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Sierra Nevada Bird Observatory

**ASSESSING WILLOW FLYCATCHER POPULATION SIZE AND DISTRIBUTION TO
INFORM MEADOW RESTORATION PRIORITIES IN THE SIERRA NEVADA AND
SOUTHERN CASCADES**

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Above: Willow Flycatcher (inset) and breeding habitat at Red Lake Peak, Alpine County.

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Table of Contents

Executive Summary	1
Introduction.....	1
Methods.....	2
Data collation	2
Meadow mapping.....	4
Site history and population trend	5
Management and restoration prioritization.....	6
Habitat description and territory density	6
Results.....	7
Data collation	7
Meadow mapping.....	7
Site history and population trend	7
Management and restoration prioritization.....	12
Habitat description and territory density	15
Discussion	16
Data collation	16
Meadow mapping.....	16
Site history and population trend	16
Management and restoration prioritization.....	17
Habitat description and territory density	24
Literature cited	22
Appendix A: First and last site visit and positive detections by site	27
Appendix B: Willow Flycatcher presence/absence by year and site.	39
Appendix C: Maps of 12-km buffer around Willow Flycatcher sites	48

EXECUTIVE SUMMARY

Many reports and peer reviewed papers have documented significant declines in Willow Flycatchers across the greater Sierra Nevada within the last 30 years and more than ten years have passed since state and federal survey efforts have been collated to provide a current picture of the distribution and population size of Willow Flycatcher in the Sierra Nevada and southern Cascades. We partnered with the US Forest Service (USFS) and the California Department of Fish and Wildlife (CDFW) to bring together recent survey results from state and federal agencies and other groups, and provide an updated range map and population estimate for Willow Flycatcher in the region. We estimate 93 meadow and riparian systems may currently support Willow Flycatchers. Most extirpations have occurred south of Lake Tahoe and we estimate a 50% decline in the number of breeding sites in the last 30 years. Important management recommendations include restoring currently occupied meadows and large meadows within a 12 km dispersal distance from occupied meadows, and creating an inter-agency data repository to allow for easier and more accurate tracking of trends for Sierra Nevada Willow Flycatcher populations.

INTRODUCTION

Willow Flycatchers are an excellent target species for prioritizing meadow restoration efforts across the greater Sierra Nevada and southern Cascades of California because, although many bird species are associated with meadows, no other Sierra bird species is so exclusively dependent on both saturated meadow conditions and an extensive shrub component. One or both of these habitat components is frequently lost when meadows are degraded by human activities. Willow Flycatcher colonization of a restoration site may be the ultimate measure of success. Willow Flycatcher migration patterns and breeding-site fidelity also make them well suited for focusing restoration effort. Although Willow Flycatchers often show high site fidelity for multiple years, they are also known to move from one meadow to another between or within years (Sedgwick 2000, Sedgwick 2004, Paxton et al. 2007, Mathewson 2010). Long-term studies have also shown that the species will sometimes reoccupy a site that has been vacant for many years (Mathewson 2010). In addition, juvenile Willow Flycatchers are known to “prospect” for future breeding sites prior to their first migration and visit meadows where they are not (yet) actually breeding during migration in late summer and early fall (Paxton et al. 2007, Mathewson 2010, Vormwald et al. 2011, Siegel et al. 2008). These behaviors make it possible for Willow Flycatchers to colonize or recolonize meadows where hydrologic conditions and riparian shrub communities are improved through meadow restoration or changes in meadow management.

The chances of successful colonization or re-colonization of a restored meadow by Willow Flycatchers depends on many factors. Assuming that restored meadows are capable of supporting abundant willow and standing water, the most important factor in successfully attracting Willow Flycatchers is likely the proximity of the restored meadow to another meadow that is currently occupied by the species. Recent analysis of marked birds indicates that the average distance Willow Flycatchers in the Sierra Nevada disperse between their natal site and the first site where they breed as adults is 8 km (sd = 4km), with 76% of dispersal events occurring within 10 km (Mathewson 2010, Mathewson et al. 2012). Therefore, when restoration efforts are applied at sites within 12 km (mean plus one standard deviation) of an occupied

meadow, the likelihood of successful colonization is highest (assuming that the population is producing adequate numbers of young to colonize new locations, and that the restoration project creates conditions preferred by the species).

In addition to proximity to occupied sites, meadow size is another important factor influencing colonization by Willow Flycatchers. Although Willow Flycatchers are known to breed in meadows <10 ha in size, the majority of birds are found in large meadows >100 ha (or clusters of meadows encompassing >100 ha) (Green et al 2003). Large meadows provide land managers the opportunity to create or restore habitat extensive enough for multiple territories, increasing the likelihood of consistent use as a breeding site over time (Green et al 2003, Mathewson et al. 2012). In addition, newly restored meadows that are relatively large may be more likely than smaller sites to be detected by migrating Willow Flycatchers.

Many reports and peer reviewed papers have documented significant declines in Willow Flycatchers across the greater Sierra Nevada within the last 30 years (Harris et al. 1987, Green et al. 2003, Siegel et al 2008, Mathewson et al. 2012). Recently, Mathewson et al. (2013) documented a 19% annual decline in the area including Lake Tahoe and the adjacent West Carson River to the south, a 6% annual decline in the area centered on the Little Truckee River and non significant decline in the Lassen area, based on 14 years of demographic monitoring. Siegel et al. (2008) found no breeding Willow Flycatchers in Yosemite National Park during two consecutive years of surveying virtually all potential habitat in the park. Mathewson et al. (2013) and Siegel et al. (2008), as well as the Sierra Nevada Forest Plan Amendment (Stefani et al. 2001) and other internal agency documents, have observed that the species' range appears to be contracting northward within the Sierra Nevada and southern Cascade region.

More than ten years have passed since state and federal survey efforts have been collated to provide a current picture of the distribution and population size of Willow Flycatcher in the Sierra Nevada and southern Cascades. Our first objective was to collate recent survey results to provide an updated population estimate for Willow Flycatcher in the region. By updating the population estimate we provided the National Fish and Wildlife Foundation's Sierra Meadows Group critical baseline data needed to measure the success of restoration efforts for this meadow-obligate species. Thoughtful prioritization efforts will help ensure that restoration intended to help Willow Flycatchers is as effective as possible. As such, our second objective was to use this updated information along with existing work on the species dispersal distances in the Sierra Nevada to identify areas where meadow restoration efforts are most likely result in Willow Flycatcher colonization. Additionally, by reporting recent population trends and identifying information gaps we hope to stimulate additional Willow Flycatcher surveys, monitoring, research, and conservation activities in the region.

METHODS

Data collation

To determine current status and range of Willow Flycatchers in the Sierra Nevada and southern Cascade region, we contacted numerous entities across California to collect and integrate location data currently held in separate databases, spreadsheets, reports, etc. Ultimately we

integrated data from 12 distinct data sources in addition to numerous references from literature and personal communications. Three important sources of data from across the region of interest were the USDA Forest Service's NRIS database, the California Department of Fish and Wildlife CNDDDB database, and The Institute for Bird Populations' (IBP) Monitoring Avian Productivity and Survivorship (MAPS) database (DeSante et al. 2013). Chris Stermer (Staff Environmental Scientist, CDFW) also provided region-wide GIS location data from Willow Flycatcher surveys during 2003 and 2004, and from localized survey and monitoring efforts along the McCloud River in 2005 and 2006. We also used territory and nest location data for all sites monitored during demographic monitoring efforts funded by the USFS between 1997 and 2010 (Mathewson et al. 2012). We incorporated original records and GIS location data from the 2001 USDA Forest Service's Sierra Nevada Framework plan amendment mapping and analysis for Willow Flycatcher (Stefani et al. 2001, unpublished data). Additional data came from Point Blue's region wide Sierra Nevada Management Indicator Species monitoring project and intensive meadow and riparian monitoring on the Lassen and Plumas National Forests (<http://data.prbo.org/apps/snamin/>, Burnett and Fogg, 2011, Burnett unpublished data). In addition to the long-term MAPs data set, we used IBP data from monitoring efforts in 2010 and 2012 that were funded by NFWF (Loffland et al. 2011a-2011g, Loffland et al 2013), and Willow Flycatcher survey results from extensive efforts in Yosemite National Park in 2007 and 2008 (Siegel et al, 2008). Tina Mark (Forest Biologist, Tahoe National Forest) shared spreadsheets in which she summarized site history for all known Willow Flycatcher locations throughout the region (including years with negative results) that she prepared in 2011 after consulting with biologists on all National Forests across the Sierra Nevada.

All data was imported into a single Microsoft Access database with an "Observation" table to include all observations, both positive and negative. We included all critical data that could be gathered across data sources including:

- Unique Observation record ID
- Year
- Date (month/day/year)
- Julian date
- Number of Willow Flycatchers detected
- Willow Flycatcher presence/absence (1/0)
- Longitude location coordinate (in UTM's; GCS 1983)
- Latitude location coordinate (in UTM's; GCS 1983)
- Comments
- Location description
- Original data source
- Original unique ID
- Original ID field name

We then created additional tables for each of the 12 original data sources. Each of these tables maintained the structure and data that was provided to us. Using the original unique Observation ID we linked each source table to the master "Observation" table (described above).

Meadow mapping

Due to variation in spatial scale of data reporting across sources, it was necessary for us to generate a GIS polygon layer that included all meadows or riparian areas with positive detections of Willow Flycatchers from any of our data sources. From this layer we could then link all positive detections to a specific meadow or riparian area in both the GIS and Access database applications. To create the meadow polygon layer we projected location data for positive detections into the same geographic projection and overlaid this point data with the NRIS “wildlife sites” polygon layer, the UC Davis Sierra Meadows Clearinghouse meadow GIS polygon data (Fryjoff-Hung & Viers 2012, <http://meadows.ucdavis.edu>), IBP’s meadow polygon data (Loffland et al 2013, <http://birdpop.net/index.php/en/map-of-sites>), and the Willow Flycatcher Demographic Study meadow polygon layer (Mathewson et al 2013, Loffland unpublished data).

We compared these varied meadow mapping efforts with the detection locations (and associated site descriptions), topographic data layers, and 2012 aerial photographic imagery available through ArcMap 10.1 from the NAIP program. With the exception of sites already mapped during the Willow Flycatcher Demographic Study (Mathewson et al. 2012), all remaining meadows with positive detections required refined polygon mapping based primarily on photographic imagery to account for both the open herbaceous meadow habitat and the riparian shrub habitat utilized by this species. The UC Davis Sierra Nevada Meadows Clearinghouse

geospatial mapping layer (UCD Sierra Meadow layer; Fryjoff-Hung & Viers, 2012, <http://meadows.ucdavis.edu>) often did not include large patches of riparian shrub or areas of marsh as part of meadow polygons, and NRIS *wildlife sites* were frequently mapped using the low resolution black and white imagery available during the Sierra Nevada Framework mapping exercise in 2000, or accounted for only gross survey area boundaries. At this time we have limited our analysis and mapping to meadows and riparian areas with positive detections that occur within the Sierra Nevada and Cascade ranges in California and western Nevada (and neighboring foothills)(Figure 1).

When mapping meadow and riparian polygons we attempted to use natural vegetation or geographic boundaries and ignored ownership boundaries, however when a portion of a meadow had clearly been converted to developed space, row

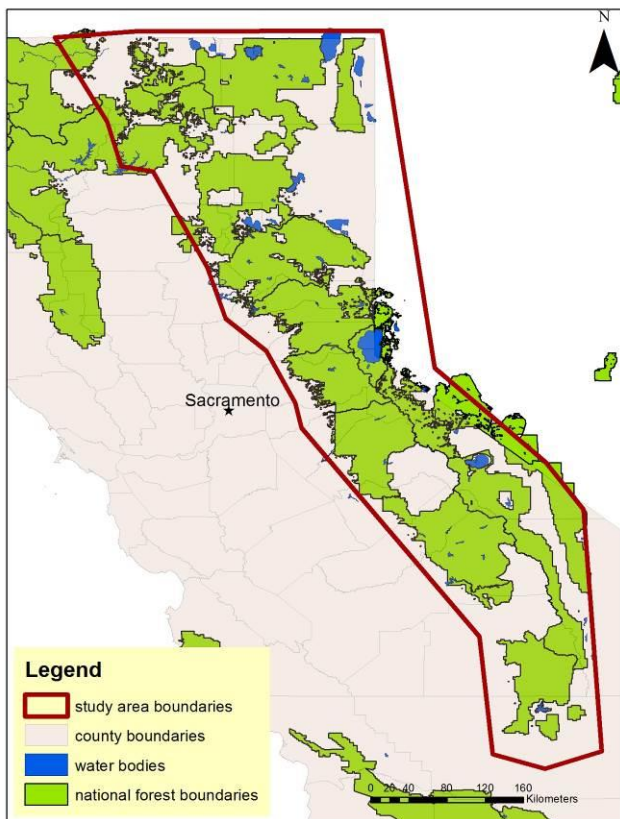


Figure 1. Sierra Nevada and southern Cascades study area

crops, etc, this area was not included in the mapped area. In general we tried to include entire meadows, not simply the portion with a shrub component, even if Willow Flycatchers were only likely to inhabit a small portion of the meadow.

Once meadow polygon mapping was complete, we reviewed location data to determine if any positive detections occurred more than 250 m outside of mapped meadows or riparian areas, and then determined if the discrepancy was a mapping error, projection error, or represented a new location. Adjustments were then made to either meadow polygon boundaries or location coordinates or a new meadow polygon was created. If the discrepancy could not be reasonably explained and incorrect coordinates were apparently reported, the location was eliminated from further investigation.

Each meadow or riparian polygon with any Willow Flycatcher detection data was given a unique 7 digit code. The first 4 digits denote the site name and the last 3 denote the ownership. Site names were based on names assigned by original data sources, or from topographic mapping features and ownership was designated based on original data sources or from the Administrative Boundary and Basic Ownership GIS layers available from the USDA Forest Service GIS clearinghouse (<http://www.fs.usda.gov/main/r5/landmanagement/gis>). Once all meadows with positive detections were identified and coded, a meadow table was created in the Access database that included: unique site code, area and perimeter, longitude and latitude of the polygon centroid, a descriptive place name, and a comments field. Each positive detection in the observation table was then linked to the meadow table by importing the appropriate unique site identification code ("site_code") into the observation table to allow analysis and mapping across datasets and years.

Site history and population trend

We used Willow Flycatcher presence/absence data from all positive and negative observations to generate site histories. It would have been preferable to document change in numbers of territories at sites over time, rather than merely presence/absence over time, but limitations of the dataset made this impossible. The existing data allowed us to determine the first and last years that survey visits were reported for each site and also the year during which the last detection (any date) and last breeding-season detection (June 15 – August 1) were reported (Appendix A).

We examined whether the available data corroborated the conjectured pattern of northward range contraction and possibly extirpation from southern Sierra meadows reported in Mathewson et al (2013). We calculated the year of the last breeding season detection for every site and then conducted a linear regression of year of last detection at each meadow versus latitude of each meadow, to determine whether increased time since last detection might be a function of latitude. Although we have a number of historic records of nests and breeding locations from the early 1900's, no standardized and consistent effort to record Willow Flycatchers occurred prior to the 1980s. For that reason we limited our regression to observation histories since 1980.

We also generated a matrix of Willow Flycatcher presence or absence during the breeding season (June 15 through July 31) for all meadows across all years that were known to have been surveyed since 1980. We then visually inspected this dataset for consistent patterns of occurrence

relative to survey effort (Appendix B). We used this matrix along with observation-specific comments to generate a map of meadow sites that are known or presumed to be currently supporting breeding Willow Flycatchers, as opposed to merely hosting non-breeding floaters or migrants. Specifically we examined the “recent breeding season detections” and then eliminated sites where multiple negative surveys have occurred in the last few years, or where subsequent demographic or other monitoring efforts provided additional data suggesting that the site is no longer occupied by breeding Willow Flycatchers.

Management and restoration prioritization

A primary objective of this effort was to map sites with recent positive detections and make recommendations for targeting management and restoration efforts to areas either already occupied by, or those most likely to be colonized by, Willow Flycatchers. Mathewson et al. (2012) documented a mean dispersal distance of 8 km (sd = 4 km) for Willow Flycatchers in the Truckee and Lassen region. We applied this knowledge of dispersal behavior with geographic data and recent detection history to identify areas most likely to be colonized or re-colonized by Willow Flycatchers after restoration or management changes that result in increased habitat quantity or quality. We classified sites with Willow Flycatcher detections into three groups: those with any positive detection on any date in any year, those with positive detections during the breeding season (June 15 through July 31), and those with recent (2000 or later) positive detections during the breeding season. We mapped 12-km (mean dispersal distance plus one standard deviation) buffers around the meadows in each of these groups to create a tool for prioritizing potential restoration projects with regard to their likelihood of recruiting breeding Willow Flycatchers. We also intersected these buffers with the UCD Sierra Meadow layer and calculated the number and area of all meadows, and of meadows > 50 acres (20.2 ha) that occurred within them.

Habitat description and territory densities

To better quantify Willow Flycatcher habitat for use in restoration or management prescriptions we summarized total meadow area, total riparian shrub area and surface water area found in meadows and territories used by Willow Flycatchers in recent years. We calculated Willow Flycatcher territory density and mean habitat characteristics from mean annual territory numbers at 26 meadows monitored between 1997 and 2010 in the vicinity of Lassen NF, Tahoe NF, Lake Tahoe Basin MU, and Toiyabe NF (Bombay 1999, Bombay et al. 2001a, 2001b) and summarized total shrub acreage and meadow size calculated using digital imagery in ArcMap 10.1 (ESRI 2011). We then compared the extent of these three habitat variables against average territory numbers at the meadow scale (Mathewson 2012, Mathewson et al. 2012, H. Loffland unpublished data). We used multi-year averages to calculate territory density, though we caution that declines occurred during the course of the study (and hence, observed averages are well below maximum possible territory densities).

RESULTS

Data collation and meadow mapping

Inclusion of all breeding and migration season data resulted in 16,985 combined positive and negative Willow Flycatcher observation records. Of these, 6,182 were positive observations (detections). These detections occurred at 285 distinct meadow or riparian areas. Of these areas, 222 had breeding season (June 15 – August 1) detections and 138 had recent (2000 or later) breeding season detections (Table 1). Mean meadow size was 47 ha (sd = 94) for all sites combined, 54 ha (sd=102) for sites with breeding-season detections, and 66 ha (sd = 120) for sites with breeding-season detections since 2000 (Table 1).

Table 1. Number of meadows and area of meadows with Willow Flycatcher detections in the Sierra Nevada and Cascades of California and Nevada (all ownerships).

	No. of meadows	Total area of meadows	Mean meadow size (sd)
All positive detections (all dates)	285	33,420 ac/ 13,525 ha	116 ac (232) 47 ha (94)
Breeding-season detections	222	29,503 ac/ 11,940 ha	132 ac (252) 54 ha (102)
Breeding-season detections since 2000	138	22,620 ac/ 9,154 ha	163 ac (296) 66 ha (120)

Meadows with positive detections occurred on 13 national forests and 4 national parks, as well as on lands owned or managed by the State of California, Bureau of Land Management, Nature Conservancy, and other private landholders (Table 2). Of the total 285 meadows, 52 meadows were mapped as private lands, 44 of those with breeding season detections, and 24 with recent breeding season detections. By total area, these private lands make up approximately 27% of the total occupied lands in the Sierra Nevada (Table 2). It should be noted that this is likely an underestimate of private lands occupied by Willow Flycatcher since many meadows designated as public lands in this database also have some of their total acreage under private ownership. Additionally, private lands have not been systematically surveyed so additional occupied locations are likely going unreported.

Site history and population trend

We found 45 meadows that were known to have been occupied as recently as 2000 had data that suggested they were not currently supporting breeding Willow Flycatchers, leaving a total of 93 remaining meadows with probable breeding activity in 2013 (Figure 2 – white stars). Most notable here is the almost complete loss of west-slope Sierra breeding sites south of Lake Tahoe, as well as loss of southern east-side montane meadow breeding sites, with flycatchers apparently only remaining along major river systems in lower elevation valley willow riparian areas (Kern, Owens, and Walker Rivers). Surveys completed after these data were collated now suggest a larger than predicted population in the Owens River system (C. McCreedy personal communication). A few high elevation east-side meadows directly south of Lake Tahoe in the Carson watershed are still thought to have active breeding, but not in every year and with no more than a single territory per meadow. We stress that Figure 2 is by no means definitive but

rather provides a summary of the best information currently available. The map could be further refined with compilation of additional negative survey data, territory-scale data extracted from the existing data sources, and/or implementation of region-wide unified surveys.

Table 2. Ownership or management of meadows with Willow Flycatcher detections.

Ownership or management	n	Area (acres)	Area (ha)	Percent of total area
National Parks				
Devils Postpile NP	1	15	6	0.04
Lassen NP	2	140	57	0.42
Sequoia Kings Canyon NP	5	119	48	0.36
Yosemite NP	11	512	207	1.53
<i>National Park subtotal</i>	<i>19</i>	<i>786</i>	<i>318</i>	<i>2.30</i>
National Forests				
Eldorado NF	7	381	154	1.14
Humboldt Toiyabe NF	7	830	336	2.49
Inyo NF	32	2,238	905	6.71
Klamath NF	2	1,072	434	3.21
Lake Tahoe Basin MU	17	1,119	453	3.35
Lassen NF	18	2,586	1047	7.75
Modoc NF	11	1,738	703	5.21
Plumas NF	27	2,146	868	6.43
Sequoia NF	13	488	197	1.46
Shasta Trinity NF	11	1,065	431	3.19
Sierra NF	16	441	179	1.32
Stanislaus NF	7	554	224	1.66
Tahoe NF	34	3,216	1,302	9.64
<i>National Forest subtotal</i>	<i>202</i>	<i>17,874</i>	<i>7,233</i>	<i>53.6</i>
Other management				
Bureau of Indian Affairs	1	648	261	0.02
Bureau of Land Management	2	10	4	0.03
State of California	8	1,795	726	5.49
The Nature Conservancy	1	2,654	1,074	8.11
State of Nevada	1	328	133	1.00
Private	52	9,274	3,753	28.34
<i>Other management subtotal</i>	<i>64</i>	<i>14,709</i>	<i>5,851</i>	<i>44.08</i>
TOTAL	285	33,367	13,501	

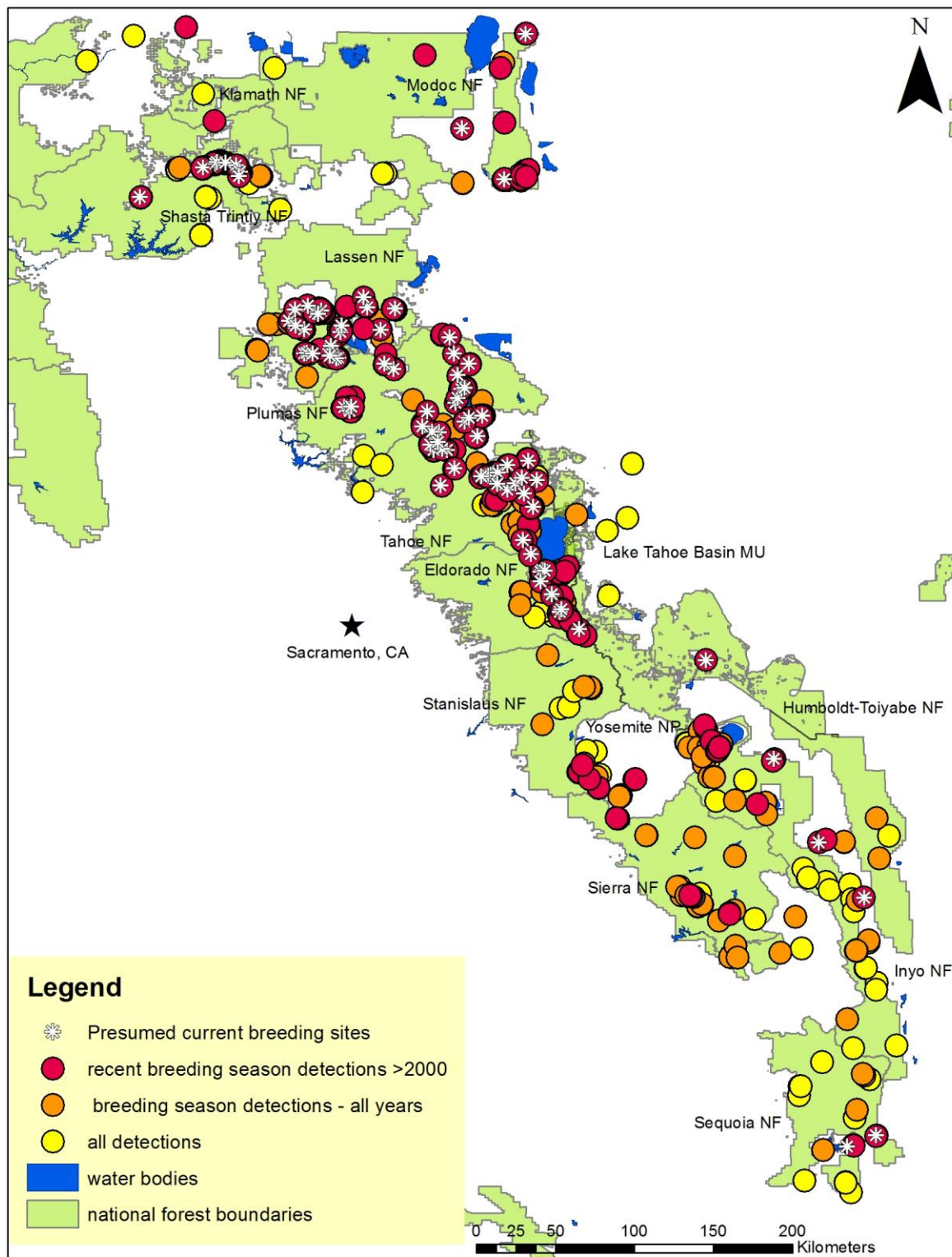


Figure 2. Locations of Willow Flycatcher detections since the 1980s across the Sierra/Cascades region of California.

We assume that all 222 meadows and riparian areas with historic Willow Flycatcher breeding season detections (Figure 2 – orange dots) were likely to have also supported breeding populations prior to the landscape-level land conversion, intensive grazing, and water diversion projects that began with the gold rush and continued through the 1970's; although presumably there were far more than 222 occupied sites given the early descriptions of the species as “locally common” (Grinnell and Miller 1944). Despite these uncertainties we are using the value of 222 as the baseline for Willow Flycatcher breeding sites in the early 1900's, up until the onset of surveys in the 1980s (conducted by the California Department of Fish and Wildlife). Using this estimate we observed a decline in numbers of sites with breeding season detections from 222 (estimated 1900-1980) to our current (2013) estimate of 93 breeding sites (white dots), a 58% decrease in breeding sites relative to historic descriptions. If we consider only the 138 sites (figure 2 - red dots) with breeding season detections since 2000 and assume all of these were also occupied in 2000 (rather than recently colonized) we see an observed decline of 138 to 93 sites (Figure 2 –white stars), or a 33% decline in just 13 years.

Another way of examining trend is by assessing the number of years since a site last had a breeding season detection. We found a significant relationship between time since occupancy and latitude ($F = 26.07$, $R^2 = 0.11$; $P=0.0001$), with meadows further north having a greater likelihood of being occupied more recently. Another way of looking at this is that the population is contracting northward at a rate of 0.06 degrees latitude per year. Visual examination of the relationship (Figure 3) shows a distinct clustering of recently occupied sites above approximately 39° North, which corresponds to projections of local extirpations south of Alpine County and the Carson River watershed Mathewson et al. (2014).

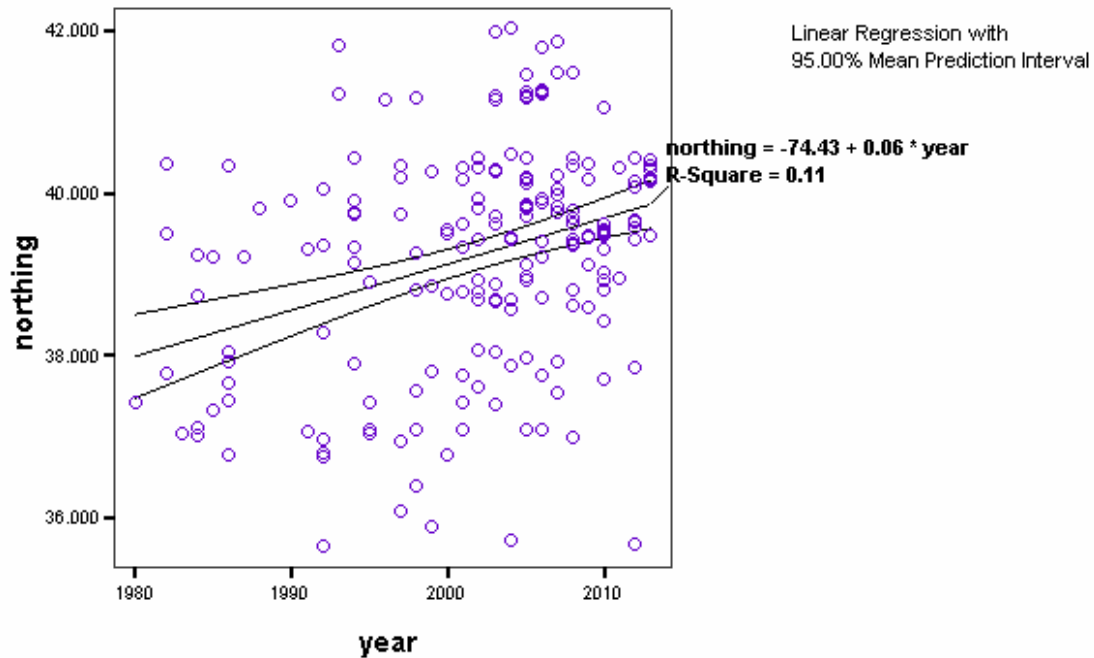


Figure 3. Linear regression assessing the relationship between year during which Willow Flycatchers were last detected at each meadow and latitude.

These data reveal particularly sharp declines in the southern Sierra Nevada. Of the 138 sites with recent breeding season detections 43 (31%) are located below latitude 39' N, and 95 (69%) are located above this latitude. Further if we examine how the latitudinal breakdown changes when we examined only the 93 sites thought to currently support breeding flycatchers we find only 17 (18%) below 39 N, and 76 (82%) above that latitude. The Sierra National Forest in particular has had consistent survey and reporting for historically occupied sites and only two (Markwood Meadow and Long Meadow) have been occupied, on two occasions each, since 2000. These two sites have not however, been occupied in the last five years. Follow-up visits for detections at other sites with detailed multi-year data in the sub region have failed to produce evidence of birds persisting through the breeding season. Similarly, long-term annual monitoring at MAPS stations in Yosemite National Park occasionally detects one or more Willow Flycatchers in late June or July, but breeding condition of captured birds and subsequent follow up surveys indicate that Willow Flycatchers have not bred at these sites for many years. After many years of repeated negative surveys at historic sites, the Stanislaus National Forest had 2 detections in 2012 at Ackerson Meadow and Lily Lake. Follow-up visits to Ackerson Meadow a few days after the initial detection in early July did not detect a Willow Flycatcher. The Lily Lake bird was first detected late in the breeding season and persisted many weeks. Nonetheless due to the timing of detection we could not rule out a post breeding migrant and the bird did not return to breed in 2013.

On the east side of the Sierra, Willow Flycatchers bred successfully for a number of years at Rush Creek near Mono Lake after hydrologic restoration measures were implemented but reports since 2010 suggest the birds are once again absent from this site (McCreedy and Heath 2004). Willow Flycatchers may still breed on private lands along the Walker and Owens River. Recent surveys in 2014, have found a large population breeding along the Owen River (C. McCreedy personal communication), but their status on the Walker River largely unknown. The Southwestern subspecies breeding at the Kern River Preserve continue to decline despite riparian restoration measures and cowbird control. The number of territories declined from 23 to 14 between 2002 and 2007, and has declined to under 10 since that time (USFWS 2014, M. Whitfield personal communication).

Although a few Willow Flycatchers continue to be detected in the southern Sierra, consistent breeding and population connectivity occur only in areas directly around Lake Tahoe and locations to the north, as suggested by Mathewson et al. (2013).

Using the best available information, we estimate there are currently approximately:

- 95 territories in the northern Sierra and southern Cascades (largely along Warner Creek and Lake Almanor in the Lassen County and the McCloud River on the Klamath NF)
- 65 territories in the north central Sierra (the majority along the Little Truckee River and surrounding watersheds)
- 5 - 10 territories in the south central Sierra (in the vicinity of Red Lake and South lake Tahoe and scattered throughout the Carson watershed)
- 0 – 5 territories from Alpine county south to Sequoia NF
- 45 territories within the Southwestern Willow Flycatcher range (Kern River and Owens River vicinity)

With approximately 28% of total estimated occupied acres occurring on private lands with little or no access, substantial uncertainty remains about the numbers of individual territories that remain, or even whether particular sites continue to support the species at all. Our overall estimate is approximately 215 territories within the region, but efforts to count territories at many sites have been inconsistent in the last 5 to 10 years. If the rate of decline reported in Mathewson et al. (2013) has continued, these values could be an overestimate.

Management and restoration prioritization

The 12-km dispersal buffers around areas with the three classes of detection provide three useful levels of restoration priority (Figure 4 and Appendix C).

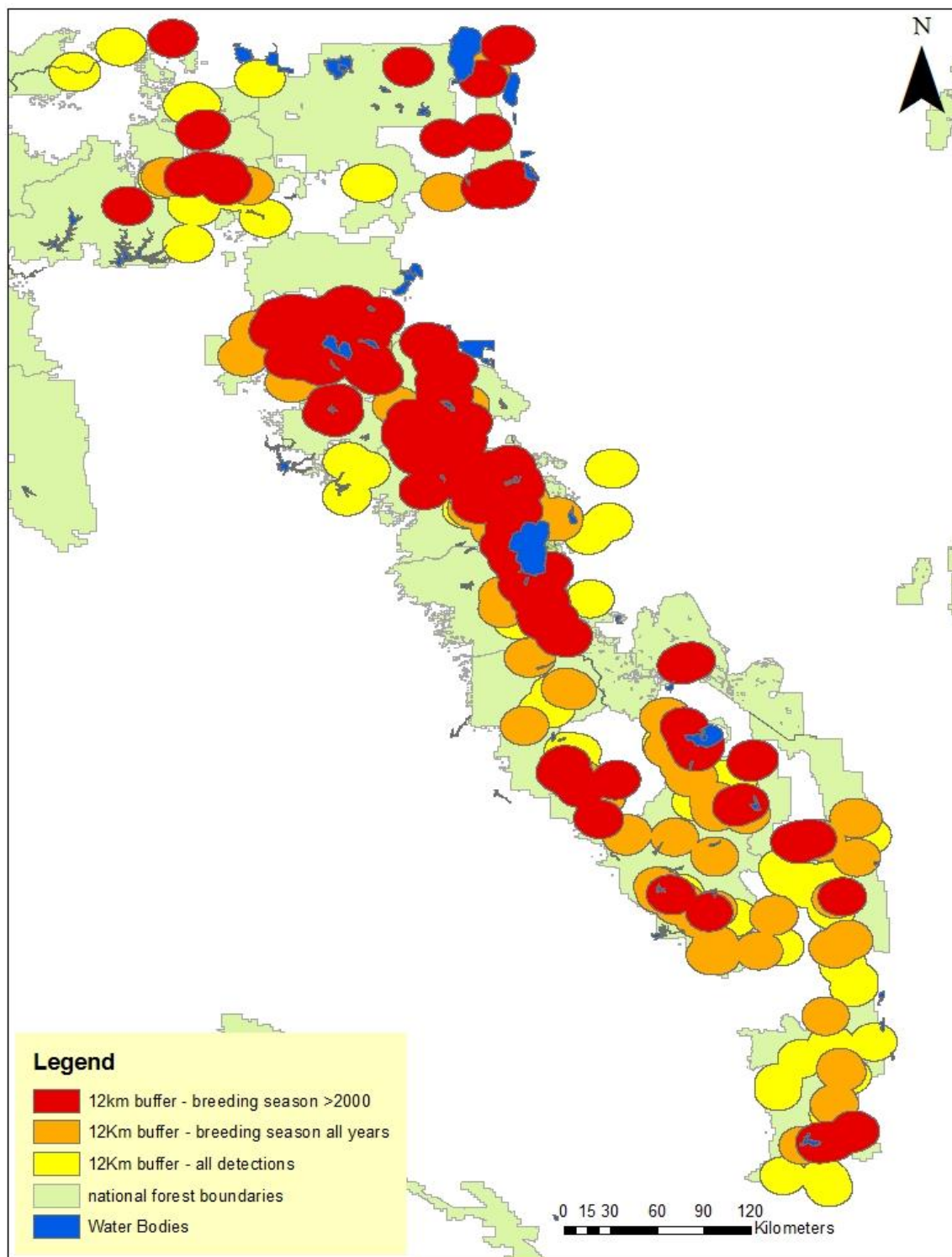


Figure 4. Dispersal-distance buffers (12 km) around Willow Flycatcher detection locations.

The most inclusive subset of all detections (yellow polygons) identifies areas with some history of the species and likelihood of being visited by migrating Willow Flycatchers. The second (orange polygons) and third (red polygons) subsets provide respectively greater chances of being discovered and colonized by the species (or are already being utilized by the species). We choose not to treat the 93 “current likely breeding locations” described above as a separate level of priority because delineation of this level required more subjective interpretation of existing data and may not represent whether a site is truly extirpated or extant. We also did not want to place meadows where Willow Flycatchers may still be present only in some years at a lower level of priority than more stable locations, when it could be argued that such sites are the most at-risk and in need of intervention.

Red Zone

Red polygons in Figure 4 represent the highest priority areas for restoration efforts aimed at benefiting Willow Flycatchers, as the species is known to have used these sites since 2000. In the more northern parts of the state, management intervention will bolster the more stable part of the population, while in the southern part of the Sierra, successful restoration efforts might spur re-colonization by migrating or ‘prospecting’ birds, and reverse local extirpations. In the central Sierra, the red polygons represent the area most at risk of sub-regional extirpation, but where Willow Flycatchers still regularly occur. Successful restoration efforts in this area could slow the decline or potentially reverse it.

Orange zone

Areas within the orange polygon zone in Figure 4 represent sites within the known breeding range that no longer have breeding Willow Flycatchers, but may still be visited by migrating birds. Many meadows within this area are known to have had at least the basic hydro-geomorphic conditions that can support the species (based on historic breeding records). Restoration within these areas still has potential benefits for the species, especially where it could allow populations to expand into and re-colonize a broader elevational and latitudinal area (potentially making the population more resilient to climate change, catastrophic wildfire events, etc.).

Yellow Zone

Areas within the yellow zone in Figure 4 have a lower priority for meadow restoration efforts focused on Willow Flycatcher because records from this area may only represent migration habitat and not breeding habitat (although descriptive records from the early 1900’s describe the species as locally common in riparian areas throughout the Sierra). Willow Flycatchers regularly use migration habitat in the fall that is quite similar to their breeding habitat (as is their wintering habitat) (Paxton et al. 2011). Because fall migration is also a critical time for building fat stores and because meadow habitat is relatively rare within the landscape overall, efforts to restore or manage meadows and riparian areas that are important during migration could also boost survival and recruitment of the Sierra Nevada breeding population of Willow Flycatchers.

We found that a great deal of meadow habitat occurs within the 12-km buffers around Willow Flycatcher sites (Table 3 and Appendix C), ranging from 71,123 to 129,614 acres (28,728 to 52,453 ha) depending on the detection class. Because Willow Flycatchers often select larger meadows, and because larger meadows support larger clusters of breeding sites that are more

likely to persist over time, future management intended to provide for self-sustaining breeding sites should focus on larger meadows. Meadows >200 acres (>81 ha) in size are generally considered ideal for this species, but because the species will occupy smaller sites, and because we did not wish to unduly restrict restoration and management focus from otherwise ideal settings, we assessed the number and area of meadows >50 acres (>20 ha) within the 12-km buffers to identify restoration priorities (Table 3). Narrowing the focus to larger meadows within 12 km of sites with recent breeding-season detections, yields 207 meadows, including the occupied meadows themselves, that might be considered most likely to be colonized should habitat be restored (Table 3 and Appendix C). Although these represent a substantial land area at just over 44,000 acres (17,820 ha), this is a relatively tractable number of sites that could be reasonably assessed, prioritized, and restored or managed differently if warranted.

Table 3. All meadows occurring within 12 km of Willow Flycatcher detections in the Sierra Nevada and Cascades of California and Nevada.

	All meadows			Meadows > 50 acres		
	No. of meadows	Meadow area	Mean meadow size (sd)	No. of meadows	Meadow area	Mean meadow size (sd)
Meadows with detections (all dates)	10,593	129,614 ac/ 52,453 ha	12 ac (80) 5 ha (32)	374	69,805 ac/ 28,271 ha	184 ac (385) 75 ha (156)
Meadows with breeding-season detections	8,675	108,938 ac/ 44,086 ha	12 ac (71) 5 ha (29)	339	59,395 ac / 24,055 ha	175 ac (317) 71 ha (128)
Meadows with breeding-season detections since 2000	4,499	71,123 ac/ 28,782 ha	15 ac (101 sd) 6 ha (41 sd)	207	44,010 ac/ 17,820 ha	212 ac (426) 86 ha (173)

Habitat description and territory density

Demography study meadows occupied by Willow Flycatchers ranged from meadows supporting a single territory to those supporting more than 10 territories. On average, breeding sites contained 0.07 (sd=0.06) territories per acre of meadow, or 0.36 (sd=0.25) territories per acre of willow (Table 4).

Table 4. Mean (sd) territory numbers per area of meadow and willow at 26 meadows monitored as part of the Willow Flycatcher Demography Study (n=26 meadows).

	Mean no. flycatcher territories/ area of willow (sd)	Mean no. flycatcher territories/area of meadow (sd)	Mean area willow/ area of meadow (sd)
acres	0.362 terr./ ac (0.252)	0.070 terr./ac (0.064)	0.192 (0.123)
hectares	0.894 terr./ha (0.622)	0.173 terr./ha (0.158)	0.192 (0.123)

DISCUSSION

Although negative survey results are not well documented in the data, the Land Management Plan amendment completed in 2001 (Powell and Blackwell 2003) required National Forests to survey meadows that were designated as “occupied” by Willow Flycatcher every four years. For occupied sites under the purview of this amendment, which include a relatively large geographic area and portion of known occupied sites, we can be relatively certain of changes in occupancy status since 2001 (given the assumption that positive data would have been reported to the NRIS database, even though negative data may not have been).

Data collation and meadow mapping

We recommend maintaining the database we developed for this project to manage Willow Flycatcher data across agencies and better inform conservation planning at a regional level. Without better communication across sub regional and administrative boundaries it will remain difficult to monitor ongoing declines, or appropriately acknowledge and learn from restoration successes that may mitigate or even reverse those declines. The database currently includes only a ‘meadow’ component and an ‘observation’ component. What is still needed is an additional visit component that can house negative data and summarize results from each visit to a site. Once a visit component is incorporated, then the observation component can track occupancy at the level of individual territories. Tracking and recording negative data is vitally important to understanding true population status.

In addition, maintaining a unified database will allow easier assessment of site-specific and sub-regional changes as they occur. Variability in reporting made this difficult. For example, in one case the site rather than the individual Willow Flycatcher is the unit of observation. In another the individual survey station is the unit of observation, with data accounting for negative survey results or positive detections at each individual station. Some data sources may thus document all results in a given year at a given site by collapsing them into just one record of presence or absence, while others provide individual observations for each survey station during each visit. In some cases within NRIS and CNDDDB, fledglings are included with the adults in the total count of individuals. Most of the variation in the scale and reported units of observation between separate datasets is accounted for by additional explanatory fields in individual data sources, but cannot be easily queried so will require substantial effort to unify across all data sources. Many data sources included only positive detections, with patchy and incomplete negative survey results. Because data were collected and managed by multiple agencies and individuals for a variety of management and research needs, data sets varied in scope and detail and this limited which analyses could be done without further data refinement and agency collaboration.

Site history and population trend

Population trend information, even when limited to tracking occupancy of meadows, suggests the species has continued its precipitous decline since being listed as endangered in the state in 1991 (CDFG 1991). Recent absences at sites where breeding occurred in the last decade are not reassuring for population persistence. Although negative survey results are not well documented

in the data, the Land Management Plan amendment completed in 2001 (Powell and Blackwell 2003) required National Forests to survey meadows that were designated as “occupied” by Willow Flycatcher every four years. For occupied sites under the purview of this amendment, which include a relatively large geographic area and portion of known occupied sites, we can be relatively certain of the apparent decline in occupancy status since 2001 (given the assumption that positive data would have been reported to the NRIS database, even though negative data may not have been).

What is promising is that Willow Flycatchers continue to be detected regularly at MAPS stations and during point counts in Yosemite National Park and the Stanislaus, Sierra and Inyo National Forests. These detections of pre- and post-breeding migrants are encouraging because we know that the species is still encountering and moving through meadows that could have improved habitat condition and once again become available for breeding. With the recent emphasis on meadow restoration within the Sierra Nevada and new awareness of the importance of conspecific attraction for this species, there is still hope that re-colonization could occur within some portions of the historic range of this species if they encounter restored areas during migration periods. Nonetheless, it is important that we continue to keep migrants separate from breeders in our evaluation of species conservation status because detection of migrants is very common in many habitats in May and early June throughout California, and these detections could mask a more dire situation for the species if we inadvertently count these individuals as breeders during statewide tallies, when in fact they are not.

Although many restoration projects in the central and northern Sierra and cascades are less than 10 years old (meaning that newly recruited or planted willow may not yet have reached a mature stature) we have seen some breeding season use of restored meadows by Willow Flycatchers at sites where they did not breed prior to restoration (e.g. Meeks Bay, Blackwood Creek). Similarly, two restoration sites on the Little Truckee River that already supported multiple breeding pairs have retained similar territory numbers (Little Truckee 1 & 2, and Perazzo Meadow) while nearby unrestored sites have shown continued declines (Little Truckee 3, Lacey Valley) (H. Loffland unpublished data). It should be noted however that many more restored sites have not yet achieved the goal of attracting breeding Willow Flycatchers (Red Clover, Long Valley, Cookhouse Meadow), so restoration alone may not be enough to re-populate historic breeding grounds. Nonetheless, success of hydro-geomorphic restoration at attracting or retaining Willow Flycatchers at even a few restored sites suggests that the idea of creating large enough patches of habitat to support multiple flycatcher territories is not out of reach.

Management and restoration prioritization

Central and Southern Sierra Nevada

Given the declines and irregular detections south of Lake Tahoe, these areas may require more than habitat improvement to become re-colonized. We suggest a 3-tiered approach of 1) hydro-geomorphic habitat restoration, 2) passive restoration through improved grazing management, and 3) experimenting with conspecific attraction to lure Willow Flycatchers back to meadows where suitable habitat has been restored. Conspecific attraction is a novel restoration technique that is based on the concept that many territorial birds aggregate their territories near conspecifics (others of the same species) (Ward and Schlossburg 2004). In some cases, songbird

populations may fail to re-establish even after otherwise successful habitat restoration, simply because the necessary cues to breed at a location (other singing birds) are absent (Ward and Schlossburg 2004). In 2007 Mathewson et al. (unpublished data) conducted a small pilot study in which Willow Flycatchers colonized 2 of 3 previously unoccupied test sites and continued to breed successfully there for multiple years after a single year of automated song broadcasts during May and early June. In some Sierra Nevada locations, failure by Willow Flycatchers to re-colonize historic areas may be a response to decreased habitat quality, but where otherwise successful meadow restoration has occurred, it may be a result of a behavioral unwillingness to settle in currently unoccupied meadows despite dramatic improvements in habitat condition. Caution should be used however to avoid applying conspecific attraction techniques in areas with high densities of Brown-headed Cowbirds.

This three tiered approach should be implemented at clusters of large meadows (preferably greater than 200 acres) rather than single isolated meadows, whenever possible. Hodgdon Meadow in Yosemite is in good condition and still has regular Willow Flycatcher migrant detections, but alone it is somewhat small to maintain a thriving population. Restoration at nearby Ackerson meadow (a degraded former breeding site) might create a reasonable amount of habitat in relatively close proximity. The combined Ackerson Meadow and Hodgdon Meadow cluster (Figure 5) along the Stanislaus National Forest and Yosemite National Park boundaries is an example of group of sites that may provide adequate acreage once Ackerson is restored, as could the Markwood, Dinky, Lost Meadow area of the Sierra National Forest (Figure 6).

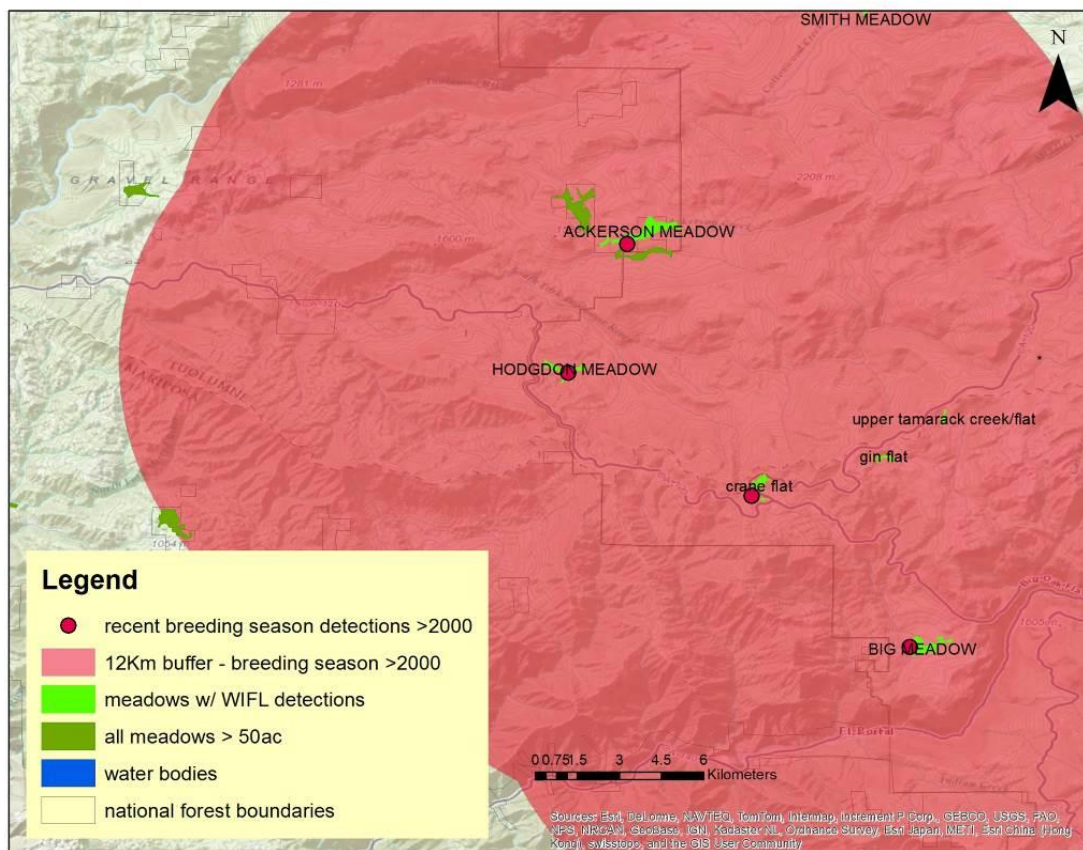


Figure 5. Restoration suggestions - Ackerson and Hodgdon Meadow area.

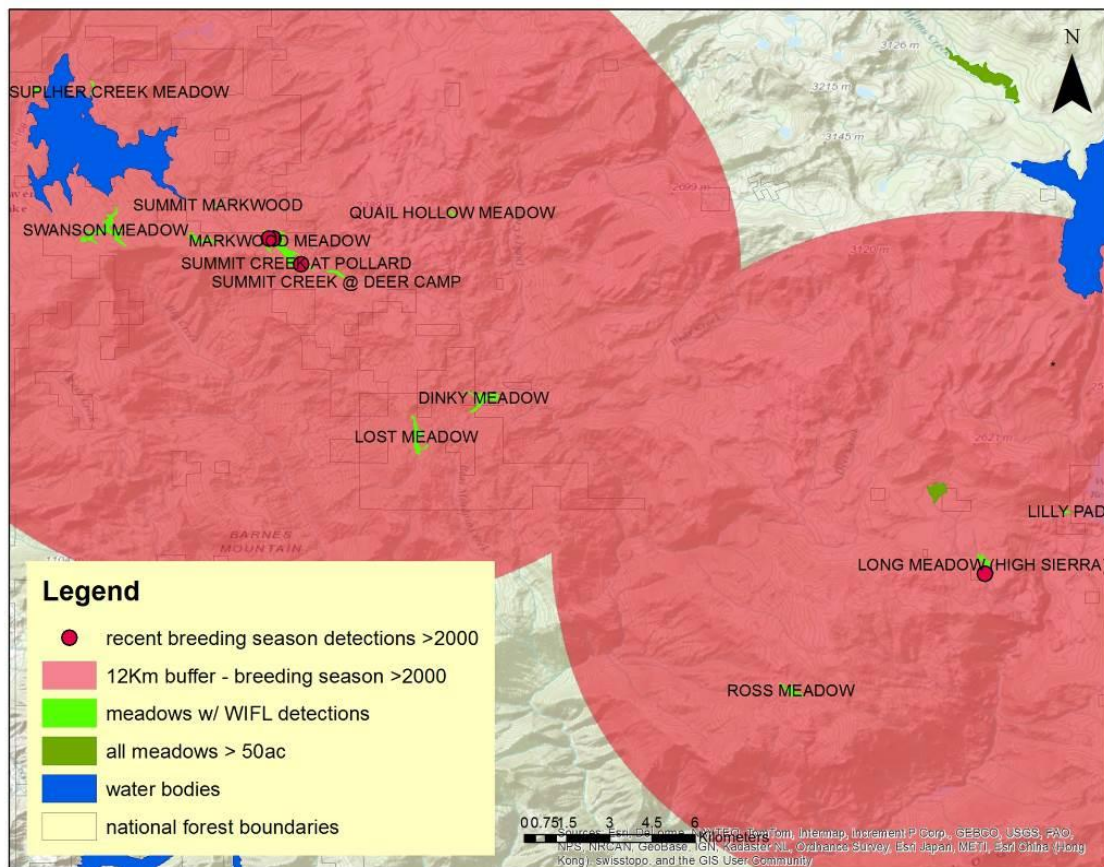


Figure 6. Restoration suggestions – Markwood, Lost, Long Meadows area.

A number of historic locations on the Inyo NF occur in close proximity of one another and may be candidates as well, namely the area due west of Mono Lake in the vicinity of Rush Creek and Lee Vining Creek (Figure 7). In this case however Brown-headed cowbird densities would need to be addressed prior to attempting to attract Willow Flycatchers. At this time it is believed that high cowbird densities in this area are the result of backyard bird feeders and other human-induced attractions rather than livestock grazing (C. McCreedy, personal communication).

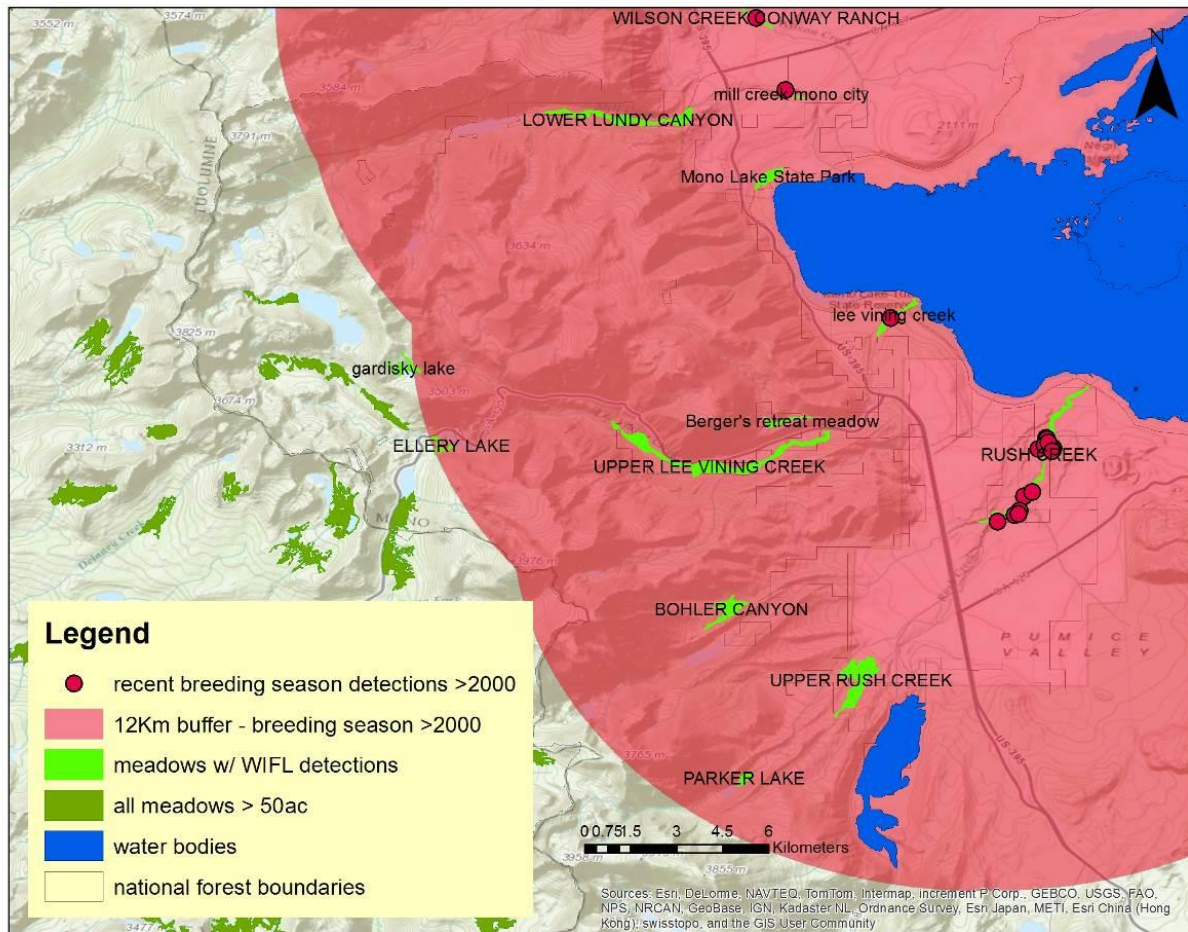


Figure 7. Restoration suggestions – vicinity of Lee Vining Canyon and Rush Creek.

One of the highest priorities for restoration combined with conspecific attraction is the Hope Valley and Red Lake area in the Carson River watershed where Willow Flycatchers still breed in some years, but population size is so small that it does not maintain itself, and small population size may reduce the social cues needed for colonization by new individuals. Recent and planned restoration of hundreds of acres in close proximity to one another and to other breeding locations make this area very promising. Future restoration at Faith Valley and Charity Valley (historic breeding sites currently in poor condition) could finalize a large cluster of high quality habitat in the area as Hope Valley restoration moves closer to implementation (Figure 8).

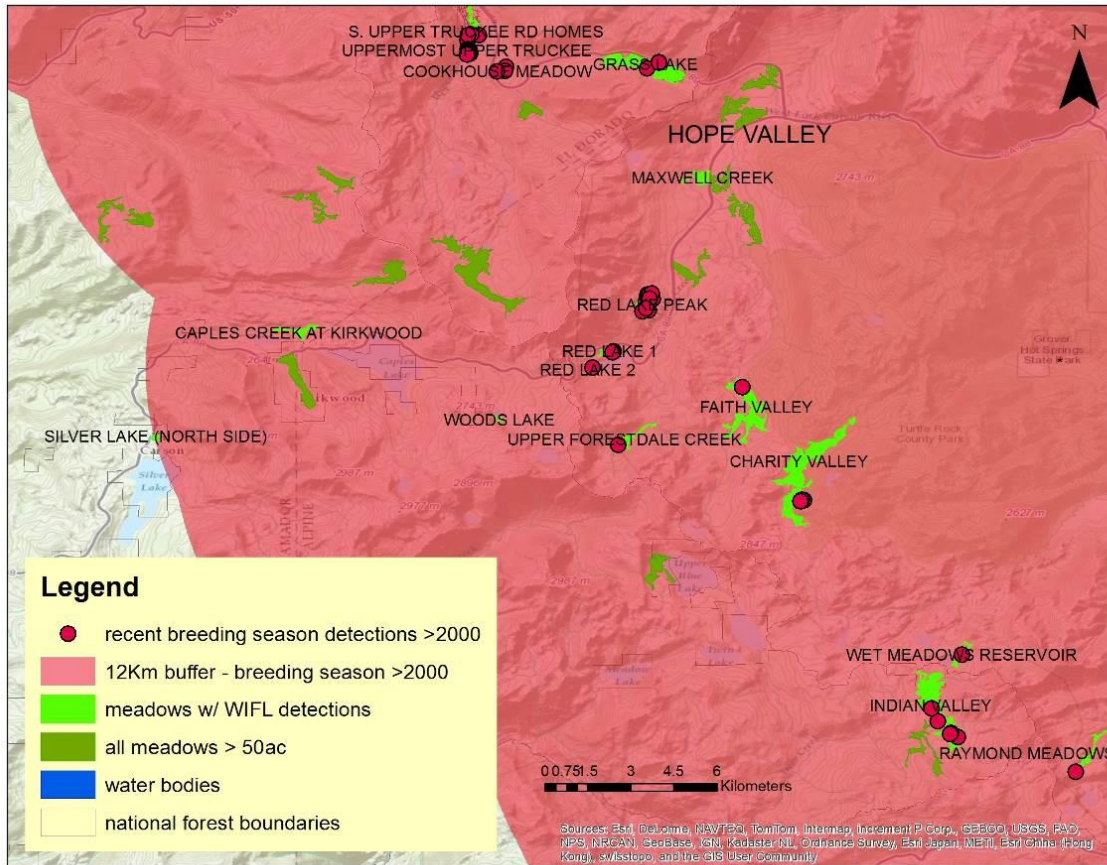


Figure 8. Restoration suggestions - vicinity of Carson Watershed and Hope Valley.

Proposed sub-regional 10 year goals (2014-2019) for the southern and central Sierra regions include:

Southern Sierra Nevada – Willow Flycatchers may have already been extirpated from montane meadows in this region, but individuals still breed in lower elevation riverine areas, and migrants are still detected here. Create re-colonization opportunities by restoring currently occupied meadows or 3 largest previously occupied meadows.

Central Sierra Nevada (Calaveras, Alpine, Eldorado, Amador, Placer, Washoe) – Willow Flycatchers are on verge of extirpation from this sub region). Annual increase of 19% necessary to stabilize this breeding population, assuming 10 territories are currently extant. Restore currently occupied but degraded meadows (5?). Restore or recolonize meadows to support an additional 2 territories annually for five years or preferably a total of three 110 acre meadows in five years. (10 territories = 330 acres of meadow = 40 acres of willow).

Northern Sierra Nevada and Southern Cascades

The area between the 2 large population clusters at Warner Valley (north of Lake Almanor) and Little Truckee River (north of Truckee) is dotted with many breeding season detections but few sites that consistently support more than 3 territories in close proximity. Efforts to restore and manage a large site or cluster of sites (like those already restored in the Feather River Watershed) that could maintain 20 or more territories in the region between these two areas would provide more population continuity and stability. Restoration of meadow along the Feather River near Portola and riparian fringes around Sierra Valley could provide a large amount of high quality habitat in a prime location (Figure 9).

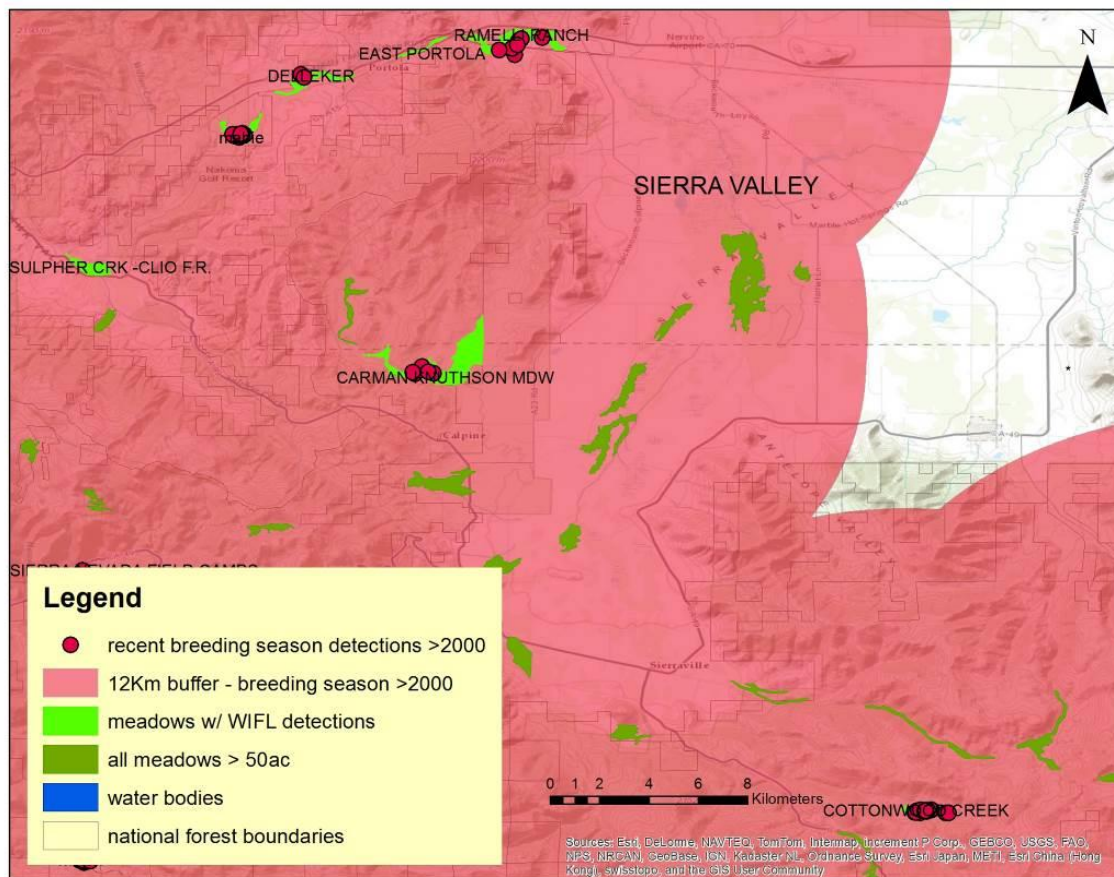


Figure 9. Restoration suggestions – vicinity of Sierra Valley.

Restoration of additional large meadow systems near the recently restored area in Humbug Valley are likely to build on the positive effects of that occupied site and are within dispersal distance of the high density cluster of territories in Warner Valley and Lake Almanor (Figure 10). The Mountain Meadows watershed just to the east should be evaluated as well. This watershed contains a massive meadow complex (3000 acres+) that has been highly degraded but probably once supported more than 50 Willow Flycatchers.

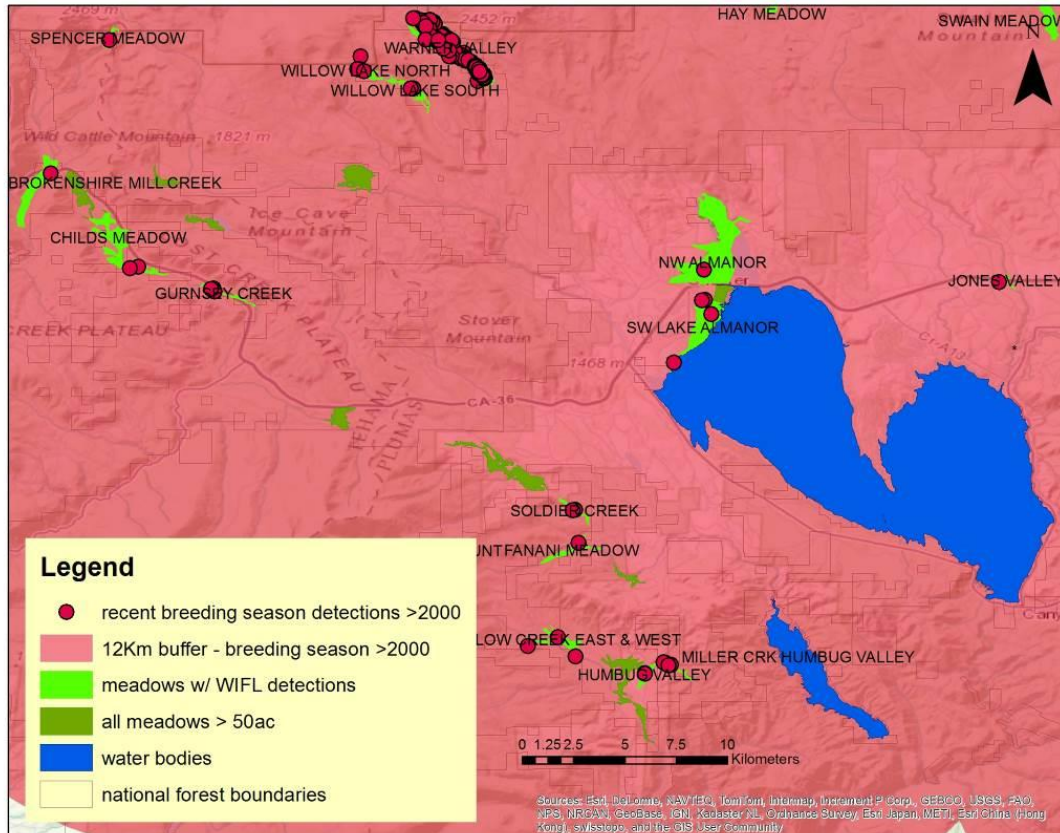


Figure 10. Restoration suggestions – vicinity of Lake Almanor and Humbug Valley.

Although conspecific attraction may not be as critical in the northern Sierra and southern Cascades as in the central and southern sierra, other unique opportunities exist. Because so many meadow systems in this region are expansive and privately owned, livestock grazing has historically been the primary land use. By working with both private individuals and public agencies to physically restore old hydrologic degradation while actively managing livestock to improve willow regeneration could result in substantial habitat gains for Willow Flycatcher.

In this region Willow Flycatcher are found in areas with abundant beaver activity providing both standing water and willow regeneration. Active use of beaver as a restoration tool could create highly favored habitat conditions at both small and large sites. Willow Flycatchers are often found around beaver ponds that more closely resemble marshland edge with a willow (or other riparian shrub) component and abundant emergent vegetation around a series of ponds or lake

margin. Beaver could also be useful in terracing higher gradient stream systems could create excellent habitat and increase Willow Flycatcher habitat connectivity between more typical floodplain meadow systems (Cooke and Zacke 2006). Likewise because so many large meadows are privately owned, restoration and terracing smaller riparian systems may be all that is available to public land managers in some areas.

Proposed sub-regional 10 year goals (2014-2019) for the southern and central Sierra regions include:

Northern Sierra Nevada (Sierra, Yuba, Nevada, Plumas) – Significant declines documented in this sub region but a number of larger breeding sites persist. An annual increase of 6% is necessary to stabilize the breeding population, assuming 65 breeding territories currently extant. Restore all currently occupied, but degraded meadows, starting with largest. Restore or recolonize meadows to support an additional 4 territories annually for five years or preferably a total of six 110 acre meadows in five years. (20 territories = 660 acres of meadow = 80 acres of willow).

Southern Cascades (Lassen, Modoc, Shasta, Klamath) – The Southern Cascades population may be stable but known breeding sites are largely restricted to private lands. In this sub region with proportional higher reproduction and survival, the goal is to bolster the Sierra/Cascades population through restoration or altered management on public and private lands. Restore currently occupied, but degraded meadows, starting with largest. Restoration or management to result in newly protected or restored occupied sites with a total of 330+ acres restored and planted with willow to create 40 acres future habitat for at least 10 new territories.

Habitat description and territory density

Demography study breeding sites had approximately 20% of their area covered by willow or other riparian deciduous shrubs (H. Loffland unpublished data) and 40% cover by surface water (Bombay 1999, Bombay et al. 2001a). Riparian shrubs were generally 2-4 meters in height within occupied territories (Bombay 1999, Bombay et al. 2001a). All consistently occupied meadows monitored by the demography study were also occupied by beaver that created impoundments within the meadow system (Bombay 1999). Meadows greater than 200 acres were most likely to persist as breeding sites (Mathewson et al. 2012). We recommend prioritizing meadows greater than 50 acres in size, and preferably greater than 200 acres, for restoration and/or grazing management changes that increase the proportion of meadow with surface water (40% meadow cover by water) during the entire breeding season, from the initiation of nest-building to the post-fledging period (June 1 through August 31), and increase riparian shrub cover (20% of meadow cover by willow or other riparian shrub) and shrub height (2-4 meters) to decrease predation and improve foraging habitat.

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Appendix A. First and last site visit and positive detections by site - sites listed by ownership or management unit.

Ownership	Site name	Easting ¹	Northing	First detection (all dates)	Last detection (all dates)	First detection (6/15 – 8/1)	Last detection (6/15 – 8/1)	Last visit
BLM	Bairs Creek	-118.234	36.68204	1999	1999			1999
BLM	Dry Creek	-120.528	41.14089	1996	1996	1996	1996	1996
California State	Antone Mdws - Burton Crk	-120.152	39.20305	1926	2006	2006	2006	2007
California State	Martis	-120.124	39.30052	2003	2010	2004	2010	2010
California State	Red Lake 1	-119.974	38.70246	1991	2006	1991	2006	2008
California State	Red Lake 2	-119.98	38.69762	1992	2004	1992	2004	2008
California State	Solari Meadow	-120.71	39.73866	1991	1997	1991	1997	1997
California State	Upper Ash Creek	-120.966	41.1943	2010	2012			2012
California State	Warner Valley	-121.332	40.416	1996	2013	1996	2013	2013
California State	Washoe State Park/ Upper	-120.026	38.85797	1942	2000	1942	1999	2008
Devils Post Pile NP	Devil's Postpile	-119.085	37.6287	2002	2002			2002
Eldorado NF	Caples Creek At Kirkwood	-120.072	38.70905	1997	1997			1997
Eldorado NF	Indian Valley	-119.871	38.59054	2003	2009	2003	2009	2009
Eldorado NF	Packsaddle Pass Road	-120.201	38.74069	1984	1984	1984	1984	1984
Eldorado NF	Silver Lake (North Side)	-120.117	38.67544	1998	1998			1998
Eldorado NF	Upper Forni Rd	-120.197	38.81773	1984	1984			1984
Eldorado NF	Vadn	-120.074	38.81882	1911	1911	1911	1911	1911
Eldorado NF	Woods Lake	-120.009	38.68137	2006	2006			2007
Humboldt Toiyabe NF	Charity Valley	-119.913	38.66462	1986	2003	1986	2003	2003
Humboldt Toiyabe NF	Faith Valley	-119.931	38.68383	1986	2003	1986	2003	2007
Humboldt Toiyabe NF	Maxwell Creek	-119.946	38.75739	1998	2000	1998	2000	2008
Humboldt Toiyabe NF	Raymond Meadows	-119.824	38.57525	2004	2004	2004	2004	2004
Humboldt Toiyabe NF	Red Lake Peak	-119.963	38.71717	2003	2007	2003	2006	2008
Humboldt Toiyabe NF	Upper Forestdale Creek	-119.968	38.67476	2002	2002	2002	2002	2008
Humboldt Toiyabe NF	Wet Meadows Reservoir	-119.864	38.60667	2008	2008	2008	2008	2008
Inyo NF	Alpers Ranch	-118.907	37.75414	1994	1994			1994

Ownership	Site name	Easting ¹	Northing	First detection (all dates)	Last detection (all dates)	First detection (6/15 – 8/1)	Last detection (6/15 – 8/1)	Last visit
Inyo NF	Baker Creek Meadow	-118.459	37.17048	1992	1992			1992
Inyo NF	Berger's Retreat Meadow	-119.143	37.94258	1994	1994			1994
Inyo NF	Big Pine Creek	-118.438	37.12427	1992	1992			1992
Inyo NF	Bohler Canyon	-119.159	37.88729	1994	1994	1994	1994	1994
Inyo NF	Convict Creek	-118.826	37.6149	1922	2002	1922	2002	2002
Inyo NF	Cottonwood Creek	-118.163	37.53323	1954	1954	1954	1954	1954
Inyo NF	Dexter Creek	-118.754	37.86688	2004	2004	2004	2004	2004
Inyo NF	Ellery Lake	-119.243	37.93563	1973	1973	1973	1973	1973
Inyo NF	Gardisky Lake	-119.254	37.95845	1992	1992			1992
Inyo NF	Grays Mdw Independence Ck	-118.29	36.78334	1942	2000	1982	2000	2000
Inyo NF	Intake Dam	-118.586	37.24682	1979	1979			1979
Inyo NF	Jordan Hot Springs	-118.303	36.2281	2002	2002			2002
Inyo NF	Lee Vining Creek	-119.11	37.97306	2000	2005	2001	2005	2005
Inyo NF	Lower Lundy Canyon	-119.188	38.03179	1986	1986	1986	1986	1986
Inyo NF	Mammoth Creek	-118.978	37.63279	1950	1950	1950	1950	1950
Inyo NF	Mcgee Creek	-118.793	37.55568	1998	1998	1998	1998	1998
Inyo NF	Mill Creek Mono City	-119.14	38.03864	1901	2005	1901	2003	2005
Inyo NF	Mono Lake State Park	-119.147	38.01433	1994	1994			1994
Inyo NF	Parker Lake	-119.154	37.83767	1936	1936	1936	1936	1936
Inyo NF	Roberts Ranch Wyman Crk	-118.098	37.43162	1917	1917			1917
Inyo NF	Rodeo Evans	-119.096	37.76699	1940	1982	1940	1982	1982
Inyo NF	Rush Creek	-119.067	37.9322	1901	2009	1901	2007	2010
Inyo NF	Salt Lick Meadow	-118.336	36.39231	1998	1998	1998	1998	1998
Inyo NF	Silver Lake Rush Creek	-119.122	37.76953	1937	1982	1937	1937	1982
Inyo NF	Summit Westgaard Pass	-118.156	37.30613	1932	1932	1932	1932	1932
Inyo NF	Taboose Creek	-118.3	37.00373	1998	1999			1999

Ownership	Site name	Easting¹	Northing	First detection (all dates)	Last detection (all dates)	First detection (6/15 – 8/1)	Last detection (6/15 – 8/1)	Last visit
Inyo NF	Tuttle Creek	-118.173	36.55841	1998	2000			2000
Inyo NF	Upper Lee Vining Creek	-119.163	37.93251	1941	1992	1941	1986	1992
Inyo NF	Upper Rush Creek	-119.121	37.86667	1982	1982			1982
Inyo NF	Walker Creek	-118.058	36.24295	1999	1999			1999
Inyo NF	Willow Campground	-118.561	37.19287	1996	1996			1996
Klamath NF	Antelope Creek	-121.929	41.49483	2000	2008	2008	2008	2008
Klamath NF	Orr Lake	-121.992	41.65094	2005	2005			2005
Lake Tahoe Basin MU	Blackwood West	-120.183	39.1098	2003	2009	2003	2009	2010
Lake Tahoe Basin MU	Blackwood East	-120.167	39.11045	2005	2005	2005	2005	2005
Lake Tahoe Basin MU	Cookhouse Meadow	-120.008	38.79095	2002	2002	2002	2002	2008
Lake Tahoe Basin MU	Edgewood Creek	-119.927	38.96167	2005	2005	2005	2005	2005
Lake Tahoe Basin MU	Grass Lake	-119.963	38.79258	1998	2001	1998	2001	2010
Lake Tahoe Basin MU	Lilly Lake	-120.083	38.87562	2002	2003	2002	2003	2011
Lake Tahoe Basin MU	Meeks Bay	-120.136	39.03073	2010	2010	2010	2010	2011
Lake Tahoe Basin MU	Morton St, Upper Truckee	-120.018	38.80911	1998	1998	1998	1998	2011
Lake Tahoe Basin MU	S. Upper Truckee Rd Homes	-120.017	38.80352	1998	2008	1998	2008	2008
Lake Tahoe Basin MU	Spring Creek	-120.083	38.93067	2008	2010	2008	2010	2010
Lake Tahoe Basin MU	Tallac	-120.072	38.93972	2003	2011	2003	2011	2011
Lake Tahoe Basin MU	Taylor Creek Lagoon	-120.058	38.93728	1992	2010	1992	2010	2010
Lake Tahoe Basin MU	Trout Creek Main	-119.975	38.92694	1910	2002	1910	2002	2008
Lake Tahoe Basin MU	Trout/Sierra House/Cold	-119.971	38.91247	1902	1995	1902	1995	2003
Lake Tahoe Basin MU	Upper Truckee Airport	-119.994	38.88932	2003	2007	2003	2003	2011
Lake Tahoe Basin MU	Uppermost Upper Truckee	-120.019	38.79762	1998	2010	1998	2010	2010
Lake Tahoe Basin MU	Ward Creek	-120.199	39.14078	1984	1994	1984	1994	1994
Lassen NF	Battle Creek Meadow	-121.597	40.33925	1983	1986	1983	1986	1986
Lassen NF	Brokenshire Mill Creek	-121.513	40.3556	1998	2009	1998	2009	2009

Ownership	Site name	Easting¹	Northing	First detection (all dates)	Last detection (all dates)	First detection (6/15 – 8/1)	Last detection (6/15 – 8/1)	Last visit
Lassen NF	Butt Creek	-121.429	40.17253	1994	2013	1994	2013	2013
Lassen NF	Butt Crk Lower Exclosure	-121.381	40.1704	2009	2009	2009	2009	2009
Lassen NF	Coon Hollow	-121.417	40.04209	1992	1992	1992	1992	1997
Lassen NF	Gurnsey Creek	-121.43	40.30886	1986	2011	1986	2011	2013
Lassen NF	Hay Meadow	-121.19	40.43316	1994	1994	1994	1994	2006
Lassen NF	Hay Meadow Vicinity	-121.191	40.43899	2005	2005	2005	2005	2005
Lassen NF	Humbug creek	-121.234	40.14554	1986	2012	1986	2012	2013
Lassen NF	Pit River Lake Britton	-121.567	40.99044	2000	2000			2000
Lassen NF	Robbers Creek	-121.005	40.35786	1982	1982	1982	1982	1997
Lassen NF	Savercool Place	-121.695	40.19294	1997	1997	1997	1997	1997
Lassen NF	Soldier Creek	-121.277	40.21442	2001	2007	2001	2007	2013
Lassen NF	Susan River	-121.091	40.4916	2004	2004	2004	2004	2004
Lassen NF	Susan River S. Hog Flat	-120.912	40.42561	1997	2013	1997	2012	2013
Lassen NF	Swain Meadow	-121.071	40.43172	1982	2012	1982	2012	2013
Lassen NF	Yellow Crk East & West	-121.284	40.15773	2008	2013	2008	2013	2013
Lassen NP	Hot Springs Creek	-121.407	40.44315	1997	2008	1997	2008	2008
Lassen NP	Spencer Meadow	-121.481	40.42033	1990	2002	1990	2002	2002
Modoc NF	Blue Lake Ranch Meadow	-120.291	41.16129	1984	2003	1984	2003	2003
Modoc NF	Dismal Swamp 12mile Creek	-120.168	41.98661	1993	2003	1993	2003	2009
Modoc NF	Headwaters Cold Creek	-120.311	41.7934	2006	2006	2006	2006	2006
Modoc NF	Lassen Crk @ Cold Crk	-120.298	41.82876	1993	1993	1993	1993	1993
Modoc NF	Mosquito Creek	-120.199	41.16291	2003	2005	2003	2005	2005
Modoc NF	Parsnip Springs	-120.263	41.15847	1989	1989			1989
Modoc NF	Patterson Mill	-120.193	41.18934	1993	2003	1993	2003	2010
Modoc NF	Sheep Camp Butte	-121.598	41.79447	2003	2003			2003
Modoc NF	South Fork East Crk	-120.165	41.19586	1993	2003	1993	2003	2010

Ownership	Site name	Easting¹	Northing	First detection (all dates)	Last detection (all dates)	First detection (6/15 – 8/1)	Last detection (6/15 – 8/1)	Last visit
Modoc NF	Willow Creek Ranch	-120.743	41.86247	2007	2007	2007	2007	2007
Modoc NF	Willow Spring Branch	-120.29	41.48441	2004	2007	2004	2007	2007
Nature Conservancy	Kern River Preserve	-118.337	35.66699	1997	2012	2003	2012	2012
Nevada State	Little Valley Franktown	-119.881	39.252	1996	2004	1998	1998	2004
Plumas NF	Arlington Bridge	-120.919	40.0837	1992	2012	1992	2012	2012
Plumas NF	Boulder Creek	-120.6	40.26146	2003	2003	2003	2003	2003
Plumas NF	Chucks Rock	-121.188	39.92254	1993	2002	1993	2002	2002
Plumas NF	Crocker Creek	-120.418	39.90739	1994	1994	1994	1994	1994
Plumas NF	Delleker	-120.49	39.80457	1990	2003	1990	2002	2005
Plumas NF	Doyle Crossing	-120.49	40.11301	1998	2005	1998	2005	2005
Plumas NF	East Portola	-120.45	39.81636	1988	1988	1988	1988	1988
Plumas NF	Faggs Pond	-121.17	39.84419	1992	2005	2002	2005	2005
Plumas NF	Freeman Creekpnf-BK-11103	-120.568	39.89185	2005	2006	2005	2006	2006
Plumas NF	Grass Lake	-120.7	39.725	1993	2005	1993	2005	2005
Plumas NF	Gray Eagle Lodge	-120.66	39.7229	1994	2003	1994	2003	2003
Plumas NF	Grizzly Crk Bucks Lake S.	-121.201	39.8651	2002	2005	2002	2005	2005
Plumas NF	Little Antelope Creek	-120.577	40.17059	1982	2005	1982	2005	2005
Plumas NF	Lower Freeman Creek	-120.554	39.91883	2006	2006	2006	2006	2006
Plumas NF	Lower Squaw Queen Creek	-120.554	40.04812	2007	2007	2007	2007	2007
Plumas NF	Mabie	-120.516	39.78556	2002	2008	2002	2008	2008
Plumas NF	Mcrae Meadows	-120.755	39.75717	1982	2007	1982	2007	2008
Plumas NF	Pierce Creek	-120.644	40.27799	2003	2003	2003	2003	2003
Plumas NF	Ramelli Ranch	-120.414	39.81883	1995	2005	1995	2005	2006
Plumas NF	Red Clover Pnf-Bk-10807	-120.532	39.97081	2005	2007	2005	2007	2007
Plumas NF	Red Clovertrib	-120.515	39.97559	2007	2007	2007	2007	2007
Plumas NF	Right Hand Branch Mill Ck	-121.148	39.92664	2002	2002	2002	2002	2002

Ownership	Site name	Easting¹	Northing	First detection (all dates)	Last detection (all dates)	First detection (6/15 – 8/1)	Last detection (6/15 – 8/1)	Last visit
Plumas NF	Rocky Point	-120.43	39.81961	1982	1988	1986	1988	2006
Plumas NF	Round Valley Reservoir	-120.972	40.11321	1986	2005	1986	2005	2005
Plumas NF	Sloat Creek Tributary	-120.728	39.84074	2007	2007	2007	2007	2007
Plumas NF	Strawberry	-121.092	39.58926	2004	2004			2004
Plumas NF	Wolf Creek	-120.962	40.16198	2001	2001	2001	2001	2001
Private	Baker Crk Btwn Big Pine	-118.32	37.16037	1992	1992			1992
Private	Bear Creek Se Pondosa	-121.677	41.18107	1998	2005	1998	1998	2005
Private	Beasore Meadow	-119.481	37.43816	1986	1986	1986	1986	1986
Private	Bijou Golf Course	-119.964	38.9342	1942	1942	1942	1942	1942
Private	Billy Mack Flat	-120.311	39.33552	1994	1994	1994	1994	1994
Private	Birch Creek 1	-118.277	37.06633	1991	1991	1991	1991	1991
Private	Birch Creek Lower	-118.311	37.07369	1998	1998			1998
Private	Canebrake	-118.172	35.72951	1998	2011	2003	2004	2011
Private	Carls Walters Ranch	-118.208	36.83015	1917	1917	1917	1917	1917
Private	Carpenter Valley/Prosser	-120.27	39.39693	1998	2006	1998	2006	2006
Private	Chalk Bluff Owens River	-118.447	37.41045	1998	2001	1998	2001	2001
Private	Childs Meadow	-121.477	40.33032	2011	2013	2011	2013	2013
Private	Copco Road At Jenny Creek	-122.399	41.97671	2008	2008			2008
Private	Dayton Carson River	-119.587	39.23901	2002	2006			2006
Private	Deerheart Creek	-120.989	40.26272	1999	1999	1999	1999	1999
Private	East Carson - Park Fam.	-119.694	38.79732	2009	2009			2009
Private	East Waker River	-119.14	38.43005	2010	2010	2010	2010	2010
Private	Empire Ranch	-119.706	39.16694	2003	2005			2005
Private	Fanani Meadow	-121.279	40.19685	2005	2005	2005	2005	2013
Private	Farmington Ranch - Laws	-118.364	37.40718	1917	1980	1917	1980	1980
Private	Haskins Valley	-121.159	39.86821	1986	2005	1986	2005	2005

Ownership	Site name	Easting ¹	Northing	First detection (all dates)	Last detection (all dates)	First detection (6/15 – 8/1)	Last detection (6/15 – 8/1)	Last visit
Private	Heavenly Valley West	-119.946	38.93585	2005	2005	2005	2005	2005
Private	Hirshdale Truckee River	-120.068	39.36682	1992	1992	1992	1992	1992
Private	Horton Creek	-118.498	37.3915	2003	2003	2003	2003	2003
Private	Hull Meadow	-120.072	38.06554	1939	1939	1939	1939	2002
Private	Humbug Crk @ Klamath River	-122.666	41.83274	1995	1995			1995
Private	Humbug Valley	-121.246	40.14244	1982	2013	1982	2013	2013
Private	Jones Valley	-121.087	40.31392	2001	2001	2001	2001	2001
Private	Kemp Flat Bear Creek	-121.746	41.14224	2005	2005			2005
Private	Lacey Valley/ Webber Lake	-120.42	39.47372	1983	2009	1983	2009	2009
Private	Lil Truckee Kyburz Crk	-120.263	39.5021	1982	1982	1982	1982	2003
Private	Lone Pine Creek	-118.17	36.5981	1998	1998			1998
Private	Mccarran Ranch Truckee River	-119.567	39.54671	2004	2004			2004
Private	Mineral Cold Crk Mdw	-121.632	40.33873	1997	1997	1997	1997	1997
Private	NW Almanor	-121.217	40.32868	1997	2008	2005	2008	2008
Private	Pahatsi Rd Mckay Crk	-120.405	39.312	2008	2008			2008
Private	Pig Creek Meadow Mccloud	-122.153	41.2179	1992	2004			2004
Private	Pine Creek Alturas	-120.529	41.45175	1994	2005	1995	2005	2005
Private	Ruffa Ranch Butt Crk	-121.412	40.17448	2005	2005	2005	2005	2005
Private	Sanges Slu Tributary Owen	-118.238	37.08044	2006	2006	2006	2006	2006
Private	Smith Creek Mohawk	-120.64	39.77108	1994	1994	1994	1994	1994
Private	Squaw Valley Crk Mccloud	-122.138	41.22919	1993	1993	1993	1993	1993
Private	Sulpher Crk -Clio F.R.	-120.57	39.73616	1986	1994	1986	1994	1994
Private	Suplher Creek Meadow	-119.289	37.14305	1985	1985			1985
Private	Sw Lake Almanor	-121.221	40.29403	1994	2013	1994	2013	2013

Ownership	Site name	Easting¹	Northing	First detection (all dates)	Last detection (all dates)	First detection (6/15 – 8/1)	Last detection (6/15 – 8/1)	Last visit
Private	Topsy Klamath River	-122.101	42.0254	1998	2008	1998	2004	2008
Private	Truckee Downtown	-120.174	39.33217	1915	1915	1915	1915	1915
Private	Truckee Marsh	-119.994	38.93391	1923	1923	1923	1923	2008
Private	Vicinity Tahoe City	-120.142	39.16684	1920	1920	1920	1920	1920
Private	Webber Lake NORT	-120.408	39.48946					1998
Private	Webber Lake WEST CAMP	-120.419	39.48948					1998
Private	Westwood Mill Pond	-120.992	40.30632	1986	2002	1986	2002	2002
Private	Williams Loop	-120.807	39.90948	1990	1990	1990	1990	1990
Private	Willow Creek	-120.885	41.91713					
Private	Willow Lake North	-121.369	40.40657	1998	2013	1998	2013	2013
Private	Willow Lake South	-121.349	40.39748	1990	2013	1990	2013	2013
Private	Wilson Creek Conway Ranch	-119.15	38.06096	2000	2005	2001	2002	2005
SEKI NP	General Grants	-118.963	36.7418	1940	1940	1940	1940	1940
SEKI NP	Lion Meadow	-118.981	36.74498	2008	2008			2008
SEKI NP	Simpson Meadow	-118.633	36.97289	1992	1992	1992	1992	1992
SEKI NP	Zumwalt Meadow	-118.597	36.79201	1984	1984			1984
SEKI NPS	Summit Meadow	-118.722	36.76823	1986	1986	1986	1986	1986
Sequoia NF	Converse Meadow	-118.973	36.80686	1992	1992	1992	1992	1992
Sequoia NF	Crane Meadow	-118.606	36.01036	1996	1996			1996
Sequoia NF	French Meadows	-118.342	35.46006	2001	2001			2001
Sequoia NF	Holey Meadow	-118.61	35.95866	1995	1995			1995
Sequoia NF	Lake Isabella Dam	-118.474	35.64804	1992	1992	1992	1992	1992
Sequoia NF	Lloyd Flat Area	-118.479	36.14725	2009	2009			2009
Sequoia NF	Mace Meadow	-118.314	35.40541	2001	2001			2001
Sequoia NF	Manter Meadow	-118.284	35.88142	1999	1999	1999	1999	1999
Sequoia NF	Mill Crk W. Squirrel Mdw	-118.582	35.47326	1991	1991			1991

Ownership	Site name	Easting¹	Northing	First detection (all dates)	Last detection (all dates)	First detection (6/15 – 8/1)	Last detection (6/15 – 8/1)	Last visit
Sequoia NF	Millwood	-119.003	36.74436	1992	1992	1992	1992	1992
Sequoia NF	Rodeo Flat	-118.208	36.05050	1999	1999			1999
Sequoia NF	Taylor Meadow	-118.293	35.83011	2000	2000			2001
Sequoia NF	Troy Meadow	-118.247	36.08090	1986	1997	1986	1997	2010
Shasta Trinity NF	Algoma Raccoon Crk	-121.878	41.25617	1987	2005	1987	2005	2005
Shasta Trinity NF	Bigelow Bundora	-122.003	41.22797	1986	2008	1986	2006	2008
Shasta Trinity NF	Cattle Camp Nitwit 4mile	-121.925	41.25962	1987	2006	1987	2006	2006
Shasta Trinity NF	Cedar Salt Log Crk	-121.988	41.06276	2008	2008			2008
Shasta Trinity NF	Colby	-121.793	41.20366	2005	2005	2005	2005	2005
Shasta Trinity NF	Curtis Cow Creek	-121.815	41.24013	2005	2006	2005	2006	2006
Shasta Trinity NF	Hazel Creek Sacramento Rv	-122.362	41.06167	1998	2010	1998	2010	2010
Shasta Trinity NF	Mcgee Creek	-121.966	41.05565	2008	2008			2008
Shasta Trinity NF	Pit River Potem Crk	-122.013	40.84550	2008	2008			2008
Shasta Trinity NF	Tate Creek Mccloud River	-121.934	41.24798	1986	2006	2006	2006	2006
Shasta Trinity NF	Vicinity Moosehead Crk	-121.799	41.17917	2005	2005	2005	2005	2005
Sierra NF	Cow Meadow	-119.206	37.42368	1985	1995	1985	1995	2010
Sierra NF	Crown Ridge South	-118.864	36.96050	1990	1990			1990
Sierra NF	Dinky Meadow	-119.165	37.04443	1980	1995	1980	1995	1995
Sierra NF	Grade/Poison Complex	-119.255	37.09499	1983	1999	1983	1998	2010
Sierra NF	Lilly Pad	-118.981	37.00884	1984	1984	1984	1984	2003
Sierra NF	Long Meadow (High Sierra)	-119.007	36.99204	1978	2008	1978	2008	2008
Sierra NF	Lost Meadow	-119.186	37.03247	1979	1983	1979	1983	2010
Sierra NF	Markwood Meadow	-119.23	37.09336	1982	2006	2003	2005	2010
Sierra NF	Poison Mdw San Joaquin River	-118.976	37.31261	1985	1985	1985	1985	1985

Ownership	Site name	Easting ¹	Northing	First detection (all dates)	Last detection (all dates)	First detection (6/15 – 8/1)	Last detection (6/15 – 8/1)	Last visit
Sierra NF	Quail Hollow Meadow	-119.175	37.10304	1989	1989			1989
Sierra NF	Ross Meadow	-119.068	36.95232	1995	1997	1995	1997	2010
Sierra NF	Stevenson Creek/Hwy168	-119.307	37.14204	1978	1985	1978	1978	1985
Sierra NF	Summit Creek @ Deer Camp	-119.212	37.08423	1977	1995	1977	1995	2010
Sierra NF	Summit Creek At Pollard	-119.224	37.08738	1983	2001	1983	2001	2010
Sierra NF	Summit Markwood	-119.25	37.10582	1984	1984	1984	1984	1984
Sierra NF	Swanson Meadow	-119.285	37.09782	1984	1984	1984	1984	1984
Stanislaus NF	Ackerson Meadow	-119.839	37.83932	1986	2012	1986	2012	2012
Stanislaus NF	Bloods Meadow	-120.043	38.45833	1936	1936	1936	1936	2002
Stanislaus NF	Eagle Meadow	-119.835	38.28303	1982	1992	1986	1992	2002
Stanislaus NF	Lily Lake	-119.969	38.15883	2012	2012			2012
Stanislaus NF	Long Valley 1 & 2	-119.8	38.27206	1982	1989			2002
Stanislaus NF	Upper Bell Meadow	-119.925	38.16561	1982	1982			2002
Stanislaus NF	Willow Meadow	-119.895	38.25524	1983	1993			2002
Tahoe NF	Butcher Ranch Lower	-120.692	39.62232	2004	2008	2004	2008	2008
Tahoe NF	Carman Knuthson Mdw	-120.441	39.70208	1992	2010	1995	2008	2010
Tahoe NF	Castle Valley	-120.353	39.34744	2008	2008	2008	2008	2008
Tahoe NF	Church Freeman	-120.616	39.67052	1993	1994			2004
Tahoe NF	Cottonwood Creek	-120.27	39.53802	2003	2010	2003	2010	2010
Tahoe NF	Donner Picnic Area	-120.176	39.37495	1995	2009	2008	2008	2010
Tahoe NF	Gold Lake Inflow	-120.667	39.66903	1997	2012	1999	2012	2012
Tahoe NF	Gold Valley	-120.71	39.65240	1997	2012	1999	2012	2012
Tahoe NF	Independence Lake	-120.329	39.43011	1998	2008	1998	2008	2008
Tahoe NF	L Truckee Below Stampede	-120.102	39.45137	2004	2004	2004	2004	2004
Tahoe NF	L Truckee Below	-120.1	39.43861	2004	2004	2004	2004	2004

Ownership	Site name	Easting ¹	Northing	First detection (all dates)	Last detection (all dates)	First detection (6/15 – 8/1)	Last detection (6/15 – 8/1)	Last visit
	Stampede							
Tahoe NF	Lake Van Norden	-120.363	39.31456	1991	2007	1991	1991	2008
Tahoe NF	Lewis Mill	-120.151	39.56074	2003	2012	2004	2012	2012
Tahoe NF	Little Perazzo	-120.365	39.48125	1997	2010	1997	2010	2010
Tahoe NF	Little Truckee 1 & 2	-120.35	39.49261	1982	2010	1997	2010	2010
Tahoe NF	Little Truckee 3	-120.325	39.49431	1982	2010	1982	2010	2010
Tahoe NF	Little Truckee 4 West	-120.301	39.49080	2006	2006			2008
Tahoe NF	Loney Meadow	-120.652	39.42135	2012	2012	2012	2012	2012
Tahoe NF	Lower Silver Creek	-120.208	39.22039	1984	1988	1984	1985	1988
Tahoe NF	Maiden Valley	-120.446	39.55112	2000	2000	2000	2000	2000
Tahoe NF	Middle Yuba @ Wagner Crk	-121.097	39.38668	2012	2012			2012
Tahoe NF	Milton	-120.574	39.52012	2001	2010	2002	2010	2010
Tahoe NF	Packer Creek	-120.642	39.62974	2003	2003	2003	2003	2003
Tahoe NF	Perazzo Meadow	-120.38	39.47559	1982	2013	1982	2013	2013
Tahoe NF	Rest Area - I80_ Boreal	-120.334	39.34120	2001	2001	2001	2001	2001
Tahoe NF	Saddle Meadow	-120.309	39.48884	1991	2000	1991	2000	2008
Tahoe NF	Sagehen Creek	-120.226	39.43501	1984	2002	1984	2002	2007
Tahoe NF	Salmon Creek	-120.617	39.62425	1993	2010	1993	2010	2010
Tahoe NF	Sierra Nevada Field Camps	-120.573	39.62556	2001	2001	2001	2001	2001
Tahoe NF	Silver Creek	-120.242	39.20597	1987	1987	1987	1987	1987
Tahoe NF	Stampede	-120.19	39.46285	2001	2010	2001	2009	2010
Tahoe NF	Ta32a Point Count	-120.988	39.54023	2013	2013			2013
Tahoe NF	Truckee River @Silver Crk	-120.202	39.22530	1984	1984	1984	1984	1984
Yosemite	Poopenaut Meadow	-119.82	37.91979	1999	1999			2007
Yosemite NP	Big Meadow	-119.749	37.70556	1993	2010	2010	2010	2010
Yosemite NP	Crane Flat	-119.802	37.75696	1993	2009	1993	2001	2009

Ownership	Site name	Easting¹	Northing	First detection (all dates)	Last detection (all dates)	First detection (6/15 – 8/1)	Last detection (6/15 – 8/1)	Last visit
Yosemite NP	Gin Flat	-119.762	37.76634	2000	2000			2000
Yosemite NP	Hodgdon Meadow	-119.864	37.79464	1986	2012	1986	1999	2012
Yosemite NP	Mirror Lake	-119.545	37.75378	2005	2006	2006	2006	2007
Yosemite NP	Peregoy Meadow	-119.623	37.66629	1974	1974			2007
Yosemite NP	Smith Meadow	-119.768	37.91084	1999	1999			2007
Yosemite NP	Upper Tamarack Creek/Flat	-119.743	37.77953	1994	1996			1996
Yosemite NP	Wawona Meadow	-119.644	37.52942	1982	2007	1982	2007	2007
Yosemite NP	Westfall Meadow	-119.634	37.65305	1986	1986	1986	1986	2007

Appendix B. Detailed site history of presence (1) or absence (0) of Willow Flycatchers between June 15 and Aug 1, annually. Sites are listed from north to south by latitude.

Ownership / land manager	Site name	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Private	Topsy Klamath River															1		1			1									
Modoc NF	Dismal Swamp 12mile Creek										1									1					0	0				
Modoc NF	Willow Creek Ranch																						1							
Modoc NF	Lassen Crk @ Cold Crk										1																			
Modoc NF	Headwaters Cold Creek																					1								
Klamath NF	Antelope Creek																								1					
Modoc NF	Willow Spring Branch																				1		1							
Private	Pine Creek Alturas												1	1	1			1		1	1	1								
Shasta Trinity NF	Cattle Camp Nitwit 4mile				1																	1	1							
Shasta Trinity NF	Algoma Raccoon Crk				1																	1								
Shasta Trinity NF	Tate Creek McCloud River																					1								
Shasta Trinity NF	Curtis Cow Creek																					1	1							
Private	Squaw Valley Crk McCloud										1																			
Shasta Trinity NF	Bigelow_Bundora			1	1					1												1	1							
Shasta Trinity NF	Colby																					1								
Modoc NF	South Fork East Crk										1	1								1		0				0	0			
Modoc NF	Patterson Mill										1	1								1	0					0	0			
Private	Bear Creek Se Pondosa															1														
Shasta Trinity NF	Vicinity Moosehead Crk																					1								
Modoc NF	Mosquito Creek																			1		1								
Modoc NF	Blue Lake Ranch Meadow	1			1															1										
BLM	Dry Creek													1																

Ownership / land manager	Site name	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Shasta Trinity NF	Hazel Creek Sacramento RV														1											1				
Lassen NF	Susan River									0		0									1									
Lassen NP	Hot Springs Creek													1					1		1	1		1	1					
Lassen NF	Hay Meadow Vicinity											0			0				0		1									
Lassen NF	Hay Meadow									0	1	0			0	0		0	0	0	0	0	0	0	0	0	0	0	0	0
Lassen NF	Swain Meadow							1		0	1	1	1	0	1	1	1	1	1	1	1	1	1		1	1	1	1	1	0
Lassen NF	Susan River S. Hog Flat													1		1	1											1		
Lassen NP	Spencer Meadow							1											1											
California State	Warner Valley												1		1	1	1	1	1	1	1	1			1		1	1	1	1
Private	Willow Lake North														1	1	0	1	1	1	1	1			1	1	1		1	1
Private	Willow Lake South							1		0		0	1		1	1	1	1	1	1	1	1			1	1	1		1	1
Lassen NF	Robbers Creek									0		0		0																
Lassen NF	Brokenshire Mill Creek														1	1			0							1				
Lassen NF	Battle Creek Meadow			1																										
Private	Mineral Cold Crk Mdw													1																
Private	Childs Meadow																											1	1	1
Private	NW Almanor																				1				1					
Lassen NF	Gurnsey Creek			1						1	1	1		1	1	0	0	0	0	0	1	0	0	0	1	0	0	1	0	0
Private	Westwood Mill Pond			1															1											
Private	SW Lake Almanor							0				1	1		1		1		1	1	1	1	1	1	1	1	1	1	1	1
Plumas NF	Pierce Creek																		1											
Private	Deerheart Creek															1														
Plumas NF	Boulder Creek																		1											
Lassen NF	Soldier Creek																		0	0	0	0	0	1	0	0	0	0	0	0
Private	Fanani Meadow																			0	1	0	1	0	0	0	0	0	0	0
Lassen NF	Savercool Place													1																

Ownership / land manager	Site name	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	
Lassen NF	Butt Creek										0	1	1		1	1	1	1	1	1	1	1	1		1	1	1			1	
Plumas NF	Little Antelope Creek																1			0		1									
Lassen NF	Butt Crk Lower Exclosure													0												1					
Plumas NF	Wolf Creek																														
Lassen NF	Yellow Crk East & West										0		0		0				0	0	0	0	0	0	1	0	1	0	1	1	
Lassen NF	Humbug Creek			1												1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	
Private	Humbug Valley			1										1				0	1			1		1	1	1	1	1	1	1	
Plumas NF	Round Valley Reservoir			1						1	1		1						1	1		1									
Plumas NF	Doyle Crossing															1	1		0			1				0	0	0	0	0	
Plumas NF	Arlington Bridge									1	1								1							1			1		
Plumas NF	Lower Squaw Queen Creek																						1								
Lassen NF	Coon Hollow									1					0								0	0	0	0	0	0	0	0	
Plumas NF	Red Clover trib																						1								
Plumas NF	Red Clover Pnf-Bk-10807																					1		1			1	0	0		
Plumas NF	Right Hand Branch Mill Ck																		1												
Plumas NF	Chucks Rock										1								1												
Plumas NF	Lower Freeman Creek																						1								
Private	Williams Loop							1																							
Plumas NF	Crocker Creek											1																			
Plumas NF	Freeman Creeknf-BK-11103																			0		1	1								
Private	Haskins Valley			1															1			1									
Plumas NF	Grizzly Crk Bucks Lake S.																		1	0	0	1									
Plumas NF	Faggs Pond																		1			1									
Plumas NF	Sloat Creek Tributary																							1							
Plumas NF	Rocky Point			1		1													0			0	0								
Plumas NF	Ramelli Ranch												1		0				1			1	0								

Ownership / land manager	Site name	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Plumas NF	East Portola					1																								
Plumas NF	Delleker							1											1			0								
Plumas NF	Mabie																		1	1	1	1		0	1					
Private	Smith Creek Mohawk											1																		
Plumas NF	Mcrae Meadows			1							1	1			1							1		1	0					
California State	Solari Meadow								1			1			1															
Private	Sulpher Crk -Clio F.R.			1								1																		
Plumas NF	Grass Lake										1				1				1	1		1								
Plumas NF	Gray Eagle Lodge											1			1				1	1										
Tahoe NF	Carman Knuthson Mdw												1		1	0									1					
Tahoe NF	Church Freeman														0					0	0									
Plumas NF	Gold Lake Inflow																1			1	1	1			1				1	
Tahoe NF	Gold Valley																1			1	1	1			1				1	
Tahoe NF	Packer Creek																			1										
Tahoe NF	Sierra Nevada Field Camps																													
Tahoe NF	Salmon Creek										1						1		1	1	1	1	1		1	1	1			
Tahoe NF	Butcher Ranch Lower																				1				1					
Tahoe NF	Lewis Mill																				1	0							1	
Tahoe NF	Maiden Valley																	1												
Tahoe NF	Cottonwood Creek																			1	1	1	1	1	1	1	1	1		
Tahoe NF	Milton																		1	1	1	1	1	1	1	1	1	1		
Private	Lil Truckee Kyburz Crk																													
Tahoe NF	Little Truckee 3															1	1	1	1	1	1	1	1	1	1	1	1	1		
Tahoe NF	Little Truckee 1 & 2														1	1	1	1	1	1	1	1	1	1	1	1	1	1		
Tahoe NF	Little Truckee 4 West																				0	0			0					
Tahoe NF	Saddle Meadow								1							1	1	1		0			0	0	0					

Ownership / land manager	Site name	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Tahoe NF	Little Perazzo														1	1	1	1	1	1	1	1	1	1	1	1				
Tahoe NF	Perazzo Meadow									1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	
Private	Lacey Valley/ Webber Lake			1												1	1	1	1	1	1	1	1	1	1					
Tahoe NF	Stampede																		1	1	1	1	1		1	1				
Tahoe NF	L Truckee Below Stampede															0			0		1									
Tahoe NF	Sagehen Creek	1														0			1					0						
Tahoe NF	Independence Lake															1	1	1	1	1	1	1	1	1						
Tahoe NF	Loney Meadow														0													1		
Private	Carpenter Valley/Prosser															1	1	1	1	1	1	1	1							
Tahoe NF	Donner Picnic Area														0								0		1		0			
Private	Hirshdale Truckee River									1																				
Tahoe NF	Castle Valley														0										1					
Tahoe NF	Rest Area - I80_ Boreal																													
Private	Billy Mack Flat											1																		
Tahoe NF	Lake Van Norden								1							0									0					
California State	Martis																				1	1	1	1	1	1	1			
Nevada State	Little Valley Franktown															1														
Tahoe NF	Truckee River @Silver Crk	1																												
Tahoe NF	Lower Silver Creek	1	1																											
Tahoe NF	Silver Creek				1																									
California State	Antone Mdws - Burton Crk																						1	0						
Private	Vicinity Tahoe City																													
LTBMU	Ward Creek	1										1																		
LTBMU	Blackwood East																					1								
LTBMU	Blackwood West														0					1	1	1	1	1	1	1	0			
LTBMU	Meeks Bay																					0					1	0		

Ownership / land manager	Site name	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
LTBMU	Edgewood Creek																				1									
LTBMU	Tallac									0									1	1	1	1	1	1	1	1	1	1		
LTBMU	Taylor Creek Lagoon								1							0			0	0	1	0	0	0	1	1	1			
Private	Heavenly Valley West																				1									
Private	Bijou Golf Course																													
Private	Truckee Marsh															0									0					
LTBMU	Spring Creek																								1		1			
LTBMU	Trout Creek Main															0			1	0		0			0					
LTBMU	Trout/Sierra House/Cold												1			0			0	0										
LTBMU	Upper Truckee Airport															0				1					0	0	0	0		
LTBMU	Lilly Lake																		1	1		0						0		
California State	Washoe State Park/ Upper														1	1	1		0		0				0					
Eldorado NF	Vadn																													
LTBMU	Morton St, Upper Truckee															1	0	0	0	0			0				0	0		
LTBMU	S. Upper Truckee Rd Homes															1	1		1		1	1	1		1					
LTBMU	Uppermost Upper Truckee															1	1	1	1	1			1		1	1	1			
LTBMU	Grass Lake															1	1	1	0	0	0			0	0	0	0			
LTBMU	Cookhouse Meadow														0				1						0					
Humboldt Toiyabe NF	Maxwell Creek															1	1	1	0		0		0		0					
Eldorado NF	Packsaddle Pass Road	1																												
Humboldt Toiyabe NF	Red Lake Peak																			1	1	1	1		0					
Eldorado NF	Caples Creek At Kirkwood														0															
California State	Red Lake 1								1	1					1	1	1	1	1	1	1		1		0					
California State	Red Lake 2									1					1	1	1	1	1	1	1		0		0					
Humboldt	Faith Valley			1											0		0		1	1		0		0						

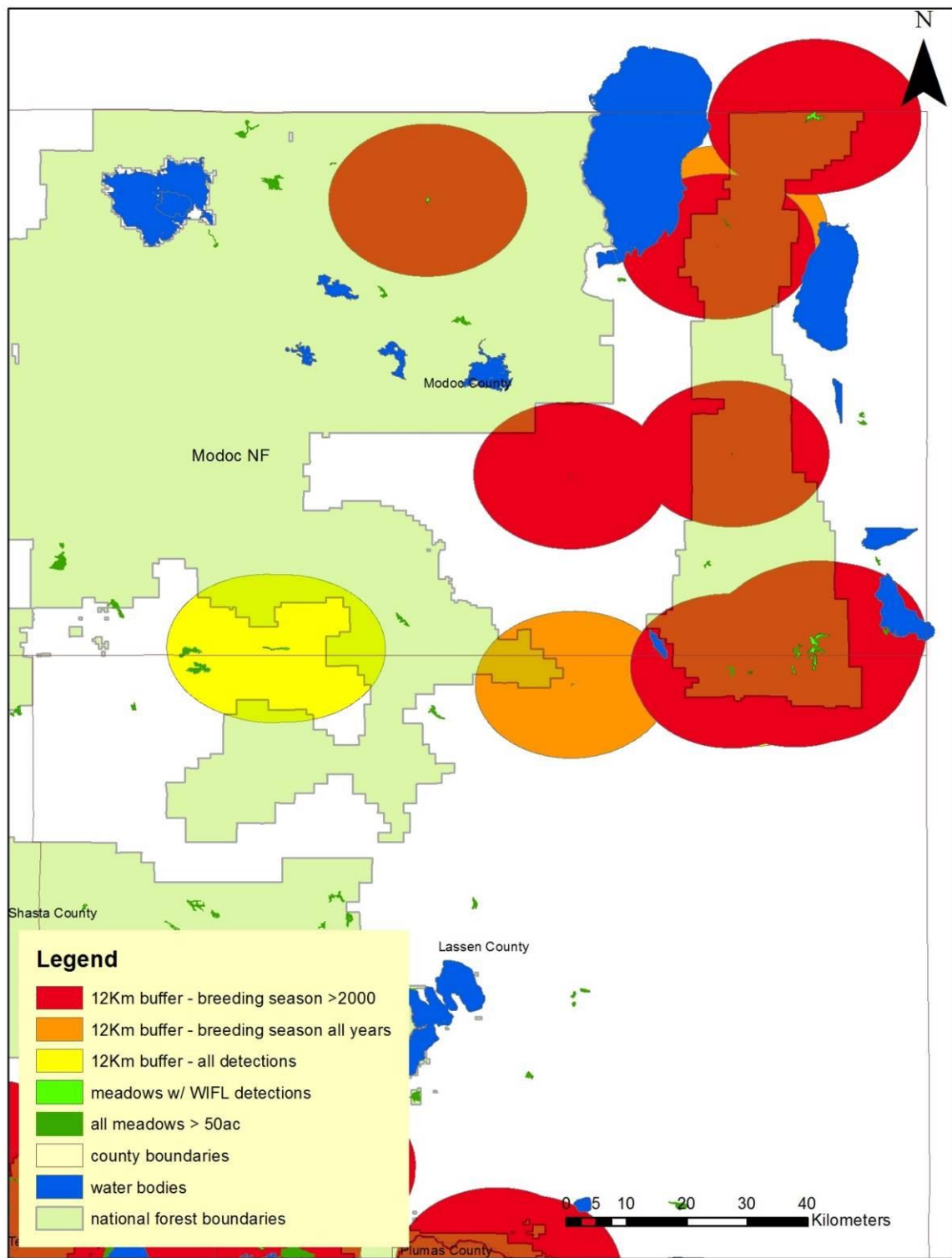
Ownership / land manager	Site name	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Toiyabe NF																														
Eldorado NF	Woods Lake																			0	0			0						
Humboldt Toiyabe NF	Upper Forestdale Creek																		1	0			0		0					
Humboldt Toiyabe NF	Charity Valley			1																1										
Humboldt Toiyabe NF	Wet Meadows Reservoir																			0					1					
Eldorado NF	Indian Valley																			1	1					1				
Humboldt Toiyabe NF	Raymond Meadows																			0	1									
Stanislaus NF	Bloods Meadow																		0											
Private	East Walker River																										1			
Stanislaus NF	Eagle Meadow			1						1										0										
Stanislaus NF	Long Valley 1 & 2																		0											
Stanislaus NF	Willow Meadow																		0											
Stanislaus NF	Upper Bell Meadow																		0											
Private	Hull Meadow																		0											
Private	Wilson Creek Conway Ranch																		1											
Inyo NF	Mill Creek Mono City																			1										
Inyo NF	Lower Lundy Canyon			1																										
Inyo NF	Lee Vining Creek																			1		1								
Inyo NF	Ellery Lake																													
Inyo NF	Upper Lee Vining Creek			1																										
Inyo NF	Rush Creek															1		1	1	1	1		1	1			0			
Yosemite NP	Poopenaut Meadow																						0	0						
Yosemite NP	Smith Meadow																						0	0						
Inyo NF	Bohler Canyon											1																		
Inyo NF	Dexter Creek																				1									

Ownership / land manager	Site name	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Stanislaus NF	Ackerson Meadow			1									1						0										1	
Inyo NF	Parker Lake																													
Yosemite NP	Hodgdon Meadow			1				1	1	1	1	1	1		1		1						0	0	0	0	0	0		
Inyo NF	Silver Lake Rush Creek																													
Inyo NF	Rodeo Evans																													
Yosemite NP	Crane Flat										1												0							
Yosemite NP	Mirror Lake																						1	0						
Yosemite NP	Big Meadow																							0	0	0	1	0		
Yosemite NP	Peregoy Meadow																						0	0						
Yosemite NP	Westfall Meadow			1																			0	0						
Inyo NF	Mammoth Creek																													
Inyo NF	Convict Creek																		1											
Inyo NF	Mcgee Creek															1														
Inyo NF	Cottonwood Creek																													
Yosemite NP	Wawona Meadow			1																				1	0	0	0	0		
Private	Beasore Meadow			1																										
Sierra NF	Cow Meadow		1										1						0	0		0	0		0	0	0			
Private	Chalk Bluff Owens Rvr															1														
Private	Farmington Ranch - Laws																													
Private	Horton Creek																			1										
Sierra NF	Poison Mdw San Joaquin River		1																											
Sierra NF	Stevenson Creek/Hwy168																													
Sierra NF	Summit Markwood	1																												
Sierra NF	Swanson Meadow	1																												
Sierra NF	Grade/Poison Complex	1	1	1	1	1					1		1			1			0	0		0	0			0	0			
Sierra NF	Markwood Meadow																		0	1		1				0	0			

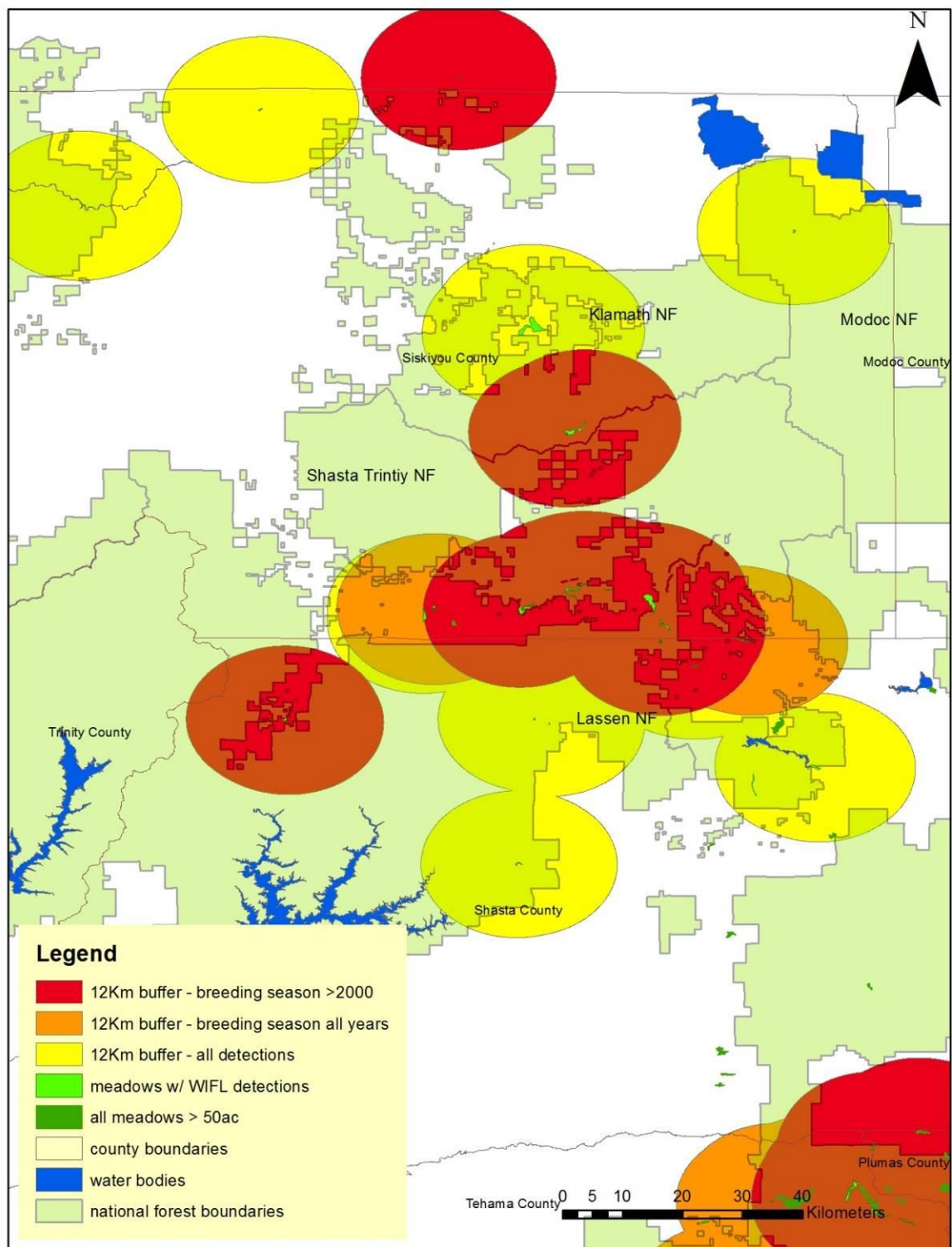
Ownership / land manager	Site name	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Sierra NF	Summit Creek At Pollard	1	1	1		0	0		0	0	0	0	0		0	0			0			0	0			0	0			
Sierra NF	Summit Creek @ Deer Camp	1	1	1	0				0		0	1	1		0	0			0	0		0	0			0	0			
Private	Sanges Slu Tributary Owen																					1								
Private	Birch Creek 1								1																					
Sierra NF	Dinky Meadow	1	1	1	1		1			1	1		1																	
Sierra NF	Lost Meadow															0			0	0		0	0		0	0	0			
Sierra NF	Lilly Pad	1																		0										
Sierra NF	Long Meadow (High Sierra)	1	1	1	1	1	1				1		1							0	1				1					
SEKI NP	Simpson Meadow									1																				
Sierra NF	Ross Meadow											1			1	0	0	0	0	0		0	0	0	0	0	0			
Private	Carls Walters Ranch																													
Sequoia NF	Converse Meadow									1																				
Inyo NF	Grays Mdw Independence Crk																	1												
SEKI NP	Summit Meadow			1																										
Sequoia NF	Millwood									1																				
SEKI NP	General Grants																													
Inyo NF	Salt Lick Meadow															1														
Sequoia NF	Troy Meadow			1											1				0								0			
Sequoia NF	Manter Meadow																1													
Sequoia NF	Taylor Meadow																													
Private	Canebrake																			1	1									
Nature conservancy	Kern River Preserve																			1	1								1	
Sequoia NF	Lake Isabella Dam									1																				

Appendix C.

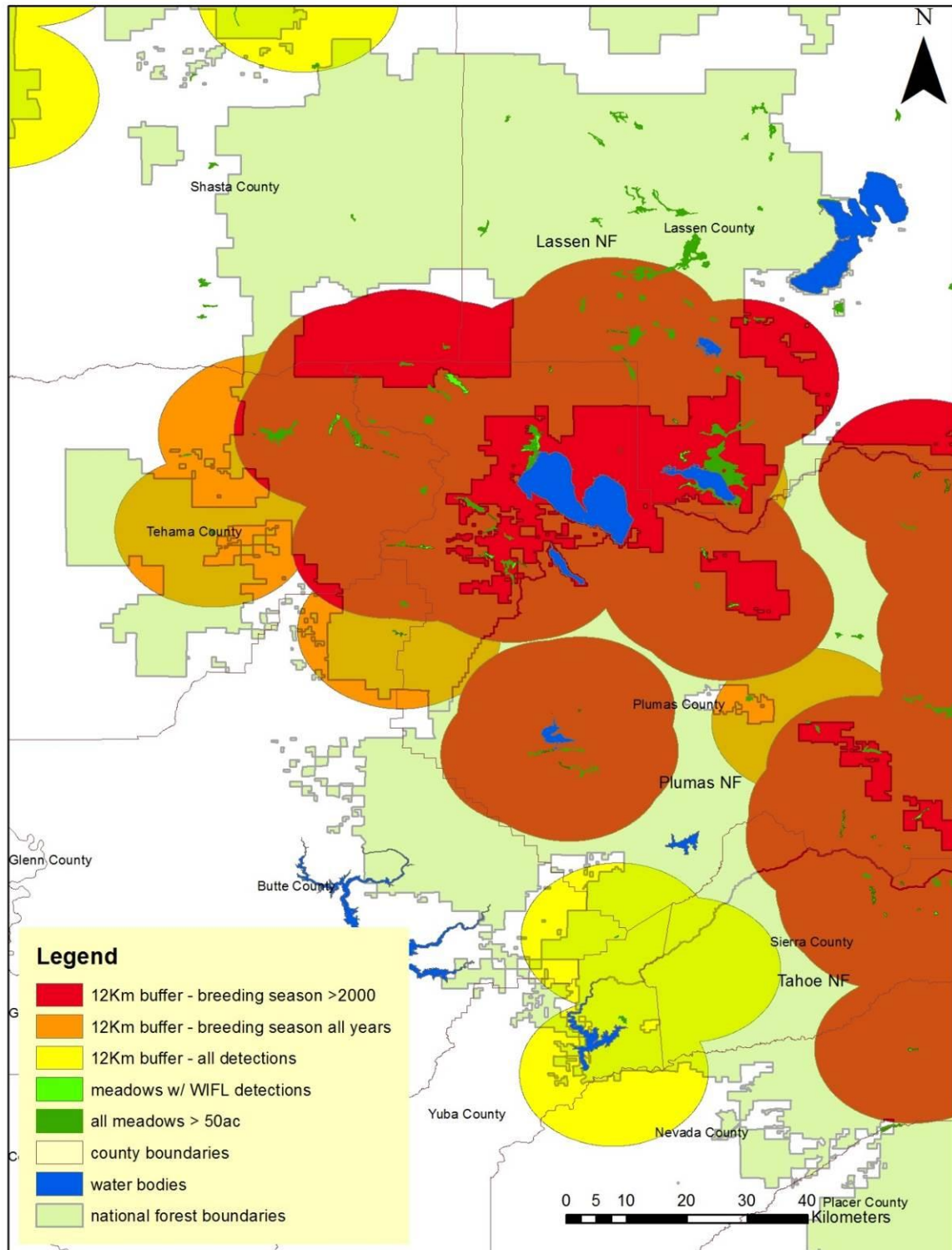
Sierra Nevada and southern Cascade Willow Flycatcher locations with 12-km dispersal buffers



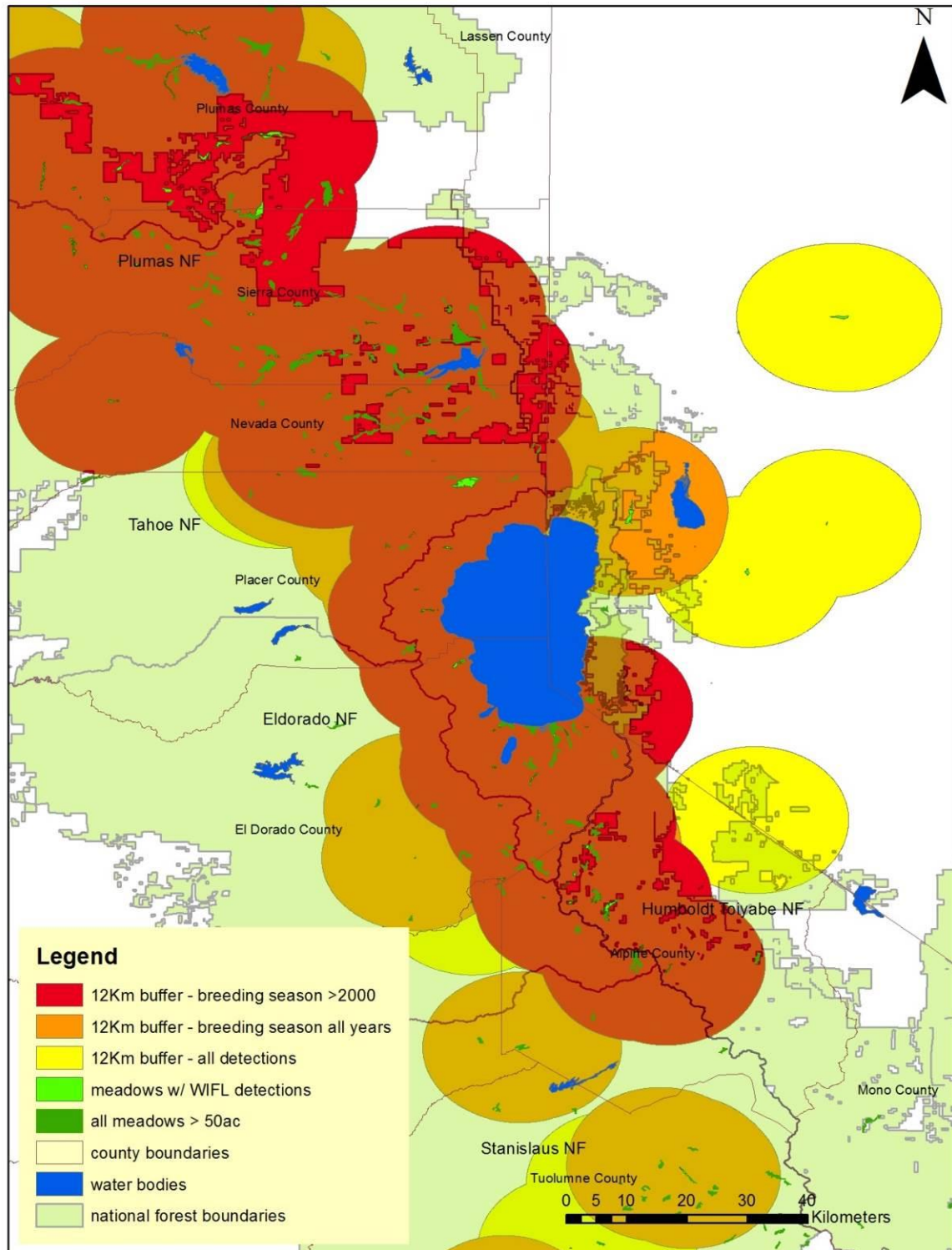
Vicinity Modoc National Forest



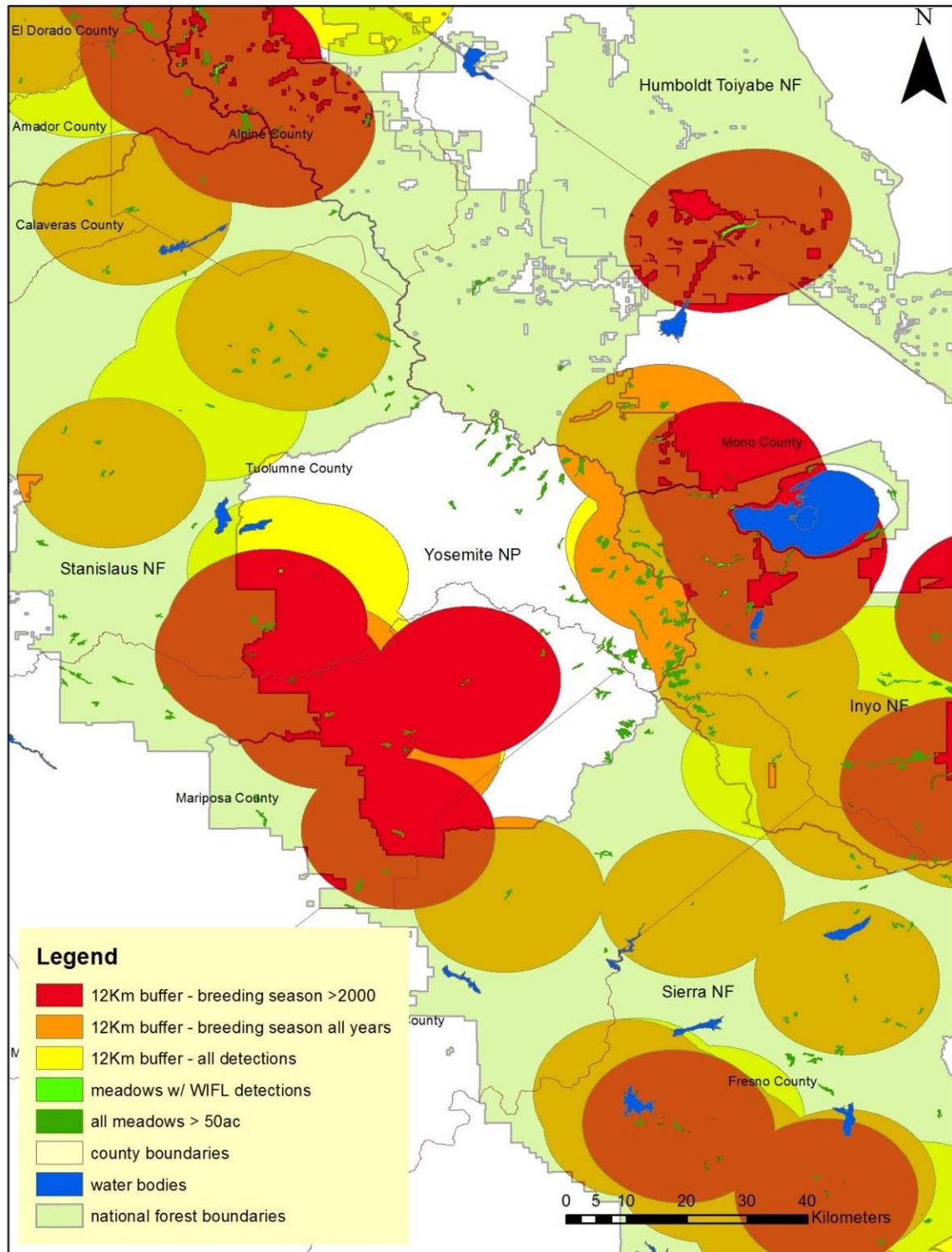
Vicinity Klamath, Modoc, Shasta Trinity National Forests



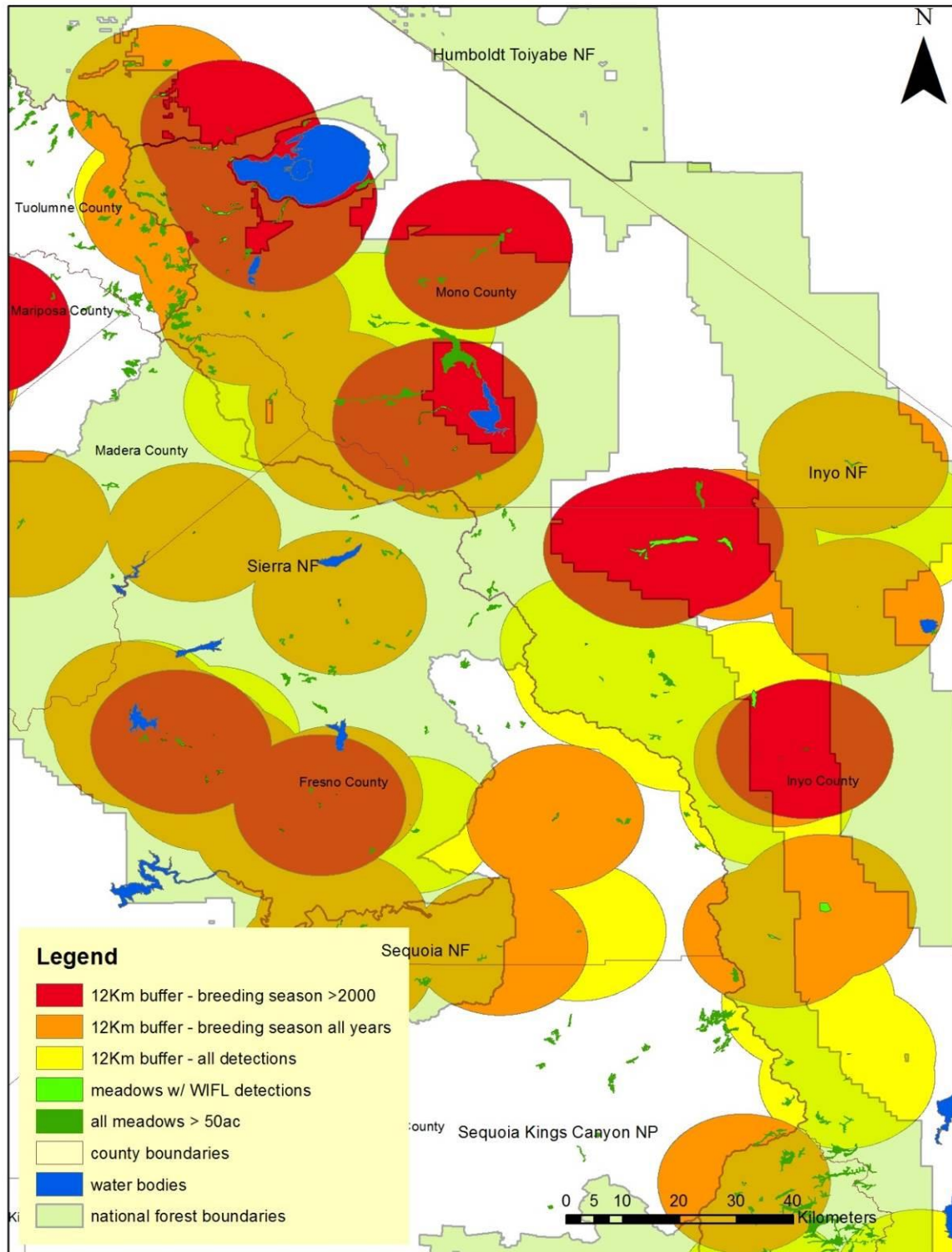
Vicinity Lassen, Plumas, Tahoe National Forests



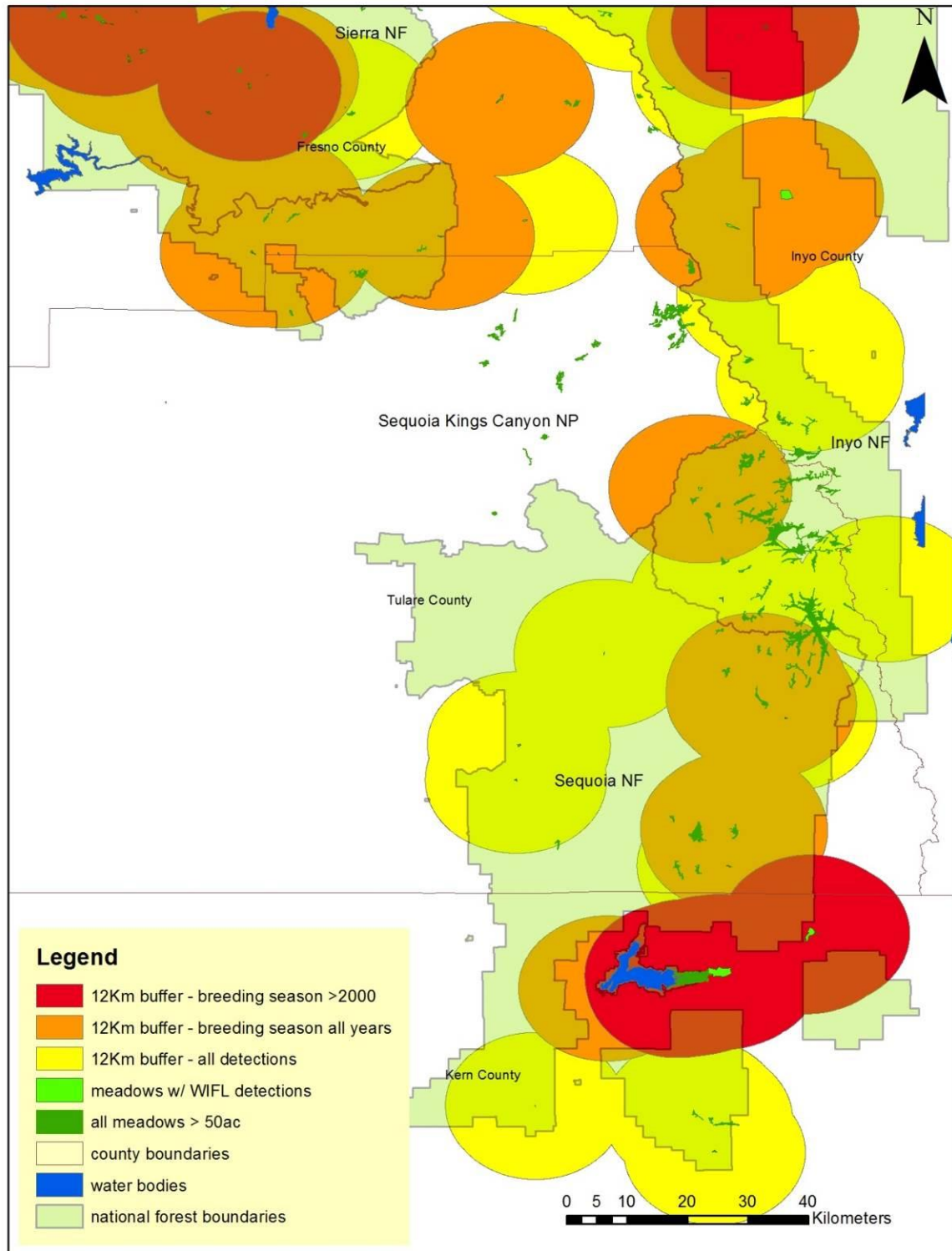
Vicinity Plumas, Eldorado, Tahoe, LTBMU, Humboldt Toiyabe National Forests



Vicinity Yosemite National Park, Stanislaus and Sierra National Forests



Vicinity Sierra and Inyo National Forests



Vicinity Sequoia and Inyo National Forests