Point Blue Report

Monitoring Bird Response to Childs Meadow Restoration

 

2016 Annual Report to The Nature Conservancy

DECEMBER 2016

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Conservation science for a healthy planet

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Cover photo: *Beaver ponds and Song Sparrow nestlings at Childs Meadow. Photos by Wendy Willis.*

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EXECUTIVE SUMMARY

The Nature Conservancy and its partners are studying the efficacy of using beaver-dam analogs and other low-cost restoration actions to increase carbon storage, improve water storage capacity, and increase populations of meadow birds and Cascades frog in Childs Meadow. The primary objective of Point Blue's research within this project is to measure the response of meadow birds to the restoration. In this report we provide an update on our 2015 and 2016 activities and a synthesis of our findings to-date.

As expected, we did not yet observe any effects of willow planting or riparian fencing on the bird community in the first breeding season following these restorative actions. Among the five study reaches, the highest territory densities of meadow focal bird species were in the US Forest Service reach with 7.4 territories per ha, followed by 4.5 on the Positive Control reach. The negative control and two treatment reaches had very low densities or no territories at all.

We found 154 focal species nests in 2015 – 2016. The proportion of nests resulting in at least one fledged young was higher in USFS reach (0.71) than the Positive Control reach (0.57), both of which were higher than the three upstream reaches with limited sample sizes. Results from habitat assessments at these nests and random locations in each study reach demonstrate use of a habitat structure for nesting that was generally unavailable to birds in the Negative Control and the two treatment reaches, primarily because of a lack of shrub cover and water over the meadow surface.

The positive control reaches illustrate the large potential of the upstream reaches to support bird habitat in a restored condition. Our first two years of data provide a solid foundation from which to evaluate whether the treated reaches achieve that potential.

ACTIVITIES

2015

- Point Blue initiated a study of bird response to riparian fencing and beaver-dam analog restoration of Childs Meadow along five reaches of Gurnsey Creek.
- Two interns and one field supervisor censused birds using spot-mapping, nest monitoring, and point count methods from May – July 2015.
- We completed habitat assessments at 64 nest locations and 138 random locations within the 5 study reaches in July – August 2015.
- We helped design and implement initial willow planting in October 2015.

2016

- We planted approximately an additional 245 willows in May 2016 with a crew of 8 people.
- Two interns and one field supervisor censused birds using spot-mapping, nest monitoring, and point count methods from May – July 2015.
- We completed a willow survival survey in June 2016 of all willows planted to date.
- We completed habitat assessments at 90 nest locations and 140 random locations within the 5 study reaches in July – August 2015.
- Three Point Blue staff members assisted in beaver-dam analog construction in October 2016.

INTRODUCTION

Restoration practitioners are increasingly using beaver to accomplish stream, wetland, and floodplain restoration (Pollock et al. 2015). The activity of beaver, or creating structures that mimic their behavior, impounds water and retains sediment, thereby substantially altering the physical, chemical, and biological characteristics of the surrounding riparian ecosystem, providing benefits to plants, fish, wildlife, and people. There are several mechanisms by which this occurs. Beaver dams increase the vertical and lateral connectivity of rivers and create heterogeneous habitat for riparian birds and frogs. For example, in a study of beaver-modified streams in Wyoming, McKinstry et al. (2001) found that the riparian width in streams with beaver ponds averaged 111 feet, in contrast to 35 feet in streams without beaver. Beaver dams also increase surface and groundwater storage, store sediment and organic material, and increase the frequency of overbank flow. The dams attenuate moderate and small flood flows and increase late-season flows, sometimes converting intermittent streams into perennial ones (Naiman et al 1998). By raising the water table with dams, beaver increase the productivity of riparian and aquatic vegetation that they rely on for forage, which in turn increases carbon storage and habitat value to riparian- and meadow-dependent species.

Intensive livestock grazing and widespread removal of beaver and willows, along with other land uses, have transformed many of the Sierra Nevada's riparian meadows from multi-thread channels with seasonally active floodplains into single-thread, incised channels that store less carbon and are lower in habitat quality for a diverse suite of meadow-dependent wildlife. Compared to upland habitats, cattle congregate and forage more intensively in riparian areas where vegetation is most productive. Beaver populations, where they have been reintroduced or survived naturally, have failed to recover in riparian areas that are heavily grazed by cattle or ungulates like elk. This, combined with active and persistent removal of willows from meadow systems by landowners has limited beaver populations and other ecosystem processes (Ripple and Beschta 2004, Baker et al. 2005, Beschta and Ripple 2011). As a result of these broad-scale changes to meadow function, their capacity to serve as natural sinks for carbon, to store and release water during the summer months, and to provide habitat for meadow-dependent wildlife have been severely compromised across the Sierra Nevada mountain range.

The Nature Conservancy and its partners in this research are in the process of restoring Childs Meadow using beaver-dam analogs among other restorative actions, to increase carbon storage, improve water storage capacity, and increase populations of meadow birds, amphibians, and other sensitive meadow-dependent species. Childs Meadow is a 290-acre meadow near Lassen National Park that is typical of many Sierra Nevada and southern Cascades meadows, having been grazed at levels common to other meadows, yet it has also been colonized by beavers in two reaches in the lower section of the meadow. This land-use history and mosaic provides the foundation for our study design: seasonally grazed meadow and meadow with natural beaver ponds can be compared to areas with restoration treatments in the same meadow complex. The Childs Meadow project is using a modified Before-After Control-Impact design to test the impacts of lost-cost restoration treatments in the middle portion of the meadow on carbon sequestration, hydrology, and sensitive species (Figure 1). Point Blue is one of the primary collaborators in the research, with the responsibility of measuring the response of meadow-dependent birds to the restoration. More specifically, we are testing the hypothesis that removing livestock grazing from the riparian area, planting willows, and building beaver-dam analog (BDA) structures in the restoration treatment area will create more habitat for sensitive and meadow-dependent bird species than what was available prior to treatment.

METHODS

Sampling Design

Childs Meadow is located 10 miles from the south entrance to Lassen National Park. It is 7.5 miles northwest of the intersection of highway 36 and 32. The 290-acre meadow runs northwest-southeast along Gurnsey Creek, which flows into Deer Creek about 4 miles downstream. The restoration project includes two treatment reaches—referred to as Riparian Fence and BDA (beaver-dam analog)—and three control reaches—Negative Control, Positive Control, and USFS (USDA Forest Service). The Negative Control reach is just upstream of the two treatment reaches; willows were planted, but cattle grazing continues there. The two restoration treatments are in the central section of Childs Meadow. The Riparian Fence reach included willow planting and the exclusion of cattle from the reach using an electric fence. The BDA reach includes a combination of willow planting, cattle exclusion via an electric fence, and beaver-dam analogs (BDAs). Five BDA's were installed in October 2016 after all data in this report were collected.

Willows were planted in October of 2015 and April 2016 at equal densities and similar configurations across the negative control, riparian fence, and BDA reaches. Willow stakes were planted in pods. Pods consisted of three 15-willow-stake clusters. Within a cluster 0.5 – 2-inch willow stakes were planted 1 – 2 m apart. Stakes were planted approximately 2 – 3 feet deep with a goal of getting them deep enough to intercept the dry season water table. Clusters within a pod were 15 m apart such that each pod spanned approximately 50 m. Each pod was spaced 45 m apart. We then planted willow stakes every 5 meters along the stream channel between each pod. This resulted in approximately 261 willow stakes planted per reach or approximately 65 willows per hectare. Willows were not planted in the Positive Control or USFS reaches. The electric fence was erected in October 2015 following all 2015 data collection. The Positive Control reach was grazed up until July 2015 when a cross fence approximately 1 km upstream was erected that subsequently excluded all grazing. This reach has had beaver activity for at least 6 years (probably longer) and is characterized by multiple dams, ponds, and beaver herbivory. The USFS reach has had beaver activity for 10 (downstream) to over 20 years (upstream) and has been ungrazed for over 20 years; there are multiple dams and one large pond. No willows were planted or BDAs installed in either of these reaches. We divided these five reaches into seven study plots (Figure 1), with the two positive control reaches each divided into 2 plots.

Focal Species

We identified seven focal species to monitor in Childs Meadow based on our local knowledge of the system and our expert knowledge of the Sierra Nevada avifauna (Table 1). Our primary considerations for inclusion were a strong association with meadow or riparian habitat, appropriately surveyed with territory mapping and point count methods, and known to be present and nesting within the Childs Meadow complex. As a sum, these species represent a range of meadow habitat attributes. Throughout this report we refer to the species by their four-letter codes listed in Table 1.

Territory Mapping and Densities

Territory mapping is an intensive census method used for determining the density of bird territories in an established area or plot. The density of territories can be used as an indicator of habitat quality, especially when combined with results from nest monitoring (Johnson 2007). We mapped the breeding territories for all focal species on each of the seven study plots in 2015 and 2016. Within each year, the same observer censused each plot at least eight times during peak activity hours during the breeding season. Singing, conspecific aggression, or any other territorial behavior was noted and marked on an aerial photo of the plot. Two preliminary maps of territories for each species were made one-third and two-thirds of the way through the breeding season. A final territory map for each species was made at the end of the breeding season. Field crew supervisors assisted interns in developing all maps. Final territory polygons were digitized with Google Earth software. To calculate territory densities for each plot, the authors assigned the percent of each territory that intersected each plot. Each territory was given a value from 0 – 100% based on the proportion of the polygon that was within the plot boundary. The territory values for each species were summed to yield the number of territories per plot. We standardized the number of territories per plot as a density of the number of territories per hectare to allow comparison between study plots of different size. We present territory density for each of seven focal species by reach and year and average densities per plot across both years combined. Data from the two Positive Control and the two USFS controls plots were combined in the analysis.

Nest Monitoring and Nest Success

Nest monitoring can provide detailed information on productivity, nest parasitism rates, and nesting habitat selection. Productivity and parasitism rates are direct measures of population health, and provide additional insight into habitat quality beyond metrics of species density.

Nest finding and monitoring followed the guidelines outlined in Martin and Geupel (1993). Nests were located at all stages: construction, egg-laying, incubation, and nestling. Nests were checked in a way to minimize human disturbance, including keeping visits brief, minimizing disturbance to the area around a nest, and avoiding nest sites when predators were detected nearby. Each nest found was monitored at least every four days (often more frequently) until the nest either fledged young or failed. Observers attempted to confirm the presence of fledged young with repeated visits to each territory.

Nest searching effort was commensurate with focal species densities. The Positive Control and USFS reaches were each divided into two plots, such that they received much more effort than the BDA, Riparian Fence, or Negative Control plots due to the lack of focal species detected on the latter plots. We searched for nests on the Positive

Control and USFS plots 2 – 4 days per week from May 15 – July 8. Nest searches began around 0600 and lasted 4 – 6 hours. The BDA, Riparian Fence, and Negative Control plots were searched 1 – 2 days per week and nest searches lasted circa 2 hours.

In this progress report we use proportional nest success as the metric of nest success. Proportional nest success was calculated by dividing the number of nests that fledged at least one of their own young (fledging only cowbirds was considered unsuccessful) by the total number of nests with known outcomes. It is important to note that estimates of nest success from proportional calculations are likely biased high because nests failing early in the nesting cycle may be missed by observers. In the future, as our sample sizes increase, we will use less biased methods for calculating nest success, such as evaluating daily nest survival and taking into consideration the amount of time a nest was exposed to predation and other causes of failure (Mayfield 1975 and Johnson 1979). These methods require large sample sizes to provide meaningful estimates of nest survival. With one more year of data at the USFS and Positive Control study plots we will be able to use these methods for about half of our focal species.

Habitat Assessments

We measured the vegetation and various habitat conditions associated with each nest and a set of randomly selected locations on each plot in each year. We selected 20 random locations within each study plot using a random point generator in ArcMAP version 10.3, yielding 20 points in the three upstream reaches and 40 points in each of the Positive Control and USFS reaches. We sampled the habitat conditions at each nest and random location using a slightly modified version of the Breeding Biology Research and Monitoring Database protocol for vegetation measurements (Martin et al. 1997). Herbaceous and shrub vegetation were sampled in a 5-m radius plot, and trees on an 11.3-m radius plot, centered on the nest or random location. We made visual estimates of vegetation cover in the three vegetation layers: herbaceous, shrub, and tree. We estimated relative cover of each species for the tree and shrub layers and the relative cover of forb, grass, and sedge/rush species in the herbaceous layer. We also estimated the percent of the 5-m radius plot covered by standing water, logs, and bare ground, and measured the depth of herbaceous thatch at 10 random locations. In this report we limit the bulk of our inference to the two habitat metrics we believe to be most influential to nest site selection in the context of this restoration project: riparian shrub cover and standing water.

RESULTS

Territory Densities

Territory densities varied largely among reaches (Table 2). Among the five study reaches, the highest territory densities were in the USFS reach with an average over both years of 7.4 total territories per ha, followed by the Positive Control reach with 4.5 total territories per ha. The negative control reach contained very low densities of focal birds at 0.6 total territories per ha, whereas the Riparian Fence and BDA reaches had no focal species territories. Annual variation in territory densities within reaches were apparent within and across species, but this variation appears minimal relative to variation among reaches (Table 2).

Song Sparrow was the most abundant species in the study area, averaging 1.3 territories per hectare across all reaches and years with a peak density in the USFS reach of 3.6 territories per ha. The next most abundant species was MacGillivray's Warbler with a peak of 1.6 territories per ha and an average of 0.37 across all plots. Yellow Warbler had a peak of 1.0 territories per ha and an average of 0.32. Willow Flycatcher was the least abundant, averaging 0.01 territories per ha across all reaches and years, a result of only one territory on the Positive Control reach in 2015. Territory densities for five of the seven focal species were highest on the USFS reach. Lincoln's Sparrow and Willow Flycatcher reached their highest densities on the Positive Control.

Nest Success

We found 154 nests from 2015 – 2016. Of those, we could only determine the fate for 141. The proportion of nests resulting in at least one fledged young was higher in USFS reach (0.71) than the Positive Control reach (0.57), adding more evidence that the USFS reach provides higher quality habitat than the Positive Control (Figure 2). Although there were more nests found in and around the Positive Control reach (n=88) than the USFS reach (n=51), the difference is likely mostly attributable to easier nest finding conditions, a higher failure which results in more nest attempts, and the Positive Control reach being larger than the USFS reach. Though nest success was lower in the Negative Control reach than the two positive control reaches, with a sample size of only two nests, our inference is limited. No nests were found on the Riparian Fence and BDA reaches. Anecdotally, two nests failed in 2015 due to trampling by cows.

Nest success rates were relatively high (≥ 0.50) for all but the two least abundant focal species, Willow Flycatcher and Lincoln's Sparrow, for which sample sizes are small (Figure 3). Cowbird parasitism rates were notably low, which may help explain the high success rates for these species relative to other riparian habitats in California. The four species with three or more nests found in both years all had higher nest success in 2015 than 2016 (Figure 4).

Habitat Assessments

Results from the habitat assessments demonstrate that the habitat structure used for nesting was generally unavailable in the Negative Control and the two treatment reaches. Of the habitat variables we investigated, shrub cover had the largest and most consistent discrepancies between nest and random locations (Tables 3 & 4). Median and mean values of shrub cover at nest locations were higher for all focal species than values at more than 99% of random locations in three upstream reaches (Figure 5). The median value for shrub cover was also lower at the Positive Control reach than at nest locations for six out of seven focal species in both years; however, the upper quartile of percent shrub cover includes the median values at nests for almost all of the focal species. Willow Flycatcher, Song Sparrow, and Lincoln's Sparrow showed a fairly consistent pattern of having nest locations with higher water cover than was generally available on the Riparian Fence and BDA reaches in 2015 and 2016 (Figure 6). The Negative Control reach did provide adequate wet ground for these species in 2016. Soil saturation and 3 small willow clumps in the Negative Control reach likely explained the presence of focal species territories in 2015 and 2016. This is in contrast to the Riparian Fence and BDA reaches which were much drier, lacked any established willow clumps, and had no territories in either year.

SUMMARY

In the first breeding season following willow planting and riparian fencing, we did not observe any effects of these actions on the bird community. The Riparian Fence and BDA treatment reaches were devoid of meadow birds in both 2015 and 2016. The Negative Control reach, which received willow planting, contained very low densities of meadow birds in both years, probably because this reach is wetter than the two treatment reaches and has 3 small willow clumps.

The two positive control reaches illustrate the potential of the upstream plots to support bird habitat in a restored condition. Even though both of the positive control reaches had substantially higher densities than the three upstream reaches, habitat quality on the USFS reach appears higher than the Positive Control reach, as measured by territory densities and nest success. The extent of water cover in the Positive Control reach appears suitable, but riparian shrub cover is likely a limiting factor. The low shrub cover is likely a result of a combination of long-term grazing (only recently ceased) and the current beaver population regulating shrub growth. Shrub cover on the USFS reach may provide an ideal target for the treatment reaches to maximize meadow bird density and nest success. Shrub cover is almost certainly a major limiting factor for focal nesting habitat on the three upper reaches and may be so on Positive Control as well, to a lesser degree. This suggests very dense clumps of willows provide high-quality habitat. Because most of the willows planted in the treatments reaches were in pods at 1- m spacing, these pods should provide some of the dense willow cover the birds are selecting. However, creating habitat that can support the densities of meadow birds in the USFS reach will require substantial willow recruitment, or planting well beyond what has already been transplanted. To expedite breeding by focal meadow birds, including Willow Flycatcher, additional willow planting is recommended.

The association with riparian shrubs was the most evident pattern, but some focal species also appear to be selecting for areas with more water cover than is available on in the treatment reaches. Beaver-dam analogs have the potential to create this habitat element for these species, as beaver activity has done in the positive control reaches. With additional data, we will provide a more formal evaluation of the selection of water cover and its effect on nest success, at least for Song Sparrow.

Nest success was high on the two positive control reaches compared to other riparian habitats in California, but similar (or even slightly lower) to what has been reported from the USFS reach from 1997 – 1999 (King et al. 2001). Mid-elevation montane habitats provide higher nest success than lower-elevation habitats for Warbling Vireo in the Sierra Nevada (Purcell 2006), and the same may be the case with other species in this study. The high nest success is also partially attributable to low cowbird parasitism rates for most species. However, it is important to note that cowbirds were not absent. We suspect a few Yellow Warbler nests were abandoned just after nest building completion because they were parasitized. Also, one of the Willow Flycatcher nests abandoned in 2015 may have been due to cowbirds.

Next year will be the first year of data collection in the post-BDA-restoration period. Our first two years of data provide a solid foundation from which to evaluate the effects of the BDA and other restoration treatments, though we do not anticipate a strong response from meadow birds in the first year following BDA installation. In fact, it will probably be five years post-restoration for habitat to be suitable for meadow birds and a decade or more before the benefits of restoration to meadow birds are fully realized, as data from other meadow re-watering methods suggests (Burnett and Campos 2015).

LITERATURE CITED

Baker BW, Ducharme HC, Mitchell DCS, Stanley TR, Peinetti HR. 2005. Interaction of Beaver and Elk Herbivory Reduces Standing Crop of Willow. Ecological Applications 15:110–118.

Beschta RL, Ripple WJ. 2012. The role of large predators in maintaining riparian plant communities and river morphology. Geomorphology 157–158:88–98.

Burnett RD, Campos BR. 2015. Avian Monitoring of Northern Sierra Meadows. Point Blue Conservation Science, Petaluma, CA.

King AM, King JR, Holmes AL, Nadav N. 2001. Songbird Monitoring in Almanor Ranger District (Lassen National Forest) and Lassen Volcanic National Park: 1997-1999. Point Reyes Bird Observatory, Stinson Beach, CA

Johnson DH. 1979. Estimating Nest Success: The Mayfield Method and an Alternative. The Auk 96:651–661.

Johnson MD. 2007. Measuring habitat quality: a review. The Condor 109:489–504.

Martin TE, Geupel GR. 1993. Nest-Monitoring Plots: Methods for Locating Nests and Monitoring Success. Journal of Field Ornithology 64:507–519.

Martin, TE, Paine CR, Conway CJ, Hochachka WM, Allen P, and Jenkins W. 1997. BBIRD Field Protocol. Montana Cooperative Wildlife Research Unit, University of Montana, Missoula, Montana, USA.

Mayfield HF. 1975. Suggestions for Calculating Nest Success. The Wilson Bulletin 87:456–466.

McKinstry MC, Caffrey P, Anderson SH. 2001. The Importance of Beaver to Wetland Habitats and Waterfowl in Wyoming. Journal of the American Water Resources Association 37:1571–1577.

Naiman RJ, Johnston CA, Kelley JC. 1988. Alteration of North American Streams by Beaver. BioScience 38:753–762.

Purcell KL. 2006. Abundance and Productivity of Warbling Vireos across an Elevational Gradient in the Sierra Nevada. The Condor 108:315–325.

Ripple WJ, Beschta RL. 2004. Wolves, elk, willows, and trophic cascades in the upper Gallatin Range of Southwestern Montana, USA. Forest Ecology and Management 200:161–181.

TABLES

Table 1. Bird focal species for Childs Meadow restoration monitoring, listed in taxonomic order, with their four-letter codes and conservation status.

Common Name	Species Name	Code	Conservation Status
Willow Flycatcher[‡, CPF]	*Empidonax traillii*	WIFL	State Endangered, USFS Sensitive
Warbling Vireo[‡, CPF]	*Vireo gilvus*	WAVI	Declining locally in CA[1]
Yellow Warbler[‡, CPF]	*Setophaga petechia*	YEWA	CA Species of Special Concern
MacGillivray's Warbler[‡]	*Geothlypis tolmiei*	MGWA	none
Wilson's Warbler[‡, CPF]	*Cardellina pusilla*	WIWA	Declining in the Sierra Nevada[2]
Song Sparrow[CPF]	*Melospiza melodia*	SOSP	none
Lincon's Sparrow[‡]	*Melospiza lincolnii*	LISP	none

[‡] Nearctic-Neotropical Migratory Bird; [CPF] California Partners in Flight Riparian Focal Species (RHJV 2004);

[1] Gardalli et al. 2000; [2] Sauer et al. 2008

Table 2. Focal species territory density per hectare on five study reaches in Childs Meadow in 2015 and 2016. All plots were between 3.65 and 4.32 hectares.

	Negative Control		Riparian Fence		BDA		Positive Control		USFS	
Species	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
LISP	0	0.26	0	0	0	0	0.46	0.13	0	0
MGWA	0	0	0	0	0	0	0.23	0.30	1.79	1.33
SOSP	0.53	0.26	0	0	0	0	2.80	2.50	4.14	3.01
WAVI	0	0	0	0	0	0	0.46	0.36	0.81	0.87
WIFL	0	0	0	0	0	0	0.01	0	0	0
WIWA	0	0	0	0	0	0	0.33	0.18	0.58	0.38
YEWA	0	0.20	0	0	0	0	0.63	0.49	1.09	0.83

Table 3. The mean percentage of cover (±SE) of vegetation, logs, litter, bare ground, and water at nest and random locations in five study reaches of Childs Meadow in 2015.

Sample Type	Species or Reach	N	Shrub	Herbaceous	Logs	Litter	Bare Ground	Water
Nest	LISP	1	10.0 ± NA	95.0 ± NA	4.0 ± NA	3.0 ± NA	0.0 ± NA	40.0 ± NA
Nest	MGWA	13	80.2 ± 3.0	66.2 ± 6.7	6.4 ± 1.7	81.3 ± 5.3	4.3 ± 1.9	2.7 ± 1.3
Nest	SOSP	31	37.9 ± 3.7	82.3 ± 3.2	1.8 ± 0.4	48.8 ± 6.2	7.6 ± 1.6	14.8 ± 2.6
Nest	WAVI	6	58.8 ± 17.0	43.2 ± 13.5	9.7 ± 4.4	91.3 ± 3.9	7.5 ± 3.4	0.0 ± 0.0
Nest	WIFL	2	65.0 ± 5.0	60.0 ± 20.0	1.0 ± 1.0	62.5 ± 27.5	5.0 ± 5.0	15.0 ± 15.0
Nest	WIWA	3	78.3 ± 4.4	71.7 ± 9.3	20.0 ± 10.4	85.0 ± 7.6	2.3 ± 1.3	0.0 ± 0.0
Nest	YEWA	8	72.2 ± 5.3	58.1 ± 8.8	2.9 ± 1.4	73.4 ± 10.4	3.2 ± 1.2	5.2 ± 3.2
Random	NegCtrl	20	1.9 ± 1.5	93.7 ± 2.8	0.0 ± 0.0	16.1 ± 4.1	7.1 ± 3.1	1.8 ± 1.1
Random	Fenced	20	0.0 ± 0.0	86.2 ± 2.6	0.0 ± 0.0	71.0 ± 5.2	19.3 ± 3.5	1.4 ± 0.9
Random	BDA	20	0.0 ± 0.0	69.2 ± 4.2	0.0 ± 0.0	79.9 ± 3.7	17.3 ± 3.6	1.3 ± 0.8
Random	PosCtrl	40	18.7 ± 4.1	84.6 ± 2.5	2.1 ± 0.7	61.3 ± 5.6	6.2 ± 1.1	11.9 ± 3.2
Random	USFS	38	52.9 ± 4.0	76.3 ± 3.0	3.5 ± 0.8	78.3 ± 4.2	3.2 ± 0.8	13.1 ± 3.2

Table 4. The mean percentage of cover (±SE) of vegetation, logs, litter, bare ground, and water at nest and random locations in five study reaches of Childs Meadow in 2016.

Sample Type	Species or Reach	N	Shrub	Herbaceous	Logs	Litter	Bare Ground	Water
Nest	LISP	2	27.5 ± 12.5	95.0 ± 5.0	1.5 ± 1.5	90.0 ± 10.0	0.0 ± 0.0	7.5 ± 7.5
Nest	MGWA	7	91.0 ± 2.6	52.1 ± 11.2	4.0 ± 1.3	90.0 ± 4.3	4.0 ± 2.8	1.4 ± 1.4
Nest	SOSP	63	43.6 ± 2.9	79.2 ± 2.5	0.8 ± 0.2	84.8 ± 2.0	1.4 ± 0.4	10.0 ± 1.8
Nest	WAVI	4	41.5 ± 19.6	63.8 ± 21.2	15.0 ± 6.5	67.5 ± 17.0	20.8 ± 19.8	5.0 ± 3.5
Nest	WIFL	0	--	--	--	--	--	--
Nest	WIWA	5	72.6 ± 7.0	49.0 ± 8.6	3.8 ± 1.0	65.0 ± 10.0	19.4 ± 11.5	2.0 ± 2.0
Nest	YEWA	9	65.4 ± 7.9	64.1 ± 10.1	0.6 ± 0.6	89.4 ± 3.9	1.9 ± 1.1	2.1 ± 1.6
Random	NegCtrl	20	0.8 ± 0.5	94.0 ± 1.6	0.0 ± 0.0	77.0 ± 4.0	3.5 ± 1.5	11.8 ± 3.7
Random	Fenced	20	0.2 ± 0.1	92.2 ± 3.5	0.0 ± 0.0	84.3 ± 5.2	5.7 ± 3.4	2.2 ± 1.3
Random	BDA	20	0.0 ± 0.0	94.0 ± 2.4	0.4 ± 0.3	89.4 ± 3.5	5.3 ± 2.4	1.8 ± 1.5
Random	PosCtrl	40	16.6 ± 3.6	85.3 ± 3.7	1.7 ± 0.5	83.2 ± 3.6	1.8 ± 0.8	8.3 ± 3.0
Random	USFS	40	53.0 ± 4.4	73.2 ± 4.0	3.8 ± 0.6	68.2 ± 4.6	5.3 ± 1.6	21.4 ± 4.1

FIGURES

Figure 1. Overview map of the Childs Meadow complex and study reaches.

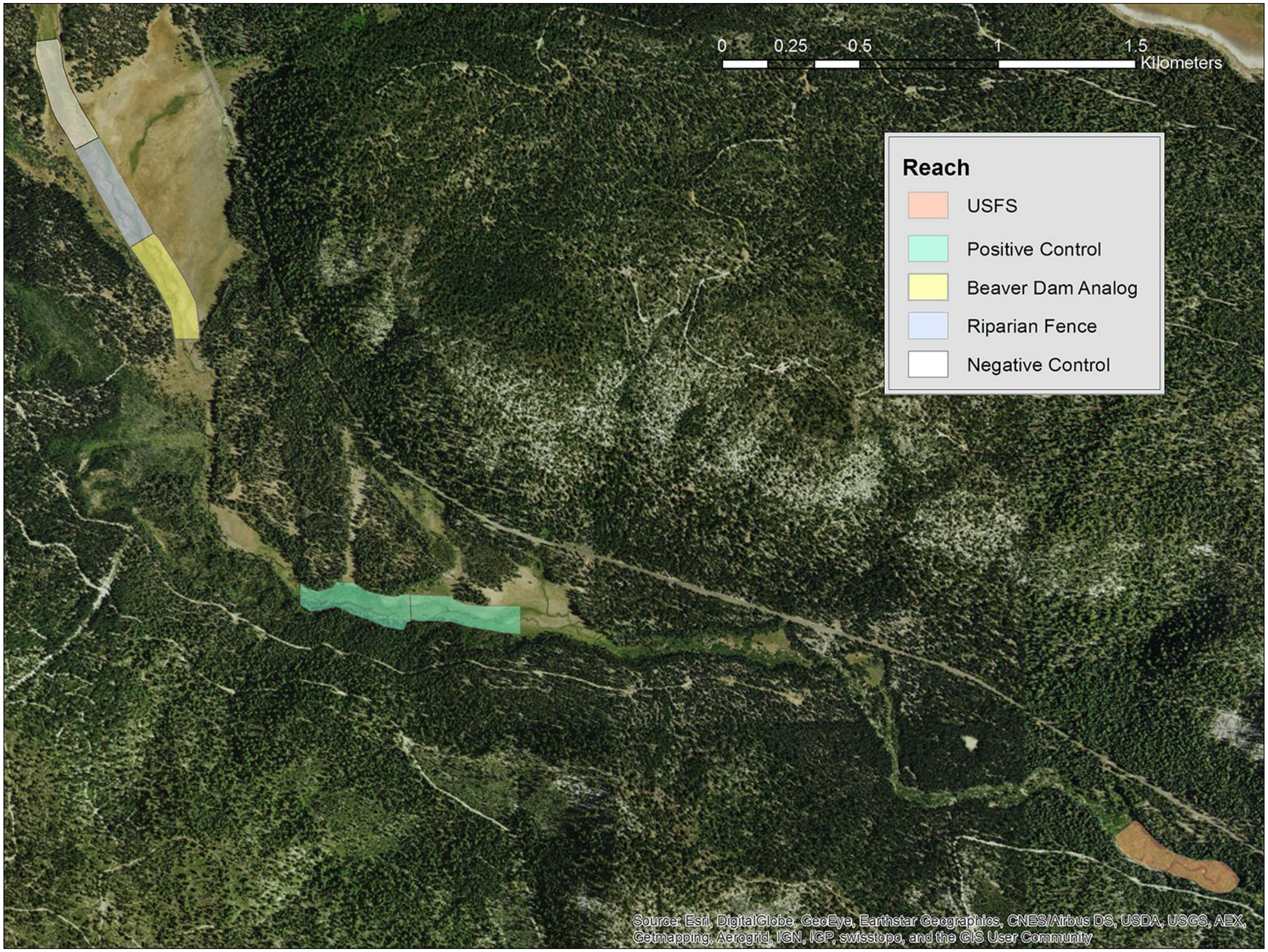


Figure 2. The proportion of nests that fledged at least one young for 141 nests found in 2015 and 2016, by reach.

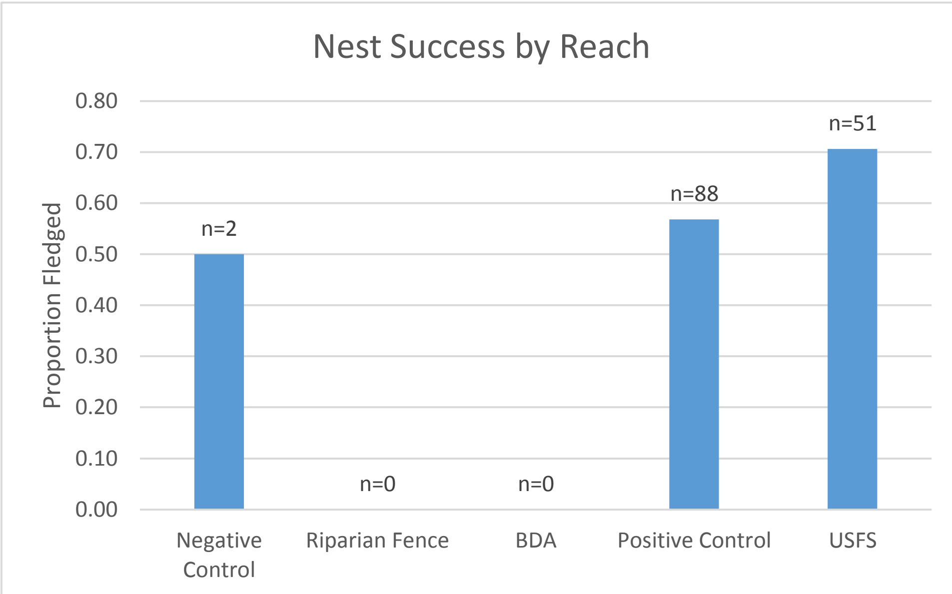


Figure 3. The proportion of nests that fledged at least one young for 141 nests found in 2015 and 2016, by species.

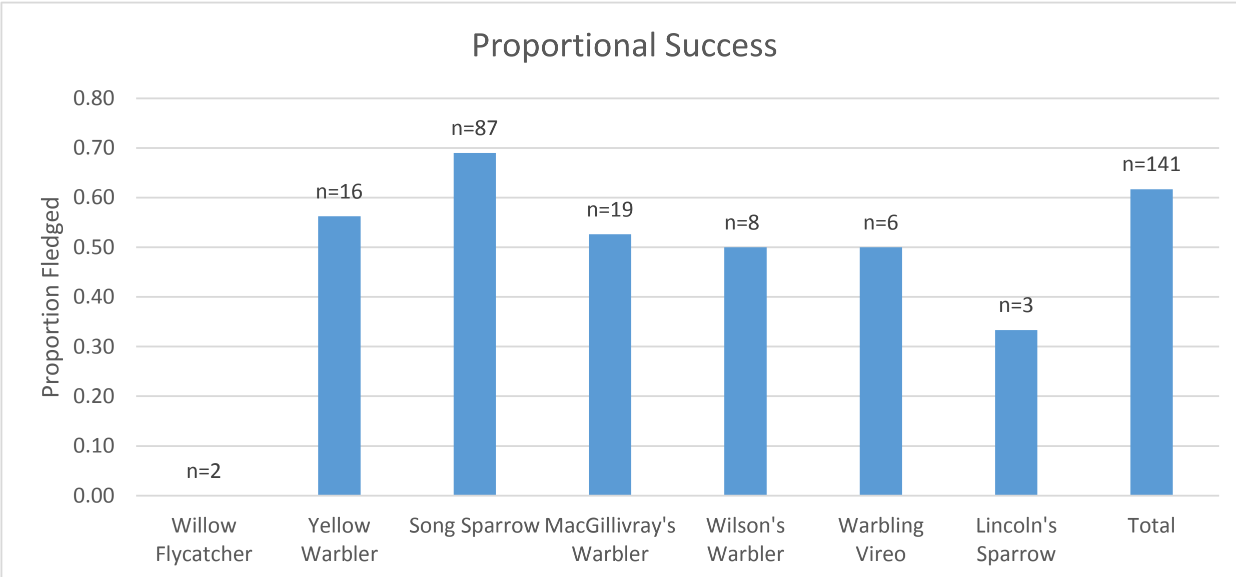


Figure 4. The proportion of nests that fledged at least one young for 141 nests found in 2015 and 2016, by species and year.

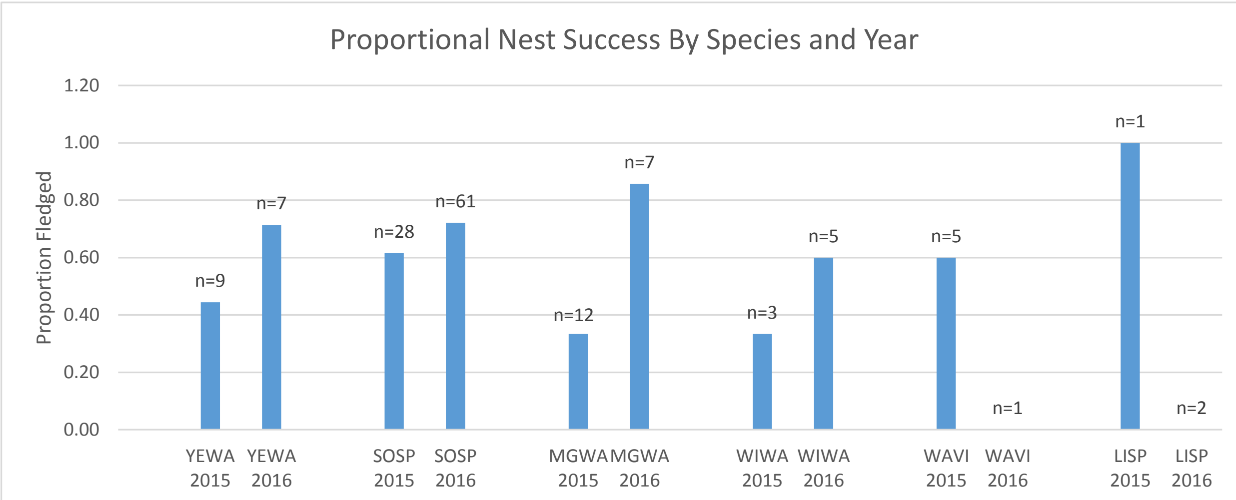


Figure 5. The percentage of shrub cover within a 5-m radius at random and nest locations for the 5 reaches and 7 bird species in the Childs Meadow bird study in (a) 2015 and (b) 2016.

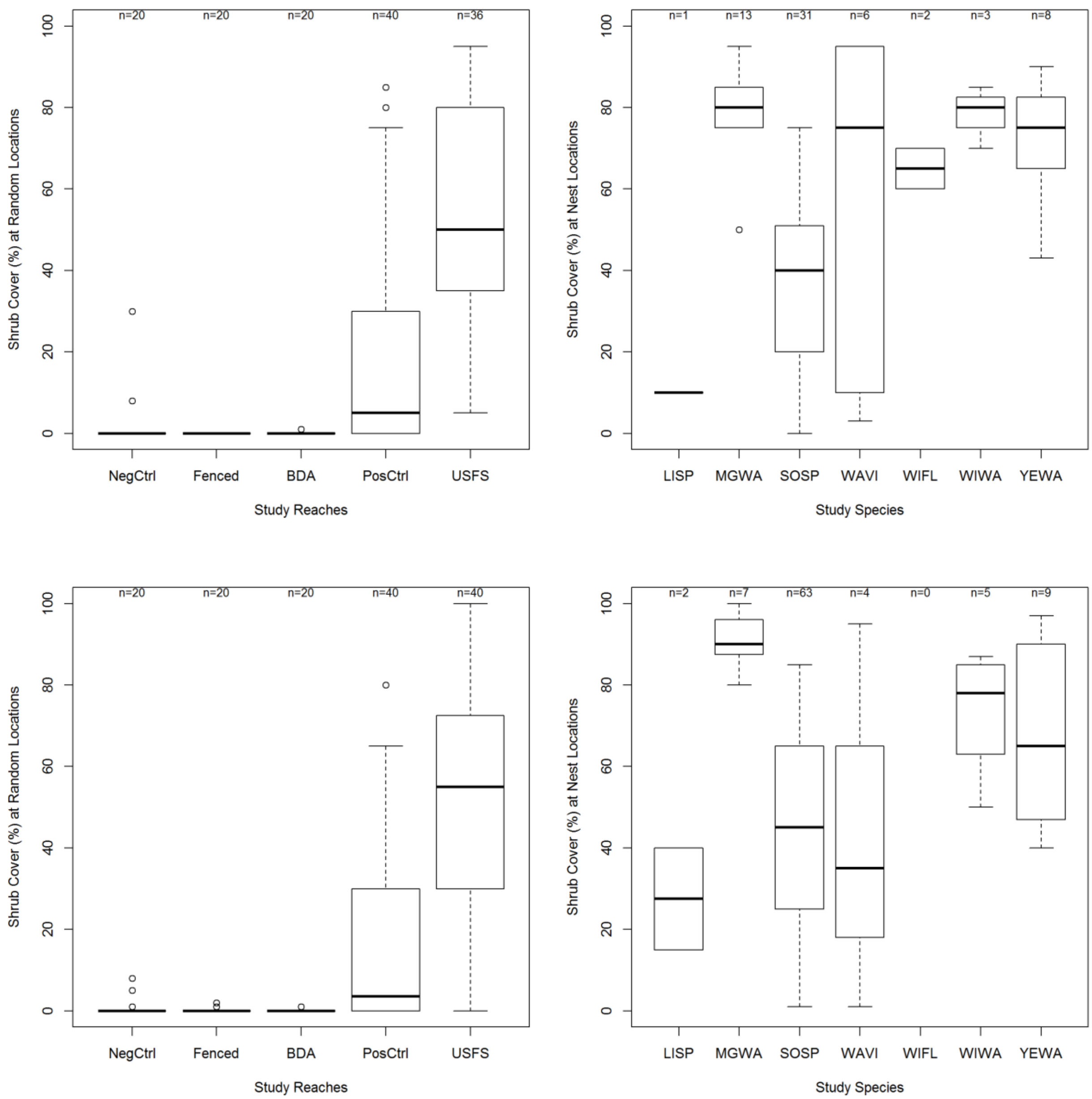
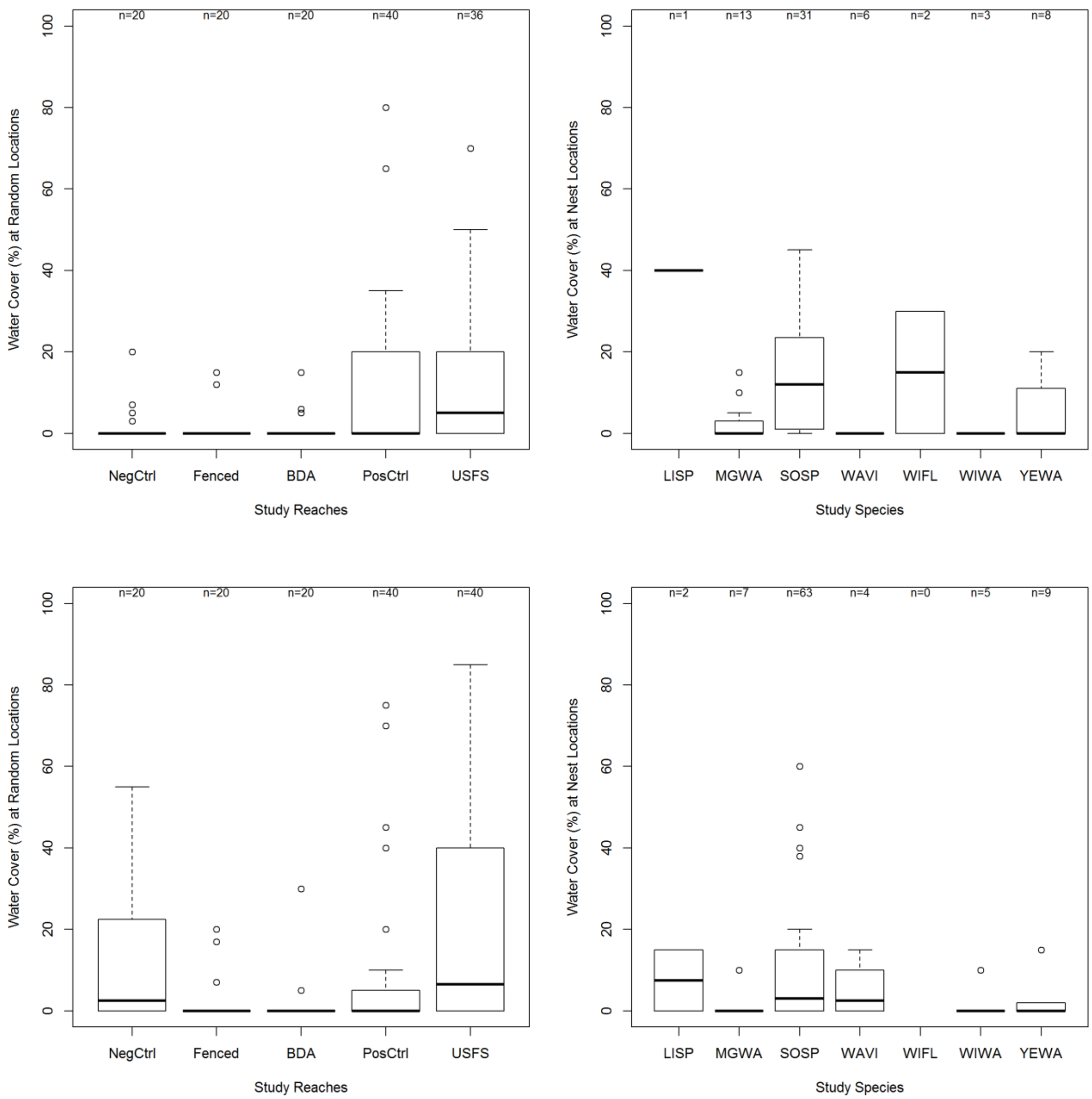
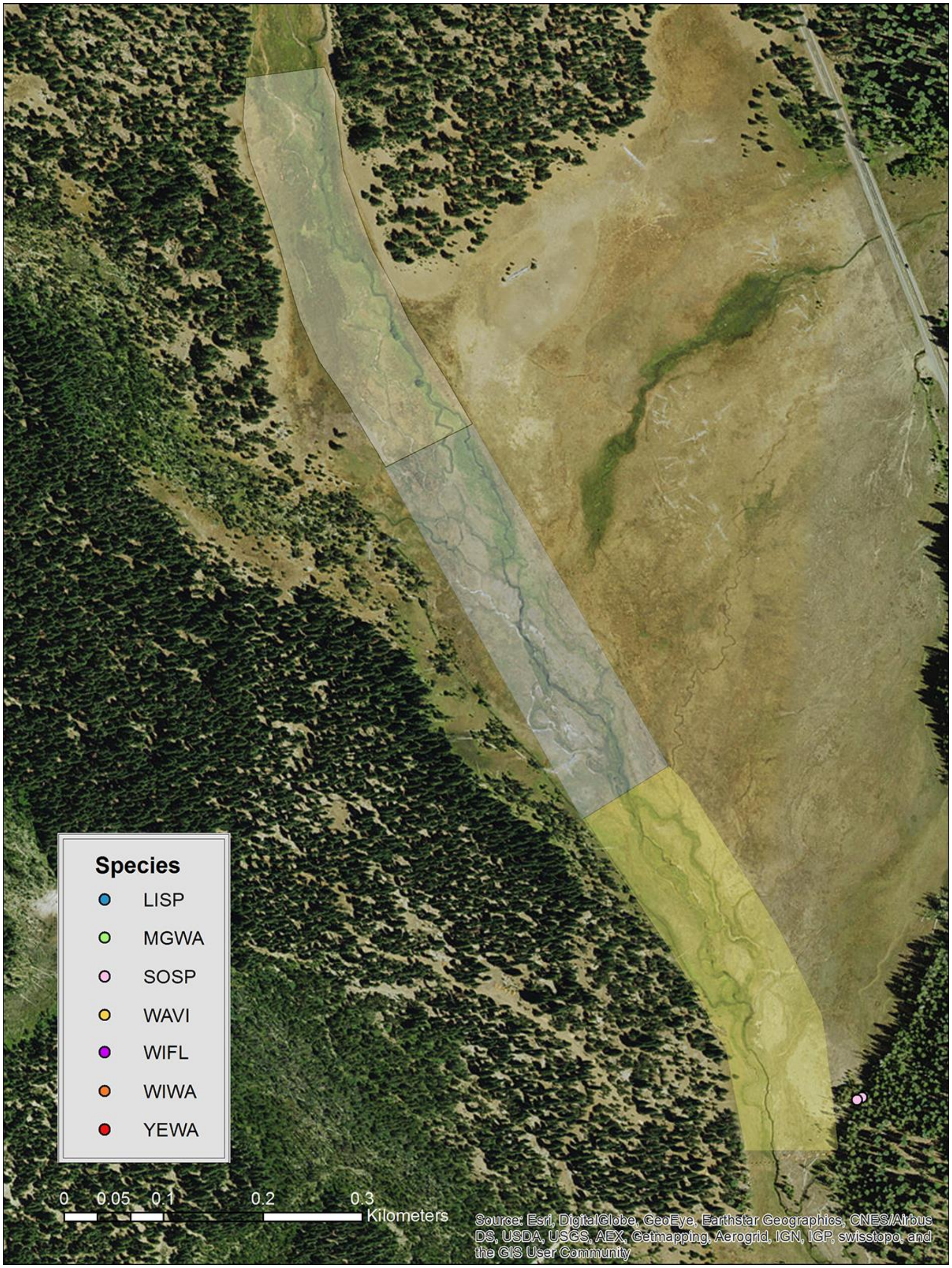


Figure 6. The percentage of meadow surface covered by water within a 5-m radius at random and nest locations for the 5 reaches and 7 bird species in the Childs Meadow bird study in (a) 2015 and (b) 2016.

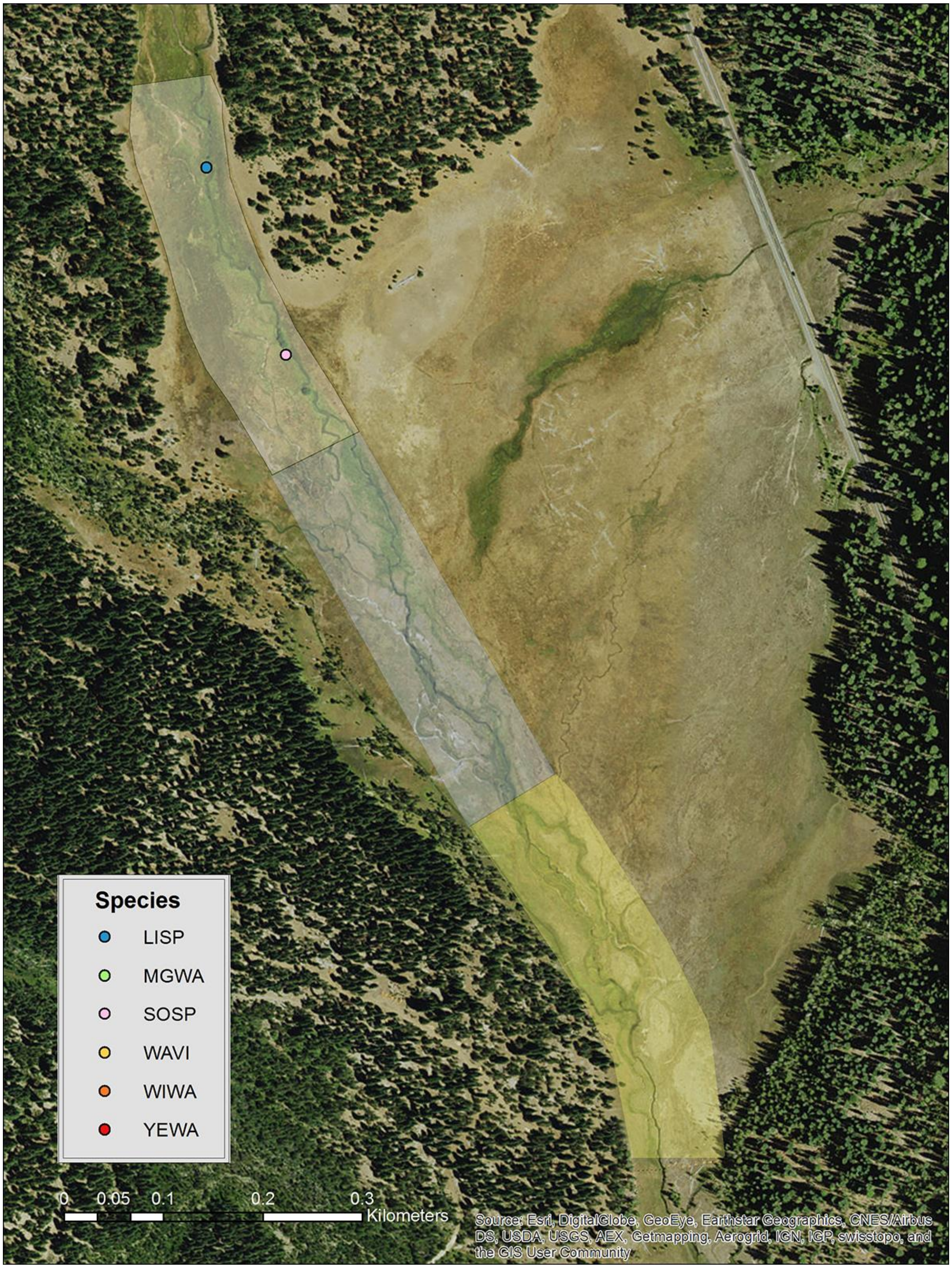


APPENDICES

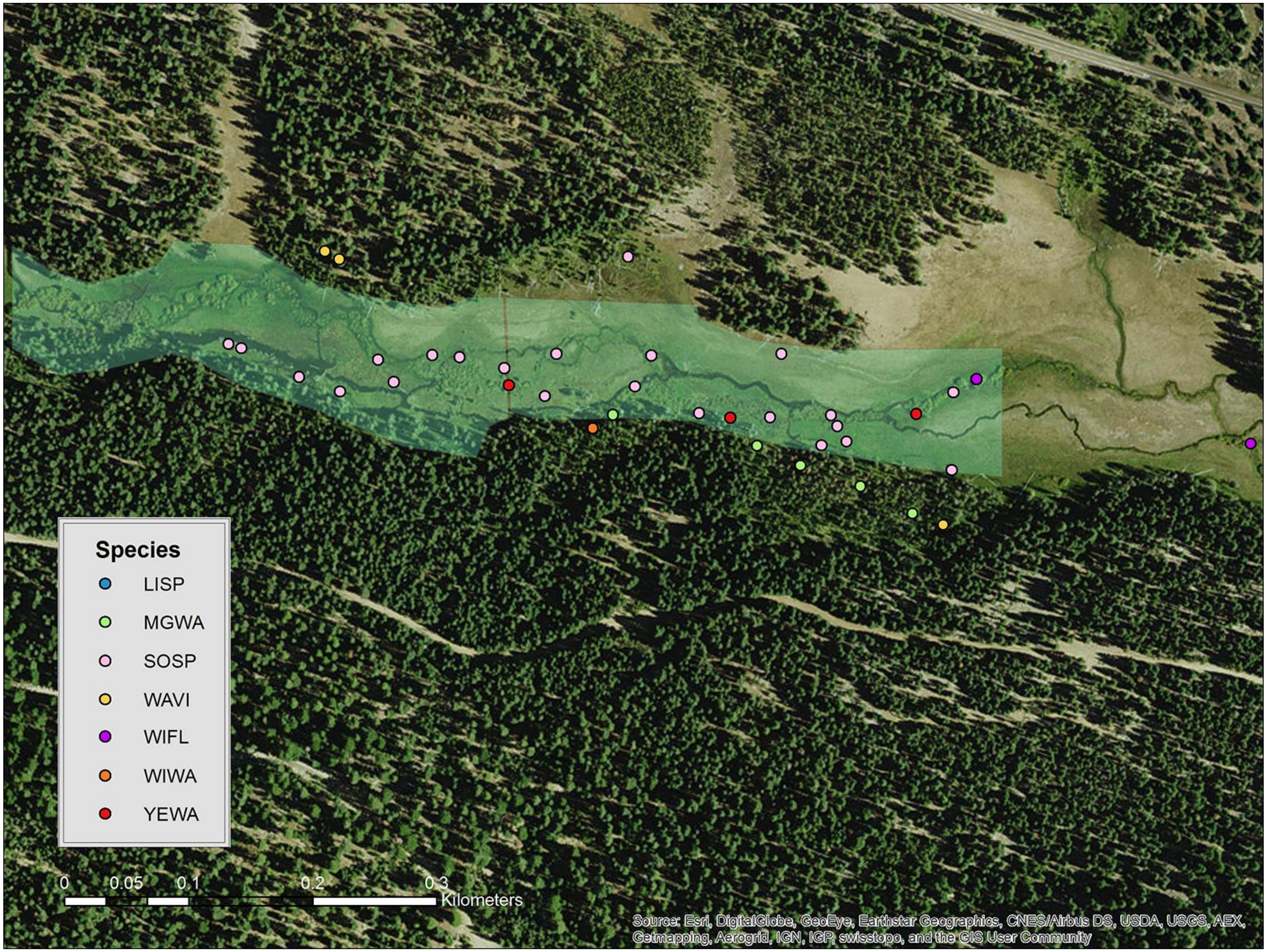
Appendix 1A. Map of nests of bird study species located in the negative control, riparian fence, and beaver-dam analog reaches of the Childs Meadow study in year 2015.



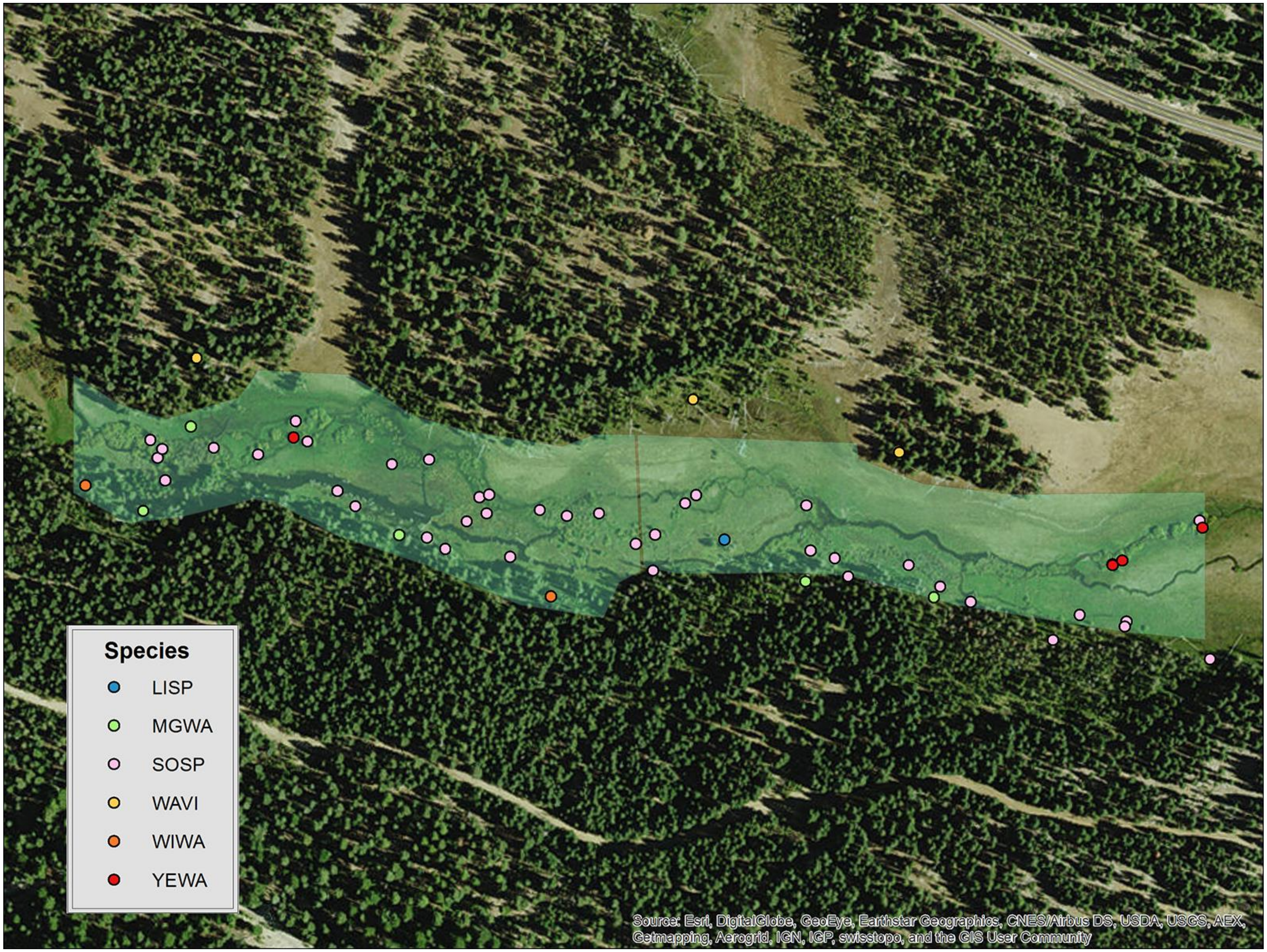
Appendix 1B. Map of nests of bird study species located in the negative control, riparian fence, and beaver-dam analog reaches of the Childs Meadow study in year 2016.



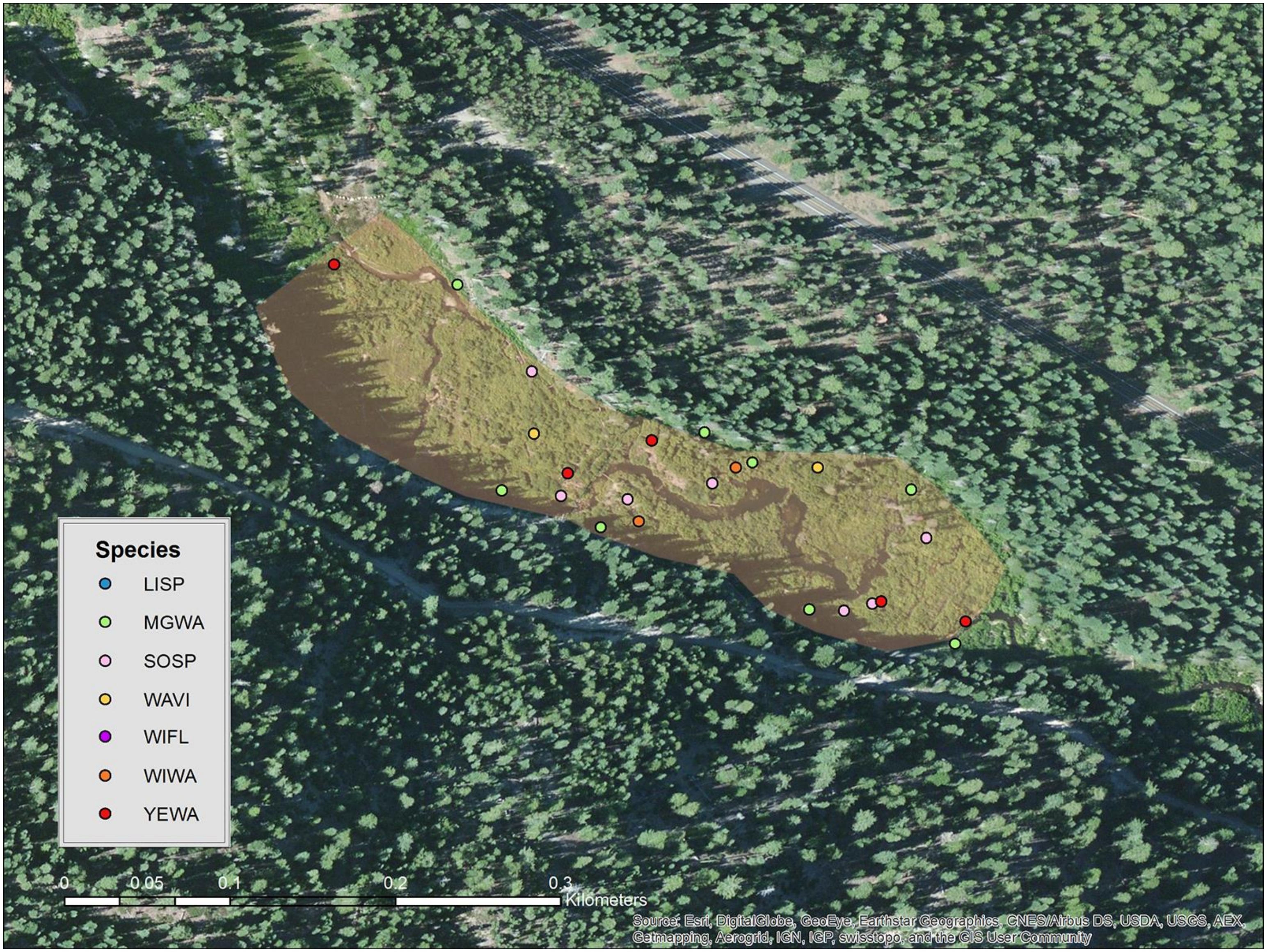
Appendix 2A. Map of nests of bird study species located in the positive control reach of the Childs Meadow study in year 2015.



Appendix 2B. Map of nests of bird study species located in the positive control reach of the Childs Meadow study in year 2016.



Appendix 3A. Map of nests of bird study species located in the US Forest Service reach of the Childs Meadow study in year 2015.



Appendix 3B. Map of nests of bird study species located in the US Forest Service reach of the Childs Meadow study in year 2016.