Baseline bird and vegetation monitoring to measure restoration effectiveness of beaver dam analogues in the Scott Valley, CA

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Rep. No. KBO-2017-0013
December 22, 2017

Recommended Citation:

Rockwell, S. M., and J. L. Stephens. 2017. Baseline bird and vegetation monitoring to measure restoration effectiveness of beaver dam analogues in the Scott Valley, CA. Rep. No. KBO-2017-0013. Klamath Bird Observatory, Ashland, OR.

On the cover:

Bewick's Wren (*Thryomanes bewickii*) perched on a willow in the Scott River Valley, CA
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On this page:

A beaver dam analogue (BDA) spanning the Scott River mainstem, CA
Photograph © Sarah Rockwell 2017

Introduction

From fall 2015 through spring 2017, Klamath Bird Observatory (KBO) worked in partnership with the Scott River Watershed Council (SRWC) and U.S. Fish and Wildlife Service (USFWS) to design and implement a study to assess bird and riparian vegetation response to restoration practices in the Scott River Valley. Recognizing the vital role that beavers historically played in maintaining diverse stream and riparian habitats, the SRWC has built beaver dam analogues (BDAs; i.e., willow screens that simulate beaver activity) on the Scott River and its tributaries. The potential benefits of beaver impoundments in a watershed include slowing and spreading the flow of water, improving water retention and groundwater recharge, increasing base flows, and lengthening the time in summer when above-ground flows are present (Pollock et al. 2015). Given that climate change is expected to increase drought and reduce snow pack (Barr et al. 2010), water storage from beaver dams may be an effective way to help offset decreased water resources. Beaver dams can also expand the size and complexity of wetlands, providing important habitat for birds, fish, aquatic invertebrates, mammals, and amphibians (Pollock et al. 2015).

KBO is partnering with SRWC to monitor the ecological changes resulting from the implementation of BDAs, and to assess the success of stream and riparian habitat restoration. Riparian vegetation will be a metric of success, but additionally, birds provide a robust measure of the ecosystem as a whole. Past studies have shown that active beaver sites, with all of their associated habitat complexity, supported more species of birds than sites without beavers (Albert and Trimble 2000, Alza 2014). Birds provide an excellent monitoring tool to track changes in ecosystems because they respond quickly to habitat change, individual species represent different aspects of healthy riparian habitat, and birds are relatively easy and cost-effective to monitor (RHJV 2004). By studying a suite of species and identifying changes in bird abundance and community composition, we can quantify whether land management has reached its desired condition. Focal riparian bird species can be used as indicators of successful restoration and/or identify habitat components that have not yet been achieved as restoration progresses (RHJV 2004). Studying the breeding bird community is important, but areas used by birds for dispersal and stopover habitat during fall migration are also critical and less well-studied (Faaborg et al. 2010). Birds need high quality stopover sites in which they can rest and refuel quickly; target riparian conditions would support an abundance of fall migrants as well as breeding birds.

In 2015-2017, KBO completed a two-year snapshot of bird populations and riparian vegetation at four restoration sites and one reference site to obtain pre- and early post-restoration baseline data. Sites are at various phases of in-stream restoration implementation (ranging from BDAs built in 2014 to 2017, and one site planned for 2018), but are all considered pre-restoration for the purposes of this study because changes to the riparian vegetation have so far been minimal. Monitoring of birds and vegetation will be replicated in the future and data will be compared before and after restoration, as well as with a reference site that represents target riparian conditions, to quantify changes over time and assess restoration success. If

restoration via BDAs is successful at enhancing and/or expanding the riparian zone along stream systems in the Scott River Valley, after several years we expect species dependent on these habitats to benefit. The goal of this report is to describe and summarize baseline bird and vegetation communities in this early restoration phase.

Methods

Study Design

Point count survey stations and fall area search plots were established at each study site, both above, near, and below existing or planned BDA locations (see maps in Appendix A). Each study site has 2-6 point count survey stations placed ≥250 m apart (to avoid counting individual birds more than once); the total number of points was limited by private property boundaries. Area search plots surrounded a subset of the point count stations, with 1-2 area search plots established per site. Playback surveys were also conducted at the subset of point count stations located within area search plots. We implemented a three-visit design to enhance sample sizes on these relatively small sites: three spring point count surveys and three fall area search surveys were conducted each year (Table 1). The three-visit study design allows calculation of a statistically rigorous mean of bird counts with the limited number of points or plots that can be placed spatially on each site. In spring, we completed an accompanying relevé vegetation survey during two of the site visits, to account for observer variation. On the first fall visit, we completed area searches only, and on the second visit we completed area searches in the morning and playback surveys in the afternoon. On the third visit, we completed area searches in the morning and relevé vegetation surveys in the afternoon.

Field Surveys

The primary methods we used are standard ornithological surveys, including spring point counts (to monitor the breeding bird community), fall area searches (to monitor the fall migration bird community), and relevé vegetation surveys (a rapid assessment of vegetation characteristics relevant to bird habitat requirements). Additionally, during each day of field work, a species checklist was kept to record all birds seen or heard whether within standardized survey periods or not (Stephens et al. 2010). Bird surveys were not completed in inclement weather.

Spring surveys to monitor breeding bird use of riparian habitats can be completed based largely on familiarity with bird songs, via point counts. Point count surveys were implemented in mid-May through the end of June using standardized field methods (Ralph et al. 1993, Stephens et al. 2010), and were conducted by field personnel highly trained in bird species identification and distance estimation. At each point a single observer recorded all individual birds detected (seen or heard) during a 5-minute survey period, including: species, detection type (the first behavioral cue that alerts the observer to the presence of the species), and horizontal distance from observer to bird. All surveys began within 15 minutes of sunrise, and were completed during the first four hours after dawn when bird activity is greatest.

Fall area search surveys require more extensive visual searches and knowledge of 'chip' calls, as few if any bird species sing full territorial songs at this time of year. A fall area search is a standardized protocol in which an observer walks a 20-minute route within a defined polygon (typically similar in area to a circle with 50 m radius, or 0.785 ha), noting all bird species seen or heard inside and outside of the study plot (Stephens et al. 2010). In practice, area search plots along streams in the Scott Valley were irregularly shaped, spanning the width of the riparian corridor on one bank, and comprising a reasonable stream length (range = 0.51-1.15 ha). Numbers of each bird species and detection types were also recorded. Surveys began within 15 minutes of sunrise, and were completed during the first four hours after dawn when bird activity is greatest. A playback method was added to these fall surveys after the area search period during one visit, using owl mobbing calls to attract quiet or skulking bird species that otherwise could be commonly missed or underestimated. Playback surveys were initiated with a regular 5-minute point count (pre-audio lure), then a second 5-minute count was performed while playing the audio lure, and finally a third 5-minute count was conducted after turning the playback off again (post-audio lure).

A relevé vegetation survey was completed in a 50 m radius circle centered on each point count station in spring, and at the point count stations located within area search plots in fall, to quantify broad measures of vegetation structure and species composition relevant to bird habitat requirements (Ralph et al. 1993, Stephens et al. 2010). Trained observers recorded ocular estimates of percent cover to the nearest 5% for the tree stratum (all woody vegetation typically ≥5 m), shrub stratum (all woody vegetation typically ≥0.5 m and <5 m), and ground stratum (all vegetation typically <0.5 m). Percent cover of each woody plant species was recorded for each vegetative stratum, as well as for forbs, grasses, and ferns in the ground stratum. The following metrics were also collected: canopy height, snag count, disturbance history, and riparian extent.

Analysis

For spring point count data, we calculated the mean and standard error of relative abundance (birds/point) for each site for all species detected within 75 m of the observer. For the Sugar Creek reference site only, we included species up to 100 m detection distance, because the width of the pond and the survey location meant that many riparian species were >75 m away from the surveyor. While using species-specific detection radius is ideal for density estimates in songbird communities, using a 75 m radius provided a conservative estimate of abundance given the mean effective detection radius for songbirds in our study region (Stephens et al. 2013). We used the mean count of all six spring visits over two years as the best estimate of breeding bird abundance (the maximum count could be inflated by possible migrants in the early spring, or by fledglings in late summer). Additionally, we used non-metric multidimensional scaling (NMS) (Mather 1976) to ordinate the point count stations based on relative abundance of all bird species detected within 75 m (100 m for Sugar Creek). Similarities in bird community composition were calculated using the Sorenson Bray-Curtis metric, 250 runs of real data, and 250 runs of randomized data. Monte Carlo tests were used to determine whether the axes generated were stronger than those obtained by chance. The ordination analysis was conducted with PC-ORD Version 7.0 (McCune and Mefford 2016). A MANOVA was

performed in R version 3.2.2 (R Core Team 2015) to analyze differences among study sites in in ordination space.

For fall area search data, we calculated the mean and standard error of bird density (per hectare) for each site for all species detected within the area search plot, using the mean count of all six fall visits over two years. We performed an NMS ordination (Mather 1976) using densities of all bird species detected on fall area search plots. Similarities in bird community composition were calculated using the same metrics as above, with Monte Carlo tests to determine the strength of the axes generated.

For both spring and fall surveys, we identified additional bird species that were recorded only on species checklists (inbetween point count or area search surveys, or outside of 75 m point count radius or area search plot boundaries). We identified which bird species detected are Partners in Flight (PIF) focal species for California riparian, oak, or coniferous forest habitats (CalPIF 2002a, b; RHJV 2004). Focal species in these conservation plans are either highly representative of specific habitat types, or are of elevated conservation concern. We also identified PIF continental landbird conservation plan Watch List species (Rosenberg et al. 2016) and North American Bird Conservation Initiative common birds in steep decline (NABCI 2014). Additionally noted were California Department of Fish and Wildlife state endangered and threatened species (CDFW 2017), and species of special concern (Shuford and Gardali 2008).

For relevé vegetation data, we calculated the mean percent of total tree, shrub, and ground cover as well as total hardwood and conifer tree cover, and the average number of snags per point. Additionally, we calculated the mean percent cover for all tree and shrub species that were detected on 20% or more of the vegetation surveys, and percent ground cover of forbs, grasses, and ferns. Because we did not detect a notable difference in vegetation in spring and fall, we used the mean value of the spring vegetation surveys (from three observers over the two years) to account for observer variance, and then determined overall means and standard errors of vegetation characteristics for each site.

Results

Bird Community

In spring of 2016 and 2017, 59 bird species were detected during standardized 75 m radius point count surveys (Table 2), with an additional 24 species recorded only on species checklists (Table 3). Of these, 11 species are PIF focal species for riparian habitat (RHJV 2004), 12 are focal species for oak woodlands (CalPIF 2002b), and 4 are focal species for coniferous forests (CalPIF 2002a). The most commonly detected birds across all sites were Red-winged Blackbird (59 individuals), Spotted Towhee (48), Tree Swallow (46), Brown-headed Cowbird (41), and Western Wood-Peewee (39). The reference site, a natural beaver dam impoundment on Sugar Creek, had the greatest relative abundance of riparian focal species such as Song Sparrow (0.83 birds/point), Yellow-breasted Chat (0.67 birds/point), and Yellow Warbler (1.67 birds/point), while the Scott River mainstem site had the highest abundance of Tree Swallow (0.86 birds/point), Black-headed Grosbeak (0.58 birds/point), and was the only site with Spotted

Sandpiper (0.08 birds/point). It was also the only site occupied by the state-threatened Bank Swallow, while the state-endangered Willow Flycatcher was recorded at both Scott River and Miner's Creek. French Creek was rather low in abundance of riparian focal species (except Tree Swallow), and so was Rattlesnake Creek (with the exception of Black-headed Grosbeak). The greatest variety of species was observed at the Miner's Creek site (38), followed by the Scott River mainstem (31). The Sugar Creek reference site had the median number of different species (24).

The spring bird community ordination resulted in a three-dimensional solution, and a minimum stress value of 10.1, which was stronger than expected by chance (Monte Carlo test, $p = 0.004$). The three axes in the ordination cumulatively explained 90.1% of the variation in the bird community. Variation in all three axis scores was significantly different among study sites (MANOVA, $F=11.66$, $p < 0.0001$). Axis 1 and 2, which together captured 77.9% of variation in the bird community, were plotted (Figure 1). Riparian focal species tended to cluster in the right-hand portion of the two-dimensional ordination space, along with points at the Scott River and Sugar Creek sites (Figure 1). Birds more indicative of upland mixed oak-conifer forest clustered in the left-hand portion of the ordination space, along with points at the Rattlesnake Creek site. Points on the French Creek site were associated with a high abundance of MacGillivray's Warbler, Bushtit, and American Crow, which were not common elsewhere. Miner's Creek had the most varied bird community, which can be visualized in how spread apart its points are in ordination space, although it differentiated more along the 3rd axis (not pictured). One point at Miner's Creek was most associated with a near oak-obligate bird (White-breasted Nuthatch) and Cliff Swallow. The other two Miner's Creek points were closely associated with MacGillivray's Warbler and Belted Kingfisher, and the suite of riparian focal species (except Yellow-breasted Chats, which were not recorded at this site), respectively.

In fall of 2015 and 2016, 77 bird species were detected during standardized area search surveys (Table 4), with an additional 37 species recorded only on species checklists (Table 3). Of these birds, 8 species are PIF focal species for riparian habitat (RHJV 2004), 12 are focal species for oak woodlands (CalPIF (California Partners in Flight) 2002b), and 9 are focal species for coniferous forests (CalPIF 2002a). A different bird community occupied study sites in the fall compared to spring: the most commonly detected birds across all sites in fall were Golden-crowned Sparrow (226 individuals), American Robin (211), Song Sparrow (159), Cedar Waxwing (110), and Spotted Towhee (105). Many riparian species had already departed the area for the winter, but Sugar Creek was home to the greatest fall density of Common Yellowthroat (3.9 birds/ha), Scott River had the most migrating Yellow Warblers (0.95 birds/ha) and Willow Flycatchers (0.37 birds/ha), and Rattlesnake Creek had the highest density of Warbling Vireos (0.65 birds/ha). Song Sparrows are resident birds that do not migrate long distances; they became most dense at Miner's Creek in fall (9.9 birds/ha). The greatest variety of species in fall was recorded at French Creek (45), followed by Miner's Creek (42). The Sugar Creek reference site was again ranked third in total diversity, but this time shared this number of species with the Scott River site (38).

The fall bird community ordination resulted in a one-dimensional solution, and a minimum stress value of <1, stronger than expected by chance (Monte Carlo test, p = 0.004). Along this single axis, Rattlesnake Creek was on the left-hand side, and all other sites clustered together on the right-hand side. This analysis had limited utility for differentiating and visualizing the fall bird community among sites, and we performed no further analyses on this ordination.

Vegetation Community

Willows were the most frequently detected woody plant species across all sites (recorded on 93.8% of surveys), followed by white alder (73.8%), and Ponderosa pine (60%) (Table 5). The most common shrubs besides willows were Himalayan blackberry (50.8%) and *Ribes* species (44.6%). The mean percent of total tree cover varied considerably among sites, ranging from just 0.7% at the Scott River mainstem site, to 29.4% at the French Creek site. French Creek also had the greatest mean cover by riparian tree species such as white alder (15%) and black cottonwood (7.9%). Miner's Creek had the greatest tall (> 5 m) willow cover (3%), while Rattlesnake Creek had the most cover by Oregon white oak (2.9%). Total shrub cover was less variable than tree cover, but French Creek (28.3%) and Rattlesnake Creek (22.5%) had substantially more than the other sites. In the shrub layer, French Creek had the most cover by Himalayan blackberry (8.9%), *Ribes* (3.4%), and *Prunus* (4.6%), Sugar Creek had the most dogwood (6.2%) and the greatest number of snags (11), Miner's Creek had the most *Berberis* (2.7%), and Rattlesnake Creek had the most cover by snowberry (4%). Scott River had the most cover by short (< 5 m) willow shrubs (9%; Table 5).

Discussion

We detected 11 PIF focal species for riparian habitat (RHJV 2004) during spring and fall bird surveys in the Scott Valley, California. We found that the sites with the strongest riparian breeding bird communities were Scott River and the reference site on Sugar Creek with the beaver dam impoundment. Differences in breeding bird communities at the restoration sites were explained by a riparian-upland vegetation gradient in ordination space (Figure 1). The Scott River mainstem site already supports a diverse riparian bird community, represented by focal species such as Song Sparrow, Yellow Warbler, Yellow-breasted Chat, and Black-headed Grosbeak, and including some that are also state-listed species (Bank Swallow and Willow Flycatcher). This site has very little canopy cover (<1%), but maintains relatively healthy, dynamic riparian vegetation, with high willow shrub density and frequent scour that keeps cover by non-native Himalayan blackberry very low (<1%). Overall, differences in vegetation metrics among sites are consistent with differences in spring and fall bird abundance and in the breeding bird community; that is, the sites differed widely in both bird and vegetation metrics.

This study was designed with the intention of using Sugar Creek as a reference (unmanipulated) site and the BDA sites as replicate treatment sites, with these first two years of surveys providing a snapshot of before (or early post-) restoration. However, baseline results confirm that the four BDA sites being studied are all quite different in bird and vegetation composition (Figure 1; Table 5), and it may not be appropriate to treat them as replicates in future analyses. Each site will likely need to be evaluated individually for ecological changes pre- and post-

restoration. As mentioned above, Scott River is the most fluvial site, characterized by shrubby willows and open gravel bars, with very little canopy cover or invasive shrubs. Miner's Creek had the highest total avian diversity, due to the diversity of different vegetation types found at this site. One point count survey location is in a section of narrow riparian habitat with a Himalayan blackberry understory and cottonwood-alder canopy, while another point (near the BDA at RKM 0.2; Map 2) has a taller riparian willow thicket, and the last survey point has an alder overstory, but is adjacent to an oak woodland, with many birds characteristic of that habitat detected during surveys. Rattlesnake Creek also has a narrow riparian corridor, surrounded by a mixed oak-conifer forest. The breeding bird community there was composed of some bird species that breed in riparian areas, but are more habitat generalists (Spotted Towhee, Black-headed Grosbeak, Warbling Vireo, Western Wood-Peewee), as well as species typical of upland forest (Black-throated Gray Warbler, California Towhee, Cassin's Vireo, Lazuli Bunting, Nashville Warbler, Western Tanager). Rattlesnake Creek currently has the most upland habitat of the sites (Figure 1). This site was not occupied by focal species Yellow-breasted Chat, Song Sparrow, Yellow Warbler, or Tree Swallow. The relatively low species abundance and diversity at French Creek was somewhat surprising; the thick shrub layer and high canopy cover of riparian trees were expected to be occupied by more riparian focal birds. This site had comparatively lower numbers of Yellow Warblers and Song Sparrows, and had no Black-headed Grosbeaks or Yellow-breasted Chats.

The Sugar Creek beaver dam impoundment functions well as a reference site for focal riparian species. It had the greatest relative abundance of Song Sparrow, Yellow-breasted Chat, and Yellow Warbler, but logistical constraints required adjustments for analysis. The best riparian habitat on the far side of the beaver pond is difficult to access, relatively far (50-100 m) from the point count survey station. The width of the pond meant that many birds were detected just over 75 m away from the surveyor; for this report we expanded our typical 75 m detection distance up to 100 m for analyses (at this point only). Because much of the area being counted in the 100 m radius was a wetland, rather than a stream as at the other sites, the amount of surveyed habitat among points should be relatively comparable for this baseline report. That is, the total number of birds should not be inflated because of the larger detection radius. During fall area search surveys, it is usually necessary to walk around the plot and obtain visual observations of many species, which is not possible in the beaver pond or in the riparian area on the far side of the beaver pond. It is likely that individual birds were missed as a result of this. Another complication is that while there are a few alder and cottonwood trees close to the point count station, a 50 m radius relevé survey does not capture the riparian habitat across the pond where most of the focal birds are detected. We also eliminated the 2nd Sugar Creek point count station from analyses because it was located in a very different habitat type, not representative of target riparian conditions (SUGA_PC02; Map 5). We will take these findings into account, and carefully consider how best to use the reference site at Sugar Creek in future analyses and reports.

Fall migration is also an important portion of the annual cycle of migratory birds, and has recently been identified as a critical but understudied component of birds' full annual life cycles that may contribute to widespread population declines (Faaborg et al. 2010). Birds need high-

quality habitats in which they can stopover to refuel and replace the significant energetic costs of migration. The ordination of fall bird density data had limited utility for explaining differences among sites, either due to the small sample size of area search plots (n = 1 or 2) at each site, or the fact that the fall migration bird community may be more similar across sites. Community composition in fall was markedly different than the breeding bird community. Species that were not ever or not often detected during the breeding season were common as fall migrants (Golden-crowned Sparrow, White-crowned Sparrow, Yellow-rumped Warbler, Common Yellowthroat, Fox Sparrow, Lincoln's Sparrow, Hermit Thrush). Some species, such as Pacific Wren, Mountain Quail, and Varied Thrush, breed at higher elevations and may occupy the Scott Valley in the winter. Lewis's Woodpecker is a notable species recorded at French Creek – an uncommon bird that historically bred in the Klamath-Siskiyou Bioregion, but now may only be present as a winter resident. Also of special note were two secretive marsh birds - Sora and Virginia Rail – that were observed at the Sugar Creek reference site in fall. Sora migrate through northern California on their way from breeding grounds to wintering grounds. Virginia Rails can potentially breed or be year-round residents in northern California, but the fact that we never detected one during the breeding season makes this individual likely to be either moving between breeding and wintering areas or be a winter resident. Both of these species depend on marshy habitats during all parts of the year, potentially making habitat like the beaver pond at Sugar Creek an important stopover site.

The state-endangered Willow Flycatcher was detected at Miner's Creek and Scott River in the spring, and at French Creek and Scott River in the fall. However, detection during point count surveys does not necessarily mean that the flycatchers were breeding at these sites. They are known to be a late migrant, and may still be moving through the Scott River Valley even in mid-June. The latest spring detection dates were May 29 and June 14 for Scott River and Miner's Creek, respectively. Playback surveys conducted for Willow Flycatchers sighted along the Trinity River (also in the Klamath River basin) have revealed no evidence of any individuals staying to breed (Rockwell and Stephens, unpub. data). We recommend single-species Willow Flycatcher surveys to confirm breeding status. Regardless of breeding status, the use of these two BDA sites for spring and/or fall migration is of note for this species. The breeding colony of state-threatened Bank Swallows at the Scott River mainstem site appeared to be greatly reduced in the second year of this study; while we recorded 22 Bank Swallow detections during point count surveys in 2016, only four were detected in 2017. This species relies on eroding vertical banks or bluffs for nesting, so any impacts to the sand bank just downstream of the BDA at RKM 69.7 (see Map 4) would have the potential to change or eliminate this breeding colony. This turnover is natural; size and longevity of Bank Swallow colonies depend on erosion that maintains vertical bank habitat, and the ephemeral nature of such nesting banks results in low levels of breeding site fidelity (Garrison 1999).

Overall, eleven PIF focal species for riparian habitat were detected during spring point counts or fall area searches (Tables 1 and 3), demonstrating the potential of this region for bird conservation. In the western United States, riparian areas are imperiled habitats, covering only a fraction (2-15%) of their former range in California, and comprising less than 0.5% of the total land area (RHJV 2004). Riparian ecosystems support disproportionately high biodiversity

(Gregory et al. 1991, Naiman et al. 1993), including the most diverse bird communities in arid and semi-arid regions of the western United States (Knopf et al. 1988, Dobkin 1994, Saab et al. 1995). Their relative rarity on the landscape, yet high biodiversity, make them one of the most important habitats for the conservation of Neotropical migrants and resident birds in the West (Manley and Davidson 1993, Rich 2002, Donovan et al. 2002). The loss of quality riparian habitat has contributed to declines in many western landbird populations (DeSante and George 1994). If the extent or complexity of the riparian zone along the Scott River and its tributaries is improved via restoration by BDAs, then we would expect focal bird species dependent on riparian habitat to benefit. More specifically, we would expect the site with an already strong riparian bird community (Scott River) to strengthen its positive association with the riparian-upland axis in Figure 1. We also hypothesize that there will be less differentiation in ordination space among sites over time, as French Creek, Miner's Creek, and Rattlesnake Creek increase in abundance of riparian focal species. In the future, we will determine the best time to return to complete post-restoration surveys in the Scott Valley, after significant riparian development has taken place. Then we will quantify changes in the bird community, recognizing that the different starting point of each site will likely continue to influence species abundance, diversity, and composition.

Acknowledgements

We would like to thank the Scott River Watershed Council and the U.S. Fish and Wildlife Service (USFWS) Yreka Office for funding this research. We appreciate the assistance of Betsy Stapleton, Charnna Gilmore, and Erich Yokel, who were of great help with the study design, spatial data, private property access, and contract management for this project. Mark Cookson and Dave Johnson of USFWS were also instrumental in supporting this monitoring project. We would also like to thank KBO field technicians Michael Fuss and Ellie Armstrong, who completed several of the spring surveys. Special thanks to Frank Lospalluto, for providing many beautiful photos, and whose expertise was much appreciated in conducting fall surveys.

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Tables

Table 1. Summary of bird survey effort in spring and fall field seasons of each year, 2015-2017.

Spring

Year	Site	Site Code	# Point Count Stations	Visit 1	Visit 2	Visit 3	Notes
2016	French Creek	FREN	3	18-May	30-May	14-Jun	
2016	Miner's Creek	MINE	3	18-May	30-May	14-Jun	
2016	Rattlesnake Ck	RATT	3			13-Jun	site added in June 2016
2016	Scott River	SCRI	6	17-May	29-May	13-Jun	
2016	Sugar Creek	SUGA	2	18-May	29-May	14-Jun	reference site
2017	French Creek	FREN	3	19-May	2-Jun	16-Jun	
2017	Miner's Creek	MINE	3	19-May	2-Jun	16-Jun	
2017	Rattlesnake Ck	RATT	3	18-May	1-Jun	15-Jun	
2017	Scott River	SCRI	6	18-May	1-Jun	15-Jun	
2017	Sugar Creek	SUGA	2	19-May	2-Jun	16-Jun	reference site

Fall

Year	Site	Site Code	# Area Search Plots	Visit 1	Visit 2	Visit 3	Notes
2015	French Creek	FREN	2	9-Sep	24-Sep	13-Oct	
2015	Miner's Creek	MINE	1	9-Sep	24-Sep	13-Oct	
2015	Rattlesnake Ck	RATT	2				site added in June 2016
2015	Scott River	SCRI	2	8-Sep	25-Sep	12-Oct	
2015	Sugar Creek	SUGA	1	9-Sep	24-Sep	13-Oct	reference site
2016	French Creek	FREN	2	9-Sep	27-Sep	13-Oct	
2016	Miner's Creek	MINE	1	9-Sep	2-Oct	13-Oct	
2016	Rattlesnake Ck	RATT	2	8-Sep	26-Sep	12-Oct	
2016	Scott River	SCRI	2	8-Sep	26-Sep	12-Oct	
2016	Sugar Creek	SUGA	1	9-Sep	27-Sep	13-Oct	reference site

Table 2. Mean relative abundance (birds/point) and standard error (SE) for species detected within 75 m during six spring point count surveys in 2016-2017, along the Scott River and several tributaries, California. Species listed in decreasing order of the total number of individuals detected on all survey visits. Conservation status from select plans in columns on the far right.

Common Name	Scientific Name	Code	Total Count	French Creek		Miner's Creek		Rattlesnake Creek		Scott River		Sugar Creek (Reference)		RHJV[1] CAlPIF[2,3] PIF[4]	NABCI[5]	CDFW[6]
				Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE			
Red-winged Blackbird	*Agelaius phoeniceus*	RWBL	59	0.000	0.000	0.056	0.056	0.000	0.000	1.028	0.209	3.500	0.719			
Spotted Towhee	*Pipilo maculatus*	SPTO	48	0.889	0.159	0.278	0.109	0.667	0.225	0.500	0.093	0.167	0.167			
Tree Swallow	*Tachycineta bicolor*	TRES	46	0.444	0.202	0.167	0.167	0.000	0.000	0.861	0.249	0.667	0.211	R		
Brown-headed Cowbird	*Molothrus ater*	BHCO	41	0.111	0.076	0.611	0.143	0.000	0.000	0.722	0.147	0.333	0.333			
Western Wood-Pewee	*Contopus sordidulus*	WEWP	39	0.778	0.222	1.111	0.212	0.250	0.131	0.000	0.000	0.333	0.211			
European Starling	*Sturnus vulgaris*	EUST	36	0.000	0.000	1.389	1.389	0.000	0.000	0.194	0.168	0.667	0.333			
Black-headed Grosbeak	*Pheucticus melanocephalus*	BHGR	33	0.000	0.000	0.333	0.140	0.333	0.142	0.583	0.101	0.333	0.211	R		
Black-billed Magpie	*Pica hudsonia*	BBMA	31	0.000	0.000	0.000	0.000	0.000	0.000	0.861	0.211	0.000	0.000			
Song Sparrow	*Melospiza melodia*	SOSP	29	0.222	0.129	0.278	0.135	0.000	0.000	0.417	0.101	0.833	0.307	R		
Bank Swallow	*Riparia riparia*	BANS	26	0.000	0.000	0.000	0.000	0.000	0.000	0.722	0.231	0.000	0.000	R	D	T
House Wren	*Troglodytes aedon*	HOWR	26	0.000	0.000	0.000	0.000	0.000	0.000	0.722	0.130	0.000	0.000			
Yellow Warbler	*Setophaga petechia*	YEWA	24	0.111	0.111	0.222	0.101	0.000	0.000	0.222	0.081	1.667	0.211	R		S
Brewer's Blackbird	*Euphagus cyanocephalus*	BRBL	23	0.000	0.000	0.111	0.076	0.000	0.000	0.500	0.185	0.500	0.224		D	
Bullock's Oriole	*Icterus bullockii*	BUOR	22	0.000	0.000	0.389	0.143	0.000	0.000	0.333	0.120	0.500	0.224			
Yellow-breasted Chat	*Icteria virens*	YBCH	20	0.000	0.000	0.000	0.000	0.000	0.000	0.444	0.109	0.667	0.211	R		S
Bewick's Wren	*Thryomanes bewickii*	BEWR	19	0.000	0.000	0.056	0.056	0.000	0.000	0.500	0.109	0.000	0.000	O		
MacGillivray's Warbler	*Geothlypis tolmiei*	MGWA	16	0.500	0.146	0.278	0.135	0.083	0.083	0.000	0.000	0.167	0.167	C		
Warbling Vireo	*Vireo gilvus*	WAVI	16	0.167	0.090	0.333	0.114	0.167	0.112	0.000	0.000	0.833	0.167	R		
Western Meadowlark	*Sturnella neglecta*	WEME	11	0.056	0.056	0.056	0.056	0.000	0.000	0.167	0.063	0.500	0.342			

Cassin's Vireo	*Vireo cassinii*	CAVI	10	0.000	0.000	0.333	0.114	0.333	0.142	0.000	0.000	0.000	0.000		
Nashville Warbler	*Oreothlypis ruficapilla*	NAWA	10	0.000	0.000	0.000	0.000	0.833	0.241	0.000	0.000	0.000	0.000		
American Robin	*Turdus migratorius*	AMRO	9	0.056	0.056	0.389	0.164	0.000	0.000	0.000	0.000	0.167	0.167		
California Scrub-Jay*	*Aphelocoma californica*	CASJ	9	0.167	0.121	0.333	0.162	0.000	0.000	0.000	0.000	0.000	0.000	O	
American Crow	*Corvus brachyrhynchos*	AMCR	8	0.444	0.166	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
Downy Woodpecker	*Picoides pubescens*	DOWO	8	0.111	0.076	0.056	0.056	0.167	0.112	0.000	0.000	0.500	0.224		
Mallard	*Anas platyrhynchos*	MALL	8	0.000	0.000	0.000	0.000	0.000	0.000	0.222	0.098	0.000	0.000		
Western Tanager	*Piranga ludoviciana*	WETA	8	0.056	0.056	0.056	0.056	0.417	0.229	0.000	0.000	0.167	0.167	C	
Wilson's Warbler	*Cardellina pusilla*	WIWA	7	0.056	0.056	0.111	0.076	0.167	0.112	0.056	0.039	0.000	0.000	R, D	D
Black-throated Gray Warbler	*Setophaga nigrescens*	BTYW	6	0.000	0.000	0.056	0.056	0.417	0.229	0.000	0.000	0.000	0.000	C	
Bushtit	*Psaltriparus minimus*	BUSH	6	0.222	0.152	0.111	0.111	0.000	0.000	0.000	0.000	0.000	0.000		
California Quail	*Callipepla californica*	CAQU	6	0.000	0.000	0.056	0.056	0.000	0.000	0.139	0.058	0.000	0.000	O	
Killdeer	*Charadrius vociferus*	KILL	6	0.000	0.000	0.056	0.056	0.000	0.000	0.139	0.058	0.000	0.000		
Steller's Jay	*Cyanocitta stelleri*	STJA	6	0.000	0.000	0.000	0.000	0.500	0.230	0.000	0.000	0.000	0.000		
Lazuli Bunting	*Passerina amoena*	LAZB	5	0.000	0.000	0.056	0.056	0.333	0.142	0.000	0.000	0.000	0.000		
White-breasted Nuthatch	*Sitta carolinensis*	WBNU	5	0.000	0.000	0.278	0.135	0.000	0.000	0.000	0.000	0.000	0.000	O	
Cedar Waxwing	*Bombycilla cedrorum*	CEDW	4	0.056	0.056	0.000	0.000	0.000	0.000	0.000	0.000	0.500	0.342		
Cliff Swallow	*Petrochelidon pyrrhonota*	CLSW	4	0.000	0.000	0.222	0.222	0.000	0.000	0.000	0.000	0.000	0.000		
Eurasian Collared-Dove	*Streptopelia decaocto*	ECDO	4	0.000	0.000	0.000	0.000	0.000	0.000	0.056	0.039	0.333	0.211		
Green Heron	*Butorides virescens*	GRHE	4	0.000	0.000	0.000	0.000	0.000	0.000	0.083	0.047	0.167	0.167		
Lesser Goldfinch	*Spinus psaltria*	LEGO	4	0.000	0.000	0.111	0.111	0.000	0.000	0.056	0.056	0.000	0.000		
Mourning Dove	*Zenaida macroura*	MODO	4	0.000	0.000	0.056	0.056	0.000	0.000	0.083	0.047	0.000	0.000		
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	NRWS	4	0.000	0.000	0.000	0.000	0.000	0.000	0.111	0.087	0.000	0.000		
Common Merganser	*Mergus merganser*	COME	3	0.167	0.121	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
Red-breasted Sapsucker	*Sphyrapicus ruber*	RBSA	3	0.056	0.056	0.111	0.076	0.000	0.000	0.000	0.000	0.000	0.000		

Spotted Sandpiper	*Actitis macularius*	SPSA	3	0.000	0.000	0.000	0.000	0.000	0.000	0.083	0.047	0.000	0.000	R		
Willow Flycatcher	*Empidonax traillii*	WIFL	3	0.000	0.000	0.056	0.056	0.000	0.000	0.056	0.039	0.000	0.000	R		E
Belted Kingfisher	*Megaceryle alcyon*	BEKI	2	0.000	0.000	0.111	0.076	0.000	0.000	0.000	0.000	0.000	0.000			
Blue-gray Gnatcatcher	*Polioptila caerulea*	BGGN	2	0.000	0.000	0.000	0.000	0.000	0.000	0.056	0.056	0.000	0.000	O		
California Towhee	*Melozone crissalis*	CALT	2	0.000	0.000	0.000	0.000	0.167	0.112	0.000	0.000	0.000	0.000	O		
Hairy Woodpecker	*Picoides villosus*	HAWO	2	0.056	0.056	0.056	0.056	0.000	0.000	0.000	0.000	0.000	0.000			
Northern Flicker	*Colaptes auratus*	NOFL	2	0.056	0.056	0.056	0.056	0.000	0.000	0.000	0.000	0.000	0.000			
Orange-crowned Warbler	*Oreothlypis celata*	OCWA	2	0.000	0.000	0.056	0.056	0.000	0.000	0.028	0.028	0.000	0.000			
Purple Finch	*Haemorhous purpureus*	PUFI	2	0.000	0.000	0.056	0.056	0.083	0.083	0.000	0.000	0.000	0.000			
Yellow-rumped Warbler	*Setophaga coronata*	YRWA	2	0.000	0.000	0.056	0.056	0.083	0.083	0.000	0.000	0.000	0.000			
Acorn Woodpecker	*Melanerpes formicivorus*	ACWO	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.167	0.167	O		
Anna's Hummingbird	*Calypte anna*	ANHU	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.167	0.167			
Golden-crowned Sparrow	*Zonotrichia atricapilla*	GCSP	1	0.000	0.000	0.000	0.000	0.000	0.000	0.028	0.028	0.000	0.000			
Turkey Vulture	*Cathartes aura*	TUVU	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.167	0.167			
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	YHBL	1	0.000	0.000	0.000	0.000	0.000	0.000	0.028	0.028	0.000	0.000			S

*formerly Western Scrub-Jay

[1] RHJV 2004 (R = riparian plan)
[2] CalPIF 2002 (O = oak plan)
[3] CalPIF 2002 (C = conifer plan)
[4] PIF 2016 (D = reverse decline, yellow watch list)
[5] NABCI 2014 (D = common bird in steep decline)
[6] CDFW 2008, 2017 (E = state endangered, T = state threatened, S = species of special concern)

Table 3. List of additional species detected on study sites in spring 2016-2017 and fall 2015-2016 (species not recorded within standardized point count or area search surveys), and conservation status from select plans.

Common Name	Scientific Name	Code	RHJV[1] CalPIF[1,2,3]	Cont. PIF[4]	NABCI[5]
Spring					
American Dipper	*Cinclus mexicanus*	AMDI			
American Goldfinch	*Spinus tristis*	AMGO			
American Kestrel	*Falco sparverius*	AMKE			
Bald Eagle	*Haliaeetus leucocephalus*	BAEA			
Black Phoebe	*Sayornis nigricans*	BLPH			
Band-tailed Pigeon	*Patagioenas fasciata*	BTPI	O	D	
Canada Goose	*Branta canadensis*	CAGO			
Chipping Sparrow	*Spizella passerina*	CHSP			
Common Raven	*Corvus corax*	CORA			
Common Yellowthroat	*Geothlypis trichas*	COYE	R		
Great Blue Heron	*Ardea herodias*	GBHE			
Great Horned Owl	*Bubo virginianus*	GHOW			
House Finch	*Haemorhous mexicanus*	HOFI			
Mountain Quail	*Oreortyx pictus*	MOUQ			
Northern Harrier	*Circus cyaneus*	NOHA			
Oak Titmouse	*Baeolophus inornatus*	OATI	O	D	
Osprey	*Pandion haliaetus*	OSPR			
Pileated Woodpecker	*Hylatomus pileatus*	PIWO	C		
Pacific-slope Flycatcher	*Empidonax difficilis*	PSFL			
Red-shouldered Hawk	*Buteo lineatus*	RSHA	O		
Red-tailed Hawk	*Buteo jamaicensis*	RTHA			
Sandhill Crane	*Grus canadensis*	SACR			
Western Bluebird	*Sialia mexicana*	WEBL	O		
Wood Duck	*Aix sponsa*	WODU	O		
Fall					
Acorn Woodpecker	*Melanerpes formicivorus*	ACWO	O		
American Dipper	*Cinclus mexicanus*	AMDI			
American Kestrel	*Falco sparverius*	AMKE			
American Pipit	*Anthus rubescens*	AMPI			
Bald Eagle	*Haliaeetus leucocephalus*	BAEA			
Barn Owl	*Tyto alba*	BANO			
Brown-headed Cowbird	*Molothrus ater*	BHCO			
Brewer's Blackbird	*Euphagus cyanocephalus*	BRBL			D
Band-tailed Pigeon	*Patagioenas fasciata*	BTPI	O	D	
Canada Goose	*Branta canadensis*	CAGO			
Clark's Nutcracker	*Nucifraga columbiana*	CLNU			

Cooper's Hawk	*Accipiter cooperii*	COHA			
Common Merganser	*Mergus merganser*	COME			
Common Raven	*Corvus corax*	CORA			
Eurasian Collared-Dove	*Streptopelia decaocto*	ECDO			
Evening Grosbeak	*Coccothraustes vespertinus*	EVGR		D	
Ferruginous Hawk	*Buteo regalis*	FEHA			
Golden Eagle	*Aquila chrysaetos*	GOEA			
Green Heron	*Butorides virescens*	GRHE			
Grasshopper Sparrow	*Ammodramus savannarum*	GRSP			D
Greater Yellowlegs	*Tringa melanoleuca*	GRYE			
Horned Lark	*Eremophila alpestris*	HOLA			D
Mourning Dove	*Zenaida macroura*	MODO			
Northern Pintail	*Anas acuta*	NOPI			D
Northern Pygmy-Owl	*Glaucidium gnoma*	NOPO	O		
Peregrine Falcon	*Falco peregrinus*	PEFA			
Pileated Woodpecker	*Hylatomus pileatus*	PIWO	C		
Red Crossbill	*Loxia curvirostra*	RECR			
Red-shouldered Hawk	*Buteo lineatus*	RSHA	O		
Say's Phoebe	*Sayornis saya*	SAPH			
Snowy Egret	*Egretta thula*	SNEG			
Swainson's Thrush	*Catharus ustulatus*	SWTH	R		
Tree Swallow	*Tachycineta bicolor*	TRES	R		
Western Bluebird	*Sialia mexicana*	WEBL	O		
Western Meadowlark	*Sturnella neglecta*	WEME			
Western Screech-Owl	*Megascops kennicottii*	WESO			
Western Wood-Pewee	*Contopus sordidulus*	WEWP			

[1] RHJV 2004 (R = riparian plan)
[2] CalPIF 2002 (O = oak plan)
[3] CalPIF 2002 (C = conifer plan)
[4] PIF 2016 (D = reverse decline, yellow watch list)
[5] NABCI 2014 (D = common bird in steep decline)

Table 4. Mean density (birds/ha) and standard error (SE) for species detected within area search plots during six standardized surveys in 2015-2016, along the Scott River and several tributaries, California. Species listed in decreasing order of the total number of individuals detected on all survey visits. Conservation status from select plans in columns on the far right.

Common Name	Scientific Name	Code	Total Count	French Creek		Miner's Creek		Rattlesnake Creek		Scott River		Sugar Creek (Reference)		RHJV[1] CAlPIF[1,2,3] PIF[4]	NABCI[5]	CDFW[6]
				Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE			
Golden-crowned Sparrow	*Zonotrichia atricapilla*	GCSP	226	5.487	1.966	22.84	13.756	1.990	1.259	7.854	2.351	1.375	1.019			
American Robin	*Turdus migratorius*	AMRO	211	9.061	2.556	8.951	2.411	0.000	0.000	0.675	0.508	14.605	8.071			
Song Sparrow	*Melospiza melodia*	SOSP	159	4.226	0.984	9.877	3.991	0.505	0.505	5.403	0.957	3.952	1.142	R		
Cedar Waxwing	*Bombycilla cedrorum*	CEDW	110	6.939	3.358	9.259	9.259	0.000	0.000	0.000	0.000	0.515	0.515			
Spotted Towhee	*Pipilo maculatus*	SPTO	105	3.325	0.905	8.025	1.138	5.615	1.949	2.004	0.486	0.344	0.344			
White-crowned Sparrow	*Zonotrichia leucophrys*	WCSP	93	2.707	1.725	7.099	3.686	0.000	0.000	3.943	1.193	0.515	0.352			
Yellow-rumped Warbler	*Setophaga coronata*	YRWA	82	2.745	0.716	4.012	1.387	0.654	0.654	2.391	0.638	2.234	1.315			
Common Yellowthroat	*Geothlypis trichas*	COYE	78	1.916	0.454	0.309	0.309	0.000	0.000	3.045	0.653	3.952	1.111	R		
Bushtit	*Psaltriparus minimus*	BUSH	52	1.522	1.522	0.000	0.000	0.000	0.000	3.039	1.648	0.000	0.000			
California Quail	*Callipepla californica*	CAQU	43	0.000	0.000	4.938	4.938	0.000	0.000	2.538	1.694	0.000	0.000	O		
House Finch	*Haemorhous mexicanus*	HOFI	35	0.000	0.000	1.235	0.781	0.000	0.000	2.658	0.670	0.515	0.352			
Fox Sparrow	*Passerella iliaca*	FOSP	33	0.976	0.400	3.704	1.265	2.347	1.008	0.000	0.000	0.172	0.172	C		
California Scrub-Jay*	*Aphelocoma californica*	CASJ	31	1.697	0.469	1.235	0.617	0.906	0.652	0.294	0.294	0.687	0.435	O		
Bewick's Wren	*Thryomanes bewickii*	BEWR	30	0.723	0.195	0.617	0.390	0.327	0.327	1.340	0.348	0.859	0.317			
Lesser Goldfinch	*Spinus psaltria*	LEGO	28	0.145	0.098	3.395	2.363	0.000	0.000	0.648	0.648	1.375	0.909			
Lincoln's Sparrow	*Melospiza lincolnii*	LISP	26	0.289	0.222	2.160	1.005	0.000	0.000	0.664	0.452	1.546	0.741			

Ruby-crowned Kinglet	*Regulus calendula*	RCKI	23	1.084	0.390	2.160	1.113	0.327	0.327	0.278	0.145	0.000	0.000			
Hermit Thrush	*Catharus guttatus*	HETH	22	0.470	0.172	2.160	1.005	2.496	0.560	0.000	0.000	0.172	0.172			
Purple Finch	*Haemorhous purpureus*	PUFI	16	0.722	0.293	1.235	0.916	0.579	0.371	0.294	0.211	0.000	0.000			
Yellow Warbler	*Setophaga petechia*	YEWA	16	0.181	0.125	0.309	0.309	0.327	0.327	0.953	0.368	0.344	0.344	R		S
Orange-crowned Warbler	*Oreothlypis celata*	OCWA	15	0.506	0.292	1.235	0.617	0.000	0.000	0.479	0.224	0.000	0.000			
Dark-eyed Junco (Oregon race)	*Junco hyemalis oreganus*	ORJU	15	0.506	0.346	0.000	0.000	0.980	0.980	0.577	0.418	0.000	0.000	C		
Black-capped Chickadee	*Poecile atricapillus*	BCCH	14	0.253	0.173	0.000	0.000	0.000	0.000	0.686	0.368	0.687	0.510			
Downy Woodpecker	*Picoides pubescens*	DOWO	14	0.578	0.240	1.235	0.617	0.000	0.000	0.093	0.093	0.515	0.231			
Savannah Sparrow	*Passerculus sandwichensis*	SAVS	14	0.000	0.000	0.000	0.000	0.000	0.000	1.313	1.034	0.000	0.000			
Steller's Jay	*Cyanocitta stelleri*	STJA	14	0.542	0.342	0.309	0.309	1.233	0.962	0.000	0.000	0.515	0.515			
Black Phoebe	*Sayornis nigricans*	BLPH	13	0.145	0.098	0.309	0.309	0.000	0.000	0.948	0.187	0.000	0.000			
Northern Flicker	*Colaptes auratus*	NOFL	11	0.470	0.203	0.617	0.390	0.000	0.000	0.000	0.000	0.687	0.344			
Pacific Wren	*Troglodytes pacificus*	PAWR	11	0.361	0.249	0.926	0.633	0.832	0.378	0.000	0.000	0.172	0.172			
Black-throated Gray Warbler	*Setophaga nigrescens*	BTYW	10	0.505	0.243	0.926	0.633	0.579	0.371	0.000	0.000	0.000	0.000	C		
Mountain Quail	*Oreortyx pictus*	MOUQ	10	0.000	0.000	0.000	0.000	2.897	1.854	0.000	0.000	0.000	0.000			
American Goldfinch	*Spinus tristis*	AMGO	9	0.000	0.000	0.309	0.309	0.000	0.000	0.000	0.000	1.375	1.375			
Golden-crowned Kinglet	*Regulus satrapa*	GCKI	9	0.433	0.433	0.000	0.000	0.758	0.518	0.000	0.000	0.344	0.344	C		
White-breasted Nuthatch	*Sitta carolinensis*	WBNU	8	0.181	0.125	1.543	0.569	0.000	0.000	0.000	0.000	0.172	0.172	O		
European Starling	*Sturnus vulgaris*	EUST	7	0.000	0.000	0.926	0.926	0.000	0.000	0.000	0.000	0.687	0.687			
Red-tailed Hawk	*Buteo jamaicensis*	RTHA	7	0.108	0.108	0.617	0.617	0.000	0.000	0.376	0.286	0.000	0.000			
Belted Kingfisher	*Megaceryle alcyon*	BEKI	6	0.289	0.154	0.309	0.309	0.000	0.000	0.098	0.098	0.172	0.172			
Varied Thrush	*Ixoreus naevius*	VATH	6	0.108	0.108	0.000	0.000	0.832	0.544	0.000	0.000	0.344	0.344		D	

Virginia Rail	*Rallus limicola*	VIRA	6	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.031	0.266				
Great Horned Owl	*Bubo virginianus*	GHOW	5	0.072	0.072	0.000	0.000	0.000	0.000	0.376	0.160	0.000	0.000				
Marsh Wren	*Cistothorus palustris*	MAWR	5	0.000	0.000	0.000	0.000	0.000	0.000	0.278	0.145	0.344	0.217				
MacGillivray's Warbler	*Geothlypis tolmiei*	MGWA	5	0.000	0.000	0.926	0.633	0.000	0.000	0.000	0.000	0.344	0.217	C			
Oak Titmouse	*Baeolophus inornatus*	OATI	5	0.145	0.145	0.926	0.926	0.000	0.000	0.000	0.000	0.000	0.000	O, D			
Willow Flycatcher	*Empidonax traillii*	WIFL	5	0.108	0.108	0.000	0.000	0.000	0.000	0.370	0.209	0.000	0.000	R			E
Wilson's Warbler	*Cardellina pusilla*	WIWA	5	0.541	0.541	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	R, D	D		
Wood Duck	*Aix sponsa*	WODU	5	0.145	0.098	0.000	0.000	0.000	0.000	0.185	0.185	0.172	0.172	O			
Black-billed Magpie	*Pica hudsonia*	BBMA	4	0.000	0.000	0.309	0.309	0.000	0.000	0.196	0.132	0.172	0.172				
Turkey Vulture	*Cathartes aura*	TUVU	4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.687	0.510				
Western Tanager	*Piranga ludoviciana*	WETA	4	0.108	0.108	0.926	0.926	0.000	0.000	0.000	0.000	0.000	0.000	C			
Anna's Hummingbird	*Calypte anna*	ANHU	3	0.181	0.125	0.309	0.309	0.000	0.000	0.000	0.000	0.000	0.000				
Barn Swallow	*Hirundo rustica*	BARS	3	0.000	0.000	0.000	0.000	0.000	0.000	0.294	0.294	0.000	0.000				
Lewis's Woodpecker	*Melanerpes lewis*	LEWO	3	0.325	0.325	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	O, D			
Pine Siskin	*Spinus pinus*	PISI	3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.515	0.515		D		
Red-breasted Nuthatch	*Sitta canadensis*	RBNU	3	0.000	0.000	0.309	0.309	0.505	0.505	0.000	0.000	0.000	0.000	C			
Violet-green Swallow	*Tachycineta thalassina*	VGSW	3	0.000	0.000	0.000	0.000	0.000	0.000	0.278	0.278	0.000	0.000				
Hutton's Vireo	*Vireo huttoni*	HUVI	2	0.072	0.072	0.000	0.000	0.327	0.327	0.000	0.000	0.000	0.000	O			
Northern Harrier	*Circus cyaneus*	NOHA	2	0.000	0.000	0.000	0.000	0.000	0.000	0.191	0.129	0.000	0.000				
Red-breasted Sapsucker	*Sphyrapicus ruber*	RBSA	2	0.108	0.108	0.000	0.000	0.327	0.327	0.000	0.000	0.000	0.000				
Red-winged Blackbird	*Agelaius phoeniceus*	RWBL	2	0.000	0.000	0.617	0.617	0.000	0.000	0.000	0.000	0.000	0.000				
Townsend's Warbler	*Setophaga townsendi*	TOWA	2	0.000	0.000	0.617	0.617	0.000	0.000	0.000	0.000	0.000	0.000				
Warbling Vireo	*Vireo gilvus*	WAVI	2	0.000	0.000	0.000	0.000	0.654	0.654	0.000	0.000	0.000	0.000	R			

Wrentit	*Chamaea fasciata*	WREN	2	0.000	0.000	0.000	0.000	0.000	0.000	0.185	0.185	0.000	0.000	D
American Crow	*Corvus brachyrhynchos*	AMCR	1	0.108	0.108	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Brown Creeper	*Certhia americana*	BRCR	1	0.072	0.072	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	C
Cassin's Vireo	*Vireo cassinii*	CAVI	1	0.000	0.000	0.000	0.000	0.253	0.253	0.000	0.000	0.000	0.000	
Great Blue Heron	*Ardea herodias*	GBHE	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.172	0.172	
Great Egret	*Ardea alba*	GREG	1	0.000	0.000	0.000	0.000	0.000	0.000	0.093	0.093	0.000	0.000	
Hairy Woodpecker	*Picoides villosus*	HAWO	1	0.108	0.108	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
House Wren	*Troglodytes aedon*	HOWR	1	0.000	0.000	0.309	0.309	0.000	0.000	0.000	0.000	0.000	0.000	
Killdeer	*Charadrius vociferus*	KILL	1	0.000	0.000	0.000	0.000	0.000	0.000	0.093	0.093	0.000	0.000	
Mallard	*Anas platyrhynchos*	MALL	1	0.000	0.000	0.000	0.000	0.000	0.000	0.093	0.093	0.000	0.000	
Mountain Chickadee	*Poecile gambeli*	MOCH	1	0.000	0.000	0.309	0.309	0.000	0.000	0.000	0.000	0.000	0.000	
Pacific-slope Flycatcher	*Empidonax difficilis*	PSFL	1	0.000	0.000	0.309	0.309	0.000	0.000	0.000	0.000	0.000	0.000	
Sora	*Porzana carolina*	SORA	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.172	0.172	
Sharp-shinned Hawk	*Accipiter striatus*	SSHA	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.172	0.172	
Townsend's Solitaire	*Myadestes townsendi*	TOSO	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.172	0.172	
White-throated Sparrow	*Zonotrichia albicollis*	WTSP	1	0.000	0.000	0.000	0.000	0.000	0.000	0.098	0.098	0.000	0.000	

*formerly Western Scrub-Jay

[1] RHJV 2004 (R = riparian plan)
[2] CalPIF 2002 (O = oak plan)
[3] CalPIF 2002 (C = conifer plan)
[4] PIF 2016 (D = reverse decline, yellow watch list)
[5] NABCI 2014 (D = common bird in steep decline)
[6] CDFW 2008, 2017 (E = state endangered, T = state threatened, S = species of special concern)

Table 5. Mean and standard error (SE) of percent cover for three vegetation strata (trees, shrubs, and ground); individual woody plant species that were detected on >20% of surveys; ferns, forbs, and grasses in the ground strata; and number of snags recorded during relevé vegetation surveys along the Scott River and several tributaries, California, in 2016-2017.

Vegetation Strata or Species	Scientific Name	Code	% of Surveys	French Creek		Miner's Creek		Rattlesnake Creek		Scott River		Sugar Creek (reference)	
				Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Total Tree Cover				29.4	9.2	17.8	7.8	23.8	8.2	0.7	0.5	18.3	12.5
Number of Snags				3.6	1.9	13.3	8.5	2.7	1.7	0.8	0.7	11.0	4.2
White Alder	*Alnus rhombifolia*	ALRH	73.8%	15.0	6.3	14.2	7.3	3.9	1.3	0.3	0.3	5.9	4.3
Incense Cedar	*Calocedrus decurrens*	CADE	24.6%	0.0	0.0	1.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0
Ponderosa Pine	*Pinus ponderosa*	PIPO	60.0%	0.7	0.3	1.7	1.1	2.4	0.6	0.0	0.0	3.1	2.1
Black Cottonwood	*Populus balsamifera trichocarpa*	POBA	52.3%	7.9	2.8	2.6	1.3	2.5	0.0	0.1	0.1	3.8	2.7
Wild Cherry/Plum	*Prunus* spp.	PRUN	43.1%	0.5	0.3	0.0	0.0	0.6	0.3	0.1	0.1	0.4	0.5
Oregon White Oak	*Quercus garryana*	QUGA	29.2%	0.0	0.0	2.0	1.0	2.9	0.9	0.0	0.0	0.8	0.4
Willow	*Salix* spp.	SALX	93.8%	0.8	0.5	3.0	2.5	0.1	0.1	0.4	0.4	0.8	0.5
Total Shrub Cover				28.3	7.2	16.4	6.3	22.5	4.5	13.1	4.1	18.3	8.6
Oregon/Mountain Grape	*Berberis* spp.	BERB	38.5%	1.3	0.5	2.7	0.8	2.0	0.4	0.0	0.0	2.4	0.9
Dogwood	*Cornus* spp.	CORN	36.9%	2.7	0.7	2.2	1.0	5.6	0.4	0.0	0.0	6.2	3.6
Wild Cherry/Plum	*Prunus* spp.	PRUN	43.1%	4.6	2.2	1.0	0.0	3.6	2.3	1.8	0.6	1.5	0.4
Currant/Gooseberry	*Ribes* spp.	RIBE	44.6%	3.4	1.7	1.5	0.4	0.6	0.3	1.2	0.9	1.5	0.5
Rose	*Rosa* spp.	ROSA	36.9%	1.8	0.4	1.8	0.4	0.0	0.0	0.0	0.0	2.1	0.4
Himalayan Blackberry	*Rubus discolor*	RUDI	50.8%	8.9	5.2	7.0	4.6	0.0	0.0	0.8	0.3	1.2	0.2
Willow	*Salix* spp.	SALX	93.8%	3.4	0.9	4.9	2.7	3.8	1.4	9.0	3.9	2.9	0.7
Snowberry	*Symphoricarpos* spp.	SYMP	36.9%	2.4	1.2	2.5	2.0	4.0	0.7	0.0	0.0	2.6	1.2
Total Ground Cover				43.6	8.9	42.8	12.2	23.3	8.8	7.8	3.8	37.1	12.2
Ferns	family Polypodiidae	FERN	1.5%	0.0	0.0	0.0	0.0	0.5	n/a	0.0	0.0	0.0	0.0
Forbs	multiple families	FORB	95.4%	19.4	11.0	18.6	16.1	10.1	4.5	3.1	0.8	9.0	4.2
Grasses	family Poaceae	GRAS	72.3%	20.6	5.7	29.2	14.9	14.3	6.5	5.1	2.6	27.2	15.0

Figures

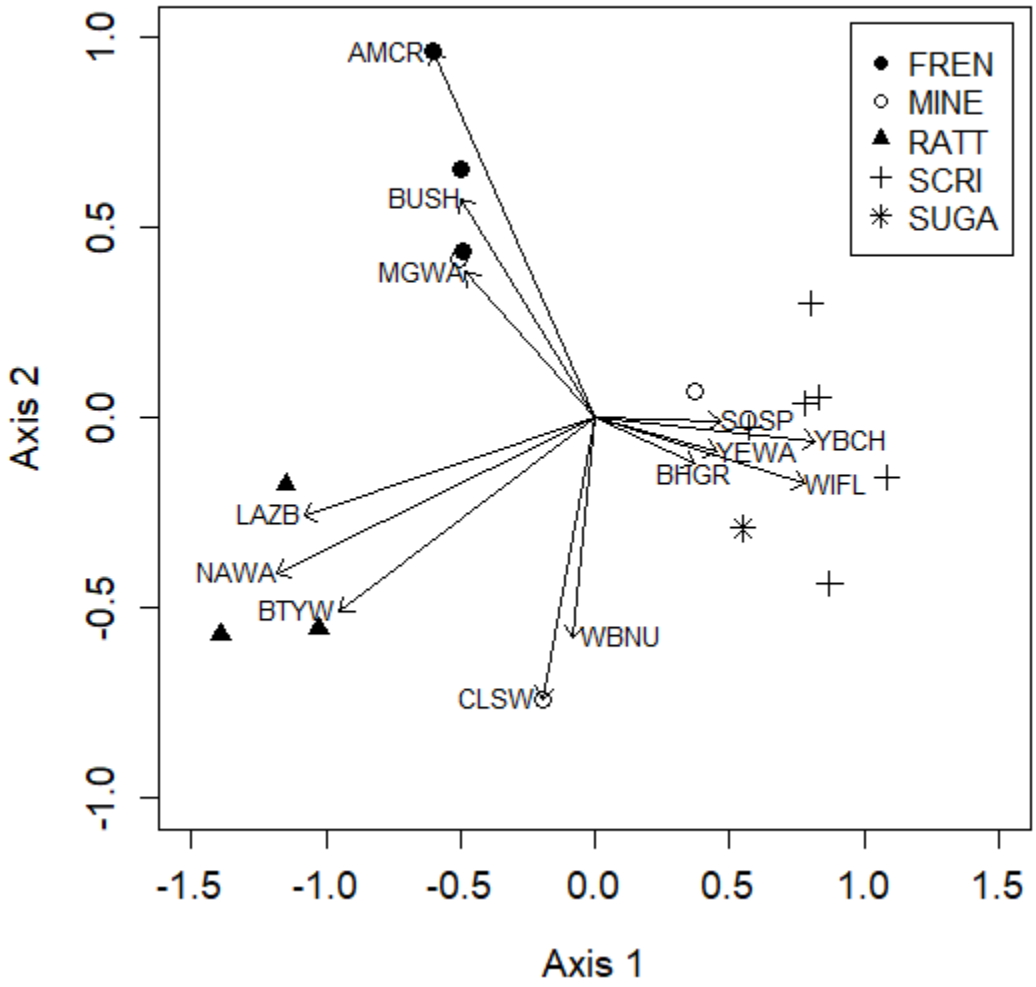
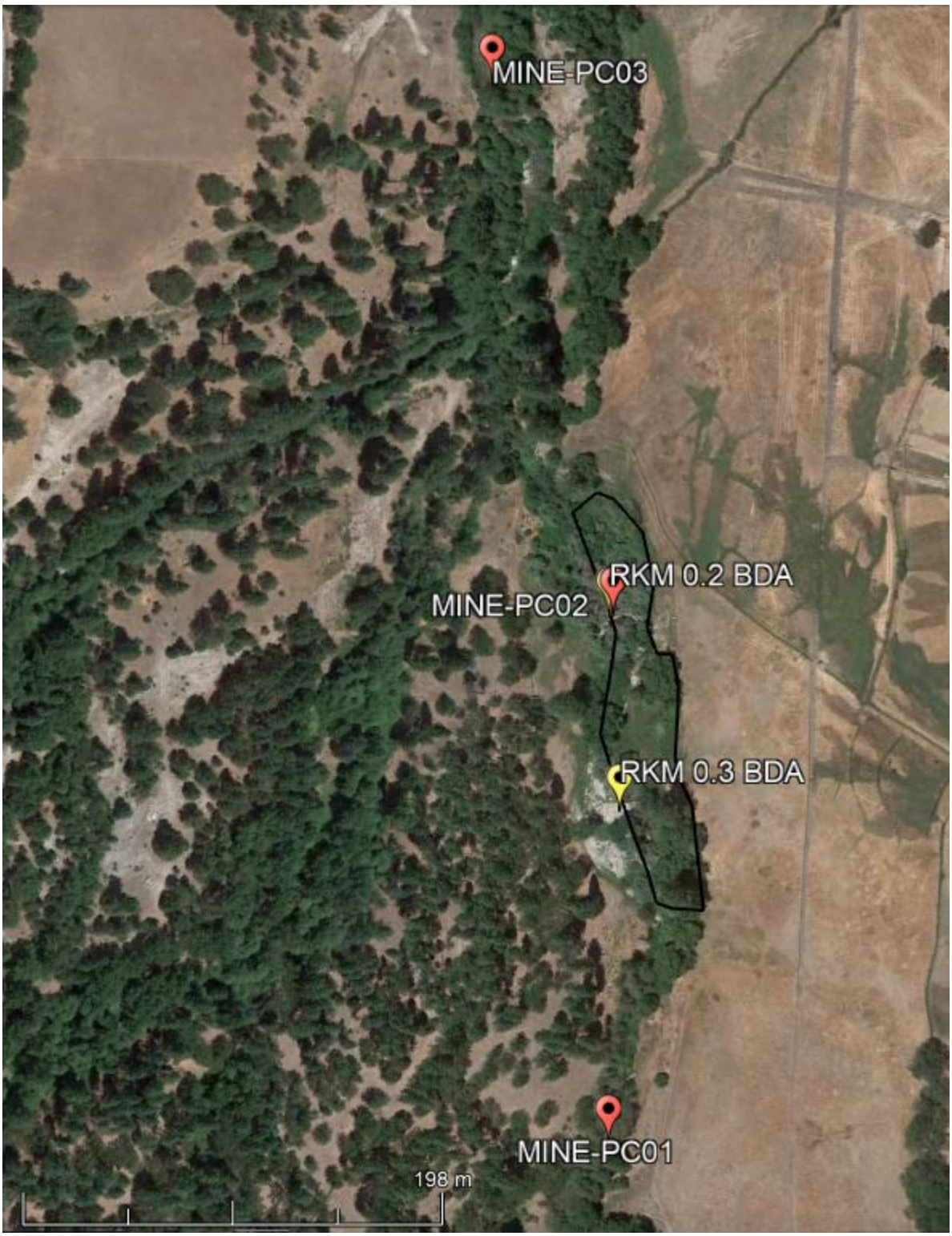


Figure 1. Non-metric multidimensional scaling (NMS) ordination of relative abundance data from spring point counts at riparian restoration sites in the Scott River Valley, CA, 2016-2017. A three-dimensional solution was reached, but only two dimensions are shown here for readability. Axes have no units, but represent underlying factors describing variation in the bird community. Each data point represents a point count survey location. Arrows represent the strength and direction of correlations between NMS axes and individual bird species abundance. Fifty-nine bird species detected within 75 m during point counts (or within 100 m for Sugar Creek) were included in the ordination, but only selected species are presented and labeled. Codes for species labels are found in Table 1.

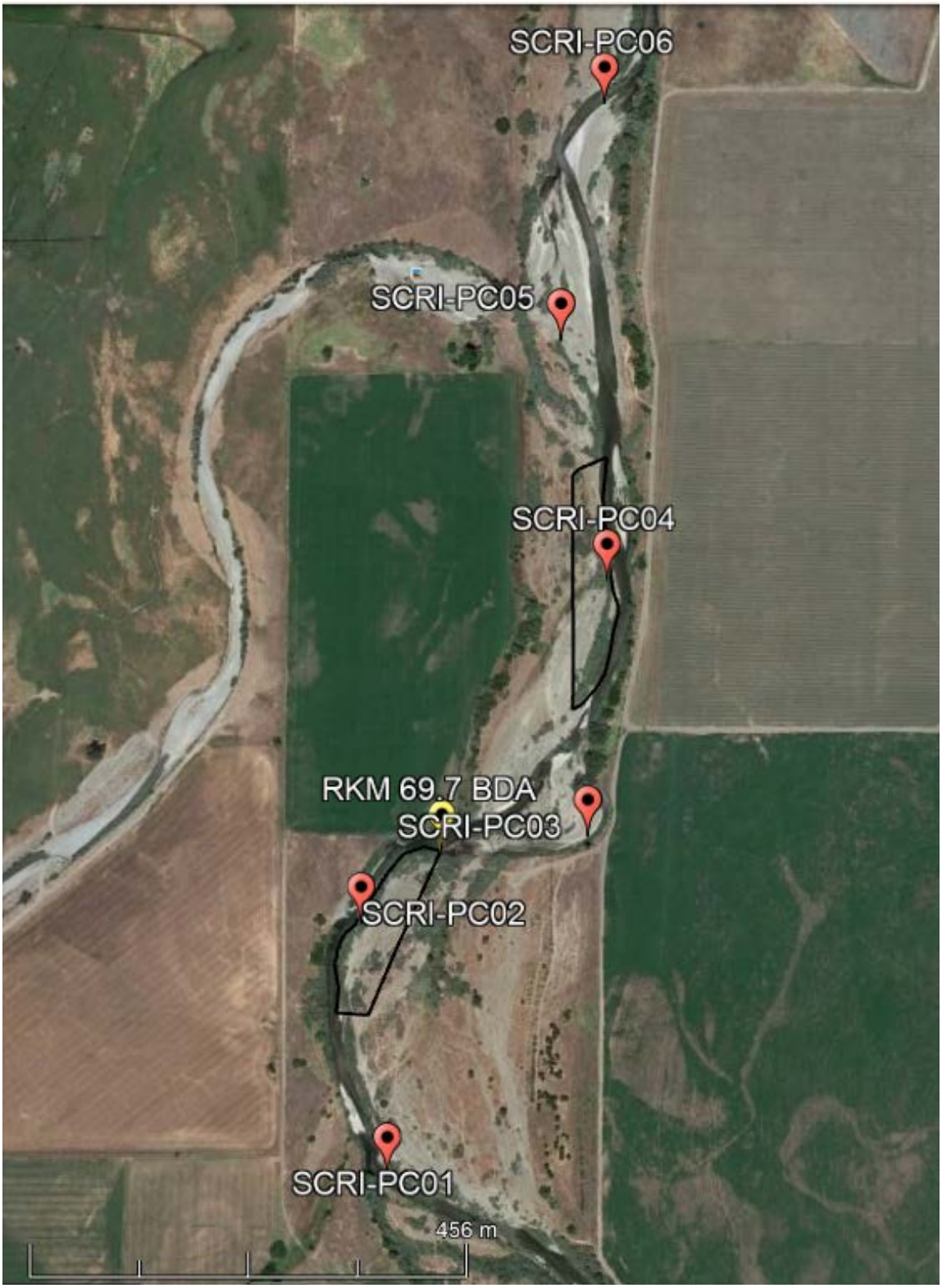
Appendix

Map 1. Aerial view of the French Creek restoration site, Scott River Valley, CA. Yellow pins are locations of beaver dam analogues (BDAs), orange pins are spring point count survey locations, and black polygons are fall area search plots. Vegetation surveys occurred at each point count station in spring, and at the point count stations within area search plots in fall.

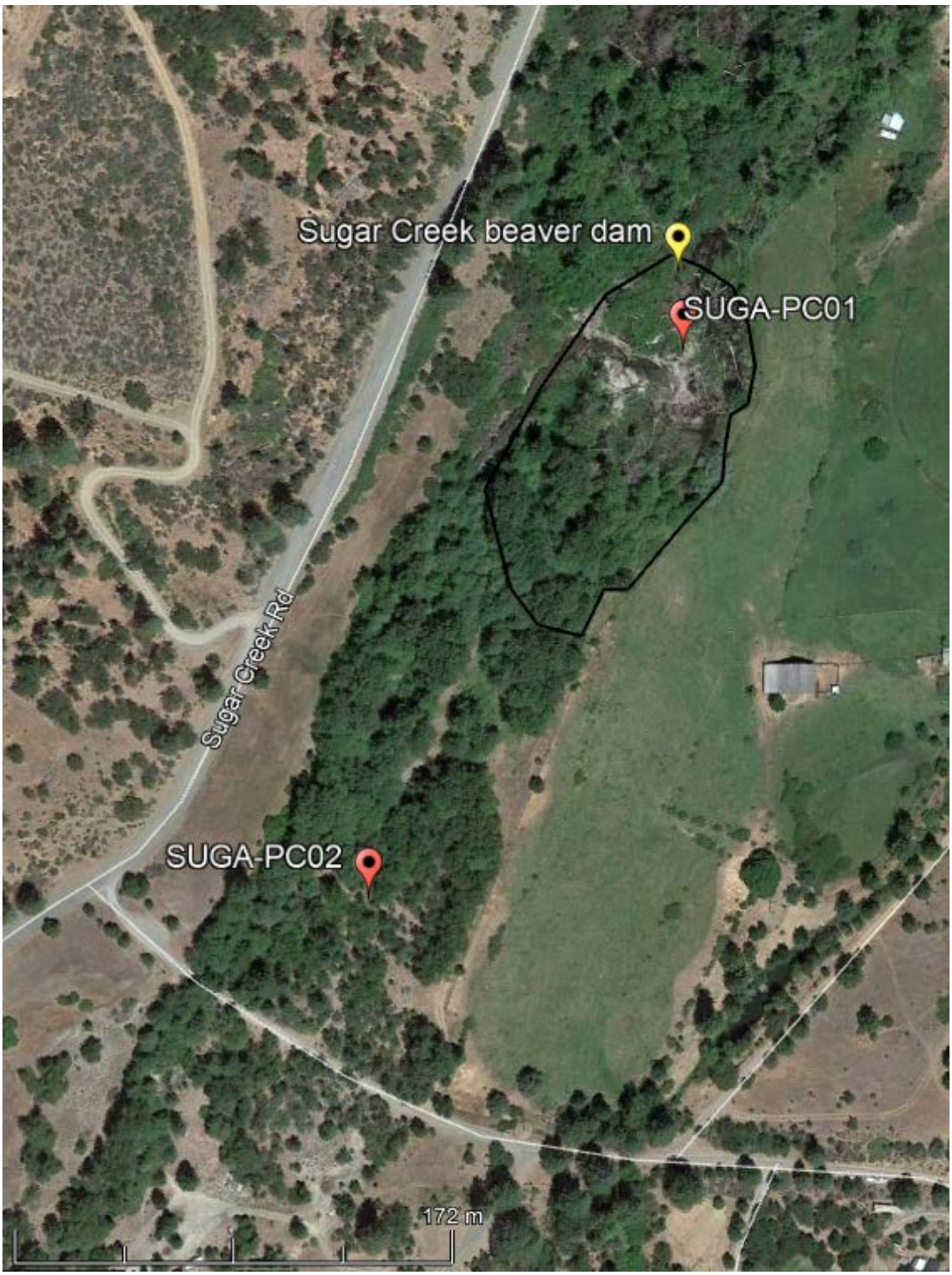


Map 2. Aerial view of the Miner's Creek restoration site, Scott River Valley, CA. Yellow pins are locations of beaver dam analogues (BDAs), orange pins are spring point count survey locations, and black polygons are fall area search plots. Vegetation surveys occurred at each point count station in spring, and at stations within area search plots in fall.

Map 3. Aerial view of the Rattlesnake Creek restoration site, Scott River Valley, CA. Yellow pins are proposed locations of beaver dam analogues (BDAs), orange pins are spring point count survey locations, and black polygons are fall area search plots. Vegetation surveys occurred at each point count station in spring, and at stations within area search plots in fall.



Map 4. Aerial view of the Scott River mainstem restoration site, Scott River Valley, CA. Yellow pins are locations of beaver dam analogues (BDAs), orange pins are spring point count survey locations, and black polygons are fall area search plots. Vegetation surveys occurred at each point count station in spring, and at stations within area search plots in fall.



Map 5. Aerial view of the Sugar Creek reference site, Scott River Valley, CA. Yellow pin shows location of natural beaver dam, orange pins are spring point count survey locations, and black polygons are fall area search plots. Vegetation surveys occurred at each point count station in spring, and at stations within area search plots in fall.