

***Pre-restoration bird surveys at meadows
on Sierra National Forest and Sequoia
National Park***

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***Helen L. Loffland
Rodney B. Siegel
Robert L. Wilkerson***

***The Institute for Bird Populations
PO Box 1346
Point Reyes Station, CA 94956***

www.birdpop.org



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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 6 meadows (3 intended restoration sites, and 3 paired reference sites) on the Sierra National Forest and Sequoia National Park. We surveyed all meadows twice during the 2010 breeding season, conducting a total of 38 point count and broadcast surveys, and over 7 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 3 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, Kattelman 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. We worked closely with the Regional Hydrologist as he queried forests in Region 5. We also consulted with personnel at Yosemite and Sequoia 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 Areas, 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 two 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 Sierra National Forest and Sequoia National Park.**

Conversations with biologists and hydrologists on the Sierra National Forest and at Sequoia National Park identified 3 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 Sierra National Forest and Sequoia National Park where pre-restoration bird surveys were conducted during the 2010 breeding season.

<i>Restoration Site (land manager)</i>	<i>Reference Site(s) (land manager)</i>
Long Meadow – Chiquito Campground (Sierra N.F.)	Lower Soquel Meadow (Sierra N.F.)
Long Meadow – Globe Rock (Sierra N.F.)	Upper Muglers Meadows (Sierra N.F.)
Lower Halstead Meadow (Sequoia N.P.)	Long Meadow – Wolverton Creek (Sequoia N.P.)

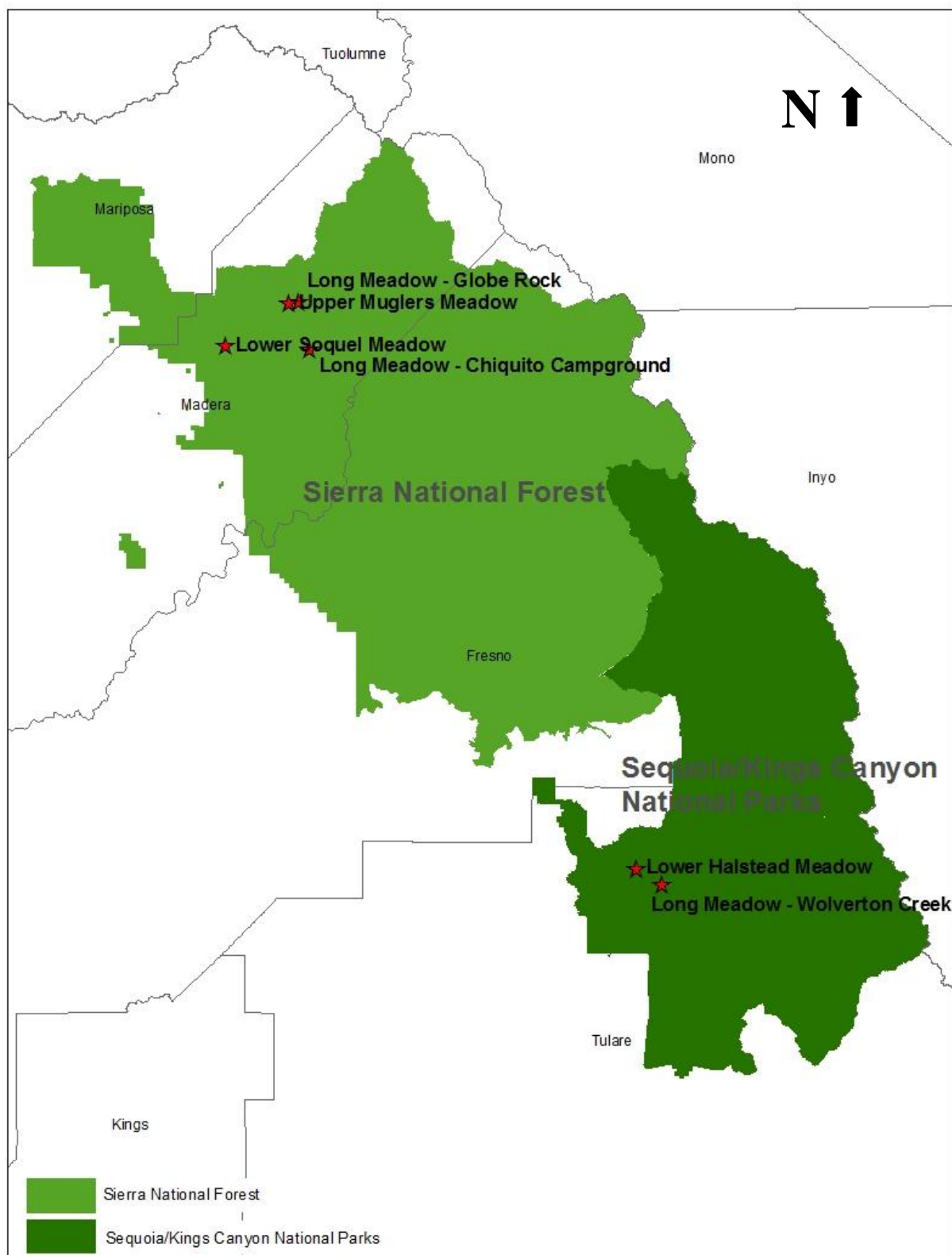


Figure 1. Location of restoration and reference meadows in Sierra N.F. and Sequoia N.P.

The two restoration projects in Sierra National Forest - Long Meadow near Chiquito Campground and Long Meadow near Globe Rock - have their planning documents completed and were slated for restoration activities during summer/fall of 2010. Both sites and their reference sites are typical of mid-elevation west slope meadow systems. They are relatively small in size and associated with small to moderately sized streams. They do not have broad, open floodplains or oxbow systems, but occur in a linear formation along the primary stream channel and have riparian and meadow vegetation that extends upstream and downstream of the main meadow in a "stringer meadow" pattern. Because of their narrow form, these meadows are considerably influenced by the adjacent upland forest. Long meadow near Chiquito Creek Campground is the lowest elevation of this group at 5,000 ft (1524 m) in elevation. As such, we had some difficulty locating a similar reference site nearby that occurred on public lands. 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. After careful consideration we selected the publicly owned portion of Lower Soquel Meadow that occurs below Sky Ranch Road as a reference site for Long Meadow near Chiquito Creek. Despite the considerable distance from the restoration site it is well matched in elevation and vegetation.

Long Meadow near Globe Rock is somewhat higher in elevation at 6800 feet (2078 m), and is moderately sized with stringer riparian vegetation occurring along the stream above the main meadow. We found a similar meadow system to use as a reference site just a few kilometers to the west at Upper Muglers Meadow. Both meadows occur at the upper reaches of associated tributaries to Muglers Creek. Because the eastern portion of the Muglers Meadow is privately owned, we limited our monitoring activities to the western portion of the meadow.

The remaining restoration and reference sites at Lower Halstead Meadow and Long Meadow near Wolverton Creek (Table 1) are located in the Sequoia National Park and occur at elevations just over 7000 feet (2134 m). Halstead Meadow is bisected by General's Highway and as a result has experienced hydrologic impacts over time. Restoration of the upper portion of the meadow was recently completed, and restoration of the lower portion of the meadow (where we focused our surveys) is slated for 2011. In addition to the bird surveys we conducted in 2010, park personnel are completing pre-restoration invertebrate and vegetation monitoring. At 31 acres (13 ha), Halstead meadow is considerably larger than the other meadows we monitored in this region. We were however successful in finding a nearby meadow of similar size for reference at Long Meadow near Wolverton Creek. This meadow is also within a portion of the park with relatively high recreational use, so patterns of current and historical use should be relatively similar.

All 6 restoration and reference sites within this management area have a historical legacy of logging and/or grazing use. With creation of the national parks and national forests use patterns shifted, but for each reference and restoration pair, overall land management was relatively consistent. All of these sites occur in areas that experience moderate to high recreational use at this time. The mid-elevation Sierra N.F. meadows border upland forest dominated by Sierra Mixed Conifer, while the higher elevation Sequoia N.P. sites have Sierra Mixed Conifer or Lodgepole Pine along the meadow edges, 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, three restoration sites, and three reference sites (6 total) within the Sierra N.F./Sequoia N.P. region received two visits during 2010 breeding season. We established 38 survey stations at the 6 study sites.

Table 2. Site location information and survey dates for meadows on Sierra N.F. and Sequoia N.P.

<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>
Long Meadow - Chiquito Campground	Restore	288115	4142887	11s	5000	Little Shuteye Peak	6/22/2010	7/1/2010	2
Lower Soquel Meadow	Reference	273592	4144234	11	5350	White Chief Mtn	6/20/2010	6/29/2010	4
Long Meadow - Globe Rock	Restore	286166	4150982	11s	6800	Little Shuteye Peak	6/23/2010	7/1/2010	3
Upper Muglers Meadow	Reference	284525	4150872	11	6900	Little Shuteye Peak	6/23/2010	7/1/2010	3
Lower Halstead Meadow	Restore	340413	4053699	11s	7000	Giant Forest	6/23/2010	6/30/2010	3
Long Meadow - Wolverton Creek	Reference	344633	4051116	11	7250	Giant Forest	6/22/2010	6/30/2010	4

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

Point Counts

Among the meadows with survey results reported here, no strong patterns in bird abundance or species diversity exist relative to meadow size or location (Table 3).

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

Meadow Name ^a	No. of Survey Stations	Avg. No. Birds Detected ^b		Avg. No. Birds Per Station ^b		Species Detected (Visits Pooled)	
		<50m	Unlimited Radius	<50m	Unlimited Radius	<50m	Unlimited Radius
Long Meadow – Chiquito Campground	2	3.0	60.0	1.5	30.0	3	27
Lower Soquel Meadow	4	11.5	55.5	2.9	13.9	12	34
Long Meadow - Globe Rock	3	5.5	32.5	1.8	10.8	8	23
Upper Muglers Meadow	3	13.0	46.0	4.3	15.3	14	25
Lower Halstead Meadow	3	6.5	47.5	2.2	15.8	5	21
Long Meadow -Wolverton Creek	4	16.5	63.5	4.1	15.9	9	25

^aRestoration sites are indicated in bold text with associated reference sites directly below them in plain text. ^bReported 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, 7 were detected during point counts in the Sierra N.F./Sequoia N.P. 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).

Meadow Name^b	Survey radius	Red-breasted Sapsucker	Warbling Vireo	Yellow Warbler	MacGillivray's Warbler	Song Sparrow	Lincoln's Sparrow	Brown-headed Cowbird
Long Meadow- Chiquito Campground	≤50 m	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Unlim.	0.00	2.50	0.50	2.00	3.00	1.50	0.00
Lower Soquel Meadow	≤50 m	0.00	0.00	0.13	0.00	0.50	0.00	0.13
	Unlim	0.00	0.38	0.50	0.50	0.88	0.00	0.25
Long Meadow - Globe Rock	≤50 m	0.17	0.00	0.00	0.00	0.00	0.00	0.00
	Unlim	0.33	0.00	0.17	0.33	0.00	0.50	0.00
Upper Muglers Meadow	≤50 m	0.17	0.33	0.00	0.00	0.00	0.17	0.00
	Unlim	0.17	1.00	0.17	0.33	0.00	0.33	0.00
Lower Halstead Meadow	≤50 m	0.00	0.00	0.00	0.00	0.33	0.83	0.00
	Unlim	0.00	0.17	0.00	0.67	0.83	2.00	0.00
Long Meadow - Wolverton Creek	≤50 m	0.13	0.00	0.00	0.25	0.00	1.00	0.00
	Unlim	0.13	1.00	0.00	1.13	0.13	2.25	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, and at an unlimited distance. ^bRestoration sites are indicated with bold type.

The number of focal species detected at a given meadow ranged from a low of 4 at Lower Soquel and Lower Halstead Meadows to a high of 5 at the remaining four meadows. Of the focal species detected, Brown-headed cowbird was only detected at Lower Soquel Meadow, while Warbling Vireo was detected at all 6 sites. Each of the remaining focal species was detected at three 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 50 m of the survey station during the preceding point count. No target species were detected using broadcast surveys in the Sierra N.F./Sequoia N.P. 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 3.2 (SD = 1.47) additional species per meadow in the Sierra N.F./Sequoia N.P. 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.

<i>Meadow Name^b</i>	<i>No. Species Detected - Area Searches</i>	<i>No. Species Detected - Point Counts</i>	<i>No. Species Detected Only During Area Searches</i>	<i>No. Species - Both Methods Combined</i>
Long Meadow – Chiquito Campground	17	27	3	30
Lower Soquel Meadow	28	34	2	36
Long Meadow - Globe Rock	20	23	3	26
Upper Muglers Meadow	22	25	2	27
Lower Halstead Meadow	20	21	3	24
Long Meadow -Wolverton Creek	28	25	6	31

^aResults are pooled across all visits. ^bRestoration sites are indicated with bold type.

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 linear 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. Stations at Long Meadow near Globe Rock and Upper Muggers Meadow had average tree cover values greater than 40%. Long Meadow near Wolverton Creek had the greatest amount of cover from riparian shrubs within the 50-m plots (8.94%), while the remaining sites had less than 5% 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 was highest at the two meadows within the park (12.83% and 10.63%). The amount of standing water was less than 7% at all sites ($X = 3.96$; $S.E. = 0.77$)(Table 6).

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

<i>Meadow Name^a</i>	<i>No. Stations</i>	<i>Measure^b</i>	<i>Percent Cover</i>								
			<i>Trees</i>	<i>Snags</i>	<i>Riparian Shrubs</i>	<i>Sagebrush</i>	<i>Non-Woody Vegetation</i>	<i>Bare Ground</i>	<i>Gravel Bar</i>	<i>Flowing Water</i>	<i>Standing Water</i>
Long Meadow-Chiquito Cmpgrd.	2	Mean	13.13	2.63	0.00	0.00	76.88	0.00	0.00	2.25	6.25
		(S.E.)	9.88	1.88	0.00	0.00	14.38	0.00	0.00	1.25	3.75
Lower Soquel Meadow	4	Mean	31.13	0.88	2.50	0.00	47.50	9.38	4.81	4.38	0.00
		(S.E.)	16.47	0.39	0.44	0.00	18.60	4.96	4.81	1.94	0.00
Long Meadow - Globe Rock	3	Mean	41.67	2.00	0.00	0.00	51.25	8.25	0.33	7.08	4.50
		(S.E.)	7.41	0.29	0.00	0.00	12.64	6.51	0.17	1.10	1.81
Upper Muglers Meadow	3	Mean	45.00	1.08	4.50	0.00	42.50	8.42	0.00	3.75	6.00
		(S.E.)	5.00	0.65	1.23	0.00	6.61	4.59	0.00	0.72	3.06
Lower Halstead Meadow	3	Mean	12.00	2.08	1.17	0.00	68.17	2.00	0.00	12.83	3.58
		(S.E.)	9.95	1.23	0.58	0.00	10.35	0.00	0.00	3.58	0.87
Long Meadow – Wolverton Creek	4	Mean	15.75	0.19	8.94	0.00	61.25	2.13	0.00	10.63	5.13
		(S.E.)	8.43	0.12	5.40	0.00	5.91	0.68	0.00	3.70	0.41
6 Meadows Pooled	19	Mean	26.83	1.32	3.30	0.00	56.55	5.37	1.07	7.13	3.96
		(S.E.)	5.02	0.31	1.29	0.00	5.18	1.65	1.01	1.28	0.77

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

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 majority of riparian shrubs (68.14%) were 1 – 2 m tall, although two sites, Long Meadow near Wolverton Creek and Upper Muggers Meadow had a relatively large amount of mature shrubs in the <1 m height class (50% and 31%, respectively). None of the meadows had shrubs in the seedling size class (Table 7). Meadows in this region differed somewhat from other regions in that almost half of their riparian shrubs were not willow or alder but other taxonomic groups (*Cornus* spp., *Lonicera* spp, *Ribes* spp, *Rosa* spp, etc.).

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
Lower Halstead Meadow	2	Mean	0.00	0.00	92.50	7.50	86.25	0.00	13.75
		(S.E.)	0.00	0.00	2.50	2.50	13.75	0.00	13.75
Long Meadow - Wolverton Crk.	4	Mean	0.00	33.33	60.42	5.63	100.00	0.00	0.00
		(S.E.)	0.00	13.68	9.77	4.83	0.00	0.00	0.00
Lower Soquel Meadow	4	Mean	0.00	5.00	95.00	0.00	36.46	0.00	63.54
		(S.E.)	0.00	5.00	5.00	0.00	22.21	0.00	22.21
Upper Muglers Meadow	3	Mean	0.00	50.00	48.33	1.67	10.00	0.00	90.00
		(S.E.)	0.00	28.87	27.44	1.67	10.00	0.00	10.00
4 Meadows Pooled	13	Mean	0.00	22.63	68.14	3.27	51.54	0.00	40.77
		(S.E.)	0.00	8.90	8.47	1.64	11.58	0.00	12.10

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

Discussion

We strongly recommend continuing bird monitoring activities at meadows in the Sierra N.F. / Sequoia N.P. 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, results would be strengthened. 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. Even when they were 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 stations

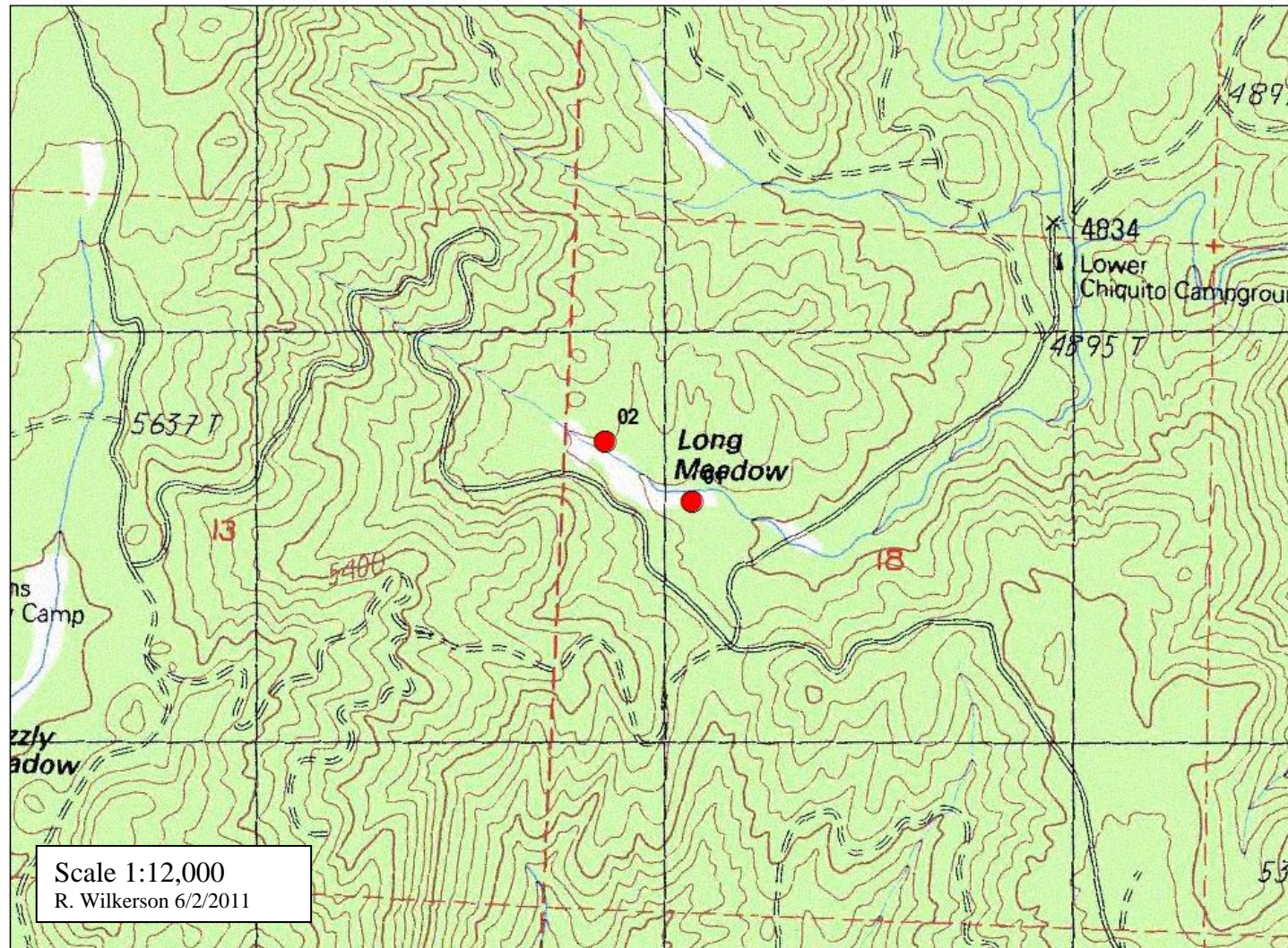
Table A-1. Geographic coordinates of survey stations^a.

Meadow Name	Station Number	UTM Zone	UTM Easting	UTM Northing
Long Meadow - Globe Rock	01	11	286162	4151265
Long Meadow - Globe Rock	02	11	286098	4150976
Long Meadow - Globe Rock	03	11	286053	4150713
Long Meadow - Chiquito Campground	01	11	287989	4142789
Long Meadow - Chiquito Campground	02	11	287777	4142934
Long Meadow - Wolverton Creek	01	11	344602	4051366
Long Meadow - Wolverton Creek	02	11	344586	4050833
Long Meadow - Wolverton Creek	03	11	344588	4051093
Long Meadow - Wolverton Creek	04	11	344563	4050573
Lower Halstead Meadow	01	11	340320	4053462
Lower Halstead Meadow	02	11	340356	4053714
Lower Halstead Meadow	03	11	340436	4053969
Lower Soquel Meadow	01	11	273828	4144615
Lower Soquel Meadow	02	11	273606	4144487
Lower Soquel Meadow	03	11	273549	4144151
Lower Soquel Meadow	04	11	273378	4143762
Upper Muglers Meadow	01	11	284570	4151084
Upper Muglers Meadow	02	11	284528	4150815
Upper Muglers Meadow	03	11	284662	4150580

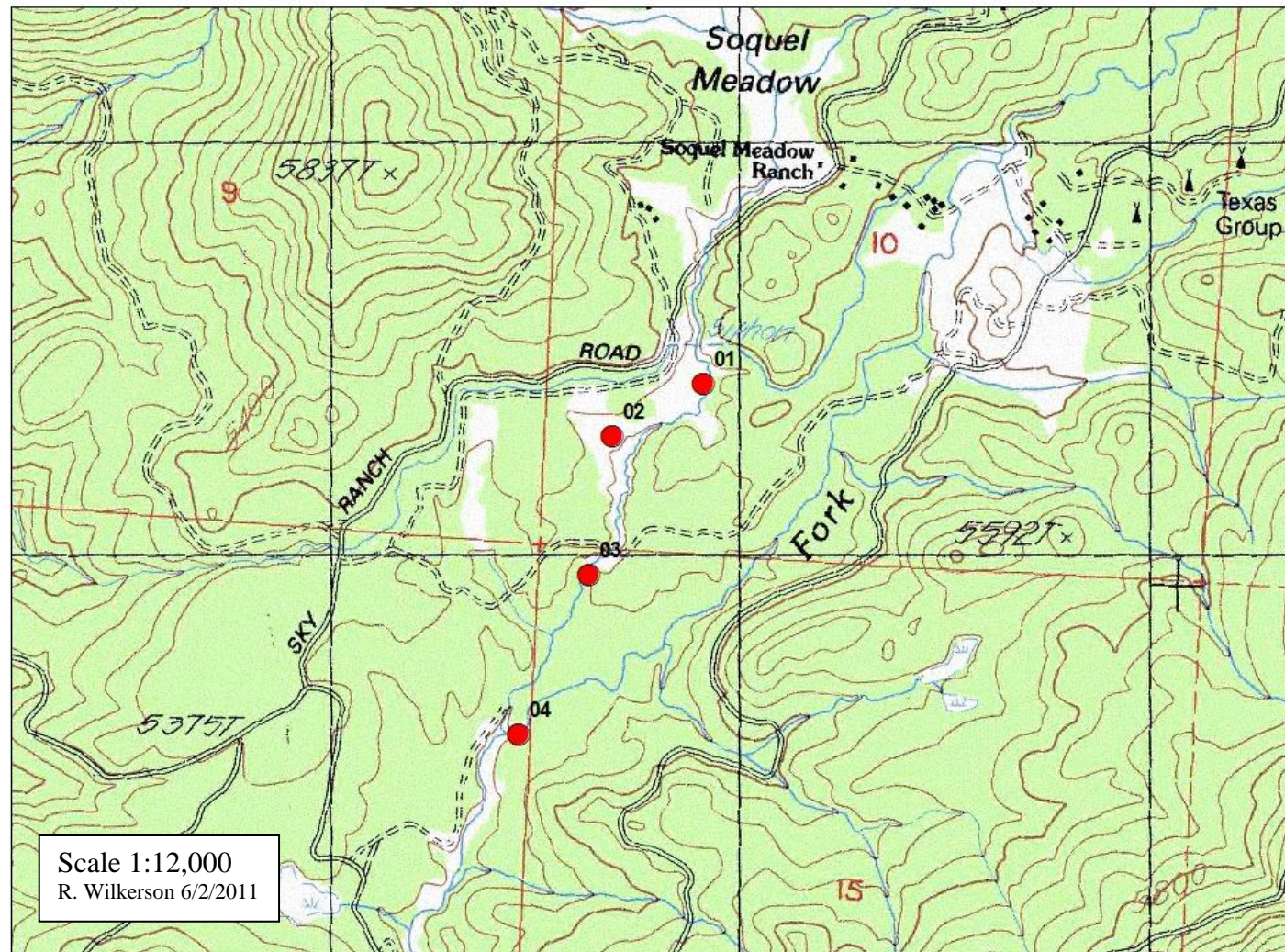
^aUTM coordinates projected in NAD 83.

Appendix B. Maps of meadows with survey station locations

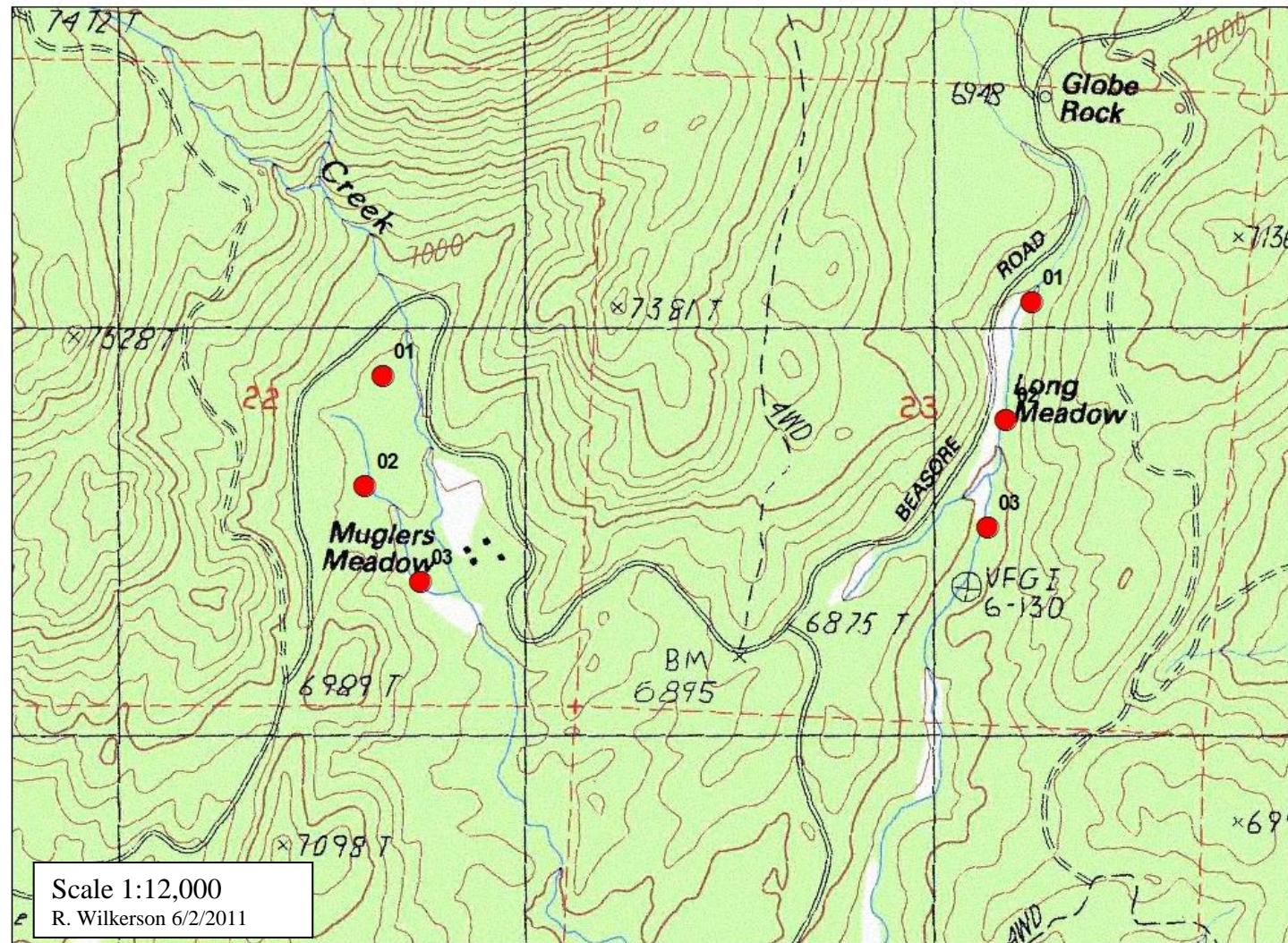
Map B-1. Long Meadow – Chiquito Campground



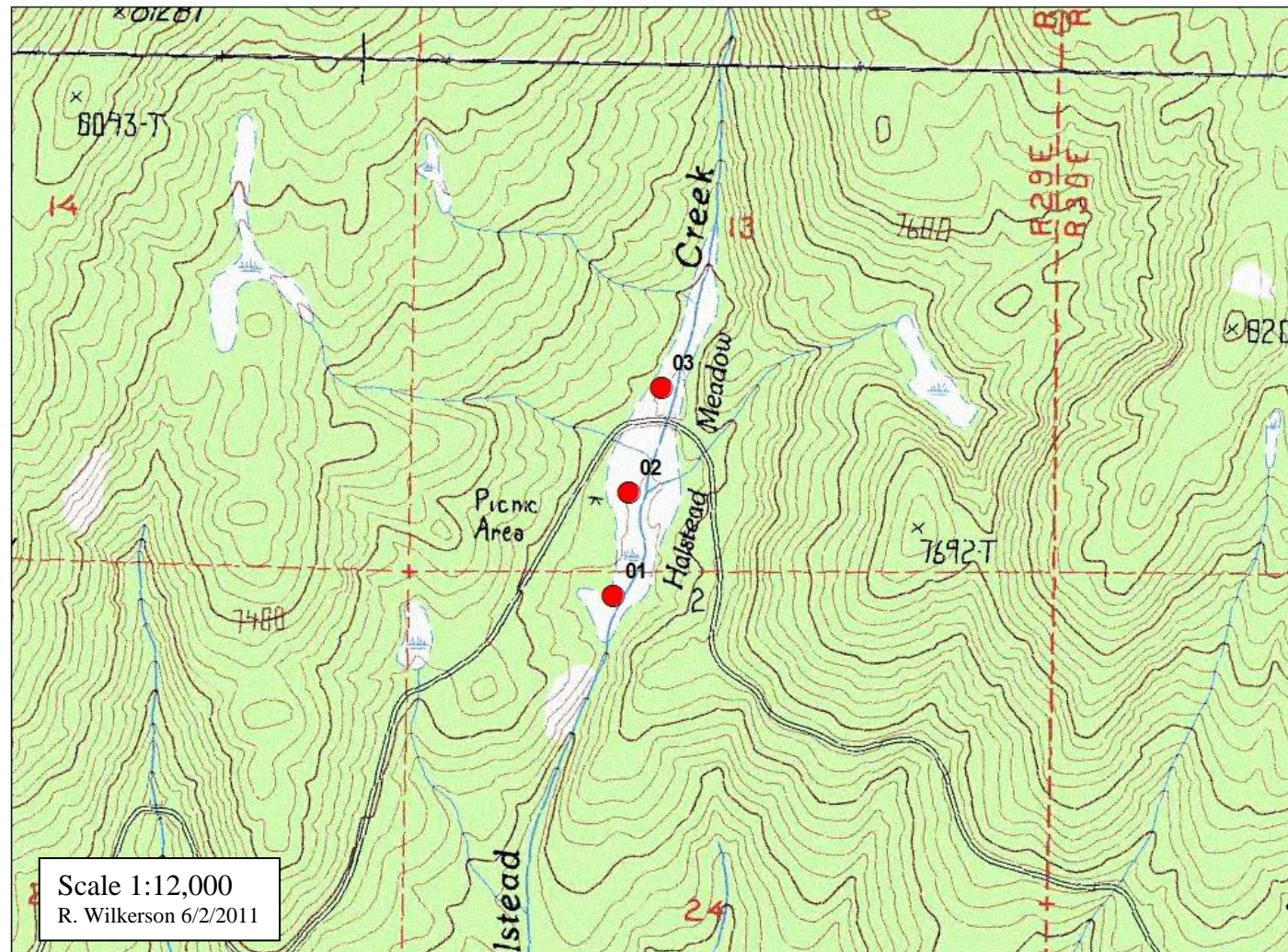
Map B-2. Lower Soquel Meadow



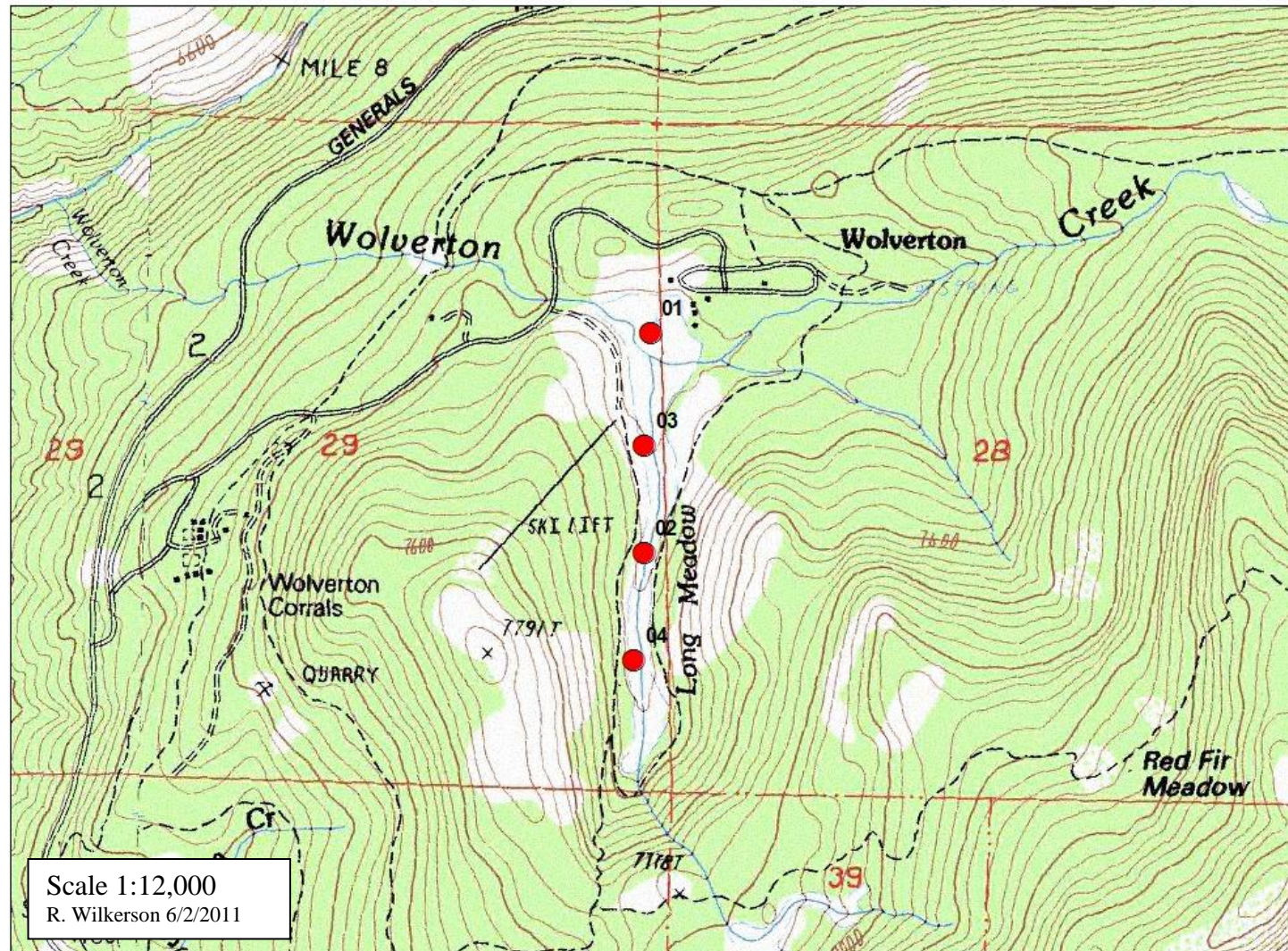
Map B-3. Long Meadow – Globe Rock and Muglers Meadow



Map B-4. Lower Halstead Meadow



Map B-5. Long Meadow – Wolverton Creek



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

Table C-1. Number of birds detected during point counts at Long Meadow – Chiquito Campground and Lower Sequel Meadow.

Species ^e	Long Meadow – Chiquito Campground (n = 2 survey stations)				Lower Sequel Meadow (n = 4 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	0.50	0.00	0.13
California Quail	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.25
Anna's Hummingbird	0.00	1.00	0.00	0.50	0.00	0.00	0.00	0.00
Downy Woodpecker	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.13
White-headed Woodpecker	0.00	1.00	0.00	0.50	1.00	1.50	0.25	0.38
Northern Flicker	0.00	1.00	0.00	0.50	0.00	0.00	0.00	0.00
Olive-sided Flycatcher	0.00	1.00	0.00	0.50	0.00	0.00	0.00	0.00
Western Wood-Pewee	0.00	4.00	0.00	2.00	0.00	0.50	0.00	0.13
Dusky Flycatcher	0.00	2.00	0.00	1.00	0.50	2.50	0.13	0.63
Pacific-slope Flycatcher	0.00	2.00	0.00	1.00	0.50	1.00	0.13	0.25
Unidentified <i>Empidonax</i> Flycatcher	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.13
Cassin's Vireo	1.00	3.00	0.50	1.50	0.00	0.50	0.00	0.13
Warbling Vireo	0.00	5.00	0.00	2.50	0.00	1.50	0.00	0.38
Steller's Jay	0.00	3.00	0.00	1.50	0.50	2.50	0.13	0.63
Common Raven	0.00	2.00	0.00	1.00	0.00	0.00	0.00	0.00
Mountain Chickadee	0.00	0.00	0.00	0.00	0.00	1.50	0.00	0.38
Red-breasted Nuthatch	0.00	2.00	0.00	1.00	0.00	2.00	0.00	0.50
Brown Creeper	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.25
House Wren	0.00	1.00	0.00	0.50	0.00	0.00	0.00	0.00
Golden-crowned Kinglet	0.00	3.00	0.00	1.50	0.50	5.00	0.13	1.25
Hermit Thrush	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.25
American Robin	1.00	2.00	0.50	1.00	0.50	2.00	0.13	0.50
Yellow Warbler	0.00	1.00	0.00	0.50	0.50	2.00	0.13	0.50
Yellow-rumped Warbler	0.00	1.00	0.00	0.50	1.00	3.50	0.25	0.88

Species ^e	Long Meadow – Chiquito Campground (n = 2 survey stations)				Lower Soquel Meadow (n = 4 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
Hermit Warbler	0.00	1.00	0.00	0.50	0.00	2.00	0.00	0.50
MacGillivray's Warbler	0.00	4.00	0.00	2.00	0.00	2.00	0.00	0.50
Unidentified Warbler	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.13
Western Tanager	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.25
Green-tailed Towhee	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.13
Spotted Towhee	0.00	0.00	0.00	0.00	1.00	2.00	0.25	0.50
Chipping Sparrow	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.25
Fox Sparrow	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.75
Song Sparrow	0.00	6.00	0.00	3.00	2.00	3.50	0.50	0.88
Lincoln's Sparrow	0.00	3.00	0.00	1.50	0.00	0.00	0.00	0.00
Dark-eyed Junco	1.00	5.00	0.50	2.50	3.00	6.50	0.75	1.63
Red-winged Blackbird	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.13
Brewer's Blackbird	0.00	1.00	0.00	0.50	0.00	0.50	0.00	0.13
Brown-headed Cowbird	0.00	0.00	0.00	0.00	0.50	1.00	0.13	0.25
Purple Finch	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.13
Cassin's Finch	0.00	1.00	0.00	0.50	0.00	0.00	0.00	0.00
Pine Siskin	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.13
Lesser Goldfinch	0.00	1.00	0.00	0.50	0.00	0.00	0.00	0.00
Evening Grosbeak	0.00	2.00	0.00	1.00	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 indicated in bold text.

Table C-2. Number of birds detected during point counts at Long Meadow – Globe Rock and Upper Muglers Meadow.

Species ^e	Long Meadow – Globe Rock (n = 3 survey stations)				Upper Muglers Meadow (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	0.00	0.00	0.00	0.00	1.50	0.00	0.50
Red-breasted Sapsucker	0.50	1.00	0.17	0.33	0.50	0.50	0.17	0.17
White-headed Woodpecker	0.00	1.00	0.00	0.33	0.00	0.00	0.00	0.00
Northern Flicker	0.00	1.00	0.00	0.33	0.00	0.00	0.00	0.00
Unidentified Woodpecker	0.50	0.50	0.17	0.17	0.50	1.00	0.17	0.33
Olive-sided Flycatcher	0.00	0.00	0.00	0.00	0.00	1.50	0.00	0.50
Western Wood-Pewee	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.17
Pacific-slope Flycatcher	1.00	2.00	0.33	0.67	0.00	0.00	0.00	0.00
Cassin's Vireo	0.00	0.00	0.00	0.00	0.50	0.50	0.17	0.17
Warbling Vireo	0.00	0.00	0.00	0.00	1.00	3.00	0.33	1.00
Steller's Jay	0.00	0.00	0.00	0.00	1.50	6.50	0.50	2.17
Common Raven	0.00	1.00	0.00	0.33	0.00	0.00	0.00	0.00
Mountain Chickadee	0.00	2.00	0.00	0.67	1.00	4.50	0.33	1.50
Red-breasted Nuthatch	0.00	3.00	0.00	1.00	0.00	3.00	0.00	1.00
White-breasted Nuthatch	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.33
Brown Creeper	0.50	0.50	0.17	0.17	0.50	1.00	0.17	0.33
Golden-crowned Kinglet	1.00	3.50	0.33	1.17	1.50	4.00	0.50	1.33
Townsend's Solitaire	0.00	0.50	0.00	0.17	0.00	0.00	0.00	0.00
Swainson's Thrush	0.00	1.50	0.00	0.50	0.00	0.00	0.00	0.00
Hermit Thrush	0.00	1.00	0.00	0.33	0.00	0.00	0.00	0.00
American Robin	1.00	2.00	0.33	0.67	1.00	1.50	0.33	0.50
Nashville Warbler	0.00	0.50	0.00	0.17	0.50	1.00	0.17	0.33
Yellow Warbler	0.00	0.50	0.00	0.17	0.00	0.50	0.00	0.17
Yellow-rumped Warbler	0.50	1.00	0.17	0.33	1.00	2.50	0.33	0.83
Hermit Warbler	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.17
MacGillivray's Warbler	0.00	1.00	0.00	0.33	0.00	1.00	0.00	0.33

<i>Species^e</i>	<i>Long Meadow – Globe Rock (n = 3 survey stations)</i>				<i>Upper Muglers Meadow (n = 3 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>
Western Tanager	0.00	1.00	0.00	0.33	0.00	0.50	0.00	0.17
Green-tailed Towhee	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.17
Chipping Sparrow	0.00	0.00	0.00	0.00	0.50	0.50	0.17	0.17
Fox Sparrow	0.50	1.50	0.17	0.50	0.00	2.50	0.00	0.83
Lincoln's Sparrow	0.00	1.50	0.00	0.50	0.50	1.00	0.17	0.33
Dark-eyed Junco	0.00	4.00	0.00	1.33	2.50	5.50	0.83	1.83
Unidentified Species	0.00	1.00	0.00	0.33	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 indicated in bold text.

Table C-3. Number of birds detected during point counts at Lower Halstead Meadow and Long Meadow-Wolverton Creek.

Species ^e	Lower Halstead Meadow (n = 3 survey stations)				Long Meadow – Wolverton Creek (n = 4 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	0.33	0.00	1.00	0.00	0.25
Red-breasted Sapsucker	0.00	0.00	0.00	0.00	0.50	0.50	0.13	0.13
White-headed Woodpecker	0.00	1.00	0.00	0.33	0.00	0.50	0.00	0.13
Northern Flicker	0.00	0.50	0.00	0.17	0.00	2.00	0.00	0.50
Olive-sided Flycatcher	0.00	0.50	0.00	0.17	0.00	0.00	0.00	0.00
Western Wood-Pewee	0.00	0.50	0.00	0.17	0.00	0.00	0.00	0.00
Dusky Flycatcher	0.00	0.00	0.00	0.00	0.50	3.00	0.13	0.75
Warbling Vireo	0.00	0.50	0.00	0.17	0.00	4.00	0.00	1.00
Steller's Jay	0.00	2.50	0.00	0.83	0.00	5.00	0.00	1.25
Common Raven	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.25
Mountain Chickadee	0.00	1.50	0.00	0.50	0.50	6.50	0.13	1.63
Red-breasted Nuthatch	0.00	2.50	0.00	0.83	0.00	3.00	0.00	0.75
Brown Creeper	0.00	1.00	0.00	0.33	0.00	0.50	0.00	0.13
Golden-crowned Kinglet	0.00	4.50	0.00	1.50	0.00	2.00	0.00	0.50
Townsend's Solitaire	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.13
Hermit Thrush	0.00	1.50	0.00	0.50	0.00	3.00	0.00	0.75
American Robin	0.00	5.50	0.00	1.83	0.50	3.50	0.13	0.88
Nashville Warbler	0.00	1.00	0.00	0.33	0.00	0.00	0.00	0.00
Yellow-rumped Warbler	1.00	4.50	0.33	1.50	0.00	0.50	0.00	0.13
MacGillivray's Warbler	0.00	2.00	0.00	0.67	1.00	4.50	0.25	1.13
Western Tanager	0.00	1.00	0.00	0.33	0.50	0.50	0.13	0.13
Green-tailed Towhee	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.13
Chipping Sparrow	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.13
Fox Sparrow	1.00	4.00	0.33	1.33	0.00	0.00	0.00	0.00
Song Sparrow	1.00	2.50	0.33	0.83	0.00	0.50	0.00	0.13
Lincoln's Sparrow	2.50	6.00	0.83	2.00	4.00	9.00	1.00	2.25
Dark-eyed Junco	1.00	3.50	0.33	1.17	1.50	3.00	0.38	0.75

Species^e	Lower Halstead Meadow (n = 3 survey stations)				Long Meadow – Wolverton Creek (n = 4 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
Brewer's Blackbird	0.00	0.00	0.00	0.00	7.50	8.50	1.88	2.13

^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 indicated 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 Long Meadow-Chiquito Campground (9 ac./3 ha).

<i>Species^a</i>	<i>Avg. No. Of Birds Detected</i>		
	<i>Meadow</i>	<i>Upland</i>	<i>Total</i>
White-headed Woodpecker	1.0	0.0	1.0
Western Wood-Pewee	0.0	3.0	3.0
Pacific-slope Flycatcher	0.0	2.0	2.0
Cassin's Vireo	0.0	2.0	2.0
Warbling Vireo	0.0	3.0	3.0
Steller's Jay	0.0	4.0	4.0
Mountain Chickadee	0.0	1.0	1.0
Brown Creeper	0.0	1.0	1.0
Golden-crowned Kinglet	0.0	1.0	1.0
American Robin	0.0	1.0	1.0
Yellow-rumped Warbler	0.0	1.0	1.0
Hermit Warbler	0.0	1.0	1.0
Song Sparrow	2.0	1.0	3.0
Lincoln's Sparrow	2.0	1.0	3.0
Dark-eyed Junco	2.0	1.0	3.0
Brown-headed Cowbird	0.0	1.0	1.0
Cassin's Finch	0.0	2.0	2.0

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

Table D-2 Average number of birds detected during area searches at Lower Sequel Meadow (17 ac./7 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	2.0	2.0
California Quail	0.0	3.0	3.0
Downy Woodpecker	0.0	1.0	1.0
White-headed Woodpecker	0.0	1.0	1.0
Pileated Woodpecker	0.0	1.0	1.0
Hammond's Flycatcher	0.0	2.0	2.0
Dusky Flycatcher	2.0	1.0	3.0
Pacific-slope Flycatcher	0.0	2.0	2.0
Cassin's Vireo	0.0	1.0	1.0
Warbling Vireo	0.0	3.0	3.0
Steller's Jay	0.5	4.5	5.0
Mountain Chickadee	0.5	1.5	2.0
Red-breasted Nuthatch	0.0	4.5	4.5
Golden-crowned Kinglet	0.5	9.0	9.5
Hermit Thrush	0.0	5.0	5.0
American Robin	2.0	2.0	4.0
Yellow Warbler	1.0	3.0	4.0
Yellow-rumped Warbler	1.0	3.5	4.5
Hermit Warbler	0.0	7.0	7.0

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

Table D-3 Average number of birds detected during area searches at Long Meadow – Globe Rock (6 ac./2 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
White-headed Woodpecker	0.0	2.0	2.0
Northern Flicker	0.0	1.0	1.0
Hammond's Flycatcher	0.0	4.0	4.0
Dusky Flycatcher	1.0	1.0	2.0
Common Raven	1.0	0.0	1.0
Mountain Chickadee	0.0	3.5	3.5
Red-breasted Nuthatch	0.0	4.0	4.0
Golden-crowned Kinglet	0.0	5.5	5.5
Swainson's Thrush	0.0	4.5	4.5
Hermit Thrush	0.0	1.0	1.0
American Robin	1.0	2.0	3.0
Nashville Warbler	0.0	4.0	4.0
Yellow-rumped Warbler	0.0	4.0	4.0
MacGillivray's Warbler	0.0	1.0	1.0
Western Tanager	0.0	1.0	1.0
Fox Sparrow	0.0	1.5	1.5
Lincoln's Sparrow	2.0	0.5	2.5
Dark-eyed Junco	0.5	6.5	7.0

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

Table D-4 Average number of birds detected during area searches at Upper Muglers Meadow (8 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	3.0	3.0
White-headed Woodpecker	0.0	2.0	2.0
Olive-sided Flycatcher	0.0	1.5	1.5
Western Wood-Pewee	0.0	1.5	1.5
Cassin's Vireo	0.0	2.0	2.0
Warbling Vireo	1.5	4.5	6.0
Steller's Jay	0.5	8.0	8.5
Mountain Chickadee	0.5	6.5	7.0
Red-breasted Nuthatch	0.0	2.5	2.5
White-breasted Nuthatch	0.0	2.0	2.0
Brown Creeper	0.0	1.5	1.5
Golden-crowned Kinglet	0.0	5.0	5.0
Hermit Thrush	0.0	1.0	1.0
American Robin	0.0	2.0	2.0
Nashville Warbler	0.0	2.0	2.0
Yellow-rumped Warbler	1.0	2.0	3.0
MacGillivray's Warbler	0.0	3.0	3.0
Green-tailed Towhee	0.0	1.0	1.0
Chipping Sparrow	1.0	1.0	2.0
Fox Sparrow	0.5	3.5	4.0
Lincoln's Sparrow	0.5	1.0	1.5
Dark-eyed Junco	2.0	5.0	7.0

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

Table D-5 Average number of birds detected during area searches at Lower Halstead Meadow (31 ac./13 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	3.0	3.0
Unidentified Woodpecker	0.0	1.0	1.0
Western Wood-Pewee	0.0	2.0	2.0
Steller's Jay	0.5	3.5	4.0
Mountain Chickadee	0.0	5.0	5.0
Red-breasted Nuthatch	0.0	4.0	4.0
Brown Creeper	0.0	2.0	2.0
Golden-crowned Kinglet	0.0	6.0	6.0
Townsend's Solitaire	0.0	1.0	1.0
Hermit Thrush	0.0	3.0	3.0
American Robin	5.5	7.0	12.5
Nashville Warbler	0.0	2.0	2.0
Yellow-rumped Warbler	1.0	4.5	5.5
MacGillivray's Warbler	0.0	3.0	3.0
Western Tanager	2.0	2.0	4.0
Fox Sparrow	5.0	2.0	7.0
Song Sparrow	2.0	0.0	2.0
Lincoln's Sparrow	11.5	0.5	12.0
Dark-eyed Junco	2.5	5.5	8.0
Brewer's Blackbird	2.0	0.0	2.0

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

Table D-6 Average number of birds detected during area searches at Long Meadow – Wolverton Creek (47 ac./19 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	2.0	2.0
White-headed Woodpecker	0.0	2.0	2.0
Northern Flicker	0.0	1.0	1.0
Pileated Woodpecker	0.0	1.0	1.0
Western Wood-Pewee	0.0	1.0	1.0
Dusky Flycatcher	3.0	6.0	9.0
Warbling Vireo	6.0	5.0	11.0
Steller's Jay	0.0	10.0	10.0
Common Raven	0.0	3.0	3.0
Mountain Chickadee	1.0	12.0	13.0
Red-breasted Nuthatch	0.0	7.0	7.0
White-breasted Nuthatch	0.0	2.0	2.0
Golden-crowned Kinglet	0.0	9.0	9.0
Hermit Thrush	0.0	8.0	8.0
American Robin	6.0	4.0	10.0
Nashville Warbler	0.0	2.0	2.0
Yellow-rumped Warbler	0.0	1.0	1.0
MacGillivray's Warbler	2.0	11.0	13.0
Western Tanager	0.0	2.0	2.0
Green-tailed Towhee	0.0	3.0	3.0
Chipping Sparrow	1.0	0.0	1.0
Fox Sparrow	0.0	3.0	3.0
Song Sparrow	0.0	2.0	2.0
Lincoln's Sparrow	16.0	4.0	20.0
Dark-eyed Junco	0.0	8.0	8.0
Brewer's Blackbird	28.0	2.0	30.0
Brown-headed Cowbird	1.0	0.0	1.0
Evening Grosbeak	0.0	2.0	2.0

^aMeadow-associated focal species are indicated 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>Long Meadow- Chiquito Campground</i>	<i>Lower Soquel Meadow</i>	<i>Long Meadow - Globe Rock</i>	<i>Upper Muglers Meadow</i>	<i>Lower Halstead Meadow</i>	<i>Long Meadow - Wolverton Creek</i>
Mountain Quail	6	X	X	X	X	X	X
California Quail	1		X				
Anna's Hummingbird	1	X					
Red-breasted Sapsucker	3			X	X		X
Downy Woodpecker	1		X				
White-headed Woodpecker	6	X	X	X	X	X	X
Northern Flicker	4	X		X		X	X
Pileated Woodpecker	2		X				X
Unidentified Woodpecker	3			X	X	X	
Olive-sided Flycatcher	3	X			X	X	
Western Wood-Pewee	5	X	X		X	X	X
Hammond's Flycatcher	2		X	X			
Dusky Flycatcher	4	X	X	X			X
Pacific-slope Flycatcher	3	X	X	X			
Unidentified <i>Empidonax</i> Flycatcher	1		X				
Cassin's Vireo	3	X	X		X		
Warbling Vireo	5	X	X		X	X	X
Steller's Jay	5	X	X		X	X	X
Common Raven	3	X		X			X
Mountain Chickadee	6	X	X	X	X	X	X
Red-breasted Nuthatch	6	X	X	X	X	X	X
White-breasted Nuthatch	2				X		X
Brown Creeper	6	X	X	X	X	X	X
House Wren	1	X					
Golden-crowned Kinglet	6	X	X	X	X	X	X
Townsend's Solitaire	3			X		X	X
Swainson's Thrush	1			X			
Hermit Thrush	5		X	X	X	X	X
American Robin	6	X	X	X	X	X	X
Nashville Warbler	4			X	X	X	X
Yellow Warbler	4	X	X	X	X		
Yellow-rumped Warbler	6	X	X	X	X	X	X
Hermit Warbler	3	X	X		X		
MacGillivray's Warbler	6	X	X	X	X	X	X

<i>Species^a</i>	<i>No. of Meadows with Detections</i>	<i>Long Meadow- Chiquito Campground</i>	<i>Lower Soquel Meadow</i>	<i>Long Meadow - Globe Rock</i>	<i>Upper Muglers Meadow</i>	<i>Lower Halstead Meadow</i>	<i>Long Meadow - Wolverton Creek</i>
Unidentified Warbler	1		X				
Western Tanager	5		X	X	X	X	X
Green-tailed Towhee	3		X		X		X
Spotted Towhee	1		X				
Chipping Sparrow	3		X		X		X
Fox Sparrow	5		X	X	X	X	X
Song Sparrow	4	X	X			X	X
Lincoln's Sparrow	5	X		X	X	X	X
Dark-eyed Junco	6	X	X	X	X	X	X
Red-winged Blackbird	1		X				
Brewer's Blackbird	4	X	X			X	X
Brown-headed Cowbird	3	X	X				X
Purple Finch	1		X				
Cassin's Finch	1	X					
Pine Siskin	1		X				
Lesser Goldfinch	1	X					
Evening Grosbeak	2	X					X

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