

***Pre-restoration bird surveys on
meadows of Stanislaus National Forest
and Yosemite National Park***

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ABSTRACT

With funding from the National Fish and Wildlife Foundation in 2009-2010, The Institute for Bird Populations developed a monitoring protocol to assess how bird populations respond to meadow restoration activities in the Sierra Nevada. During summer 2010 we field-tested the protocol by conducting pre-restoration bird surveys at 28 meadows proposed for restoration and 32 reference meadows in the Sierra Nevada. Study sites were identified in collaboration with personnel at National Forests, National Parks, California State lands, and private landowners. Monitoring visits included point count surveys, broadcast surveys, area searches, and vegetation and soil moisture assessments. This report describes results of the pre-restoration monitoring completed at 10 meadows (5 intended restoration sites, and 5 paired reference sites) on the Stanislaus National Forest and Yosemite National Park. We surveyed all meadows twice during the 2010 breeding season, conducting a total of 54 point count and broadcast surveys, and over 15 person-hours of area searching. Results of these surveys will provide baseline information for assessing the effects of future restoration activities on bird populations at each of the 5 intended restoration sites.

BACKGROUND

Montane meadows in the Sierra Nevada form ecological islands within the surrounding forest matrix (Ratliff 1985, Fites-Kaufman et al. 2007). They provide abundant water, food, and cover for birds and other wildlife, and are among the most important breeding and foraging habitats for birds in the Sierra Nevada (Grinnell and Miller 1944, Orr and Moffit 1971, Gaines 1992, Graber 1996, Heath and Ballard 2003). However, at many Sierra meadows human activities and historic management practices have altered meadow hydrology, which in turn has changed the characteristics of meadow plant communities, and often diminished the value of meadow habitat for native bird populations (Klebenow and Oakleaf 1984, Allen-Diaz 1991, Kattlemann and Embury 1996, Cicero 1997, Siegel et al. 2008).

Throughout the Sierra Nevada, many public and private land managers are seeking win-win solutions for humans and wildlife by restoring or enhancing meadow habitats, in many cases addressing the historical legacy of hydrological impacts that have led to poorly watered meadows (Rood and Mahoney 1990, Loheide and Gorelick 2006, Skidmore et al. 2009). Restoring meadow hydrology is often a critical first step in restoring the full complement of native biodiversity to a meadow (Poff et al. 1997, Dwire et al. 2006).

Well-functioning hydrologic processes in montane meadows not only yield improved habitat for wildlife, but may also provide tangible benefits for humans, including:

- increased water storage capacity (Loheide and Gorelick 2006, Skidmore et al. 2009),
- improved water quality (Alexander et al. 2007, Simon et al. 2006),
- downstream flood attenuation (Gurnell et al. 1995, Skidmore et al. 2009),
- increased duration of summer flows (Alexander et al. 2007), and
- improved forage quality for livestock (Ratliff 1985).

One way to assess the success of meadow restoration is to monitor the responses of bird populations that inhabit the meadow. Birds can respond rapidly and dramatically to meadow restoration efforts, with populations of meadow-associated bird species increasing in or even colonizing meadows within as little as one year after restoration efforts are implemented (Taylor and Littlefield 1986, Larison et al. 2001, Stanley and Knopf 2002, McCreedy and Heath 2004, Heltzel and Earnst 2006, Borgmann 2010).

Each of the meadow-associated bird species that utilizes montane meadows in the Sierra Nevada has its own particular habitat needs, and the presence or absence of those specific habitat components largely predicts which species utilize a particular meadow (Wiens 1985). When meadow habitats are degraded the number of individual birds and the number of bird species occupying them tends to decline.

The primary objective of this project was to collect pre-restoration data on bird populations at meadows where future restoration projects are planned (and at associated reference sites). These data will allow assessment of the response of bird populations to future restoration activities. Such assessments are valuable both for documenting successes of restoration activities and for facilitating improvement of restoration techniques in an adaptive management context.

We used a draft bird survey protocol (Loffland et al. 2011) under development with funding from the National Fish and Wildlife Foundation designed specifically for pre- and post-restoration bird monitoring at meadow restoration sites. The protocol includes a combination of multi-species and single-species survey techniques, and incorporates point counts, species-specific broadcast surveys, area searches, and vegetation and soil moisture plots.

The use of a standardized survey protocol will help managers and researchers to glean important lessons from restoration monitoring efforts—lessons that cannot be learned from monitoring at any single site. Standardized data from diverse sites that undergo a variety of restoration measures will facilitate comparison of bird responses across sites and projects. Such comparisons will lead to an improved understanding of which restoration efforts most effectively produce high-quality bird habitat, and will allow future meadow restoration efforts to incorporate those findings.

METHODS

All of our methods adhered to Loffland et al.'s (2011) *Avian Monitoring Protocol for Sierra Nevada Meadows*. **Here we provide a cursory summary of methods, but readers seeking more detail or a discussion of the merits and limitations of particular methods should refer to the protocol itself.**

Monitoring Scheme

Loffland et al. (2011) suggest a BACI (Before, After, Control, Impact) monitoring scheme. Under this scheme all monitoring sites where restoration activities are planned are paired with one or more reference sites with similar hydrology and vegetation, but where no restoration activities are imminent. All monitoring activities are then conducted at both the restoration and reference sites in at least one year prior to restoration and at least one year after restoration. This design improves the manager's ability to separate local population changes that are the result of restoration from regional changes that may be due to annual weather variation or other factors. Comparing change in bird populations at the restoration site with the reference site will allow managers to see how individual bird species and suites of species respond to restoration activities, and how the response varies by type of restoration activity, locality, and, if multiple years of post-restoration monitoring are conducted, time since restoration activity (Smucker et al. 2005, Ward et al. 2010).

Site Selection

During early spring of 2010 we met with USDA Forest Service Region 5 staff to discuss how best to identify meadow restoration projects in the planning stage on National Forest lands, and worked closely with the Regional Hydrologist as he queried forests in Region 5. We also consulted with personnel at Yosemite and Sequoia/Kings Canyon National Parks and state agencies, and private landowners. We placed a higher priority on restoration projects that were already in the planning stage, but also included some sites that were identified as needing restoration, but for which the NEPA/CEQA process had not yet begun. Following guidance from the National Fish and Wildlife Foundation, we made restoration projects with a hydrologic component our highest priority. The resulting set of 30 restoration projects was distributed across 6 National Forests, 2 National Parks, 2 California State Wildlife Area, 1 California State Park, and 1 private parcel. After identifying the restoration projects, we worked with local contacts to identify suitable reference sites to pair with each restoration site. These collaborations yielded 32 reference sites (in 2 instances multiple small sites were paired with a single restoration site). **This report details the subset of our 2010 study sites that were located on the Stanislaus National Forest and Yosemite National Park.**

Conversations with biologists and hydrologists on the Stanislaus National Forest and at Yosemite National Park identified 5 meadow restoration projects in various stages of planning. For each restoration site, we selected one or more reference sites based on advice of local experts and through review of aerial photography (Table 1: Figure 1).

Table 1. Restoration and associated reference sites on Stanislaus NF and Yosemite NP where pre-restoration bird surveys were conducted during the 2010 breeding season.

Restoration Site (land manager)	Reference Site(s) (land manager)
Corral Meadow (Stanislaus N.F.)	Gardner Meadow (Stanislaus N.F.)
Poopenaut Meadow (Yosemite N.P.)	Femmons Meadows (Stanislaus N.F.)
Round Meadow (Stanislaus N.F.)	Lower Bell Meadow (Stanislaus N.F.)
Sapps Meadow (Stanislaus N.F.)	Sapps Hollow (Stanislaus N.F.)
Wawona Meadow (Yosemite N.P.)	Hodgdon Meadow (Yosemite N.P.)

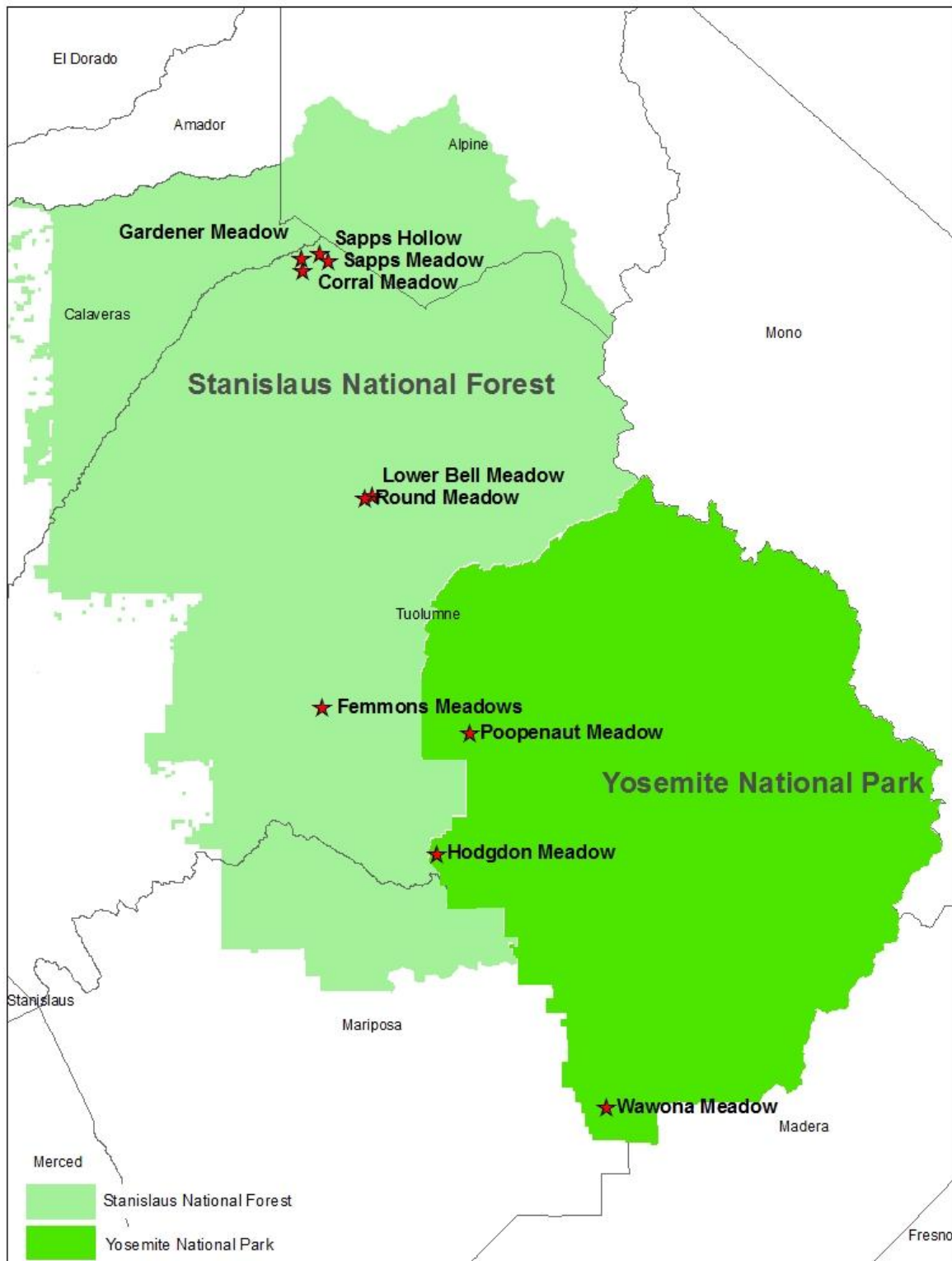


Figure 1. Locations of restoration and reference meadows surveyed for birds in 2010 on the Stanislaus National Forest and Yosemite National Park.

The two restoration projects in Yosemite National Park - Wawona Meadow and Poopenaut Meadow - have most of their planning documents completed and are awaiting final approval and/or funding. Wawona Meadow is somewhat unusual within our Sierra-wide effort in that it is a relatively large, yet low elevation (4200 ft. /1280 m) meadow on the west slope of the Sierra Nevada. Large meadows at this elevation on the west side of the Sierra crest are relatively rare and most are privately owned – sites like this were generally not incorporated into national forests when their boundaries were delineated, but were instead retained in private land ownership as base ranches for grazing allotments (Allen-Diaz et al. 1999). Additionally, many meadows of this type were popular with developers of residential and recreational areas. Likewise, even within the national parks, development of facilities often historically occurred in close proximity to meadows (including Wawona Meadow).

At the time of our survey, Wawona Meadow was slated for substantial restoration efforts targeting both hydrology and vegetation. The site has also undergone some smaller-scale improvements over the last few years. Ideally we would have selected a reference site for Wawona that was closer than Hodgdon Meadow. Because of the difficulties in locating publicly owned reference sites at low elevation (as described above) we opted to relax our requirement of selecting nearby reference sites and chose to include Hodgdon Meadow because of its similar elevation and vegetation.

Poopenaut Meadow presented some unique challenges. This is a project where the primary objective is not to restore the meadow per se, but rather to restore more natural flow regimes below Hetch Hetchy Reservoir on the Tuolumne River, which bisects Poopenaut Meadow. Despite the fact that meadow restoration is not the primary objective this project, the site fits well with the objectives of our monitoring protocol. Changes to the flow regime within the river will likely alter floodplain hydrology within the meadow and result in changes to riparian vegetation along the river and adjacent to the meadow. Planning was complete when we conducted our survey and work with the flow regime was slated to occur when funding and approval are secured. Locating a suitable reference site for Poopenaut Meadow proved to be one of the most difficult pairings of the entire Sierra-wide project. The site is at only 3500 feet (1067 m) in elevation, and we were unable to locate a nearby publicly owned meadow that had a strong riverine influence. After much debate we selected the Femmons Meadows location on nearby Forest Service land. Although these small stringer meadows are quite different in hydrologic influence, the suite of meadow birds occupying the site should be similar due to similar elevation (4200 ft /1280 m) and upland vegetation. Also, because the Femmons meadows are fenced, livestock grazing influences will be minimal, as at Poopenaut Meadow.

The remainder of the restoration and reference sites (Table 1) are located on the Stanislaus National Forest and occur at higher elevations, between 6000 and 7000 feet (1829 and 2134 m). These 6 sites all occur in active grazing allotments with similar management. Corral Meadow and its reference site, Gardner Meadow, are both located directly upstream from small lakes and have additional influence from spring fed ponds.

Plans for the Corral Meadow project include repair to multiple head cuts within the stream channel. Planning is in the initial phase and restoration is targeted for within 5 years. Similarly, planning for Sapps Meadow is in the early stages. This is another site where plans include repair of head cuts within the main stream channel, in part to protect a fen that occurs in the upper portion of the meadow. Sapps Hollow is the reference site, and has similar hydrology and vegetation. Round Meadow and its associated reference site, Lower Bell Meadow, occur on tributaries of Bell Creek within approximately 1 km of each other. Round Meadow has a more complex restoration plan to stabilize and repair the hydrology of the meadow, and planning was near completion when we conducted our survey.

All 10 restoration and reference sites within this management area have a historical legacy of logging and/or grazing use. Sites at the lowest elevations would also have experienced heavy alteration in streamside areas as a result of mining. The Yosemite N.P. sites border upland forest dominated by Sierra Mixed Conifer or Foothill Pine/Mixed Chaparral (Poopenaut Meadow only), while the higher elevation Stanislaus sites have Lodgepole Pine dominant at the meadow edges and White or Red Fir dominating the more upland areas, depending on elevation. Occasionally areas of granite outcrop make up a portion of the surrounding upland areas.

Crew Training and Certification

All data were collected by full-time crew members working or volunteering for The Institute for Bird Populations. At the beginning of the 2010 field season, crew members underwent an intensive 3-week training session that followed the guidelines in Loffland et al. (2011) for ensuring surveyors are fully competent and qualified to collect reliable data. At the end of the training session all crew members passed a rigorous bird identification exam that tested the skills necessary to conduct point counts and area searches.

Data Collection

All sites were surveyed within the May 20-July 15 temporal window specified by the Loffland et al. (2011) protocol; at most meadows we were able to complete two full surveys (excluding the vegetation and soil moisture plots which we only completed once, in accordance with the survey protocol).

Establishing Survey Stations

At restoration and reference meadows we established survey stations 250 m apart along transects that followed the general course of stream channels within meadows, as well as in areas of meadows with no adjacent stream. Where possible, survey stations were placed at least 25 m from streams that were large enough to cause substantial noise interference during surveys – this will also help ensure that if stream restoration results in inundation or widening of the channel, survey stations do not end up under water in future years. In narrow meadows (<100 m wide), stations

were placed every 250 m along a transect that traveled along the center of the meadow, regardless of where the stream channel was located. In most cases survey stations were delineated prior to the first field visit using digital aerial photos (DOQQs) and ArcMap software. Geographic coordinates of individual survey stations are provided in Appendix A and site maps with survey station locations are provided in Appendix B. In a few instances stations were inaccessible due to the unusually high water conditions in June and July of 2010. For those stations that could not be reasonably relocated to a more accessible area nearby, surveys were not completed in 2010. Nonetheless, their coordinates remain in Appendix A, and the points should be surveyed if possible during future monitoring visits.

Point Counts

We utilized 10-minute point counts, divided into four smaller time intervals to facilitate estimating detection probability and modeling occupancy rates (MacKenzie et al. 2002) in the future, if desired. All birds were classified as being either ≤ 50 m from the survey station at first detection, or at a distance >50 m.

Species-Specific Broadcast Surveys

Immediately following each 10-min point count, we remained at the survey station and conducted broadcast surveys for 3 rare or hard to detect species that may be particularly likely to respond to meadow restoration efforts: Willow Flycatcher, Sora, and Virginia Rail. Vocalizations for a particular species were broadcast only if we did not first detect the species within 50 m of the survey station during the preceding 10-minute point count.

Area Searches

When all of the point count and broadcast surveys were completed, surveyors remained at the meadow and began the area search portion of the survey. The amount of time spent area searching was dependent on the size of the meadow; surveyors spent at least 10 minutes area-searching for every survey station the meadow accommodated. One of the objectives of the areas search was to increase the likelihood of detecting rarer or more secretive species that were present at the site, particularly species that may have been missed during the point count and broadcast portions of the survey. When conducting the area search, surveyors moved through the meadow slowly and quietly, counting all birds detected at the site. Special attention was paid to areas along stream channels or other flooded/ponded areas, and locations where restoration activities were planned. Additionally, areas of the meadow where sight and sound were obstructed by dense vegetation were observed carefully. Although more time may have been spent in these specific portions of the meadow, all areas and vegetation communities were systematically covered. We tallied individual birds based on their location at the time of first detection, either within the meadow, or within the surrounding forest or other upland vegetation community.

Vegetation and soil moisture plots

After completing bird surveys we assessed the vegetative structure and vegetative community types at each survey station to characterize the meadow and provide context for bird survey results. We recorded relative cover and vegetation height for a variety of vegetative and surface water components in each of the four quadrants formed by four 50-m transects extending away from the station in each of the cardinal directions (N, S, E, W). . For each quadrant (NW, NE, SE, SW), we recorded cover for each vegetation type after first walking the quadrant to observe the entire area. Cover was estimated as if one was looking down on the site from above. Totals of all cover types combined sometimes exceeded 100% because values were combined over multiple overlapping levels of the canopy: herbaceous, shrub, and tree.

Data Analysis

Because only one year of baseline monitoring has been completed, the analysis reported here is relatively simple. From point count results at each meadow, we tabulated the number of species detected, the number of individuals of each species detected, and the number of individuals detected per point for all species combined. Results are provided separately for birds detected within 50 m of the survey station, and birds detected at any distance from the survey station. From area search results we provide numbers of individuals of each species, as well as the number of additional species detected that were not detected during point count surveys. We also tallied total number of individuals (of all species combined) counted and total number of species detected as the average across both visits (when two visits were completed). From broadcast surveys, we report the number, species and locations of any target species detected. Mean vegetation measurements are reported at the meadow scale, and are intended to characterize the areas of the meadows where we conducted point counts and broadcast surveys.

RESULTS

During the late winter and early spring of 2010 the Sierra Nevada experienced heavier than average snowfall, and unusually late snowmelt. These conditions made planning and implementation of the monitoring work more difficult because many sites and access roads were under snow well into June and, in some cases, July. Many of our monitoring efforts had to be delayed until sites became accessible. Nonetheless, we were able to visit all sites twice within our survey window of May 20 through July 15 (Table 2). Loffland et al. (2011) encourages two visits, but the second visit is considered optional. In total, five restoration sites, and five reference sites (10 total) within the Stanislaus/Yosemite region received two visits during 2010 breeding season. We established 27 survey stations at the 10 study sites.

Table 2. Site location information and survey dates for meadows on Stanislaus NF and Yosemite NP.

<i>Meadow Name^a</i>	<i>Site Type</i>	<i>UTM Easting</i>	<i>UTM Northing</i>	<i>UTM Zone</i>	<i>Elev. (ft)</i>	<i>USGS Quadrangle</i>	<i>Visit 1 Date</i>	<i>Visit 2 Date</i>	<i>No. of Survey Stations</i>
Corral Meadow	Restore	758531	4254086	10s	6700	Tamarack	6/9/2010	7/2/2010	1
Gardner Meadow	Reference	757915	4255600	10	6600	Tamarack	6/9/2010	7/2/2010	2
Poopenaut Meadow	Restore	255963	4203515	11s	3500	Lake Eleanor	6/1/2010	6/28/2010	2
Femmons Meadows	Reference	761737	4203149	10	4200	Duckwall Mtn.	5/31/2010	6/27/2010	3
Round Meadow	Restore	240771	4228042	11s	6400	Pinecrest	6/10/2010	7/2/2010	2
Lower Bell Meadow	Reference	241636	4228250	11	6450	Pinecrest	6/10/2010	7/2/2010	2
Sapps Meadow	Restore	761301	4255438	10s	6800	Tamarack	6/9/2010	7/2/2010	1
Sapps Hollow	Reference	760294	4256300	10	6950	Tamarack	6/9/2010	7/2/2010	1
Wawona Meadow	Restore	265153	4155577	11s	4200	Wawona	6/2/2010	6/29/2010	8
Hodgdon Meadow	Reference	247808	4186736	11	4650	Ackerson Mtn.	6/1/2010	6/28/2010	5

^aRestoration sites are in bold text with associated reference sites directly below them in plain text.

Point Counts

Among the meadows with survey results reported here, Wawona Meadow and Hodgdon Meadow showed the greatest species richness and relative abundance of individual birds (Table 3). These are the two largest sites monitored in the survey region, and are also the sites associated with the largest streams. The relatively high number of survey stations resulted in a greater diversity of habitat conditions surveyed, including some upland habitats at the periphery of the survey area. Many of the smaller sites (Corral Meadow, Sapps Hollow and Sapps Meadow) had lower apparent species richness and relative abundance. These sites tended to occur along smaller streams and represent more linear meadow habitat along the stream zone, with less diversity of upland types. When only the results within 50 m of survey stations were included and the number of individuals was averaged across the number of stations, some of the effects of meadow size were diminished. Results for this metric were relatively even across all sites (Table 3).

Table 3. Number of individual birds and number of species detected during point count surveys at all study sites.

<i>Meadow Name^a</i>	<i>No. of Survey Stations</i>	<i>Avg. No. Birds Detected^b</i>		<i>Avg. No. Birds Per Station^b</i>		<i>Species Detected (Visits Pooled)</i>	
		<i><50m</i>	<i>Unlimited Radius</i>	<i><50m</i>	<i>Unlimited Radius</i>	<i><50m</i>	<i>Unlimited Radius</i>
Corral Meadow	1	1.5	14.0	1.5	14.0	3	13
Gardner Meadow	2	3.0	28.5	1.5	14.3	4	22
Poopenaut Meadow	2	10.5	41.5	5.3	20.8	8	27
Femmons Meadows	3	11.5	52.5	3.8	17.5	12	31
Round Meadow	2	7.5	43.0	3.8	21.5	8	28
Lower Bell Meadow	2	10.0	36.0	5.0	18.0	13	24
Sapps Meadow	1	0.0	10.0	0.0	10.0	0	11
Sapps Hollow	1	0.0	16.0	0.0	16.0	0	15
Wawona Meadow	8	78.5	180.5	9.8	22.6	28	44
Hodgdon Meadow	5	38.0	118.5	7.6	23.7	25	34

^aRestoration sites are indicated in bold text with associated reference sites directly below them in plain text. ^bValues for numbers of birds and number of birds per stations are reported for individuals detected within a 50m radius of the survey station and for all individuals detected at all distances from the station (unlimited radius). Number of birds detected and number of birds per station are reported as the mean value averaged across 2 visits, except for sites where only one visit was completed.

Loffland et al. (2011) identify 16 meadow-associated focal species. These species were selected because of their affinity to meadow and riparian communities, and based on the expectation that their numbers would increase if meadow restoration efforts improved the quantity or quality of habitat components important to them. One exception is the Brown-headed Cowbird. While often found in meadows, this species also uses many other open or disturbed habitats with human or livestock use. Brown-headed Cowbirds were selected by Loffland et al. (2011) as focal species because of the role they play as nest parasites of other meadow-associated birds, and the association between their relative abundance and human disturbance. Of the 16 focal species identified for Sierra Nevada meadows, 14 were detected during point counts in the Stanislaus/Yosemite study region (Table 4).

Table 4. Relative abundance^a of strongly meadow-associated focal bird species at each meadow. Focal species were identified by Loffland et al. (2011).

<i>Meadow Name^b</i>	<i>Survey radius</i>	<i>Wilson's Snipe</i>	<i>Red-breasted Sapsucker</i>	<i>Warbling Vireo</i>	<i>Yellow Warbler</i>	<i>MacGillivray's Warbler</i>	<i>Wilson's Warbler</i>	<i>Song Sparrow</i>	<i>Lincoln's Sparrow</i>	<i>Brown-headed Cowbird</i>
Corral Meadow	≤50 m	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00
	unlimited	0.00	0.00	1.00	0.50	0.00	0.00	0.00	0.00	0.00
Gardner Meadow	≤50 m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	unlimited	0.00	0.25	0.75	0.00	0.00	0.00	0.25	1.00	0.00
Poopenaut Meadow	≤50 m	0.00	0.00	1.00	1.25	0.00	0.00	0.75	0.00	0.25
	unlimited	0.00	0.00	2.00	2.00	0.25	0.00	2.00	0.00	0.25
Femmons Meadows	≤50 m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33
	unlimited	0.00	0.17	0.50	0.00	0.17	0.00	0.00	0.00	0.33
Round Meadow	≤50 m	0.00	0.00	0.25	0.25	0.00	0.00	0.00	0.25	0.00
	unlimited	0.00	0.00	2.00	0.75	0.00	0.25	1.50	0.75	0.75
Lower Bell Meadow	≤50 m	0.00	0.00	0.50	0.25	0.00	0.00	0.75	0.50	0.00
	unlimited	0.00	0.00	1.75	0.25	0.00	0.00	1.75	1.25	0.25
Sapps Meadow	≤50 m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	unlimited	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sapps Hollow	≤50 m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	unlimited	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wawona Meadow	≤50 m	0.00	0.06	0.38	1.38	0.19	0.19	1.38	0.44	0.38
	unlimited	0.06	0.19	0.75	2.38	0.69	0.31	2.38	1.13	0.63
Hodgdon Meadow	≤50 m	0.00	0.20	0.40	0.10	0.10	0.00	1.10	0.70	0.00
	unlimited	0.00	0.50	1.00	0.30	0.80	0.00	2.00	1.80	0.00

^aNumber of individuals of each species divided by the number of visits and number of survey points, based on all detections within 50m of a survey point. ^bRestoration sites are indicated in bold text.

The number of focal species detected at a given site ranged from a low of 0 at Sapps Meadow to a high of 9 at Wawona Meadow. Of the focal species detected, Wilson's Snipe was only detected at one site, while Warbling Vireo was detected at 8 sites. Each of the remaining focal species was detected at two or more of the 10 meadows. The average number of individuals detected for each species, and the average number per survey station, are reported for all species at each restoration site and its associated reference site(s) in Appendix C.

Broadcast Surveys

Broadcast surveys for Sora, Virginia Rail, and Willow Flycatcher were completed at all survey stations. Vocalizations were only broadcast if the species was not spontaneously singing or calling within 50m of the survey station during the preceding point count. One Virginia Rail was detected at survey station 7 at Wawona Meadow on

6/2/2010. No other target species were detected using broadcast surveys in the Stanislaus/Yosemite region.

Area Searches

In most cases, we conducted area searches immediately following point count and broadcast surveys, but no later than 4.5 hours after sunrise. At large meadows, area searches were sometimes completed by a separate observer concurrent with point count surveys. In all but a few cases area searches were completed on the same morning as point counts. Area searches resulted in the mean detection of 8.3 (SD = 3.2) additional species per meadow in the Stanislaus/Yosemite study region, over species totals based on point count surveys alone (Table 5). Species-specific area search results for each restoration site and its associated reference site are provided in Appendix D. Appendix E contains a list of all species detected (point counts and areas searches combined) at each meadow.

Table 5. Number of species detected at each site based on combined area search and point count results^a.

Meadow Name^b	No. Species Detected - Area Searches	No. Species Detected - Point Counts	No. Species Detected Only During Area Searches	No. Species - Both Methods Combined
Corral Meadow	16	13	6	19
Gardner Meadow	30	22	11	33
Poopenaut Meadow	34	27	9	36
Femmons Meadows	34	31	5	36
Round Meadow	39	28	12	40
Lower Bell Meadow	29	24	8	32
Sapps Meadow	12	11	4	15
Sapps Hollow	16	15	5	20
Wawona Meadow	54	44	13	57
Hodgdon Meadow	40	34	10	44

^aResults are pooled across all visits. ^bRestoration sites are indicated in bold text.

Vegetation Assessment

Vegetation and water measurements were collected at each survey station for the purpose of assessing the 50-m radius area surrounding each survey station, and to provide information characterizing the general vegetation communities and hydrologic conditions within the overall meadow. Table 6 provides the average cover values for each meadow, calculated from the means of the four quadrants at each survey station.

Tree and snag cover was greatest at smaller sites where the forest edge regularly fell within 50 m of the survey stations. Tree cover within the meadow can be an indicator of lowered water tables and conifer encroachment. Although meadow associated birds will utilize trees for foraging and territory advertisement, brown-headed cowbirds and nest predators also use trees within the meadow as hunting perches. Poopenaut Meadow, Round Meadow and Wawona Meadow had the greatest amount of cover from riparian shrubs within the 50-m plots (15 – 18%), while the remaining sites had less than 8% riparian shrub cover. Extent of shrub cover is particularly important for many shrub-nesting bird species. Sagebrush cover, often an indicator of lowered water tables, did not occur at any study sites in this region. Sagebrush is relatively rare on the west slope of the Sierra when compared with the east slope, so its value as an indicator of water table height is not as meaningful in this study region.

We quantified the amount of flowing and standing water around survey stations to assess habitat quality for bird species that are associated with water or saturated conditions. This is also a measurement expected to change with restoration activities. Water cover from flowing water did not exceed 8% at any site, but standing water covered more than 20% of plots at most sites (Table 6).

Table 6. Average vegetative and water cover characteristics for 50-m plots surrounding survey stations at each meadow.

Meadow Name ^a	No. Stations	Measure ^b	Percent Cover								
			Trees	Snags	Riparian Shrubs	Sagebrush	Non-Woody Vegetation	Bare Ground	Gravel Bar	Flowing Water	Standing Water
Corral Meadow	1	Mean	4.25	0.00	0.00	0.00	80.00	12.50	3.75	0.00	25.00
		(S.E.)	.	.	.	.	.	.	.	.	.
Gardner Meadow	2	Mean	6.50	0.88	0.00	0.00	60.63	39.38	0.00	2.00	27.38
		(S.E.)	1.50	0.88	0.00	0.00	14.38	14.38	0.00	2.00	19.63
Poopenaut Meadow	2	Mean	9.50	0.00	15.13	0.00	100.00	0.00	0.00	0.00	0.25
		(S.E.)	8.25	0.00	7.88	0.00	0.00	0.00	0.00	0.00	0.25
Femmons Meadows	3	Mean	52.17	0.42	0.00	0.00	72.25	0.58	0.00	0.00	0.58
		(S.E.)	21.33	0.08	0.00	0.00	17.86	0.58	0.00	0.00	0.58
Round Meadow	2	Mean	2.63	0.00	17.50	0.00	14.38	15.00	0.00	6.88	14.38
		(S.E.)	1.38	0.00	6.25	0.00	3.13	2.50	0.00	0.63	11.88
Lower Bell Meadow	2	Mean	2.38	0.00	2.00	0.00	94.00	6.00	0.00	2.13	45.13
		(S.E.)	0.63	0.00	2.00	0.00	2.75	2.75	0.00	0.63	39.88
Sapps Meadow	1	Mean	6.50	1.00	0.00	0.00	73.75	23.75	2.50	5.00	37.50
		(S.E.)	.	.	.	.	.	.	.	.	.
Sapps Hollow	1	Mean	3.75	1.50	0.00	0.00	40.00	52.50	2.50	1.25	31.25
		(S.E.)	.	.	.	.	.	.	.	.	.
Wawona Meadow	8	Mean	0.59	0.03	18.41	0.00	96.56	0.00	0.00	3.94	30.00
		(S.E.)	0.46	0.03	5.99	0.00	2.30	0.00	0.00	1.88	12.88
Hodgdon Meadow	5	Mean	4.30	0.65	7.25	0.00	94.35	0.50	0.00	1.70	27.75
		(S.E.)	2.14	0.29	4.12	0.00	3.33	0.50	0.00	0.22	8.83

^aRestoration sites are indicated in bold text. ^bMean and standard error averaged over four 50-m radius quadrants at each survey point.

For those survey stations with riparian deciduous shrub cover, we also assessed the proportion of the shrub occurring within different height and age classes, as well as taxonomic group (Table 7). Immature shrubs in the lowest height class are indicative of shrub recruitment, an important factor in maintaining suitable habitat for shrub-nesting birds. Mature shrubs in the shortest height class can indicate certain low growing species, as well as situations where livestock or native ungulates are regulating growth patterns. These factors, as well as the proportion of the shrub community in the taller height classes, are relevant to certain focal bird species that prefer to nest at heights greater than 1 m above the ground. For all sites combined, the vast majority of riparian shrubs (88.9%) were > 2m tall, and only 2 sites, Hodgdon and Poopenaut Meadows, had any shrubs in the seedling size class (0.83% and 1.88% respectively)(Table 7). Only one site, Poopenaut Meadow, had riparian shrubs other than willows surrounding the survey stations, and in this case a non-willow species (mountain alder, *Alnus tenuifolia*) was the dominant shrub species.

Table 7. Average characteristics of riparian deciduous shrubs in 50-m plots surrounding survey stations. Vegetation plots on the 5 study sites not listed had no riparian deciduous shrubs.

Meadow Name ^a	No. Stations	Measure ^b	Height and Age Class of Riparian Shrubs (%)				Taxonomic Composition of Riparian Shrubs		
			<1m (seedling)	<1m (mature)	1 - 2m	>2m	% Willow	% Alder	% Other Riparian Shrub
Poopenaut Meadow	2	Mean	1.88	6.88	18.75	72.50	25.63	71.88	2.50
		(S.E.)	0.63	3.13	11.25	7.50	25.63	23.13	2.50
Wawona Meadow	7	Mean	0.00	0.36	5.00	94.64	100.00	0.00	0.00
		(S.E.)	0.00	0.36	3.41	3.72	0.00	0.00	0.00
Hodgdon Meadow	3	Mean	0.83	1.06	13.39	84.72	100.00	0.00	0.00
		(S.E.)	0.83	0.75	2.26	2.65	0.00	0.00	0.00
Round Meadow	2	Mean	0.00	3.33	10.83	85.83	100.00	0.00	0.00
		(S.E.)	0.00	3.33	10.83	14.17	0.00	0.00	0.00
Lower Bell Meadow	1	Mean	0.00	0.00	0.00	100.00	100.00	0.00	0.00
		(S.E.)	.	.	.	.	.	.	.

^aRestoration sites are in bold text. ^bMean and standard error averaged over four 50m-radius quadrants at each survey point

DISCUSSION

We strongly recommend continuing bird monitoring activities at meadows in the Stanislaus/Yosemite Region in as many pre- and post-restoration years as feasible. One way that we might alter monitoring methods from what was completed in 2010 would be to decrease the distance between survey stations to as little as 200 m if doing so would allow for the addition of even one more survey station at small meadows. Many of the meadows in this region contained three or fewer survey stations. These small sample sizes can be problematic for some analyses, and if one or more stations can be added it could strengthen the monitoring results. Nevertheless we do not recommend altering station locations for the sites listed in this report where surveys occurred in 2010. Rather, any new reference or restoration sites could benefit from maximizing the number of stations. We also assessed our 2010 results and decided that decreasing point count duration from 10 minutes to 7 minutes would provide reliable results while balancing the amount of time and effort necessary per point count. In addition, we did not find much benefit from species-specific broadcast surveys for Willow Flycatcher, Sora and Virginia Rail. Not surprisingly, these species were not often detected at sites in need of restoration, but even when detected there were only three instances during our surveys across the entire Sierra Nevada where broadcast surveys detected an individual that had not already been detected during point counts. While single-species broadcast surveys may still be useful for some projects, detection probabilities of Sora and Virginia Rail may be adequately high with passive survey methods that do not incorporate broadcasts, and Willow Flycatchers are likely to be surveyed with full-protocol surveys (Bombay et al. 2003) prior to restoration as part of the state and federal permitting processes.

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Appendix A. Geographic coordinates of survey station locations

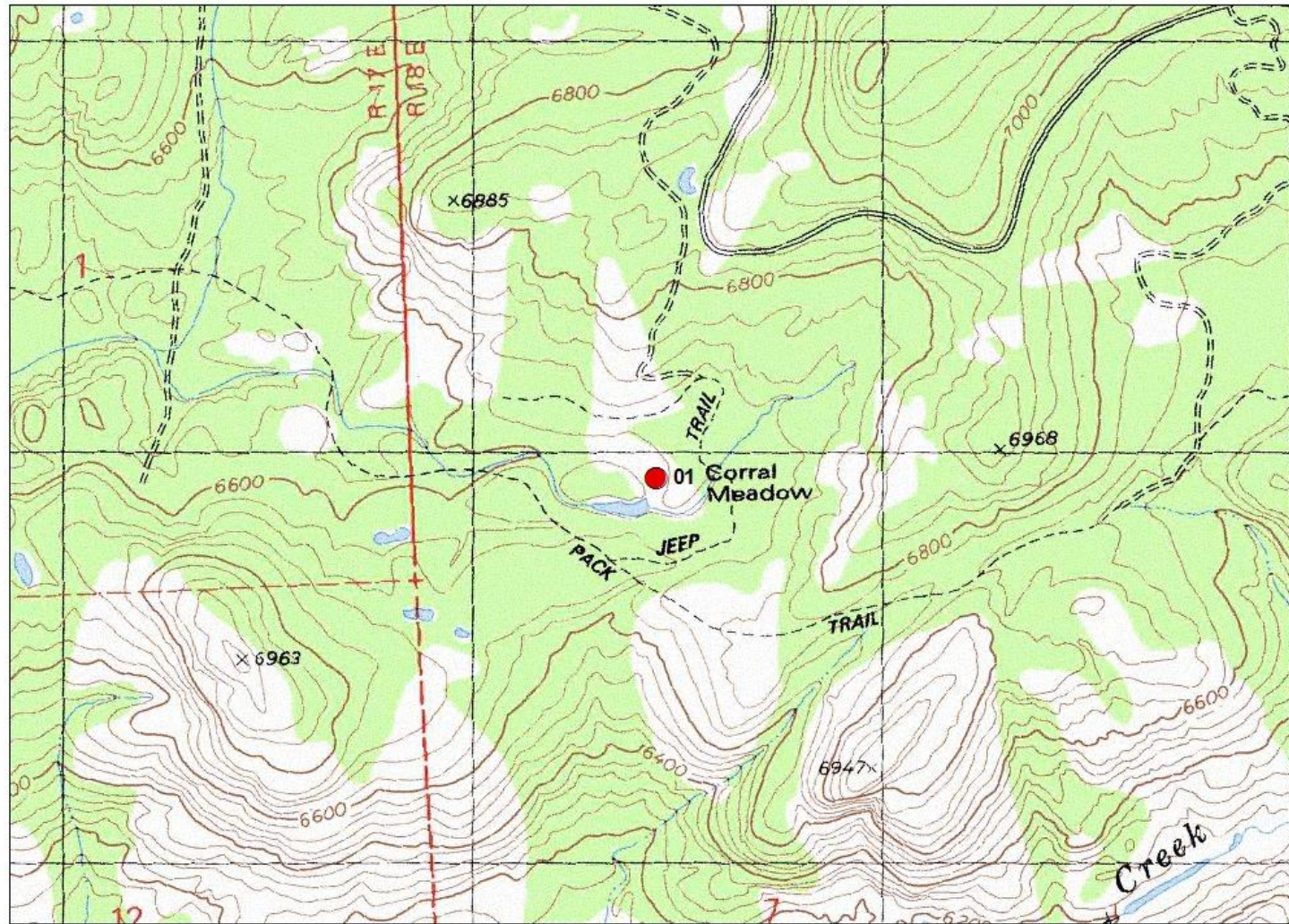
Table A-1. Geographic coordinates of survey station locations^a.

Meadow Name	Station Number	UTM Zone	UTM Easting	UTM Northing
Corral Meadow	01	10	758356	4254130
Femmons Meadows	01	10	761708	4203211
Femmons Meadows	02	10	762322	4203908
Femmons Meadows	03	10	762178	4202884
Gardner Meadow	01	10	758125	4255609
Gardner Meadow	02	10	757808	4255539
Hodgdon Meadow	01	11	248344	4187037
Hodgdon Meadow	02	11	248056	4186939
Hodgdon Meadow	03	11	247840	4186764
Hodgdon Meadow	04	11	247625	4186913
Hodgdon Meadow	05	11	247416	4187060
Lower Bell Meadow	01	11	241569	4228246
Lower Bell Meadow	02	11	242012	4228073
Poopenaut Meadow	01	11	252237	4200601
Poopenaut Meadow	02	11	251992	4200503
Poopenaut Meadow	03	11	252095	4200800
Round Meadow	01	11	240788	4227986
Round Meadow	02	11	240914	4227556
Sapps Hollow	01	10	760241	4256252
Sapps Meadow	01	10	761344	4255454
Wawona Meadow	01	11	266869	4156251
Wawona Meadow	02	11	266798	4156501
Wawona Meadow	03	11	266667	4156723
Wawona Meadow	04	11	266426	4156870
Wawona Meadow	05	11	266176	4157016
Wawona Meadow	06	11	265872	4157077
Wawona Meadow	07	11	265670	4157255

^aUTM coordinates projected in NAD 83.

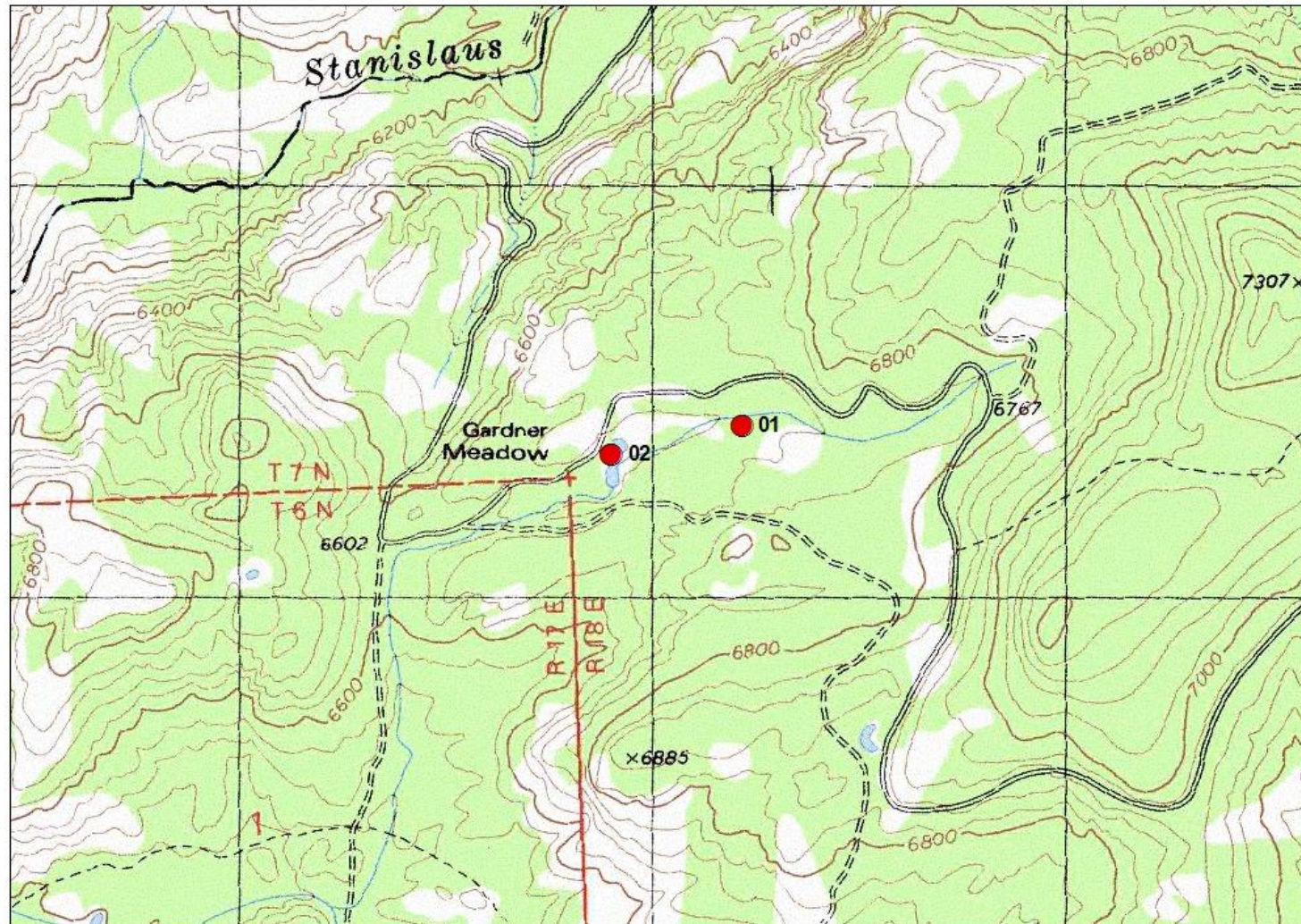
Appendix B. Maps of meadows with survey station locations

Figure B-1. Corral Meadow



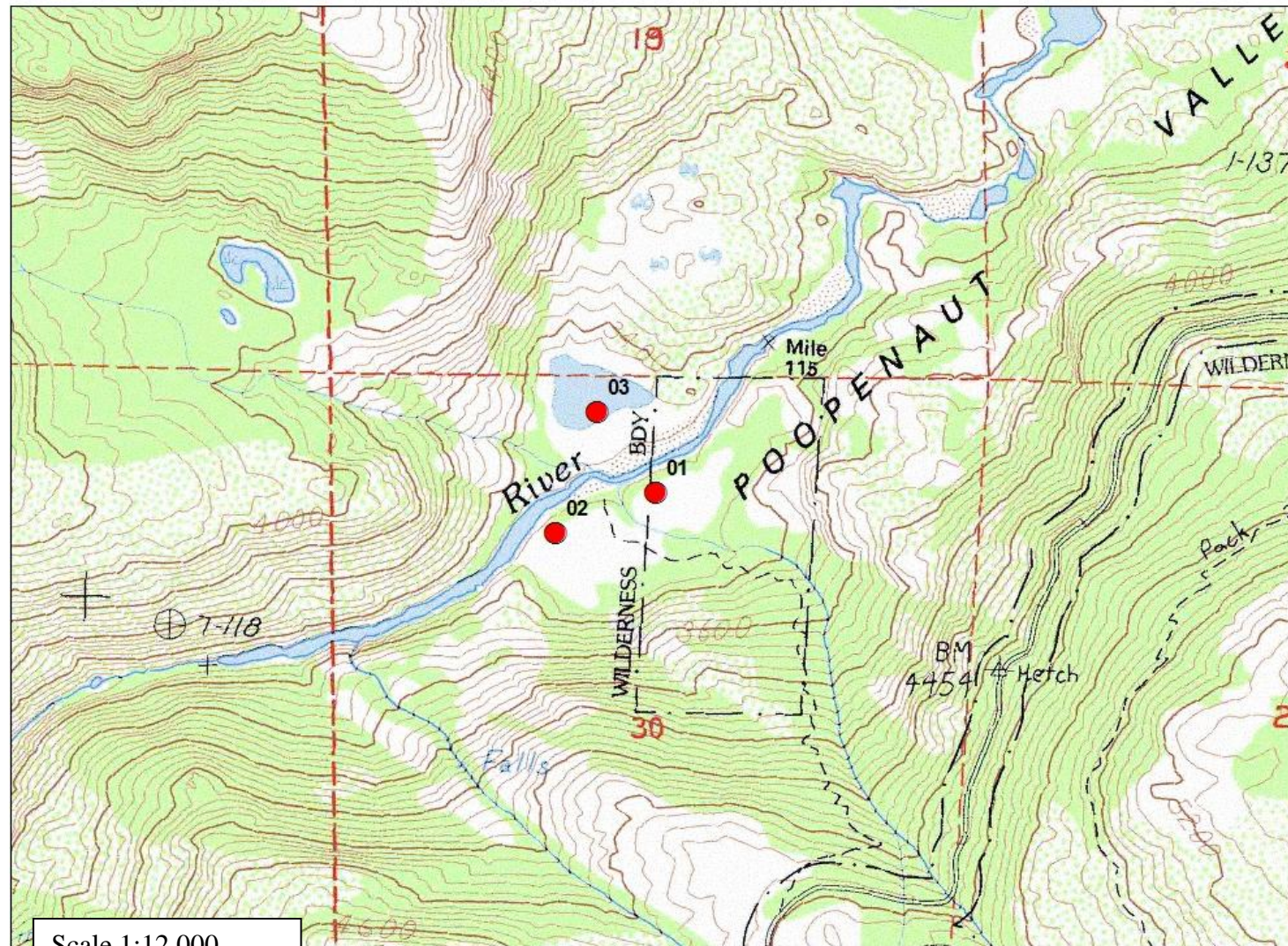
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R. Wilkerson 6/2/2011

Figure B-2. Gardner Meadow



Scale 1:12,000
R. Wilkerson 6/2/2011

Figure B-3. Poopenaut Meadow



Scale 1:12,000
R. Wilkerson 6/2/2011

Figure B-4. Femmons Meadows

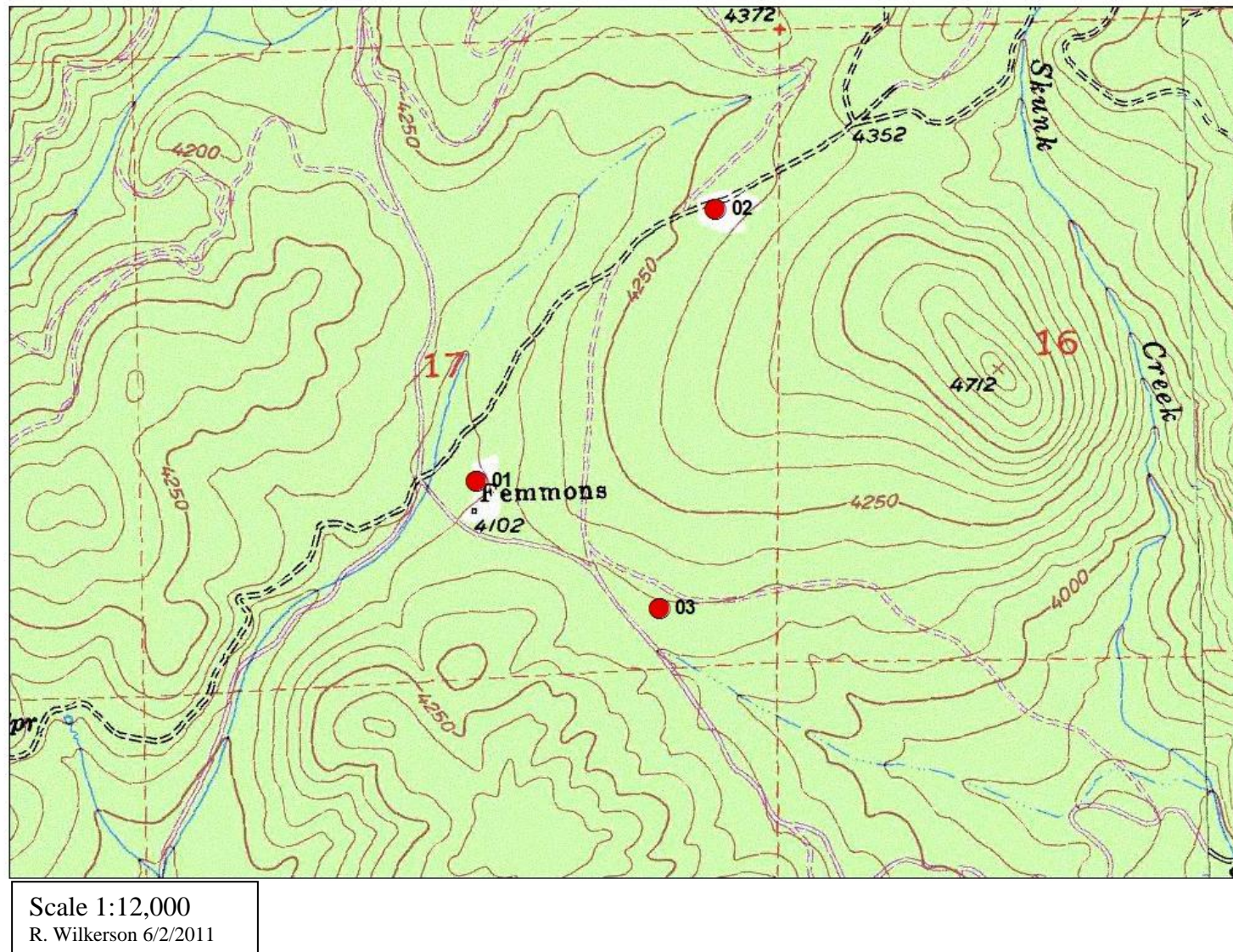


Figure B-5. Round and Lower Bell Meadows

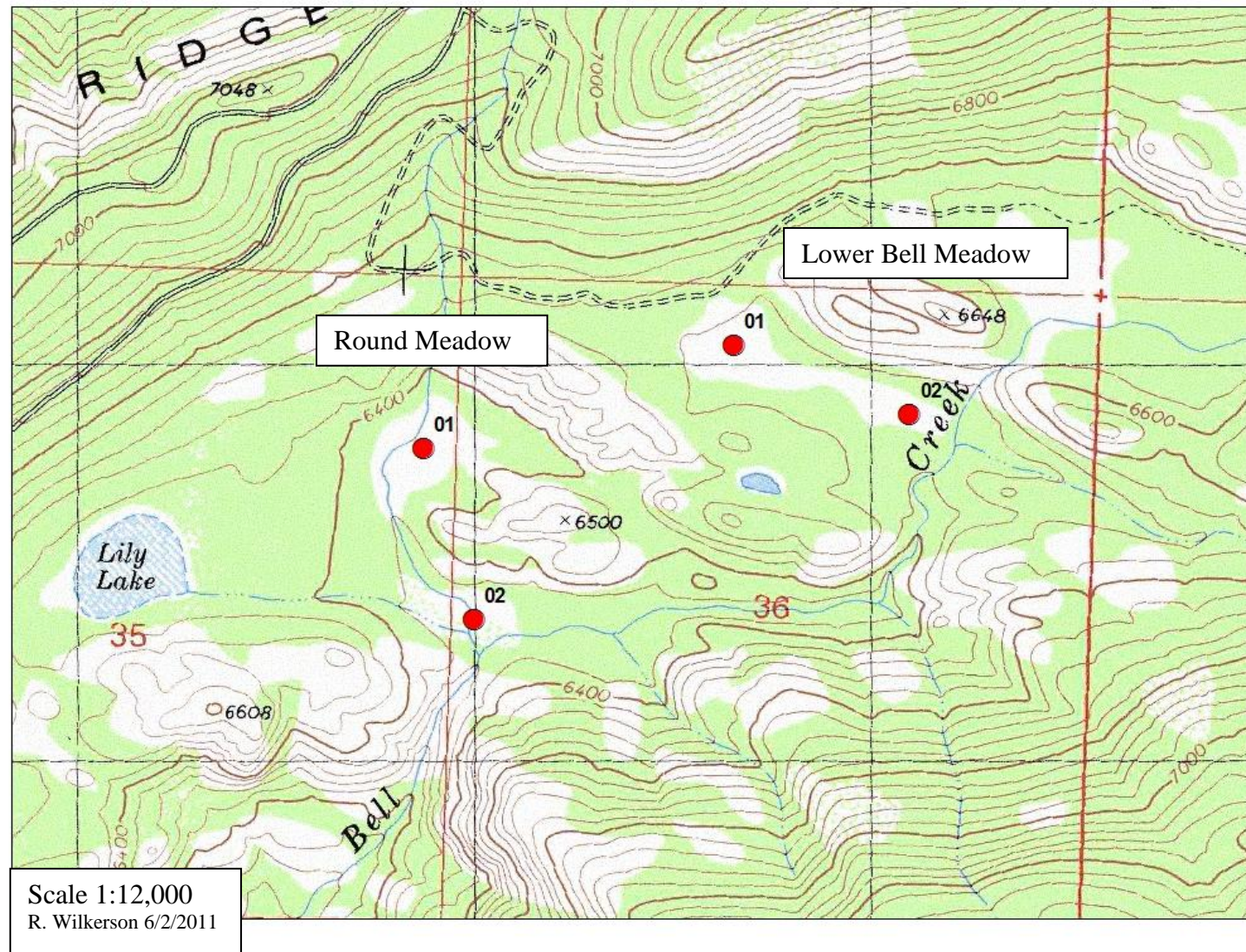


Figure B-6. Sapps Meadow and Sapps Hollow

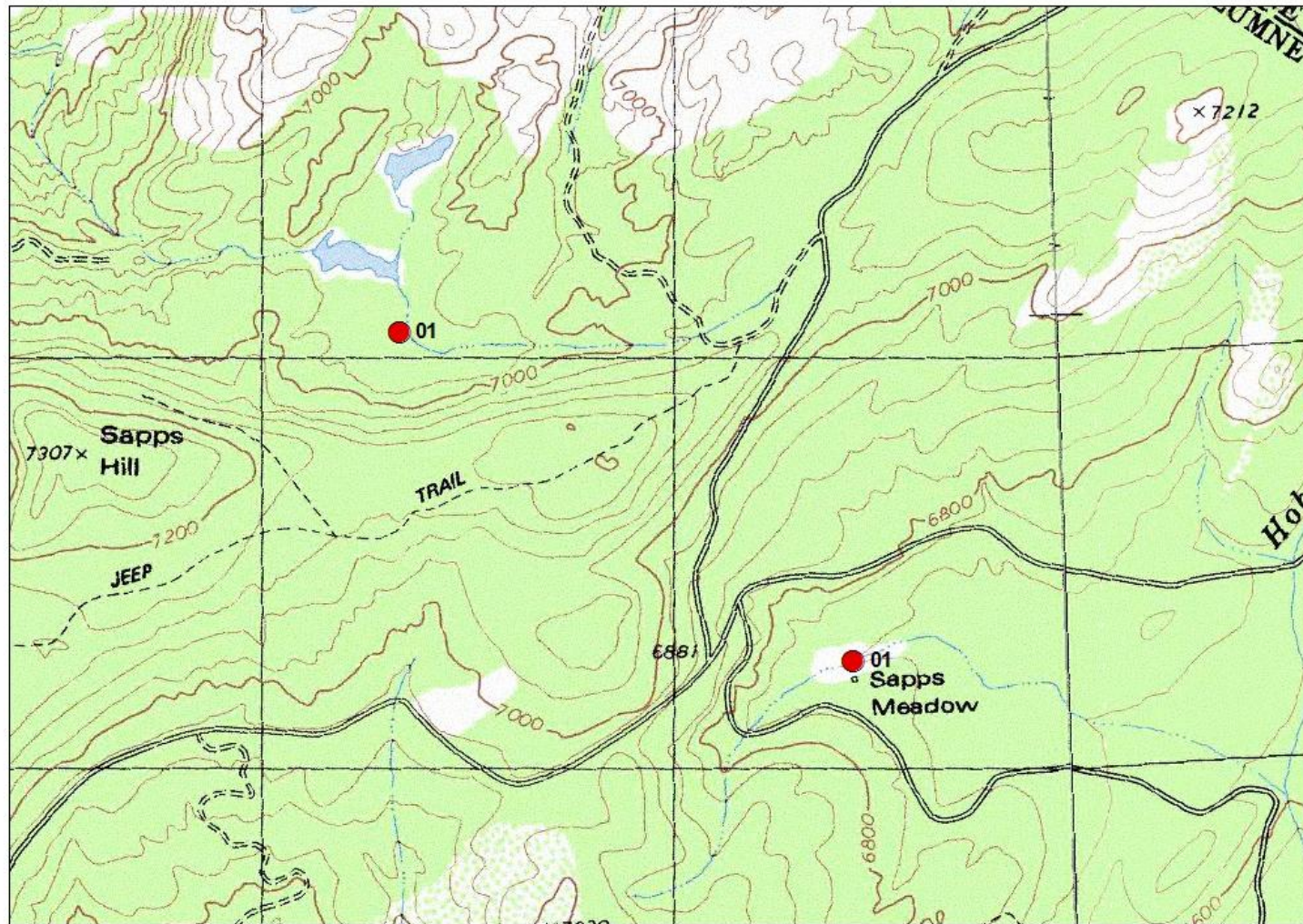


Figure B-7. Wawona Meadow

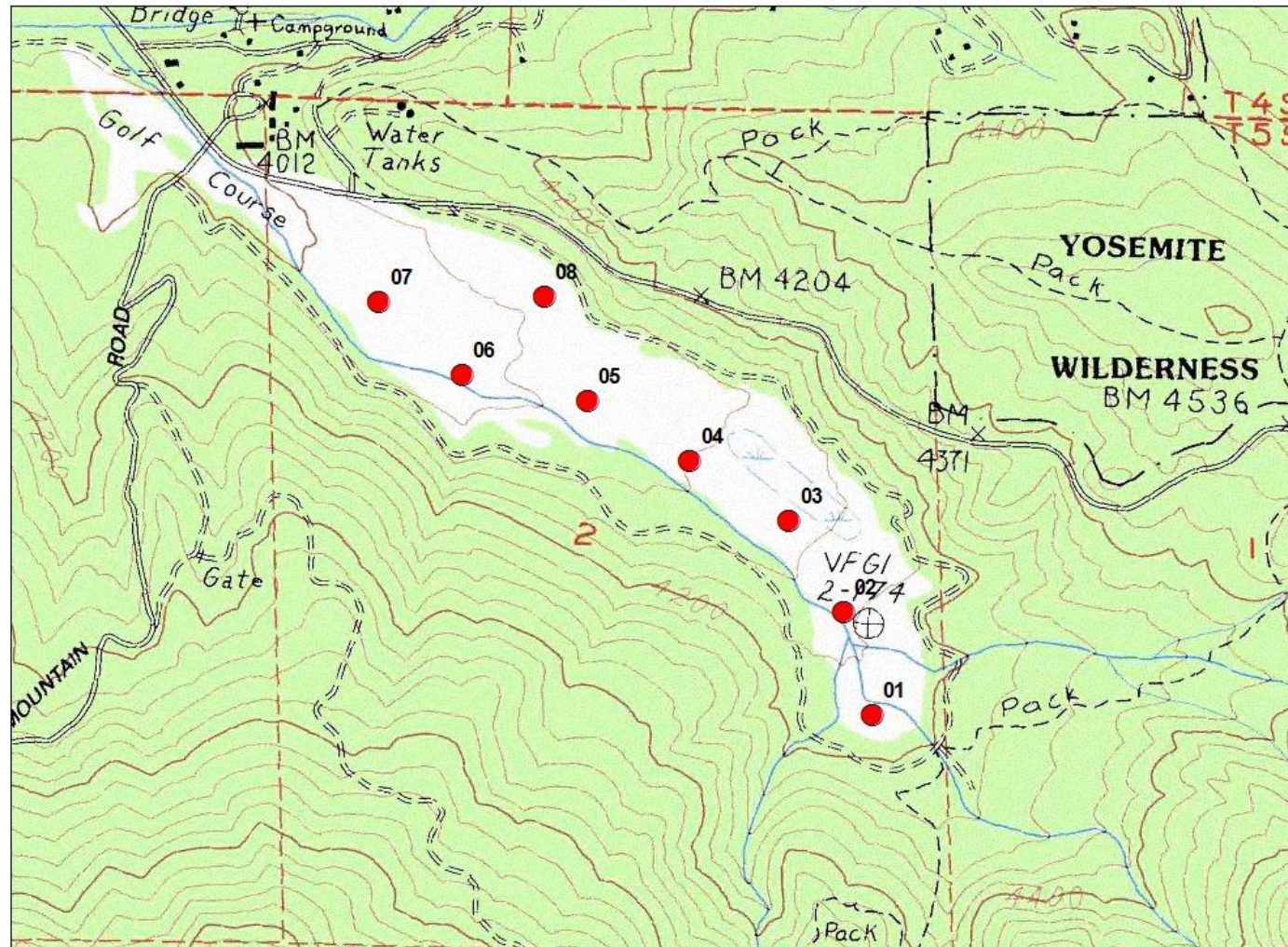
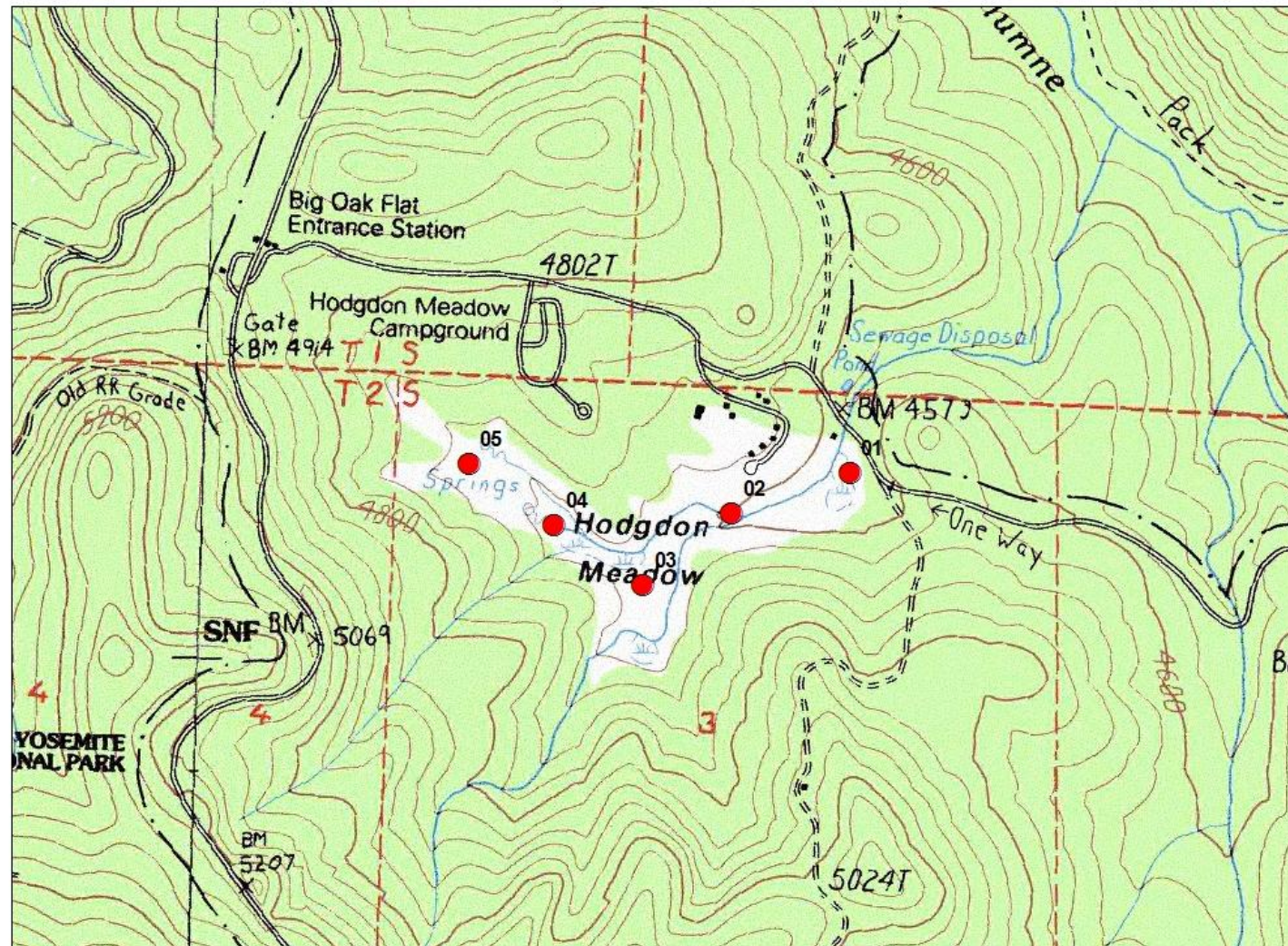


Figure B-8. Hodgdon Meadow



Appendix C. Number of birds detected during point counts at each meadow

Table C-1. Number of birds detected during point counts at Corral Meadow and Gardner Meadow.

Species ^e	Corral Meadow (n = 1 survey station)				Gardner Meadow (n = 2 survey stations)			
	Avg. No. of Birds Detected ^a		Avg. No. of Birds per Station ^b		Avg. No. of Birds Detected ^a		Avg. No. of Birds per Station ^b	
	<50m ^c	Unlimited Radius ^d	<50m ^c	Unlimited Radius ^d	<50m ^c	Unlimited Radius ^d	<50m ^c	Unlimited Radius ^d
Mountain Quail	0.00	1.00	0.00	1.00	0.00	0.50	0.00	0.25
American Kestrel	0.00	0.50	0.00	0.50	0.00	0.00	0.00	0.00
Red-breasted Sapsucker	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.25
Downy Woodpecker	0.00	0.50	0.00	0.50	0.00	0.00	0.00	0.00
Hairy Woodpecker	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.50
Northern Flicker	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.25
Western Wood-Pewee	0.00	1.00	0.00	1.00	0.00	2.00	0.00	1.00
Pacific-slope Flycatcher	0.00	0.00	0.00	0.00	0.50	0.50	0.25	0.25
Hutton's Vireo	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.25
Warbling Vireo	0.50	1.00	0.50	1.00	0.00	1.50	0.00	0.75
Steller's Jay	0.50	2.00	0.50	2.00	1.00	3.00	0.50	1.50
Mountain Chickadee	0.50	2.00	0.50	2.00	0.00	2.50	0.00	1.25
Red-breasted Nuthatch	0.00	1.50	0.00	1.50	0.00	2.00	0.00	1.00
Golden-crowned Kinglet	0.00	1.00	0.00	1.00	0.00	0.00	0.00	0.00
Hermit Thrush	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.50
American Robin	0.00	0.50	0.00	0.50	0.50	1.50	0.25	0.75
Yellow Warbler	0.00	0.50	0.00	0.50	0.00	0.00	0.00	0.00
Yellow-rumped Warbler	0.00	1.50	0.00	1.50	1.00	2.50	0.50	1.25
Western Tanager	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.25
Fox Sparrow	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.50
Song Sparrow	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.25
Lincoln's Sparrow	0.00	0.00	0.00	0.00	0.00	2.00	0.00	1.00
Dark-eyed Junco	0.00	1.00	0.00	1.00	0.00	2.00	0.00	1.00
Red-winged Blackbird	0.00	0.00	0.00	0.00	0.00	2.00	0.00	1.00
Brewer's Blackbird	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.25
Purple Finch	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.25

^aNumber of individuals detected at the meadow, averaged across two survey visits. ^bNumber of individual birds detected divided by the number of survey stations and visits. ^cOnly includes birds detected within 50m of a survey point. ^dAll birds detected regardless of distance from survey station. ^eMeadow focal species recorded in bold text.

Table C-2. Number of birds detected during point counts at Poopenaut Meadow and Femmons Meadows.

Species ^e	Poopenaut Meadow (n = 2 survey stations)				Femmons Meadows (n = 3 survey stations)			
	Avg. No. of Birds Detected ^a		Avg. No. of Birds per Station ^b		Avg. No. of Birds Detected ^a		Avg. No. of Birds per Station ^b	
	<50m ^c	Unlimited Radius ^d	<50m ^c	Unlimited Radius ^d	<50m ^c	Unlimited Radius ^d	<50m ^c	Unlimited Radius ^d
Mountain Quail	0.00	1.00	0.00	0.50	0.00	1.50	0.00	0.50
Acorn Woodpecker	0.00	2.50	0.00	1.25	0.50	1.50	0.17	0.50
Red-breasted Sapsucker	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.17
Nuttall's Woodpecker	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.17
Downy Woodpecker	0.00	0.00	0.00	0.00	1.00	1.00	0.33	0.33
Hairy Woodpecker	0.00	0.00	0.00	0.00	1.00	1.50	0.33	0.50
White-headed Woodpecker	0.00	0.50	0.00	0.25	0.00	0.50	0.00	0.17
Northern Flicker	0.00	1.00	0.00	0.50	0.00	1.00	0.00	0.33
Western Wood-Pewee	0.00	3.00	0.00	1.50	0.00	1.00	0.00	0.33
Pacific-slope Flycatcher	0.00	0.50	0.00	0.25	0.00	1.00	0.00	0.33
Cassin's Vireo	0.00	1.50	0.00	0.75	0.00	2.00	0.00	0.67
Hutton's Vireo	1.50	2.00	0.75	1.00	0.00	0.50	0.00	0.17
Warbling Vireo	2.00	4.00	1.00	2.00	0.00	1.50	0.00	0.50
Steller's Jay	0.00	2.00	0.00	1.00	0.50	2.00	0.17	0.67
Mountain Chickadee	0.00	0.00	0.00	0.00	1.50	3.50	0.50	1.17
Red-breasted Nuthatch	0.00	0.50	0.00	0.25	0.00	4.50	0.00	1.50
White-breasted Nuthatch	0.00	0.50	0.00	0.25	0.00	2.50	0.00	0.83
Brown Creeper	0.00	0.50	0.00	0.25	0.50	2.50	0.17	0.83
Canyon Wren	0.00	0.50	0.00	0.25	0.00	0.00	0.00	0.00
House Wren	1.00	3.00	0.50	1.50	0.00	0.50	0.00	0.17
Townsend's Solitaire	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.33
American Robin	0.00	1.00	0.00	0.50	1.50	3.50	0.50	1.17
Nashville Warbler	0.00	0.00	0.00	0.00	0.50	1.50	0.17	0.50
Yellow Warbler	2.50	4.00	1.25	2.00	0.00	0.00	0.00	0.00
Yellow-rumped Warbler	0.00	0.00	0.00	0.00	2.50	4.00	0.83	1.33
Black-throated Gray Warbler	0.00	0.00	0.00	0.00	0.00	2.00	0.00	0.67
Hermit Warbler	0.00	0.00	0.00	0.00	0.00	3.00	0.00	1.00
MacGillivray's Warbler	0.00	0.50	0.00	0.25	0.00	0.50	0.00	0.17

Species ^e	Poopenaut Meadow (n = 2 survey stations)				Femmons Meadows (n = 3 survey stations)			
	Avg. No. of Birds Detected ^a		Avg. No. of Birds per Station ^b		Avg. No. of Birds Detected ^a		Avg. No. of Birds per Station ^b	
	<50m ^c	Unlimited Radius ^d	<50m ^c	Unlimited Radius ^d	<50m ^c	Unlimited Radius ^d	<50m ^c	Unlimited Radius ^d
Yellow-breasted Chat	0.50	1.50	0.25	0.75	0.00	0.00	0.00	0.00
Western Tanager	0.00	1.00	0.00	0.50	0.00	1.00	0.00	0.33
Spotted Towhee	0.00	1.00	0.00	0.50	0.50	0.50	0.17	0.17
Song Sparrow	1.50	4.00	0.75	2.00	0.00	0.00	0.00	0.00
Dark-eyed Junco	0.00	0.50	0.00	0.25	0.50	4.50	0.17	1.50
Black-headed Grosbeak	0.00	2.00	0.00	1.00	0.00	0.50	0.00	0.17
Red-winged Blackbird	0.00	1.00	0.00	0.50	0.00	0.00	0.00	0.00
Brown-headed Cowbird	0.50	0.50	0.25	0.25	1.00	1.00	0.33	0.33
Lesser Goldfinch	1.00	1.50	0.50	0.75	0.00	0.00	0.00	0.00

^aNumber of individuals detected at the meadow, averaged across two survey visits. ^bNumber of individual birds detected divided by the number of survey stations and visits. ^cOnly includes birds detected within 50m of a survey point. ^dAll birds detected regardless of distance from survey station. ^eMeadow focal species recorded in bold text.

Table C-3. Number of birds detected during point counts at Round Meadow and Lower Bell Meadow.

Species ^e	Round Meadow (n = 2 survey stations)				Lower Bell Meadow (n = 2 survey stations)			
	Avg. No. of Birds Detected ^a		Avg. No. of Birds per Station ^b		Avg. No. of Birds Detected ^a		Avg. No. of Birds per Station ^b	
	<50m ^c	Unlimited Radius ^d	<50m ^c	Unlimited Radius ^d	<50m ^c	Unlimited Radius ^d	<50m ^c	Unlimited Radius ^d
Mountain Quail	0.00	2.50	0.00	1.25	0.00	2.00	0.00	1.00
Calliope Hummingbird	0.00	0.50	0.00	0.25	0.00	0.00	0.00	0.00
Downy Woodpecker	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.25
Hairy Woodpecker	0.00	0.00	0.00	0.00	1.00	1.00	0.50	0.50
White-headed Woodpecker	0.00	0.50	0.00	0.25	0.00	0.00	0.00	0.00
Northern Flicker	0.00	0.50	0.00	0.25	0.50	1.50	0.25	0.75
Pileated Woodpecker	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.25
Olive-sided Flycatcher	0.00	0.50	0.00	0.25	0.00	0.00	0.00	0.00
Western Wood-Pewee	0.50	3.00	0.25	1.50	0.50	3.50	0.25	1.75
Warbling Vireo	0.50	4.00	0.25	2.00	1.00	3.50	0.50	1.75
Steller's Jay	0.00	1.00	0.00	0.50	0.50	1.00	0.25	0.50
Clark's Nutcracker	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.25
Common Raven	0.00	0.50	0.00	0.25	0.00	0.00	0.00	0.00
Mountain Chickadee	0.00	2.50	0.00	1.25	0.50	3.00	0.25	1.50
Red-breasted Nuthatch	0.00	1.50	0.00	0.75	0.00	2.50	0.00	1.25
White-breasted Nuthatch	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.50
Brown Creeper	0.00	0.50	0.00	0.25	0.50	0.50	0.25	0.25
Golden-crowned Kinglet	0.00	0.50	0.00	0.25	0.00	1.00	0.00	0.50
Townsend's Solitaire	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.25
American Robin	0.00	2.50	0.00	1.25	0.00	0.00	0.00	0.00
Yellow Warbler	0.50	1.50	0.25	0.75	0.50	0.50	0.25	0.25
Yellow-rumped Warbler	0.50	2.50	0.25	1.25	0.00	2.00	0.00	1.00
Hermit Warbler	0.00	0.00	0.00	0.00	0.50	1.00	0.25	0.50
Wilson's Warbler	0.00	0.50	0.00	0.25	0.00	0.00	0.00	0.00
Western Tanager	0.00	0.50	0.00	0.25	0.00	0.00	0.00	0.00
Green-tailed Towhee	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.25
Chipping Sparrow	0.00	0.50	0.00	0.25	1.50	2.00	0.75	1.00
Fox Sparrow	1.50	2.50	0.75	1.25	0.00	0.00	0.00	0.00
Song Sparrow	0.00	3.00	0.00	1.50	1.50	3.50	0.75	1.75

<i>Species^e</i>	<i>Round Meadow (n = 2 survey stations)</i>				<i>Lower Bell Meadow (n = 2 survey stations)</i>			
	<i>Avg. No. of Birds Detected^a</i>		<i>Avg. No. of Birds per Station^b</i>		<i>Avg. No. of Birds Detected^a</i>		<i>Avg. No. of Birds per Station^b</i>	
	<i><50m^c</i>	<i>Unlimited Radius^d</i>	<i><50m^c</i>	<i>Unlimited Radius^d</i>	<i><50m^c</i>	<i>Unlimited Radius^d</i>	<i><50m^c</i>	<i>Unlimited Radius^d</i>
Lincoln's Sparrow	0.50	1.50	0.25	0.75	1.00	2.50	0.50	1.25
Dark-eyed Junco	2.00	3.00	1.00	1.50	0.50	1.00	0.25	0.50
Black-headed Grosbeak	1.50	1.50	0.75	0.75	0.00	0.00	0.00	0.00
Red-winged Blackbird	0.00	1.50	0.00	0.75	0.00	0.00	0.00	0.00
Brewer's Blackbird	0.00	1.50	0.00	0.75	0.00	0.00	0.00	0.00
Brown-headed Cowbird	0.00	1.50	0.00	0.75	0.00	0.50	0.00	0.25
Cassin's Finch	0.00	1.00	0.00	0.50	0.00	0.00	0.00	0.00

^aNumber of individuals detected at the meadow, averaged across two survey visits. ^bNumber of individual birds detected divided by the number of survey stations and visits. ^cOnly includes birds detected within 50m of a survey point. ^dAll birds detected regardless of distance from survey station. ^eMeadow focal species recorded in bold text.

Table C-4. Number of birds detected during point counts at Sapps Meadow and Sapps Hollow.

Species ^e	Sapps Meadow (n = 1 survey station)				Sapps Hollow (n = 1 survey station)			
	Avg. No. of Birds Detected ^a		Avg. No. of Birds per Station ^b		Avg. No. of Birds Detected ^a		Avg. No. of Birds per Station ^b	
	<50m ^c	Unlimited Radius ^d	<50m ^c	Unlimited Radius ^d	<50m ^c	Unlimited Radius ^d	<50m ^c	Unlimited Radius ^d
Mountain Quail	0.00	0.0	0.00	0.0	0.00	1.50	0.00	1.50
Red-breasted Sapsucker	0.00	0.0	0.00	0.0	0.00	0.50	0.00	0.50
Hairy Woodpecker	0.00	0.0	0.00	0.0	0.00	0.50	0.00	0.50
Northern Flicker	0.00	0.0	0.00	0.0	0.00	0.50	0.00	0.50
Western Wood-Pewee	0.00	0.0	0.00	0.0	0.00	2.00	0.00	2.00
Steller's Jay	0.00	0.50	0.00	0.50	0.00	1.00	0.00	1.00
Mountain Chickadee	0.00	3.00	0.00	3.00	0.00	2.00	0.00	2.00
Red-breasted Nuthatch	0.00	1.00	0.00	1.00	0.00	1.50	0.00	1.50
Pygmy Nuthatch	0.00	0.50	0.00	0.50	0.00	0.0	0.00	0.0
Brown Creeper	0.00	0.0	0.00	0.0	0.00	1.00	0.00	1.00
House Wren	0.00	0.50	0.00	0.50	0.00	0.0	0.00	0.0
Golden-crowned Kinglet	0.00	0.50	0.00	0.50	0.00	0.0	0.00	0.0
Hermit Thrush	0.00	0.0	0.00	0.0	0.00	0.50	0.00	0.50
American Robin	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
Yellow-rumped Warbler	0.00	1.00	0.00	1.00	0.00	1.50	0.00	1.50
Hermit Warbler	0.00	0.50	0.00	0.50	0.00	0.0	0.00	0.0
Western Tanager	0.00	0.50	0.00	0.50	0.00	0.0	0.00	0.0
Fox Sparrow	0.00	0.0	0.00	0.0	0.00	0.50	0.00	0.50
Dark-eyed Junco	0.00	1.00	0.00	1.00	0.00	1.50	0.00	1.50
Brewer's Blackbird	0.00	0.0	0.00	0.0	0.00	0.50	0.00	0.50

^aNumber of individuals detected at the meadow, averaged across two survey visits. ^bNumber of individual birds detected divided by the number of survey stations and visits. ^cOnly includes birds detected within 50m of a survey point. ^dAll birds detected regardless of distance from survey station. ^eMeadow focal species recorded in bold text.

Table C-5. Number of birds detected during point counts at Wawona Meadow and Hodgdon Meadow.

Species ^e	Wawona Meadow (n = 8 survey stations)				Hodgdon Meadow (n = 5 survey stations)			
	Avg. No. of Birds Detected ^a		Avg. No. of Birds per Station ^b		Avg. No. of Birds Detected ^a		Avg. No. of Birds per Station ^b	
	<50m ^c	Unlimited Radius ^d	<50m ^c	Unlimited Radius ^d	<50m ^c	Unlimited Radius ^d	<50m ^c	Unlimited Radius ^d
Mountain Quail	0.00	1.50	0.00	0.19	0.00	0.00	0.00	0.00
California Quail	0.00	1.00	0.00	0.13	0.00	0.50	0.00	0.10
Wilson's Snipe	0.00	0.50	0.00	0.06	0.00	0.00	0.00	0.00
Calliope Hummingbird	0.00	0.00	0.00	0.00	0.50	0.50	0.10	0.10
Red-breasted Sapsucker	0.50	1.50	0.06	0.19	1.00	2.50	0.20	0.50
Hairy Woodpecker	0.00	0.50	0.00	0.06	0.00	0.00	0.00	0.00
White-headed Woodpecker	0.50	0.50	0.06	0.06	0.50	1.00	0.10	0.20
Northern Flicker	0.00	3.00	0.00	0.38	0.50	2.00	0.10	0.40
Pileated Woodpecker	0.00	1.00	0.00	0.13	0.00	0.00	0.00	0.00
Olive-sided Flycatcher	0.00	3.00	0.00	0.38	0.50	5.00	0.10	1.00
Western Wood-Pewee	1.00	13.50	0.13	1.69	0.50	8.00	0.10	1.60
Hammond's Flycatcher	0.50	1.00	0.06	0.13	0.00	0.00	0.00	0.00
Dusky Flycatcher	1.00	1.00	0.13	0.13	0.50	1.00	0.10	0.20
Unidentified <i>Empidonax</i> Flycatcher	1.00	1.00	0.13	0.13	0.00	0.00	0.00	0.00
Black Phoebe	0.00	0.00	0.00	0.00	0.50	0.50	0.10	0.10
Cassin's Vireo	0.00	1.50	0.00	0.19	1.00	2.00	0.20	0.40
Hutton's Vireo	0.50	0.50	0.06	0.06	0.50	1.50	0.10	0.30
Warbling Vireo	3.00	6.00	0.38	0.75	2.00	5.00	0.40	1.00
Steller's Jay	0.50	2.00	0.06	0.25	1.50	7.00	0.30	1.40
Common Raven	0.00	2.00	0.00	0.25	1.00	2.50	0.20	0.50
Northern Rough-winged Swallow	0.00	0.00	0.00	0.00	0.50	1.00	0.10	0.20
Mountain Chickadee	0.00	1.00	0.00	0.13	1.00	6.00	0.20	1.20
Red-breasted Nuthatch	0.00	2.00	0.00	0.25	0.00	3.00	0.00	0.60
White-breasted Nuthatch	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.20
House Wren	0.50	1.00	0.06	0.13	0.00	0.00	0.00	0.00
Golden-crowned Kinglet	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.20
Hermit Thrush	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.20
American Robin	1.50	5.50	0.19	0.69	1.00	6.00	0.20	1.20

Species ^e	Wawona Meadow (n = 8 survey stations)				Hodgdon Meadow (n = 5 survey stations)			
	Avg. No. of Birds Detected ^a		Avg. No. of Birds per Station ^b		Avg. No. of Birds Detected ^a		Avg. No. of Birds per Station ^b	
	<50m ^c	Unlimited Radius ^d	<50m ^c	Unlimited Radius ^d	<50m ^c	Unlimited Radius ^d	<50m ^c	Unlimited Radius ^d
European Starling	0.50	0.50	0.06	0.06	0.00	0.00	0.00	0.00
Orange-crowned Warbler	1.00	1.00	0.13	0.13	0.00	0.00	0.00	0.00
Nashville Warbler	0.00	0.50	0.00	0.06	0.00	0.50	0.00	0.10
Yellow Warbler	11.00	19.00	1.38	2.38	0.50	1.50	0.10	0.30
Yellow-rumped Warbler	0.00	1.00	0.00	0.13	1.50	3.50	0.30	0.70
Hermit Warbler	0.00	0.50	0.00	0.06	0.00	2.00	0.00	0.40
MacGillivray's Warbler	1.50	5.50	0.19	0.69	0.50	4.00	0.10	0.80
Wilson's Warbler	1.50	2.50	0.19	0.31	0.00	0.00	0.00	0.00
Western Tanager	0.00	1.00	0.00	0.13	0.00	2.50	0.00	0.50
Spotted Towhee	1.50	2.50	0.19	0.31	0.00	0.00	0.00	0.00
Chipping Sparrow	1.00	1.00	0.13	0.13	0.00	0.00	0.00	0.00
Vesper Sparrow	0.00	0.50	0.00	0.06	0.00	0.00	0.00	0.00
Fox Sparrow	0.50	2.50	0.06	0.31	0.00	0.00	0.00	0.00
Song Sparrow	11.00	19.00	1.38	2.38	5.50	10.00	1.10	2.00
Lincoln's Sparrow	3.50	9.00	0.44	1.13	3.50	9.00	0.70	1.80
Dark-eyed Junco	2.00	2.50	0.25	0.31	2.00	5.00	0.40	1.00
Black-headed Grosbeak	4.50	12.00	0.56	1.50	1.50	4.00	0.30	0.80
Lazuli Bunting	0.50	0.50	0.06	0.06	0.00	0.00	0.00	0.00
Red-winged Blackbird	22.00	36.00	2.75	4.50	9.50	16.00	1.90	3.20
Western Meadowlark	0.50	0.50	0.06	0.06	0.00	0.00	0.00	0.00
Brewer's Blackbird	2.50	7.50	0.31	0.94	0.50	2.00	0.10	0.40
Brown-headed Cowbird	3.00	5.00	0.38	0.63	0.00	0.00	0.00	0.00
Purple Finch	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.10

^aNumber of individuals detected at the meadow, averaged across two survey visits. ^bNumber of individual birds detected divided by the number of survey stations and visits. ^cOnly includes birds detected within 50m of a survey point. ^dAll birds detected regardless of distance from survey station. ^eMeadow focal species recorded in bold text.

Appendix D. Average number of birds detected during area searches at each site

Table D-1. Average number of birds detected during area searches at Corral Meadow (9 ac./3 ha).

Species^a	Avg. No. Of Birds Detected		
	Meadow	Upland	Total
Mountain Quail	0.0	1.0	1.0
Spotted Sandpiper	1.0	0.0	1.0
Red-breasted Sapsucker	0.0	2.0	2.0
Hairy Woodpecker	0.0	2.0	2.0
Western Wood-Pewee	0.0	1.0	1.0
Warbling Vireo	0.0	2.0	2.0
Steller's Jay	0.0	1.5	1.5
Mountain Chickadee	0.0	6.5	6.5
Red-breasted Nuthatch	0.0	2.0	2.0
Golden-crowned Kinglet	0.0	3.0	3.0
American Robin	0.0	3.0	3.0
Yellow-rumped Warbler	1.5	2.0	3.5
Chipping Sparrow	0.0	1.0	1.0
Fox Sparrow	0.0	1.0	1.0
Lincoln's Sparrow	1.0	0.0	1.0
Dark-eyed Junco	0.0	2.0	2.0

^aMeadow-associated focal species are recorded in bold text.

Table D-2. Average number of birds detected during area searches at Gardner Meadow (12 ac./5 ha).

Species^a	Avg. No. Of Birds Detected		
	Meadow	Upland	Total
Mallard	2.0	0.0	2.0
Mountain Quail	0.0	1.0	1.0
Williamson's Sapsucker	0.0	1.0	1.0
Red-breasted Sapsucker	0.0	1.0	1.0
Hairy Woodpecker	0.0	1.0	1.0
White-headed Woodpecker	0.0	1.0	1.0
Northern Flicker	0.0	1.0	1.0
Western Wood-Pewee	0.0	7.0	7.0
Dusky Flycatcher	0.0	1.0	1.0
Hutton's Vireo	0.0	1.0	1.0
Warbling Vireo	0.0	2.0	2.0
Steller's Jay	0.0	8.0	8.0
Cliff Swallow	1.0	0.0	1.0
Mountain Chickadee	1.0	7.0	8.0
Red-breasted Nuthatch	0.0	2.0	2.0
White-breasted Nuthatch	0.0	1.0	1.0
Brown Creeper	0.0	1.0	1.0
Hermit Thrush	0.0	1.5	1.5
American Robin	0.0	4.5	4.5
Yellow-rumped Warbler	3.5	4.0	7.5
Wilson's Warbler	0.0	1.0	1.0
Green-tailed Towhee	1.0	0.0	1.0
Chipping Sparrow	0.5	1.0	1.5
Fox Sparrow	0.0	1.0	1.0
Song Sparrow	2.0	0.0	2.0
Lincoln's Sparrow	4.0	0.0	4.0
Dark-eyed Junco	0.5	1.5	2.0
Red-winged Blackbird	3.0	0.0	3.0
Purple Finch	0.0	1.0	1.0
Evening Grosbeak	0.0	2.0	2.0

^aMeadow-associated focal species are recorded in bold text.

Table D-3. Average number of birds detected during area searches at Poopenaut Meadow (47 ac./19 ha).

Species^a	Avg. No. Of Birds Detected		
	Meadow	Upland	Total
Mountain Quail	0.0	1.0	1.0
Spotted Sandpiper	1.0	0.0	1.0
Unidentified Hummingbird	1.0	0.0	1.0
Acorn Woodpecker	2.0	1.5	3.5
Downy Woodpecker	2.0	0.0	2.0
White-headed Woodpecker	0.0	1.0	1.0
Northern Flicker	0.0	1.5	1.5
Western Wood-Pewee	3.0	1.0	4.0
Pacific-slope Flycatcher	0.0	2.0	2.0
Black Phoebe	1.0	0.0	1.0
Cassin's Vireo	1.0	1.0	2.0
Hutton's Vireo	1.0	0.0	1.0
Warbling Vireo	3.5	1.0	4.5
Steller's Jay	0.0	1.5	1.5
Mountain Chickadee	0.0	1.0	1.0
Red-breasted Nuthatch	0.0	1.5	1.5
White-breasted Nuthatch	0.0	2.0	2.0
Brown Creeper	0.0	1.0	1.0
House Wren	3.0	1.0	4.0
American Robin	1.0	1.0	2.0
Yellow Warbler	6.0	0.0	6.0
MacGillivray's Warbler	1.0	1.0	2.0
Wilson's Warbler	1.0	0.0	1.0
Yellow-breasted Chat	3.0	0.0	3.0
Western Tanager	1.5	1.5	3.0
Green-tailed Towhee	0.0	1.0	1.0
Spotted Towhee	0.0	3.0	3.0
Song Sparrow	5.0	0.0	5.0
Lincoln's Sparrow	2.0	0.0	2.0
Dark-eyed Junco	0.0	2.0	2.0
Black-headed Grosbeak	1.0	0.5	1.5
Brown-headed Cowbird	1.5	0.0	1.5
Purple Finch	2.0	0.0	2.0
Lesser Goldfinch	7.0	0.0	7.0

^aMeadow-associated focal species are recorded in bold text.

Table D-4. Average number of birds detected during area searches at Femmons Meadows (10 ac./4 ha).

<i>Species^a</i>	<i>Avg. No. of Birds Detected</i>		
	<i>Meadow</i>	<i>Upland</i>	<i>Total</i>
Mountain Quail	0.0	2.5	2.5
Acorn Woodpecker	0.0	2.0	2.0
Red-breasted Sapsucker	1.0	1.0	2.0
Nuttall's Woodpecker	0.0	1.0	1.0
Hairy Woodpecker	0.0	4.0	4.0
White-headed Woodpecker	0.0	2.0	2.0
Northern Flicker	0.0	2.0	2.0
Pileated Woodpecker	0.0	1.0	1.0
Western Wood-Pewee	0.0	1.0	1.0
Pacific-slope Flycatcher	0.0	1.5	1.5
Cassin's Vireo	0.0	3.5	3.5
Hutton's Vireo	0.0	1.0	1.0
Warbling Vireo	0.0	2.0	2.0
Steller's Jay	0.0	4.0	4.0
Mountain Chickadee	0.5	2.5	3.0
Chestnut-backed Chickadee	0.0	1.0	1.0
Red-breasted Nuthatch	0.0	6.5	6.5
White-breasted Nuthatch	0.0	1.5	1.5
Brown Creeper	0.0	4.5	4.5
House Wren	0.0	1.0	1.0
Pacific Wren	0.0	1.0	1.0
Golden-crowned Kinglet	1.0	3.0	4.0
Townsend's Solitaire	0.0	2.5	2.5
Hermit Thrush	0.0	1.0	1.0
American Robin	1.0	3.5	4.5
Nashville Warbler	0.0	4.0	4.0
Yellow-rumped Warbler	2.5	4.5	7.0
Black-throated Gray Warbler	0.0	3.0	3.0
Hermit Warbler	0.0	5.0	5.0
MacGillivray's Warbler	0.0	1.0	1.0
Western Tanager	0.0	2.5	2.5
Dark-eyed Junco	0.0	8.0	8.0
Black-headed Grosbeak	0.0	1.0	1.0
Brown-headed Cowbird	2.0	0.0	2.0

^aMeadow-associated focal species are recorded in bold text.

Table D-5. Average number of birds detected during area searches at Round Meadow (20 ac./9 ha).

<i>Species^a</i>	<i>Avg. No. of Birds Detected</i>		
	<i>Meadow</i>	<i>Upland</i>	<i>Total</i>
Mountain Quail	0.0	2.5	2.5
Spotted Sandpiper	2.0	0.0	2.0
Calliope Hummingbird	1.0	0.0	1.0
Rufous Hummingbird	0.0	1.0	1.0
Red-breasted Sapsucker	0.0	1.0	1.0
Hairy Woodpecker	0.0	1.0	1.0
White-headed Woodpecker	0.0	3.0	3.0
Northern Flicker	0.0	3.0	3.0
Olive-sided Flycatcher	0.0	1.0	1.0
Western Wood-Pewee	0.5	7.0	7.5
Cassin's Vireo	0.0	1.0	1.0
Warbling Vireo	9.0	2.5	11.5
Steller's Jay	0.0	3.5	3.5
Common Raven	0.0	3.0	3.0
Mountain Chickadee	1.5	7.5	9.0
Red-breasted Nuthatch	0.0	4.5	4.5
White-breasted Nuthatch	0.0	1.0	1.0
Brown Creeper	0.0	2.0	2.0
Golden-crowned Kinglet	0.0	4.5	4.5
Townsend's Solitaire	0.0	1.0	1.0
Hermit Thrush	0.0	1.0	1.0
American Robin	1.0	3.5	4.5
Nashville Warbler	0.0	1.0	1.0
Yellow Warbler	2.0	0.0	2.0
Yellow-rumped Warbler	0.5	3.0	3.5
Hermit Warbler	0.0	1.0	1.0
MacGillivray's Warbler	1.5	0.5	2.0
Wilson's Warbler	1.5	0.5	2.0
Western Tanager	0.0	1.0	1.0
Green-tailed Towhee	1.0	0.0	1.0
Chipping Sparrow	1.0	5.0	6.0
Fox Sparrow	3.0	0.0	3.0
Song Sparrow	6.0	0.0	6.0
Lincoln's Sparrow	3.0	0.0	3.0
Dark-eyed Junco	2.5	6.5	9.0
Black-headed Grosbeak	4.5	1.0	5.5
Red-winged Blackbird	2.5	0.0	2.5
Brewer's Blackbird	4.0	0.0	4.0
Brown-headed Cowbird	2.0	1.0	3.0

^aMeadow-associated focal species are recorded in bold text.

Table D-6. Average number of birds detected during area searches at Lower Bell Meadow (20 ac./8 ha).

<i>Species^a</i>	<i>Avg. No. of Birds Detected</i>		
	<i>Meadow</i>	<i>Upland</i>	<i>Total</i>
Mountain Quail	0.0	1.5	1.5
Downy Woodpecker	0.0	1.0	1.0
Hairy Woodpecker	0.0	3.0	3.0
Northern Flicker	0.5	1.0	1.5
Pileated Woodpecker	0.0	1.0	1.0
Western Wood-Pewee	1.0	4.0	5.0
Hammond's Flycatcher	1.0	0.0	1.0
Dusky Flycatcher	0.0	2.0	2.0
Cassin's Vireo	0.0	1.0	1.0
Warbling Vireo	2.5	3.0	5.5
Steller's Jay	0.0	3.0	3.0
Mountain Chickadee	0.5	4.5	5.0
Red-breasted Nuthatch	0.0	2.0	2.0
Brown Creeper	0.0	1.0	1.0
Golden-crowned Kinglet	0.0	2.0	2.0
Townsend's Solitaire	0.0	1.0	1.0
American Robin	5.0	3.0	8.0
Yellow Warbler	1.5	0.0	1.5
Yellow-rumped Warbler	0.0	2.0	2.0
Hermit Warbler	0.0	3.0	3.0
MacGillivray's Warbler	0.0	1.0	1.0
Western Tanager	0.0	1.0	1.0
Chipping Sparrow	2.5	0.0	2.5
Song Sparrow	7.0	0.0	7.0
Lincoln's Sparrow	3.0	1.0	4.0
Dark-eyed Junco	1.0	5.0	6.0
Brewer's Blackbird	2.0	0.0	2.0
Brown-headed Cowbird	1.0	0.0	1.0
Purple Finch	1.0	0.0	1.0

^aMeadow-associated focal species are recorded in bold text.

Table D-7. Average number of birds detected during area searches at Sapps Meadow (5 ac./2 ha).

<i>Species^a</i>	<i>Avg. No. of Birds Detected</i>		
	<i>Meadow</i>	<i>Upland</i>	<i>Total</i>
White-headed Woodpecker	0.0	1.0	1.0
Steller's Jay	0.0	2.0	2.0
Common Raven	1.0	0.0	1.0
Mountain Chickadee	0.0	6.5	6.5
Red-breasted Nuthatch	0.0	2.0	2.0
Golden-crowned Kinglet	0.0	2.0	2.0
Hermit Thrush	0.0	1.0	1.0
American Robin	0.0	1.0	1.0
Yellow-rumped Warbler	0.0	4.0	4.0
Western Tanager	0.0	1.0	1.0
Lincoln's Sparrow	1.0	0.0	1.0
Dark-eyed Junco	0.0	3.0	3.0

^aMeadow-associated focal species are recorded in bold text.

Table D-8. Average number of birds detected during area searches at Sapps Hollow (6 ac./3 ha).

<i>Species^a</i>	<i>Avg. No. of Birds Detected</i>		
	<i>Meadow</i>	<i>Upland</i>	<i>Total</i>
Mountain Quail	0.0	1.0	1.0
Red-breasted Sapsucker	0.0	1.0	1.0
Western Wood-Pewee	0.0	3.0	3.0
Steller's Jay	0.0	1.0	1.0
Mountain Chickadee	0.0	4.0	4.0
Red-breasted Nuthatch	0.0	4.5	4.5
Brown Creeper	0.0	1.0	1.0
House Wren	0.0	1.0	1.0
Golden-crowned Kinglet	0.0	1.0	1.0
Hermit Thrush	0.0	1.0	1.0
American Robin	0.0	2.5	2.5
Yellow-rumped Warbler	0.0	4.0	4.0
Western Tanager	0.0	1.0	1.0
Green-tailed Towhee	0.0	1.0	1.0
Chipping Sparrow	0.0	1.0	1.0
Dark-eyed Junco	0.0	2.5	2.5

^aMeadow-associated focal species are recorded in bold text.

Table D-9. Average number of birds detected during area searches at Wawona Meadow (157 ac./63 ha).

Species^a	Avg. No. of Birds Detected		
	Meadow	Upland	Total
Mallard	1.0	0.0	1.0
Mountain Quail	0.0	1.0	1.0
California Quail	0.0	2.5	2.5
Cooper's Hawk	1.0	0.0	1.0
Red-tailed Hawk	0.0	1.0	1.0
Virginia Rail	1.0	0.0	1.0
Anna's Hummingbird	1.0	0.0	1.0
Calliope Hummingbird	1.0	0.0	1.0
Acorn Woodpecker	0.0	1.0	1.0
Red-breasted Sapsucker	0.0	1.0	1.0
Hairy Woodpecker	1.0	0.0	1.0
White-headed Woodpecker	1.0	0.0	1.0
Northern Flicker	0.5	3.5	4.0
Pileated Woodpecker	0.0	1.0	1.0
Olive-sided Flycatcher	0.5	1.5	2.0
Western Wood-Pewee	5.0	9.0	14.0
Hammond's Flycatcher	0.5	0.5	1.0
Dusky Flycatcher	2.0	0.5	2.5
Pacific-slope Flycatcher	0.0	1.0	1.0
Cassin's Vireo	0.5	2.0	2.5
Hutton's Vireo	1.0	1.0	2.0
Warbling Vireo	4.0	6.0	10.0
Steller's Jay	0.0	7.0	7.0
Common Raven	2.0	0.5	2.5
Mountain Chickadee	0.0	3.0	3.0
Red-breasted Nuthatch	0.0	3.0	3.0
White-breasted Nuthatch	0.0	3.0	3.0
Brown Creeper	0.0	3.0	3.0
Bewick's Wren	1.0	0.0	1.0
House Wren	1.0	0.0	1.0
Pacific Wren	0.0	1.0	1.0
American Robin	6.0	4.5	10.5
Orange-crowned Warbler	1.0	0.0	1.0
Nashville Warbler	0.0	3.5	3.5
Yellow Warbler	17.0	1.5	18.5
Yellow-rumped Warbler	3.0	2.0	5.0
Hermit Warbler	0.0	1.0	1.0
MacGillivray's Warbler	6.0	4.5	10.5
Wilson's Warbler	5.0	0.0	5.0
Western Tanager	0.0	3.0	3.0
Green-tailed Towhee	1.0	0.0	1.0
Spotted Towhee	1.0	2.0	3.0
Chipping Sparrow	3.0	0.0	3.0

Species^a	Avg. No. of Birds Detected		
	Meadow	Upland	Total
Vesper Sparrow	1.0	0.0	1.0
Fox Sparrow	5.0	0.0	5.0
Song Sparrow	16.0	2.0	18.0
Lincoln's Sparrow	10.0	1.0	11.0
Dark-eyed Junco	0.0	7.0	7.0
Black-headed Grosbeak	8.0	4.0	12.0
Lazuli Bunting	1.0	0.0	1.0
Red-winged Blackbird	41.0	1.5	42.5
Western Meadowlark	1.0	0.0	1.0
Brewer's Blackbird	16.0	3.0	19.0
Brown-headed Cowbird	3.0	2.5	5.5

^aMeadow-associated focal species are recorded in bold text.

Table D-10. Average number of birds detected during area searches at Hodgdon Meadow (51 ac./21 ha).

Species^a	Avg. No. of Birds Detected		
	Meadow	Upland	Total
Mountain Quail	0.0	1.0	1.0
Turkey Vulture	1.0	0.0	1.0
Calliope Hummingbird	1.0	0.0	1.0
Red-breasted Sapsucker	0.0	1.0	1.0
White-headed Woodpecker	0.5	1.0	1.5
Northern Flicker	0.5	0.5	1.0
Pileated Woodpecker	0.0	1.0	1.0
Olive-sided Flycatcher	0.5	1.5	2.0
Western Wood-Pewee	2.0	3.0	5.0
Pacific-slope Flycatcher	0.0	1.0	1.0
Black Phoebe	0.5	0.5	1.0
Cassin's Vireo	0.0	1.5	1.5
Hutton's Vireo	1.0	2.0	3.0
Warbling Vireo	2.0	2.5	4.5
Steller's Jay	0.0	4.0	4.0
Common Raven	0.5	1.0	1.5
Mountain Chickadee	0.5	3.0	3.5
Red-breasted Nuthatch	0.0	2.0	2.0
White-breasted Nuthatch	0.0	2.0	2.0
Brown Creeper	0.0	1.0	1.0
Golden-crowned Kinglet	0.0	3.0	3.0
Hermit Thrush	0.0	1.0	1.0
American Robin	3.5	2.5	6.0
Nashville Warbler	0.5	1.0	1.5
Yellow Warbler	1.0	0.0	1.0
Yellow-rumped Warbler	1.5	2.5	4.0
Hermit Warbler	0.0	3.0	3.0
MacGillivray's Warbler	2.5	0.0	2.5
Western Tanager	0.0	1.5	1.5
Chipping Sparrow	1.0	0.5	1.5
Song Sparrow	9.0	0.0	9.0
Lincoln's Sparrow	8.5	0.5	9.0
Dark-eyed Junco	2.0	2.0	4.0
Black-headed Grosbeak	1.5	3.0	4.5
Red-winged Blackbird	14.0	1.0	15.0
Brewer's Blackbird	5.0	0.5	5.5
Brown-headed Cowbird	4.0	0.0	4.0
Cassin's Finch	0.0	2.0	2.0
Pine Siskin	2.0	12.0	14.0
Evening Grosbeak	0.0	1.0	1.0

^aMeadow-associated focal species are recorded in bold text.

Appendix E. All bird species detected during point counts and area searches at each meadow

Table E-1. All bird species detected during point counts and area searches at each meadow.

<i>Species^a</i>	<i>No. of Meadows with detections</i>	<i>Corral Meadow</i>	<i>Gardner Meadow</i>	<i>Poopenaut Meadow</i>	<i>Femmons Meadows</i>	<i>Round Meadow</i>	<i>Lower Bell Meadow</i>	<i>Sapps Meadow</i>	<i>Sapps Hollow</i>	<i>Wawona Meadow</i>	<i>Hodgdon Meadow</i>
Mallard	2		X							X	
Mountain Quail	9	X	X	X	X	X	X		X	X	X
California Quail	2									X	X
Turkey Vulture	1										X
Cooper's Hawk	1									X	
Red-tailed Hawk	1									X	
American Kestrel	1	X									
Virginia Rail	1									X	
Spotted Sandpiper	3	X		X		X					
Wilson's Snipe	1									X	
Anna's Hummingbird	1									X	
Calliope Hummingbird	3					X				X	X
Rufous Hummingbird	1					X					
Unidentified Hummingbird	1			X							
Acorn Woodpecker	3			X	X					X	
Williamson's Sapsucker	1		X								
Red-breasted Sapsucker	7	X	X		X	X			X	X	X
Nuttall's Woodpecker	1				X						
Downy Woodpecker	4	X		X	X		X				
Hairy Woodpecker	7	X	X		X	X	X		X	X	
White-headed Woodpecker	7		X	X	X	X		X		X	X
Northern Flicker	8		X	X	X	X	X		X	X	X
Pileated Woodpecker	4				X		X			X	X
Olive-sided Flycatcher	3					X				X	X
Western Wood-Pewee	9	X	X	X	X	X	X		X	X	X
Hammond's Flycatcher	2						X			X	
Dusky Flycatcher	4		X				X			X	X
Pacific-slope Flycatcher	5		X	X	X					X	X
Unidentified	1									X	

Species^a	No. of Meadows with detections	Corral Meadow	Gardner Meadow	Poopenaut Meadow	Femmons Meadows	Round Meadow	Lower Bell Meadow	Sapps Meadow	Sapps Hollow	Wawona Meadow	Hodgdon Meadow
<i>Empidonax</i> Flycatcher											
Black Phoebe	2			X							X
Cassin's Vireo	6			X	X	X	X			X	X
Hutton's Vireo	5		X	X	X					X	X
Warbling Vireo	8	X	X	X	X	X	X			X	X
Steller's Jay	10	X	X	X	X	X	X	X	X	X	X
Clark's Nutcracker	1						X				
Common Raven	4					X		X		X	X
Northern Rough-winged Swallow	1										X
Cliff Swallow	1		X								
Mountain Chickadee	10	X	X	X	X	X	X	X	X	X	X
Chestnut-backed Chickadee	1				X						
Red-breasted Nuthatch	10	X	X	X	X	X	X	X	X	X	X
White-breasted Nuthatch	7		X	X	X	X	X			X	X
Pygmy Nuthatch	1							X			
Brown Creeper	8		X	X	X	X	X		X	X	X
Canyon Wren	1			X							
Bewick's Wren	1									X	
House Wren	5			X	X			X	X	X	
Pacific Wren	2				X					X	
Golden-crowned Kinglet	7	X			X	X	X	X	X		X
Townsend's Solitaire	3				X	X	X				
Hermit Thrush	6		X		X	X		X	X		X
American Robin	10	X	X	X	X	X	X	X	X	X	X
European Starling	1									X	
Orange-crowned Warbler	1									X	
Nashville Warbler	4				X	X				X	X
Yellow Warbler	6	X		X		X	X			X	X
Yellow-rumped Warbler	9	X	X		X	X	X	X	X	X	X
Black-throated Gray Warbler	1				X						
Hermit Warbler	6				X	X	X	X		X	X
MacGillivray's	6			X	X	X	X			X	X

<i>Species^a</i>	<i>No. of Meadows with detections</i>	<i>Corral Meadow</i>	<i>Gardner Meadow</i>	<i>Poopenaut Meadow</i>	<i>Femmons Meadows</i>	<i>Round Meadow</i>	<i>Lower Bell Meadow</i>	<i>Sapps Meadow</i>	<i>Sapps Hollow</i>	<i>Wawona Meadow</i>	<i>Hodgdon Meadow</i>
Warbler											
Wilson's Warbler	4		X	X		X				X	
Yellow-breasted Chat	1			X							
Western Tanager	9		X	X	X	X	X	X	X	X	X
Green-tailed Towhee	6		X	X		X	X		X	X	
Spotted Towhee	3			X	X					X	
Chipping Sparrow	7	X	X			X	X		X	X	X
Vesper Sparrow	1									X	
Fox Sparrow	5	X	X			X			X	X	
Song Sparrow	6		X	X		X	X			X	X
Lincoln's Sparrow	8	X	X	X		X	X	X		X	X
Dark-eyed Junco	10	X	X	X	X	X	X	X	X	X	X
Black-headed Grosbeak	5			X	X	X				X	X
Lazuli Bunting	1									X	
Red-winged Blackbird	5		X	X		X				X	X
Western Meadowlark	1									X	
Brewer's Blackbird	6		X			X	X		X	X	X
Brown-headed Cowbird	6			X	X	X	X			X	X
Purple Finch	4		X	X			X				X
Cassin's Finch	2					X					X
Pine Siskin	1										X
Lesser Goldfinch	1			X							
Evening Grosbeak	2		X								X

^aMeadow-associated focal species are indicated in bold text.