the first number indicates total number of days that the detector was operated; the second number in parentheses indicates the percentage that the detector was operated.

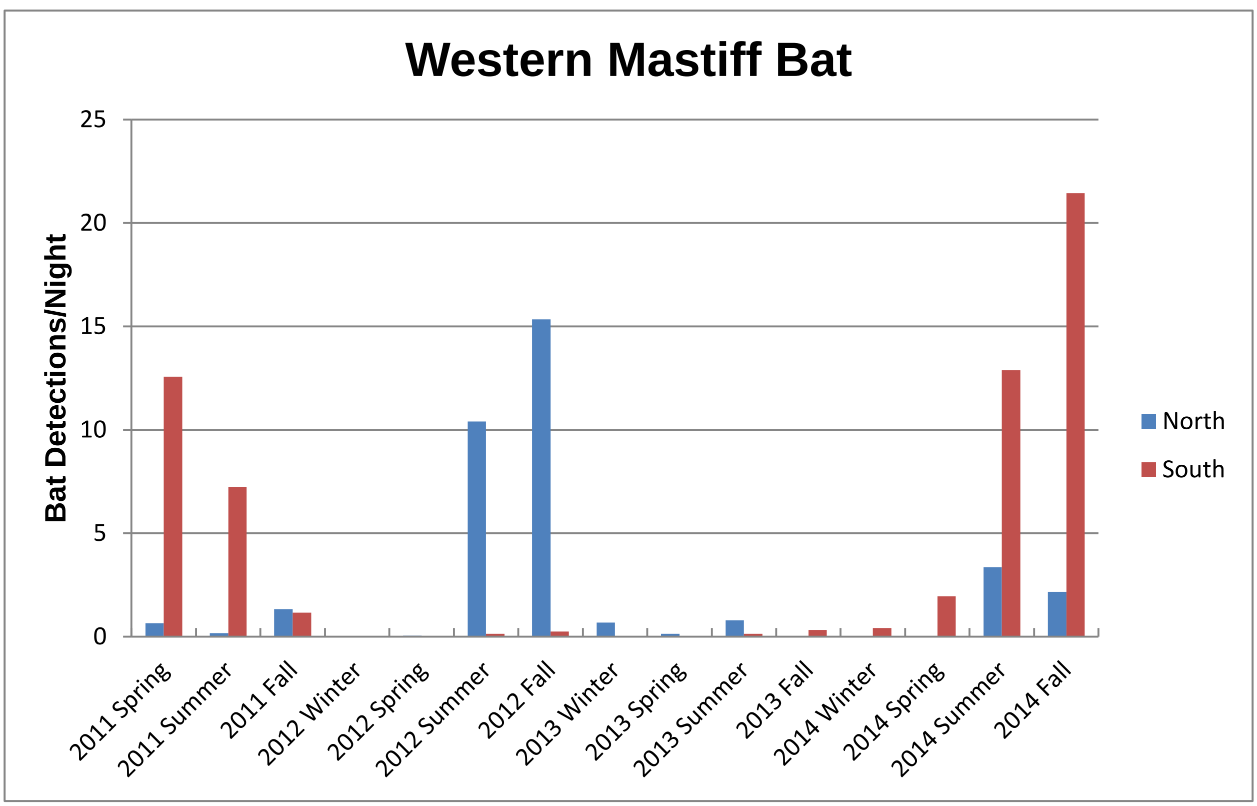
	2011			2012				2013				2014		
	Spring	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**
North	42 (46%)	5 (5%)	48 (53%)	70 (78%)	92 (100%)	88 (96%)	74 (81%)	57 (63%)	92 (100%)	92 (100%)	12 (13%)	53 (59%)	59 (64%)	36 (40%)
South	14 (15%)	18 (20%)	82 (90%)	90 (100%)	90 (98%)	92 (100%)	88 (97%)	87 (95%)	90 (98%)	91 (99%)	22 (24%)	34 (38%)	55 (60%)	68 (75%)

Table 5-3. Occurrence, habitat requirements, arrival/departure dates, and bat detections by season of the eight most frequently detected bat species in Poopenaut Valley from 14 April 2011 to 10 September 2014. Arrival/departure dates represent when each species was first/last detected each year. Some species were present year-round. Note*Acoustic bat detectors were not operating continuously during the entire monitoring period. Refer to Table 5-2 for total seasonal monitoring effort. The vertical axis on graphs is the number of bat detections/number of recording nights.

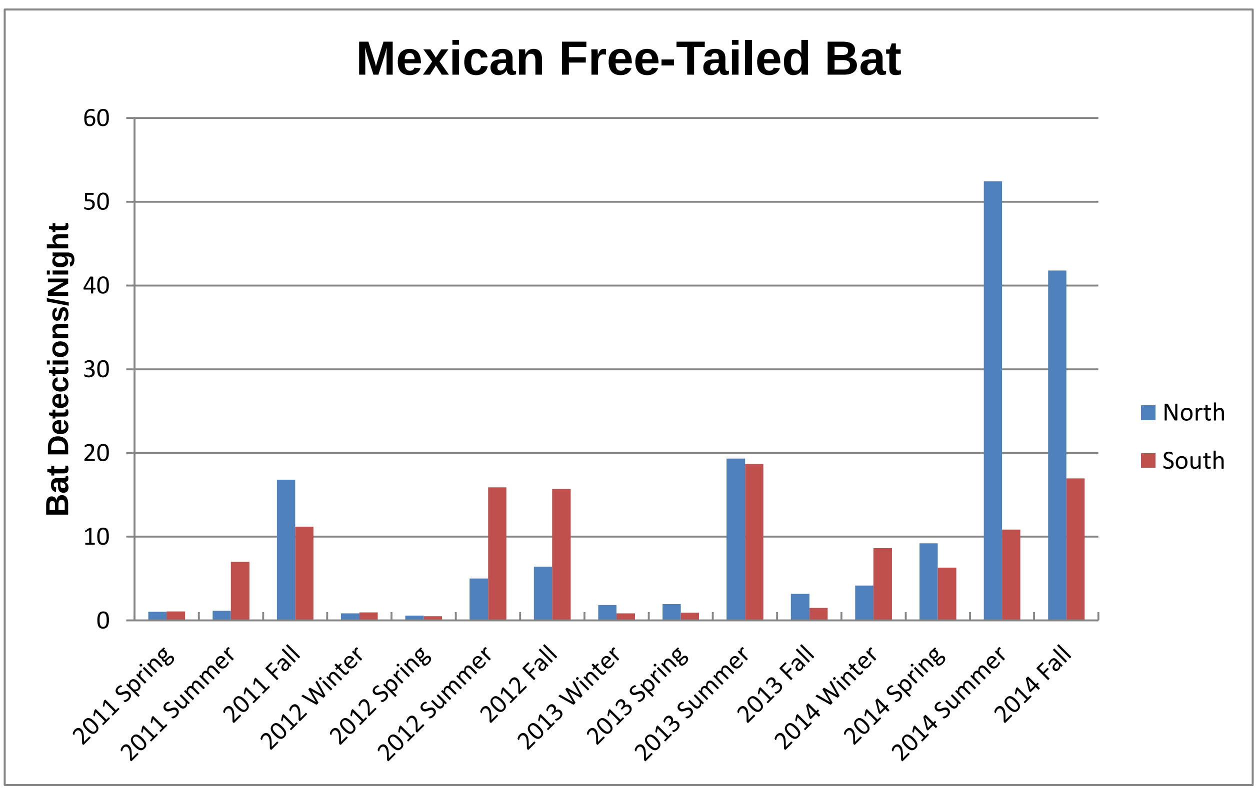
SPOTTED BAT		
Occurrence/habitat	Widely distributed throughout Sierra Nevada, with records > 3000 m. Occurs in habitats ranging from desert scrub to montane coniferous forests	
Feeding type/food source	Forages in a wide variety of habitats,5-15 m off the ground, primarily for moths	
Roosting structure	Uses crevices in rock faces for roosting and reproduction	
Seasonal movements	Makes local movements in some areas, from high elevations in summer to lower elevations in fall. Little is known about the California populations; may be yearlong residents, or migratory.	
	NORTH	**SOUTH**
2011		
Arrival	19-Apr-11	15-Apr-11
Departure	18-Sep-11	16-Sep-11
2012		
Arrival	21-May-12	27-May-12
Departure	8-Nov-12	15-Aug-12
2013		
Arrival	18-May-13	28-Jul-13
Departure	2-Sep-13	24-Aug-13
2014		
Arrival	14-Apr-14	23-Jan-14
Departure	10-Sep-14	10-Sep-14



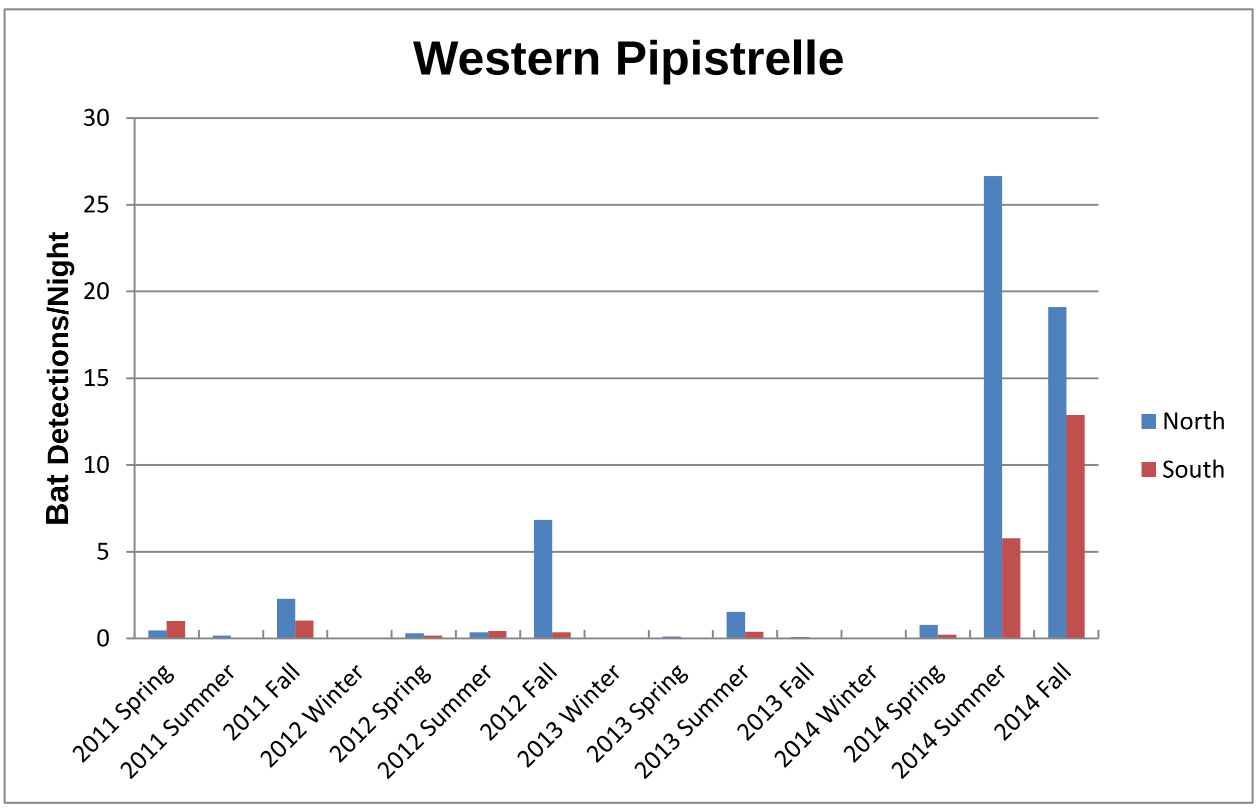
WESTERN MASTIFF BAT		
Occurrence/habitat	Found in a variety of habitats to > 3000 m in elevation. From desert scrub to chaparral to oak woodland and into the ponderosa pine belt.	
Feeding type/food source	Detected most often over meadows and other open areas, but will also feed above forest canopy; sometimes to high altitudes (1,000 feet)	
Roosting structure	Roosts primarily in crevices in cliff faces and occasionally trees	
Seasonal movements	Unknown	
	NORTH	**SOUTH**
2011		
Arrival	19-Apr-11	14-Apr-11
Departure	4-Oct-11	17-Oct-11
2012		
Arrival	1-Jan-12	30-Apr-12
Departure	11-Dec-12	30-Sep-12
2013		
Arrival	16-Jan-13	5-May-13
Departure	10-Sep-13	9-Sep-13
2014		
Arrival	18-Jul-14	28-Mar-14
Departure	10-Sep-14	10-Sep-14



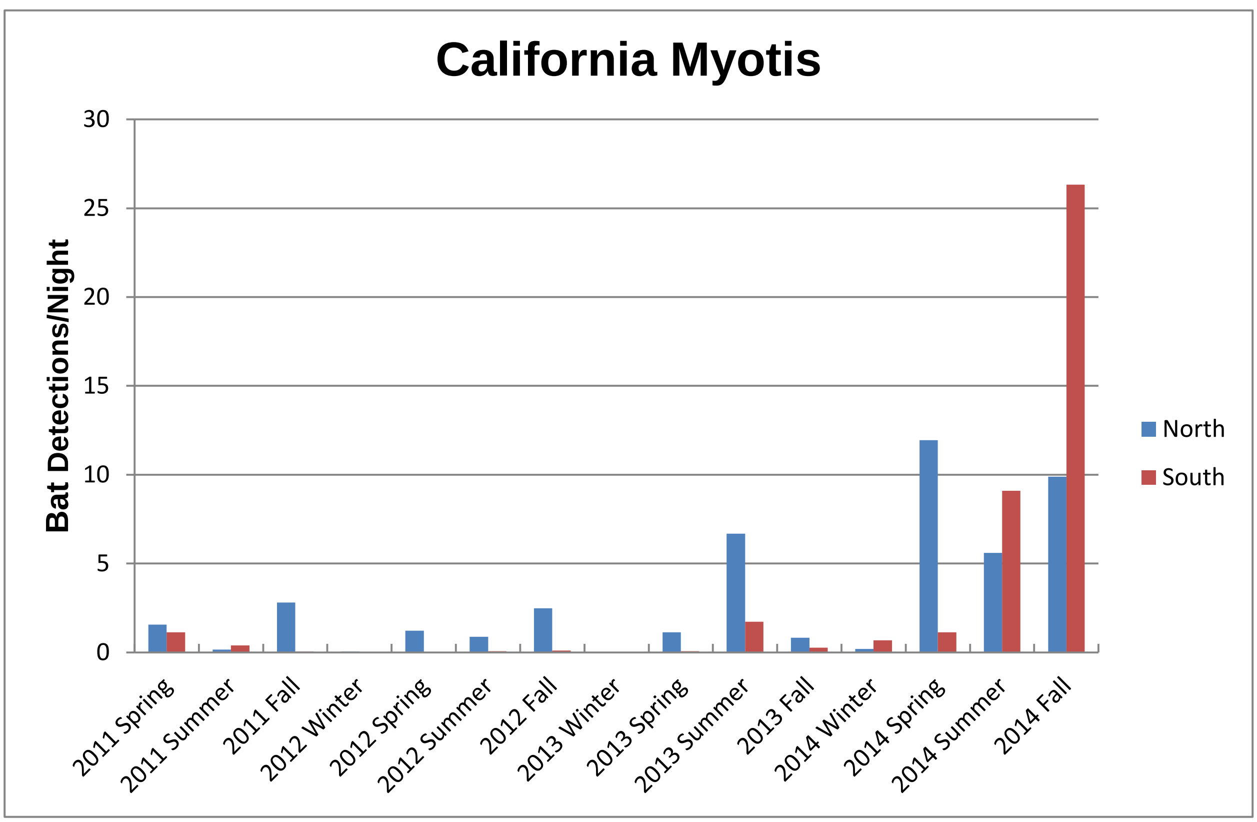
MEXICAN FREE-TAILED BAT		
Occurrence/habitat	Uncommon in high Sierra Nevada but found throughout California. Found in all habitats including mixed conifer forest, but open habitats such as woodlands, shrublands, and grasslands preferred.	
Feeding type/food source	Forages high, 100 feet above ground.	
Roosting structure	Roosts in caves, mine tunnels, crevices, and buildings.	
Seasonal movements	In California, makes local movements to and from hibernacula or short migrations attitudinally.	
	NORTH	**SOUTH**
2011		
Arrival	21-Apr-11	14-Apr-11
Departure	31-Dec-11	31-Dec-11
2012		
Arrival	2-Jan-12	1-Jan-12
Departure	11-Dec-12	26-Nov-12
2013		
Arrival	8-Jan-13	9-Jan-13
Departure	10-Sep-13	11-Sep-13
2014		
Arrival	09-Jan-14	09-Jan-14
Departure	10-Sep-14	10-Sep-14



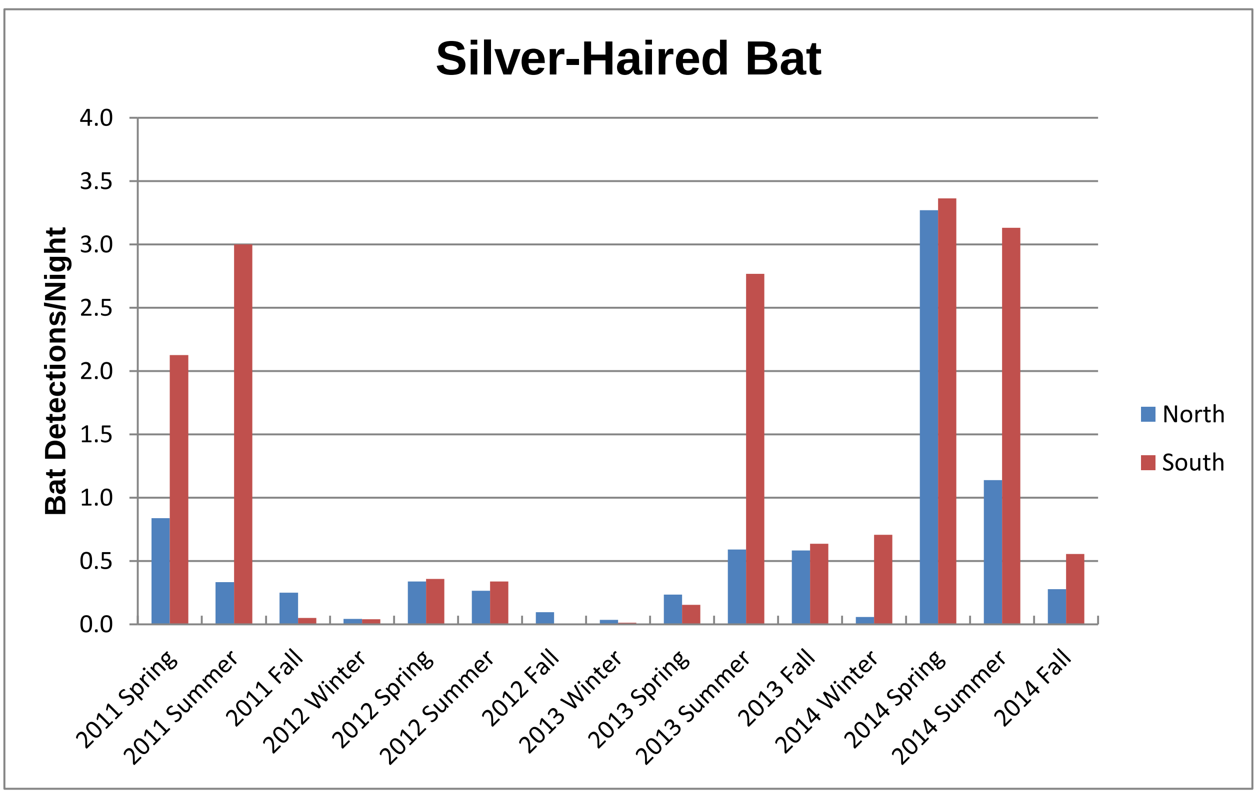
WESTERN PIPISTRELLE		
Occurrence/habitat	Wide range including desert, grassland, woodland, and mixed conifer forests. Yearlong resident in California	
Feeding type/food source	Feeds at low to moderate heights over water, rocky canyons, and along cliff faces.	
Roosting structure	Roosts in rock crevices, mines, caves, and buildings.	
Seasonal movements	Yearlong resident in California. May make local movements.	
	NORTH	**SOUTH**
2011		
Arrival	19-Apr-11	15-Apr-11
Departure	2-Oct-11	2-Oct-11
2012		
Arrival	5-Mar-12	23-Apr-12
Departure	2-Nov-12	5-Oct-12
2013		
Arrival	31-Jan-13	15-May-13
Departure	10-Sep-13	10-Sep-13
2014		
Arrival	28-Mar-14	28-Mar-14
Departure	10-Sep-14	10-Sep-14



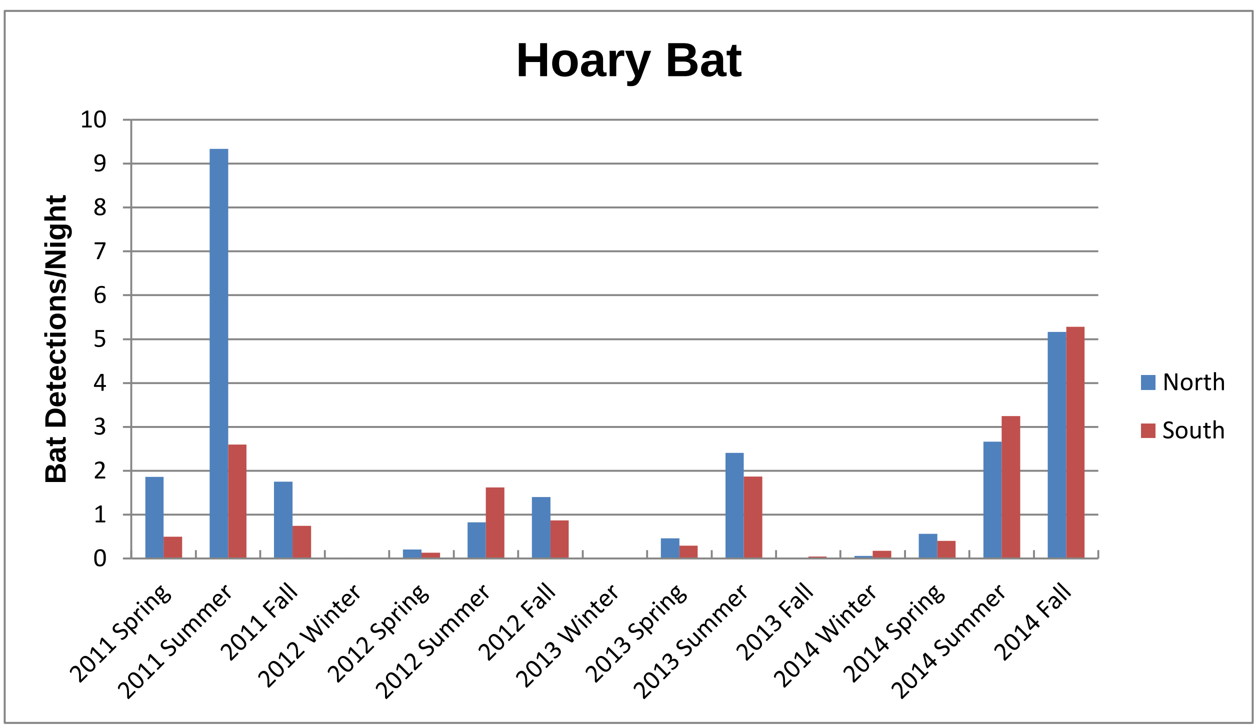
CALIFORNIA MYOTIS		
Occurrence/habitat	Broad distribution over western North America, most abundant at mid-elevations. Found in almost every habitat.	
Feeding type/food source	Forages in canopy and along riparian corridors on insects and moths.	
Roosting structure	Uses crevices in wide variety of natural and anthropogenic structures.	
Seasonal movements	Individuals can be active in winter, even in below freezing temperatures.	
	NORTH	**SOUTH**
2011		
Arrival	19-Apr-11	15-Apr-11
Departure	18-Oct-11	14-Nov-11
2012		
Arrival	13-Jan-12	31-Jan-12
Departure	7-Nov-12	5-Nov-12
2013		
Arrival	2-Mar-13	28-Apr-13
Departure	10-Sep-13	11-Sep-13
2014		
Arrival	23-Jan-14	23-Jan-14
Departure	10-Sep-14	10-Sep-14



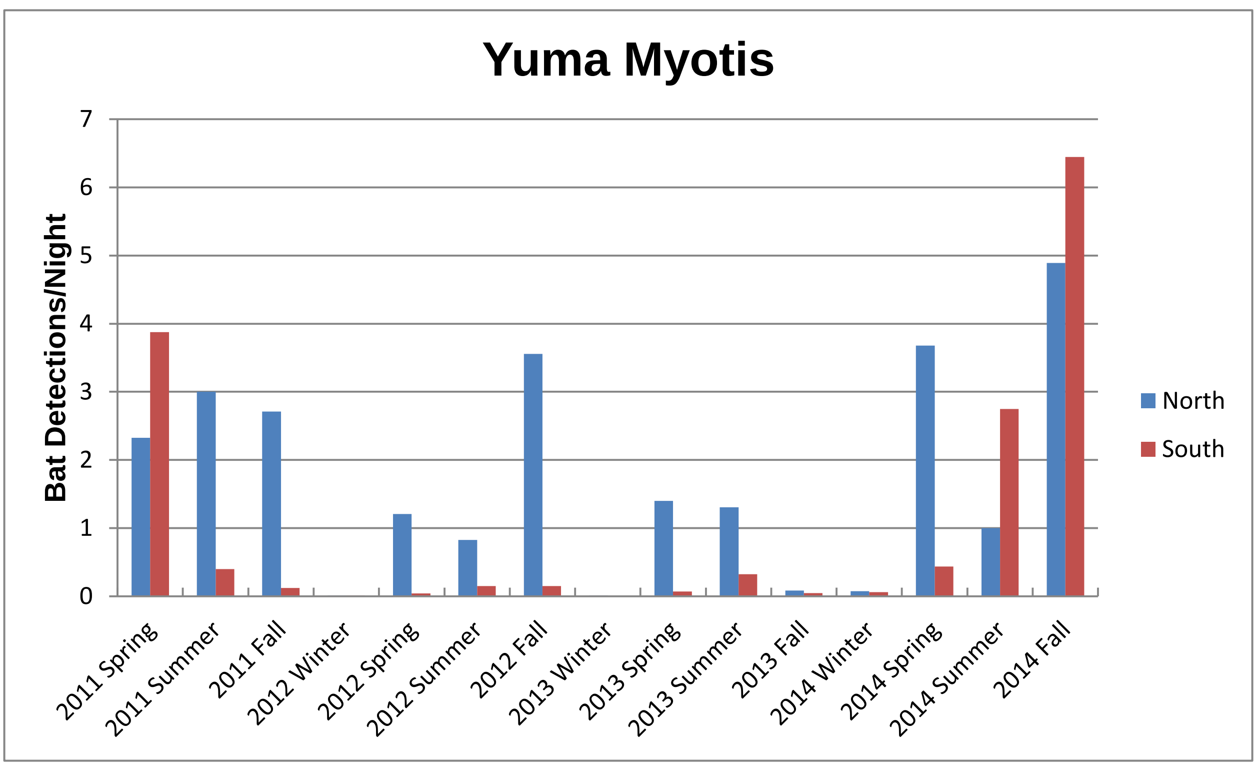
SILVER-HAIRED BAT		
Occurrence/habitat	Broad distribution concentrated in northern part of CA.	
Feeding type/food source	Forages above canopy, in forest clearings, and in riparian zone along water courses for wide variety of insects and moths	
Roosting structure	Roosts in trees	
Seasonal movements	Migratory	
	NORTH	**SOUTH**
2011		
Arrival	2-May-11	15-Apr-11
Departure	27-Dec-11	24-Dec-11
2012		
Arrival	19-Jan-12	1-Jan-12
Departure	21-Dec-12	12-Aug-12
2013		
Arrival	8-Jan-13	3-Feb-13
Departure	10-Sep-13	10-Sep-13
2014		
Arrival	23-Jan-14	23-Jan-14
Departure	10-Sep-14	10-Sep-14



HOARY BAT		
Occurrence/habitat	The hoary bat is the most widespread North American bat. Habitats include cottonwood riparian habitat, forested areas, and woodlands.	
Feeding type/food source	Feeds primarily on moths.	
Roosting structure	Roosts in dense foliage of medium to large-size trees	
Seasonal movements	Migrates between summer and winter ranges, probably over long distances. During spring and fall, large groups are encountered, occasionally in unusual locations. Females precede males in the northward spring migration, which occurs from Feb - May. Fall migration occurs Sep - Nov.	
	NORTH	**SOUTH**
2011		
Arrival	21-Apr-11	16-Apr-11
Departure	18-Oct-11	14-Nov-11
2012		
Arrival	17-Feb-12	24-Apr-12
Departure	15-Oct-12	14-Oct-12
2013		
Arrival	23-Apr-13	19-Jan-13
Departure	9-Sep-13	11-Sep-13
2014		
Arrival	25-Feb-14	23-Jan-14
Departure	10-Sep-14	10-Sep-14



YUMA MYOTIS		
Occurrence/habitat	Usually occurs below 8,000 feet in elevation. Optimal habitats are open forests and woodlands with sources of water over which to feed. More highly associated with water than any other species.	
Feeding type/food source	Forages over open, still, or slow-moving water and above low vegetation in meadows for emergent insects (midges, mayflies, caddis flies) and moths.	
Roosting structure	Roosts in buildings, caves, or crevices.	
Seasonal movements	Probably makes local or short migrations to suitable hibernacula. Individuals that spend summer at high elevations probably move downslope.	
	NORTH	**SOUTH**
2011		
Arrival	21-Apr-11	14-Apr-11
Departure	18-Oct-11	27-Dec-11
2012		
Arrival	25-Feb-12	3-May-12
Departure	7-Nov-12	8-Nov-12
2013		
Arrival	18-Feb-13	27-Apr-13
Departure	10-Sep-13	11-Sep-13
2014		
Arrival	6-Mar-14	28-Mar-14
Departure	10-Sep-14	10-Sep-14



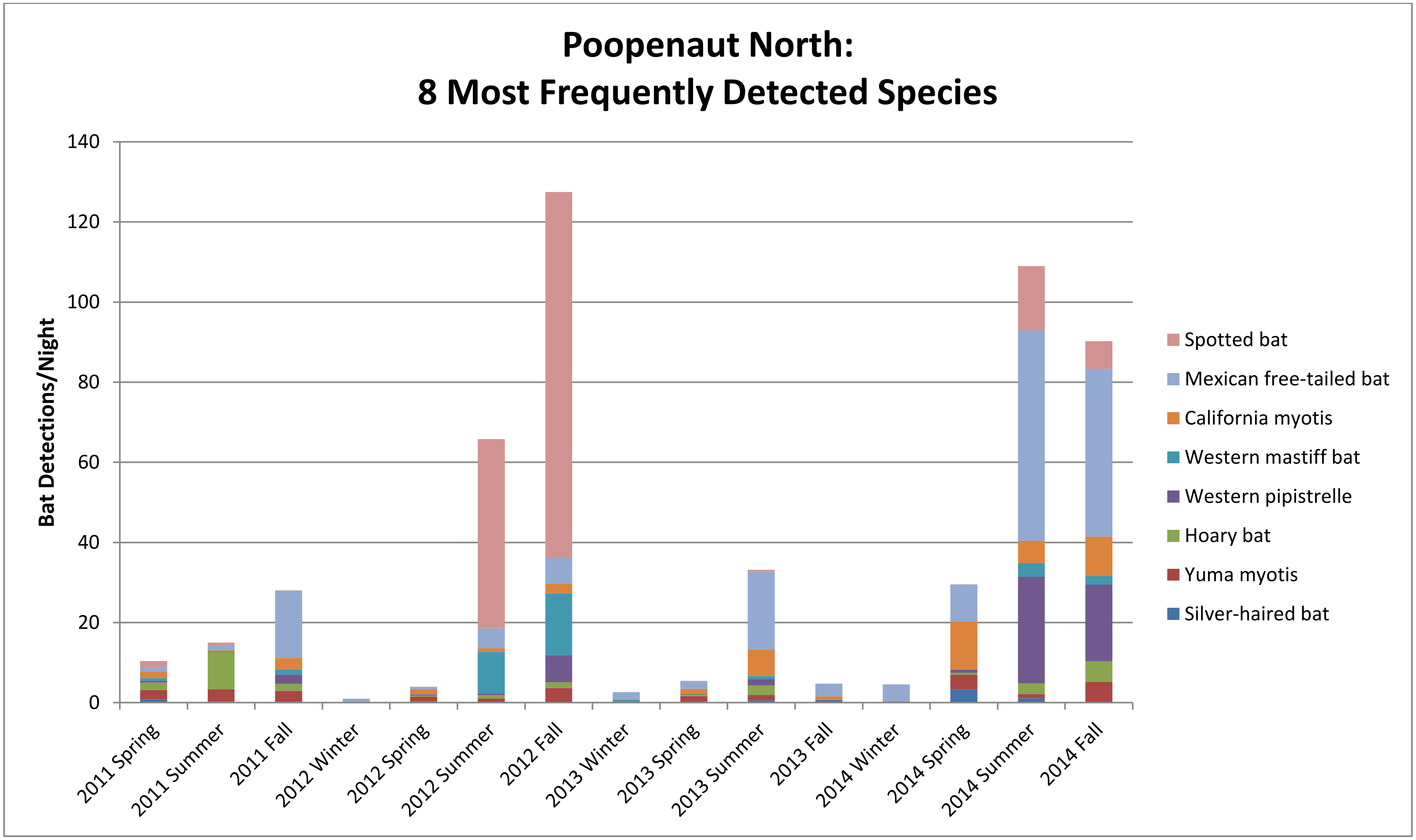


Figure 5-5. Bat detections by season of the 8 most frequently detected species at the north detector from 14 April 2011 to 10 September 2014. The vertical axis is number of bat detections/number of recording nights.

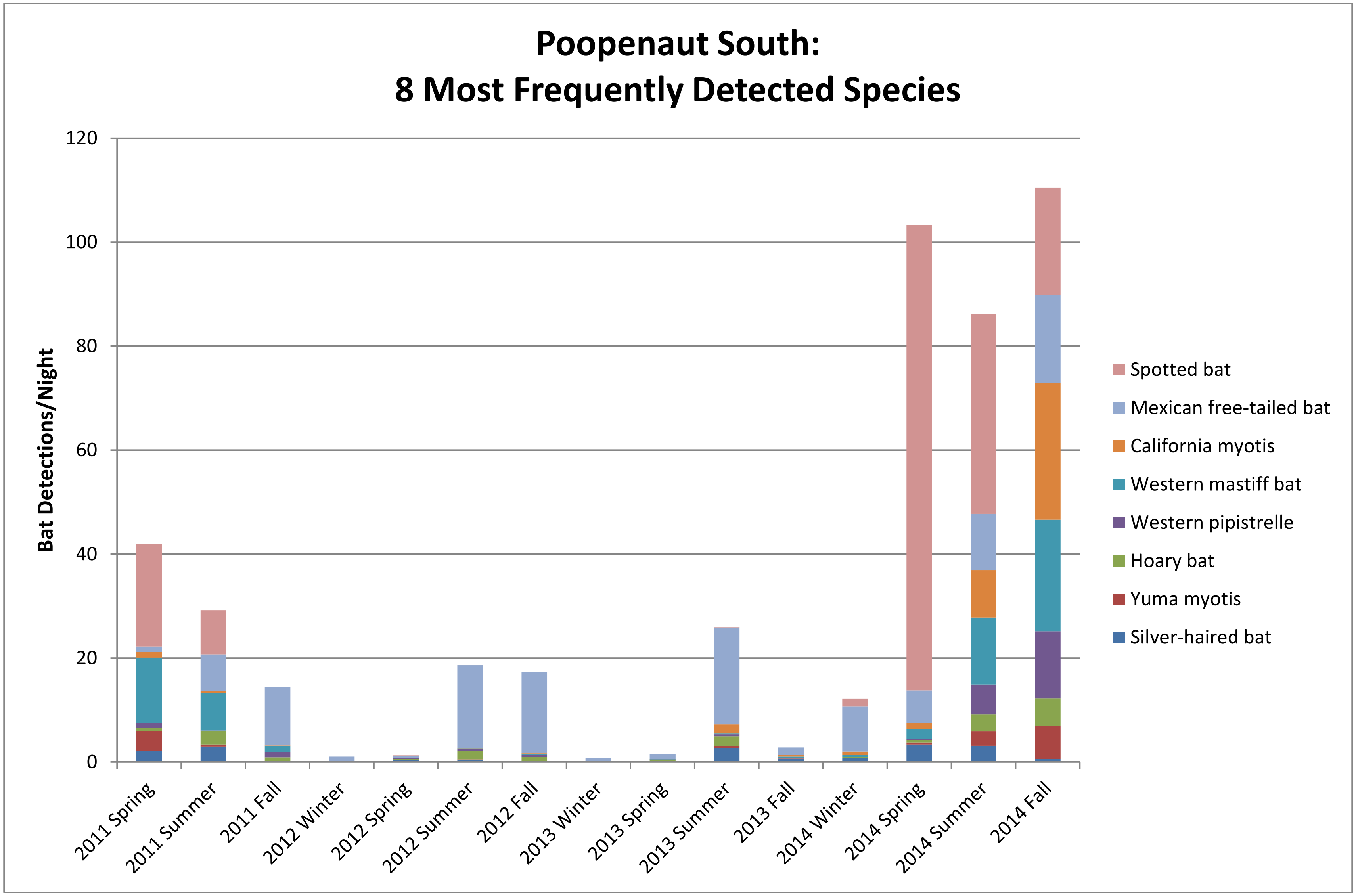


Figure 5-6. Bat detections by season of the 8 most frequently detected species at the south detector from 14 April 2011 to 10 September 2014. The vertical axis is number of bat detections/number of recording nights.

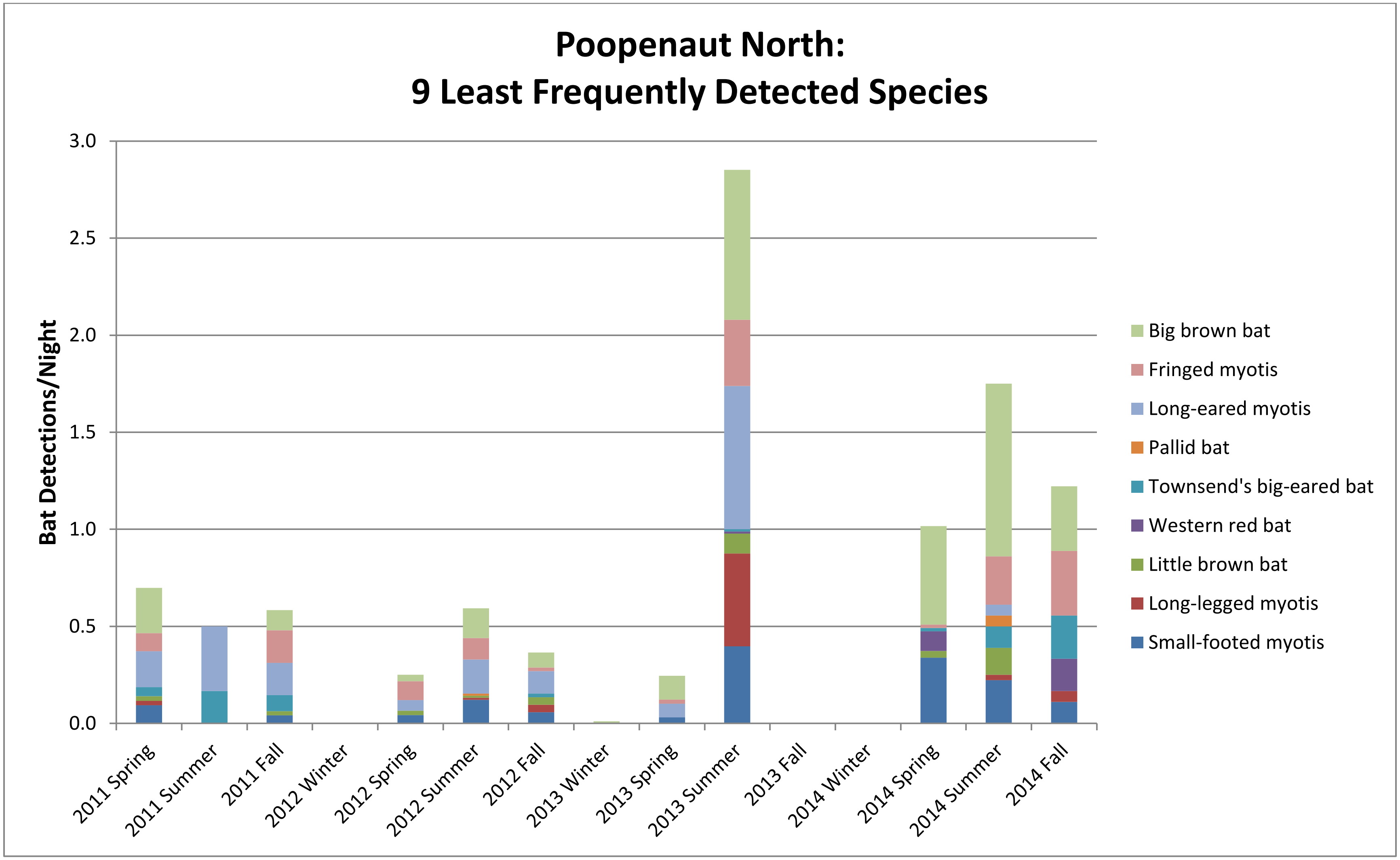


Figure 5-7. Bat detections by season of the 9 least frequently detected species at the north detector from 14 April 2011 to 10 September 2014. The vertical axis is number of bat detections/number of recording nights.

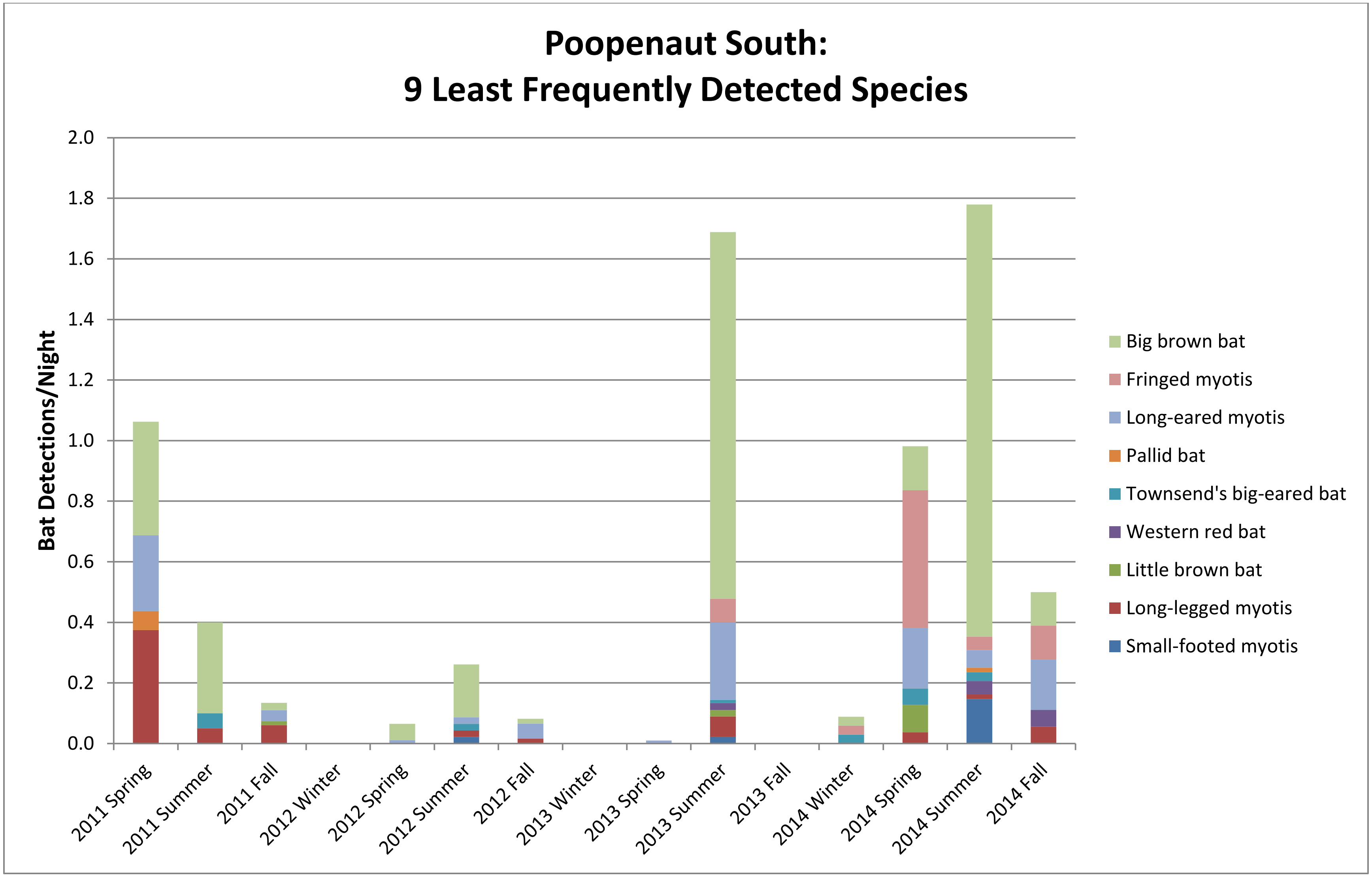


Figure 5-8. Bat detections by season of the 9 least frequently detected species at the south detector from 14 April 2011 to 10 September 2014. The vertical axis is number of bat detections/number of recording nights.

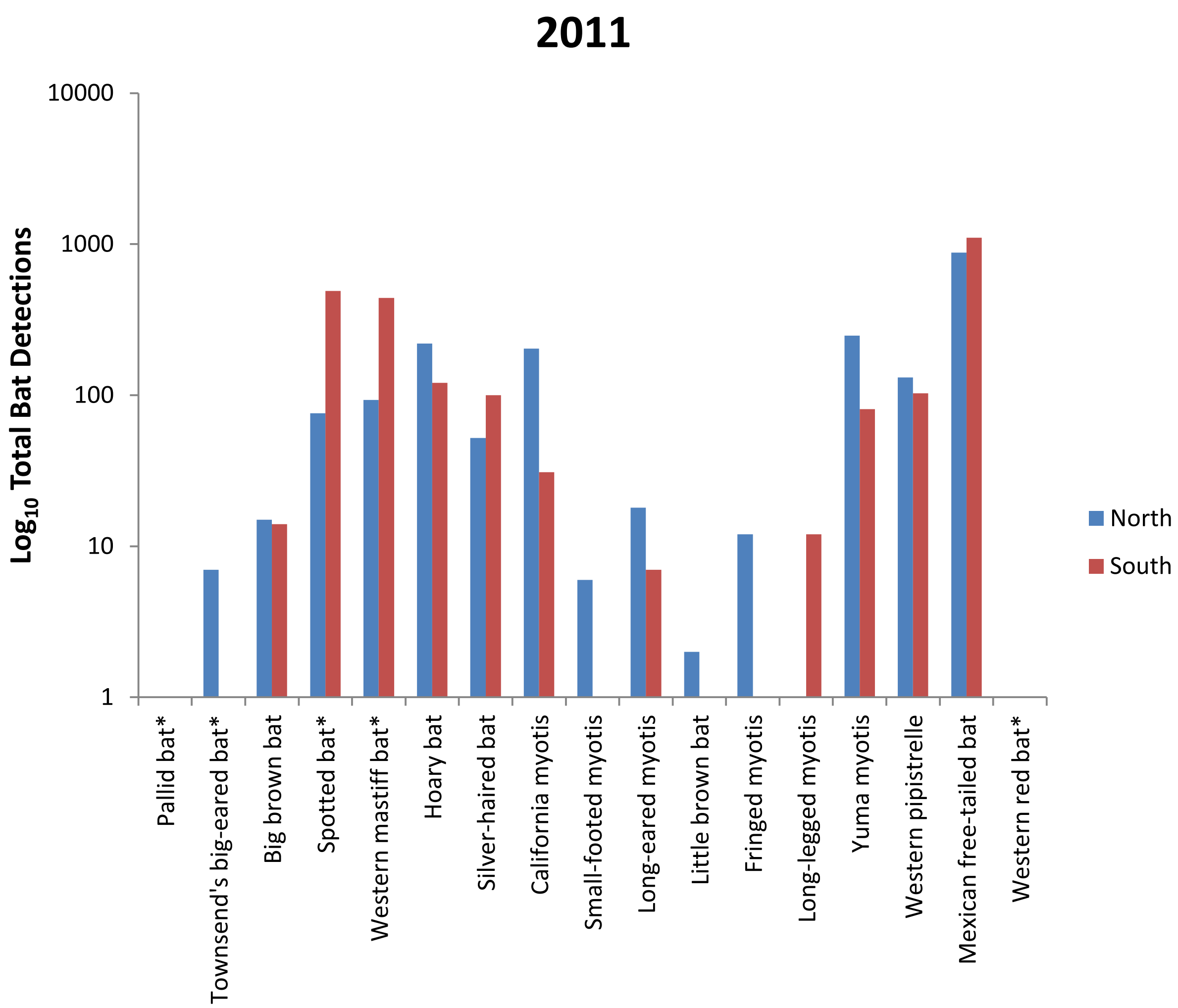


Figure 5-9. Total bat detections on a logarithmic scale (base 10) in Poopenaut Valley by site from 14 April 2011 to 31 December 2011 (Year 1). Total bat detections does not necessarily indicate abundance, as a single bat may produce many detections. A total of 16 bat species were detected. * indicates California species of special concern.

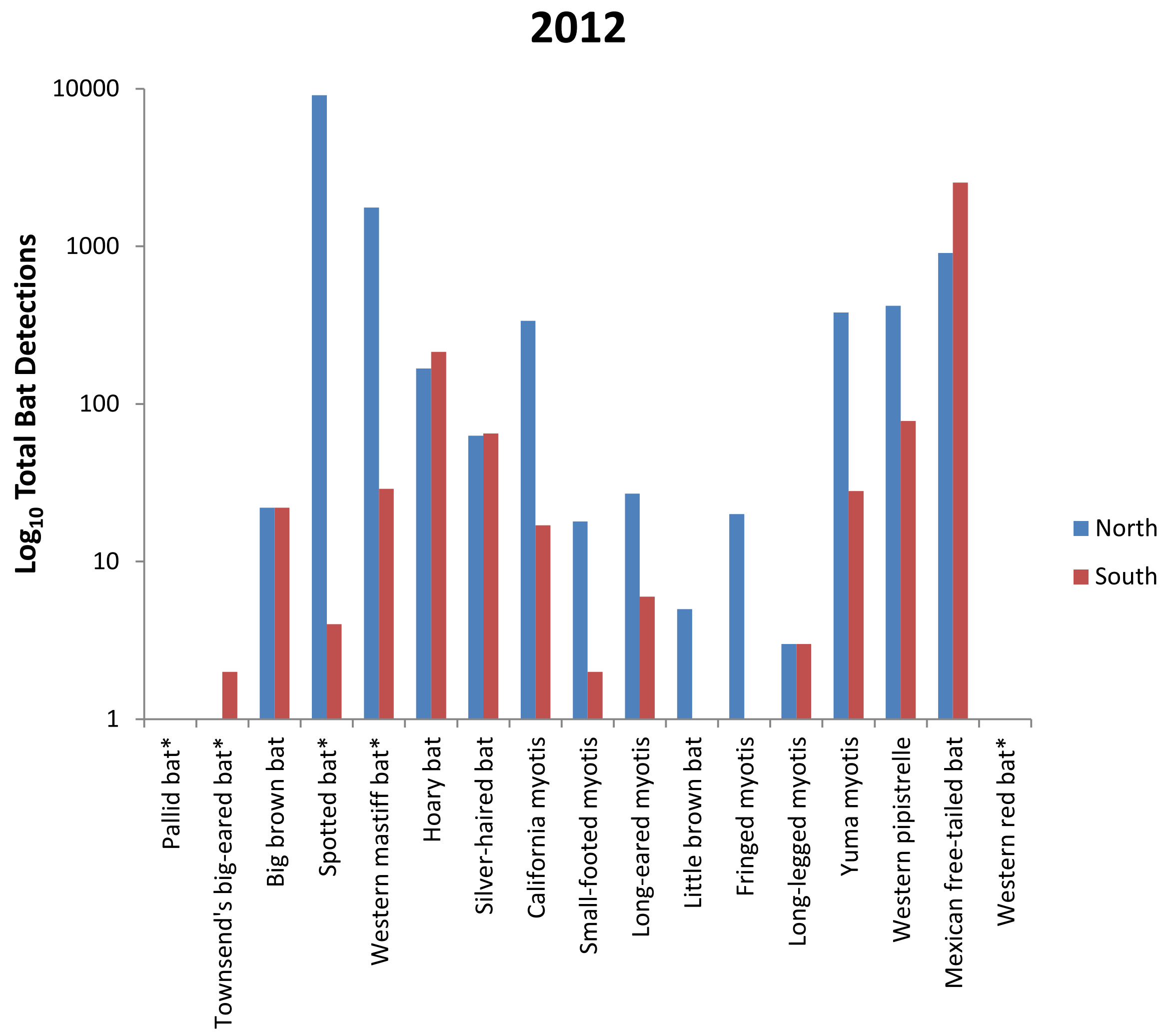


Figure 5-10. Total bat detections on a logarithmic scale (base 10) in Poopenaut Valley by site from 1 January 12 to 31 Dec 2012 (Year 2). Total bat detections does not necessarily indicate abundance, as a single bat may produce many detections. A total of 16 bat species were detected. * indicates California species of special concern.

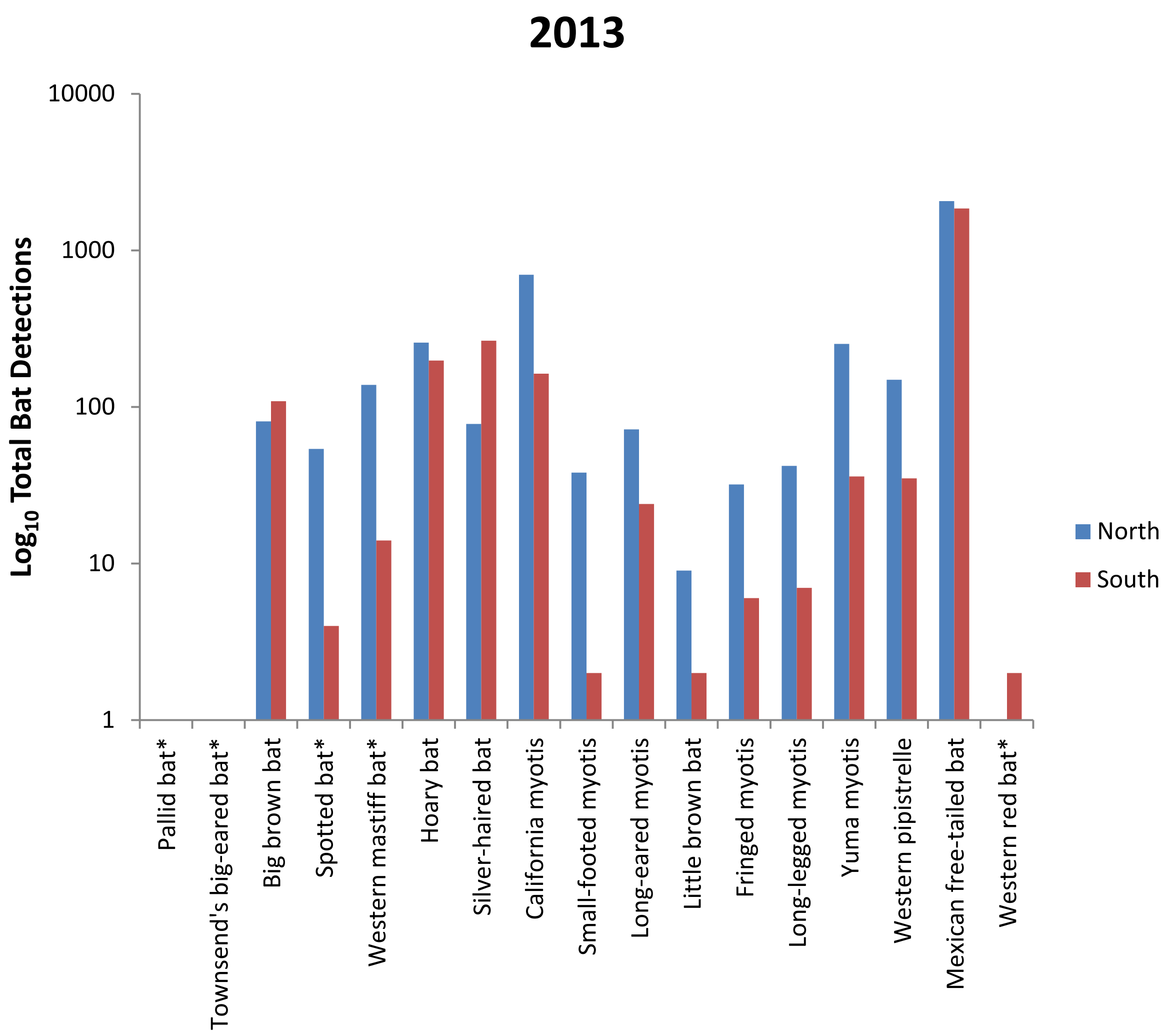


Figure 5-11. Total bat detections on a logarithmic scale (base 10) in Poopenaut Valley by site from 1 January 2013 to 11 September 2013 (Year 3). Total bat detections does not necessarily indicate abundance, as a single bat may produce many detections. A total of 16 bat species were detected. * indicates California species of special concern.

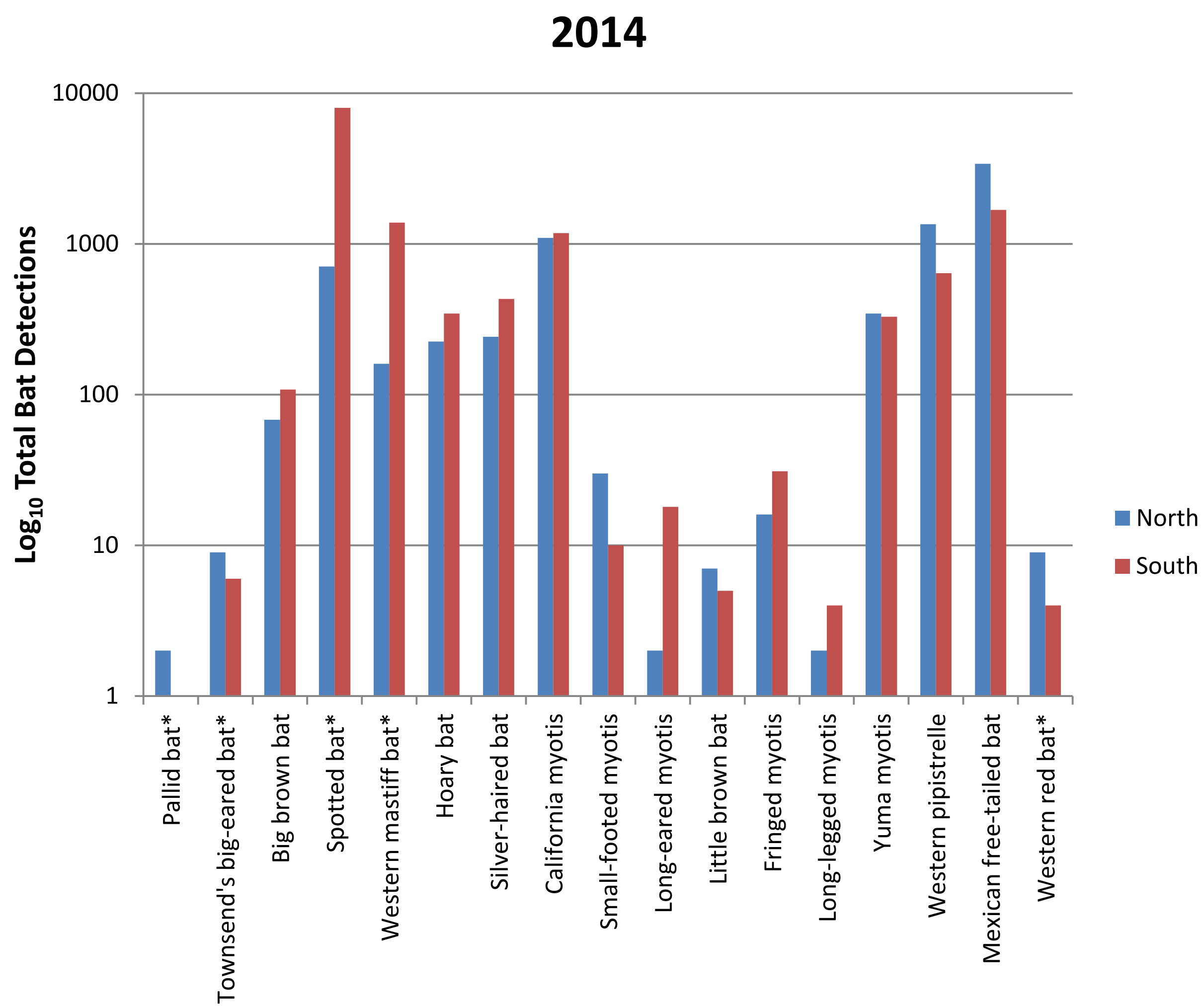


Figure 5-12. Total bat detections on a logarithmic scale (base 10) in Poopenaut Valley by site from 1 January 2014 to 10 September 2014 (Year 4). Total bat detections does not necessarily indicate abundance, as a single bat may produce many detections. A total of 17 bat species were detected. * indicates California species of special concern.

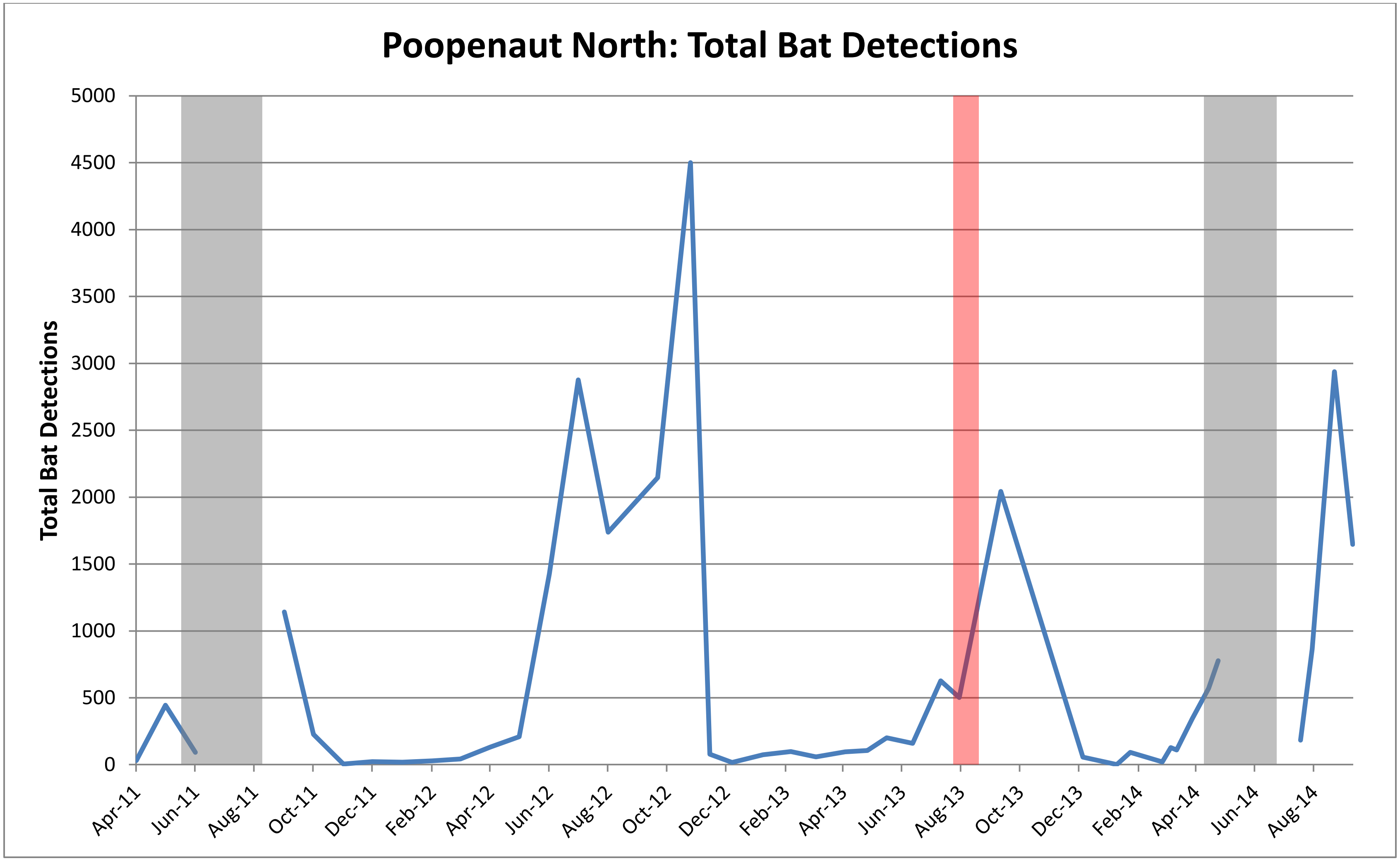


Figure 5-13. Total detections of 17 bat species north of the Tuolumne River in Poopenaut Valley, from 14 April 2011 to 10 September 2014. No data were collected from July-August 2011 and May-July 2014 (gray bars). The Rim Fire burned through the area 23-24 August 2013 (red bar).

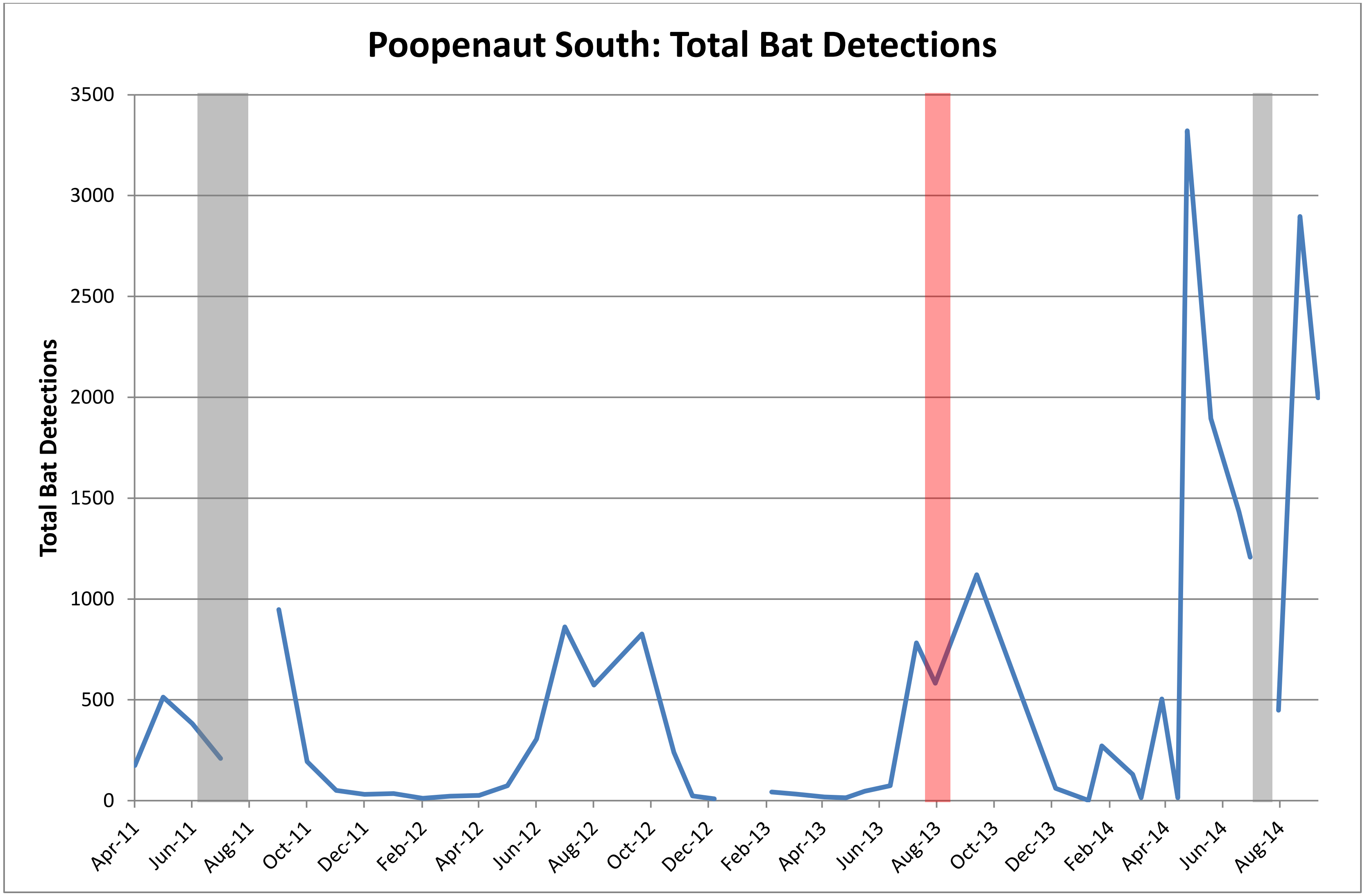


Figure 5-14. Total detections of 17 bat species south of the Tuolumne River in Poopenaut Valley, from 14 April 2011 to 10 September 2014. No data were collected in August 2011 and July 2014 (gray bars). The Rim Fire burned through the area 10-11 September 2013 (red bar).

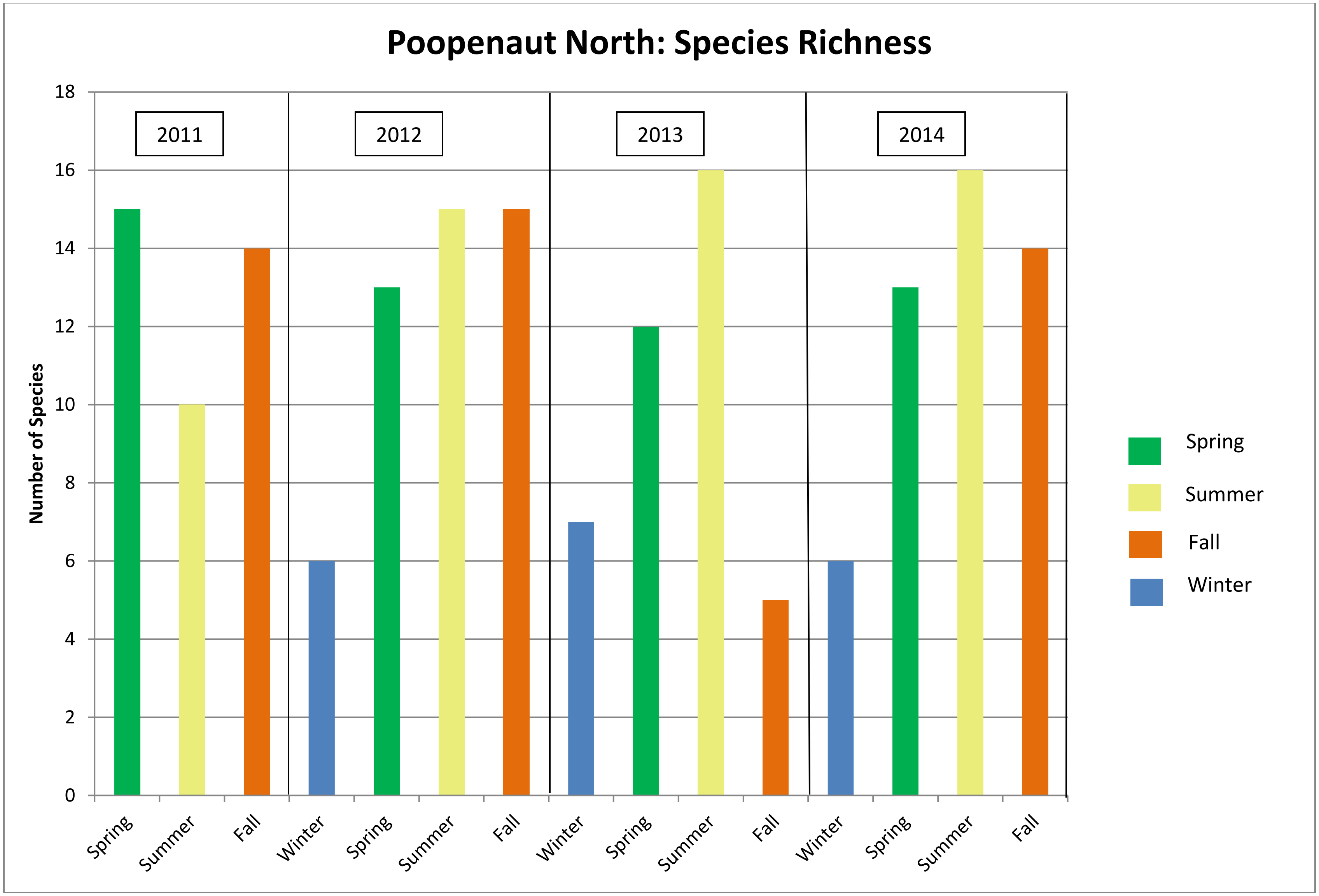


Figure 5-15. Bat species detected by season at the Poopenaut Valley north detector site.

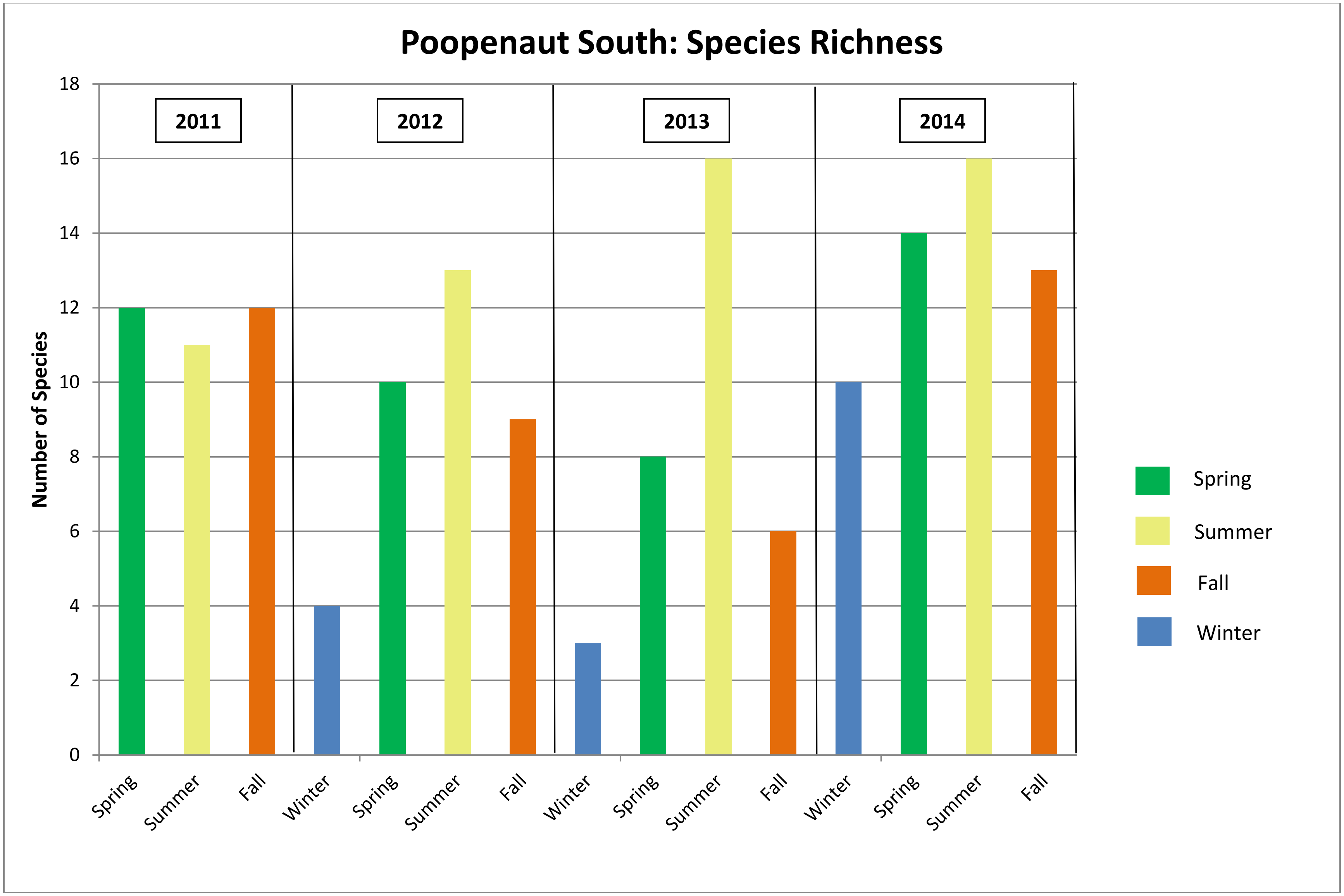


Figure 5-16. Bat species detected by season at the Poopenaut Valley south detector site.

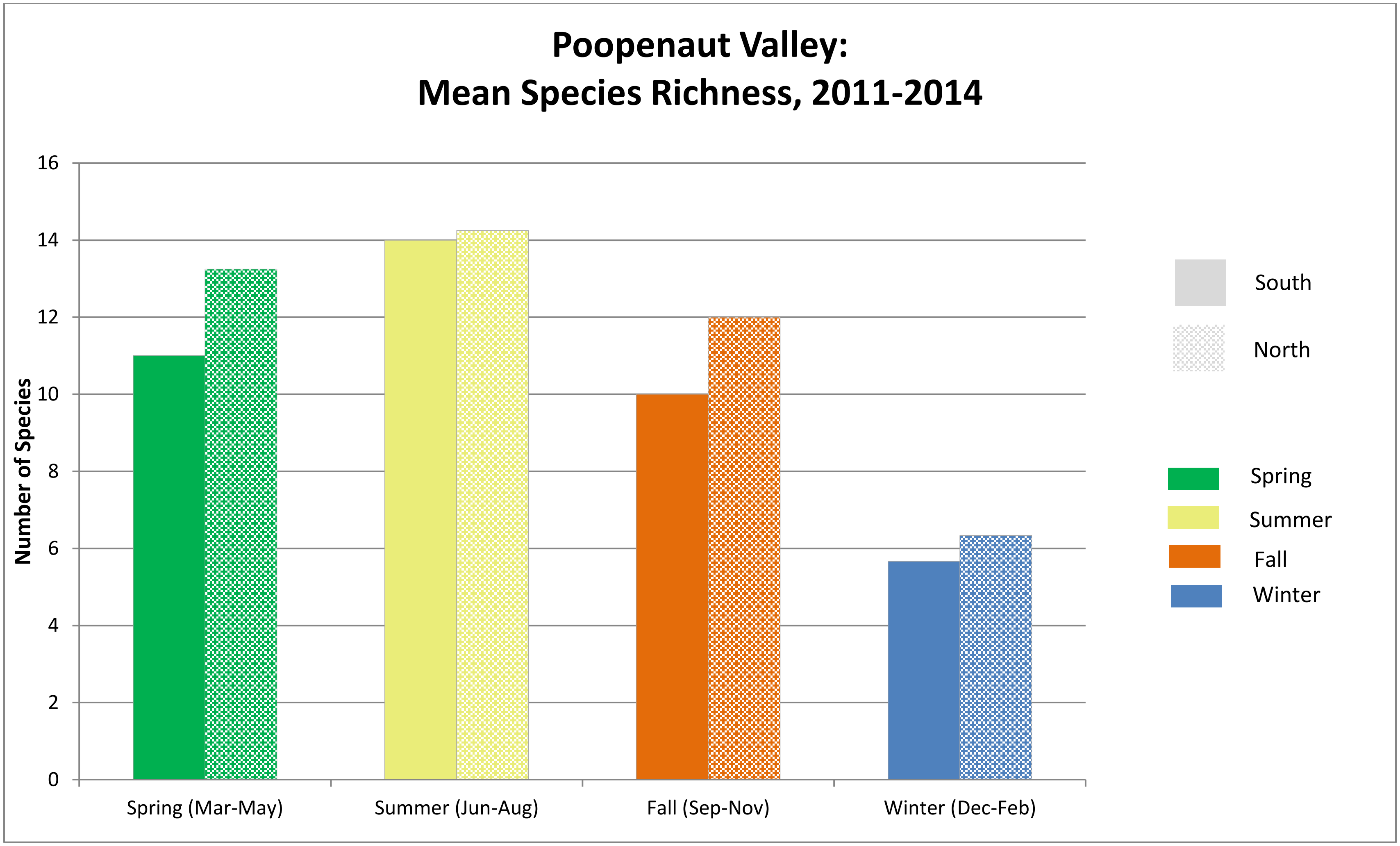


Figure 5-17. Bat species detected by season in Poopenaut Valley at both detector sites. Values are averaged from 2011-2014.

5.4 Discussion

Preliminary results of this study have identified an impressive biodiversity of bat species inhabiting Poopenaut Valley, with at least one species, the Mexican free-tailed bat, present year-round. We documented five special status species, two of which were the first (spotted bat) and fourth (western mastiff bat) most frequently detected species during 2014. The considerable jump in spotted bat and western mastiff bat detections at the south site in summer 2014 requires further study; however, habitat effects from the Rim Fire in 2013, water level, and prey availability and abundance may be factors.

Holmquist and Schmidt-Gengenbach (2012) found that benthic macro-invertebrate fauna in the seasonal pond north of the Tuolumne River adds considerably to the total biodiversity of the Poopenaut Valley ecosystem. The seasonal pond contributed an additional six orders and 28 families to those identified from the Tuolumne River benthic macro-invertebrates during 2007-2009; two orders and eight families were detected in 2011-12 (Holmquist and Schmidt-Gengenbach 2012). Winter 2013/14 was an extreme drought winter and the third in a row with below average precipitation; so perhaps the controlled water level in the seasonal pond attracted spotted bats to this area during spring 2014, when other areas across the Sierra Nevada were already dry.

Significantly higher detections of multiple species occurred in spring and summer 2014 despite the third year of reduced flows from Hetch Hetchy reservoir. In 2014, the spring runoff peak on the Tuolumne River immediately upstream of Hetch Hetchy reservoir occurred on 1 May 2014. In previous years, spring runoff peaks at the same location occurred on 23 June 2011, 23 April 2012, and 30 April 2013. The seasonal pond in Poopenaut Valley started to fill 28 February 2014 and dried up in mid-May. The seasonal pond filled in winter and spring of 2011 and 2012 containing at least some water at the time of the controlled floods each year. However, low water conditions in 2013 limited high flows necessary to spill water into the seasonal pond. Thus, the seasonal pond had less considerably less water in it and remained filled for a shorter duration in 2013 compared to the previous year. 2014 was again a low water year but, due to the potentially confounding effects of the Rim Fire, additional research is needed to determine the cause of the increase in detection rates.

Due to the absence of bat data during summer 2011 when the seasonal pond had the most water for the longest duration, we cannot conclude at this time that water alone was the main factor driving bat activity levels in Poopenaut Valley. An experimental flow that would result in the filling of the seasonal pond during summer 2015 would help address this discrepancy in the data. This would also help confirm if higher water levels for longer durations in the seasonal pond attract the impressive number of spotted bats that were detected in significantly higher frequency during the summer of 2012 and spring of 2014 when the pond had water. These elevated levels of detection for spotted bats continued into the summer and fall of 2014.

Interacting with water availability, prey abundance also affected bat assemblages in Poopenaut Valley in 2013. During 2013 sampling, Holmquist and Schmidt-Gengenbach (2013) found that a number of pond-associated benthic macro-invertebrate taxa were uncommon or absent in samples, including damselflies, mosquitos, water beetles, and some midges. The low diversity and abundance in pond riparian habitat were likely in part a result of lack of pond filling in 2013 (Holmquist and Schmidt-Gengenbach, 2013). The lack of invertebrate prey due to the pond remaining dry likely had a negative effect on the bat assemblages in Poopenaut Valley during spring and summer 2013, with spotted bat, western mastiff bat, and to a lesser extent, canyon bat, detected in significantly lower frequency.

The record setting increases for a majority of the bat species inhabiting Poopenaut Valley during spring-fall of 2014 was unexpected, and will continue to be investigated. Whether the increase in detection frequency for the majority of bat species during August-September 2013 or the subsequent increase in 2014 can be attributed directly to the Rim Fire requires further investigation. It is likely that multiple factors are interacting to affect bat activity.

The Rim Fire will also likely have affected the invertebrate assemblage in Poopenaut Valley, directly through mortality of plant-associated taxa, indirectly via habitat loss or restructuring, and via emigration of mobile organisms from the area (Holmquist and Schmidt-Gengenbach, 2013). Adults, juveniles, and eggs that were already in overwintering stages in surface soils are likely to have suffered some mortality (Holmquist and Schmidt-Gengenbach, 2013). A reduction in invertebrate prey, whether from wildfire or lack of filling of the seasonal pond, may have direct consequences for bat assemblages that inhabit Poopenaut Valley. However, wildfire on the landscape can also have a positive effect on bat species. In their study of the 2002 McNally Fire in the Sierra Nevada, Buchalski et al. (2013) suggest that bats may exhibit some resiliency to landscape scale fire in mixed-conifer forests of California, and that some species preferentially select burned areas for foraging, perhaps facilitated by reduced clutter and increased post-fire availability of prey and roosts. This may explain the increase in detection frequency for the majority of bat species inhabiting Poopenaut Valley during and after the Rim Fire. Continued monitoring will help determine what long-term effects the Rim Fire had on bat assemblages inhabiting Poopenaut Valley.

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