2016 Annual Research Report Compilation

Teton County Flammulated Owl Survey

2016 Teton Raptor Center Report

Teton Raptor Center, funded by Teton Conservation District, initiated Flammulated Owl (*Psiloscops flammeolus*) surveys in a portion of Teton County in 2016. Flammulated Owls are a small, nocturnal, migratory owl whose population status in Wyoming is largely unknown. No nest sites have ever been located in Teton County, but several factors indicate that Flammulated Owls may occur and/or nest here. Regular nesting records occur in eastern Idaho adjacent to Teton County, several injured Flammulated Owls have been admitted to Teton Raptor Center for rehabilitation in the past several years, and one fledgling was photographed in the Hoback area in 2013.

One of the only neotropical migrant owl species, Flammulated Owls generally return from spring migration in early May. While they have a near 100% night-time callback detectability rate during courtship and incubation, no systematic, public surveys have been conducted to determine the presence of breeding individuals within northwest Wyoming. Following funding by the Teton Conservation District, we systematically surveyed for Flammulated Owls using night-time callback techniques in select areas in Teton County in the spring of 2016.

Methods

We followed the Partners In Flight Flammulated Owl call-back survey protocols (Fylling et al. 2010). In short, surveys consisted of a two-minute listening period, followed by a 30-second call, two-minute listening period, 30-second call, two-minute listening period, 30-second call and a final two-minute listening period, for a total survey time of 9.5 minutes of at each location.

Survey locations were pre-determined in a Geographic Information System (GIS) using the existing Teton County and Bridger-Teton National Forest vegetation cover layers. Because our objectives were simply to determine the presence of Flammulated Owls in Teton County, we did not randomly place survey locations but rather targeted habitats suggested to host nesting Flammulated Owls from the literature. Using the Cogan

Vegetation layer for Teton County, with help from Morgan Graham, we used the following selection criteria to create a layer of “potential habitat” on private lands within the county:

Habitat Types:
Coniferous Forest
Coniferous Woodland
Deciduous Forest
Deciduous Woodland
Mixed Forest
Mixed Woodland

Forest Density:
>75%

Vegetation Height:
>5m

Size:
>= 1 Acre

Using the Bridger-Teton National Forest vegetation layer, we used the following criteria:

Habitat Types:
Lodgepole Pine Mix
Spruce/Subapline Fir Mix
Aspen
Douglas Fir Mix

Canopy Cover:
>50%

Tree Size:
DBH > 10”

Using these selection criteria, we then placed survey locations on existing trails, roads, and off-trail to encompass as much of the projected habitat as possible. We used a 200m detection radius, for a minimum of 400m between survey locations. Additional survey locations were added in the field by surveyors in areas that looked like good habitat that was not pre-determined using the GIS. Following initial positive detections, we also added survey locations in the National Elk Refuge in older-aged aspen and mixed aspen stands.

All surveys were conducted at least 0.5hr after official sunset and typically concluded around 2-3am. All surveys were conducted in pairs when hiking and either in pairs or solo when surveying from roads. We used the call sequence provided by J. Carlisle (Intermountain Bird Observatory) and played using FoxPro NX4 callers. Surveys were not conducted during inclement weather or when winds exceeded 10mph measured on a Kestrel wind meter.

At all survey locations, we recorded dominant tree species and average tree diameter at breast height (DBH). We recorded all owls detected to species, gender (if known), call type (e.g., territorial, contact, etc.), estimated direction of the call, and estimated distance to the owl. We later calculated the "actual" location of the owl using these estimates and used the calculated location for reporting purposes.

Results

We surveyed a total of 160 locations from May 11th – June 15th, 2016 (Figure 1). We surveyed 86 locations covering Bridger-Teton National Forest, 25 locations within the National Elk Refuge, and 49 locations covering private lands (Figure 1). Within those areas, we surveyed 47 locations from the roadways and 113 locations on foot, away from roadways. All private lands were surveyed from roads or with express permission from landowners.

Using vegetation data we collected at the site, most survey locations were predominantly aspen (Populous tremuloides) stands, followed by lodgepole pine (Pinus contortus) (Table 1). While conducting surveys, we also classified average stand age into three classifications of diameter at breast height (DBH): <10", 10-20", and >20" (i.e., young, mid, old). Thirty percent of the surveyed locations were classified as young, 63% as mid, and 7% as old.

We also classified vegetation within our total surveyed area using 2011 National Land Cover Database (NLCD) classifications. To do this, we buffered each survey location by 200m and extracted the NLCD classifications within that mask. The dominant cover type surveyed according to this method was evergreen forest, followed by shrub/scrub (Figure 2). Total area surveyed was 20.1 km^2.

We recorded 18 detections of Flammulated Owls (Figure 3). Several studies of Flammulated Owl home ranges sizes have indicated mean areas (minimum convex polygons) of 10 and 12 ha. To determine the number of potential territories located we combined owl locations within 300m to account for imperfect estimates of distance to owl when heard. The radius of a 12ha circle is 110m, so owl territories could be up to 220m in diameter. But considering territories are rarely circular, using a 300m threshold to separate potential neighbors was a conservative estimate for this pilot effort. Using this criterion, we located 14 potential nesting territories.

We also classified vegetation within 100m of Flammulated Owl detections. We found that 57.8% of the habitat classified was evergreen forest, 20.3% mixed forest, 10.6% deciduous forest, 7.8% shrub, and 1.5% herbaceous. Considering this as "used" habitat and comparing to the "available" habitat measured at all survey locations, Flammulated Owls appear to be selecting for mixed forested habitats (Figure 4).

During the course of our surveys, we also incidentally recorded several other species of interest, including, Common Poorwill (*Phalaenoptilus nuttallii*), boreal toad (*Bufo boreas*), and all other owl species encountered. We detected two nighthawks, six poorwills, 13 boreal toads, 4 potential boreal toad ponds, 19 Northern Saw-whet Owls (*Aegolius acadius*), 14 Long-eared Owls (*Asio otis*), two Great Gray Owls (*Strix nebulosa*), and one Northern Pygmy Owl (*Glaucidium gnoma*). Figures 5-7.

Discussion

We detected Flammulated Owls at 10% of our survey locations in Teton County during 2016. We did not systematically survey habitats, nor did we systematically conduct repeat surveys, but we did note several impressions of habitat types and call patterns that can be further investigated. Our general impression of habitats near detection sites were that Flammulated Owls occurred in older-aged aspen stands with nearby older conifers. Theoretically, owls need aspen for nesting (cavities) and coniferous trees for preferred prey (moths). This supposition is supported by the higher proportion of mixed forest habitat type near owl locations than proportion of that habitat type sampled. This may offer better initial mapping of potential Flammulated Owl habitats within Teton County, particularly on private lands (see Figure 8 for example).

In one potential nesting territory, we conducted two additional repeat surveys, and detected owls all three times, supporting the notion that Flammulated Owls have a near 100% detectability rate. However, it was our impression that owl calling was reduced during the week of a new moon while surveying the western side of Munger Mountain. While our impression of the habitat was that it could host owls, we did not detect any Flammulated Owls (and much fewer other owl species) during that time. We did not conduct repeat surveys of that area to determine if the lack of calling was due to absence of owls or reduction in calling during that period. Follow-up surveys using automated recorders in known territories may better elucidate calling patterns of these owls.

We suggest further studies on Flammulated Owls building on this initial census to document nest sites and productivity and better define habitat associations in Teton County. Further expansion around our survey points and private lands can better quantify nesting of this sensitive species. Further, using automated recording devices can better enhance our understanding of call patterns and increase survey areas.

Figure 1. All 2016 Flammulated Owl survey locations and ownership.

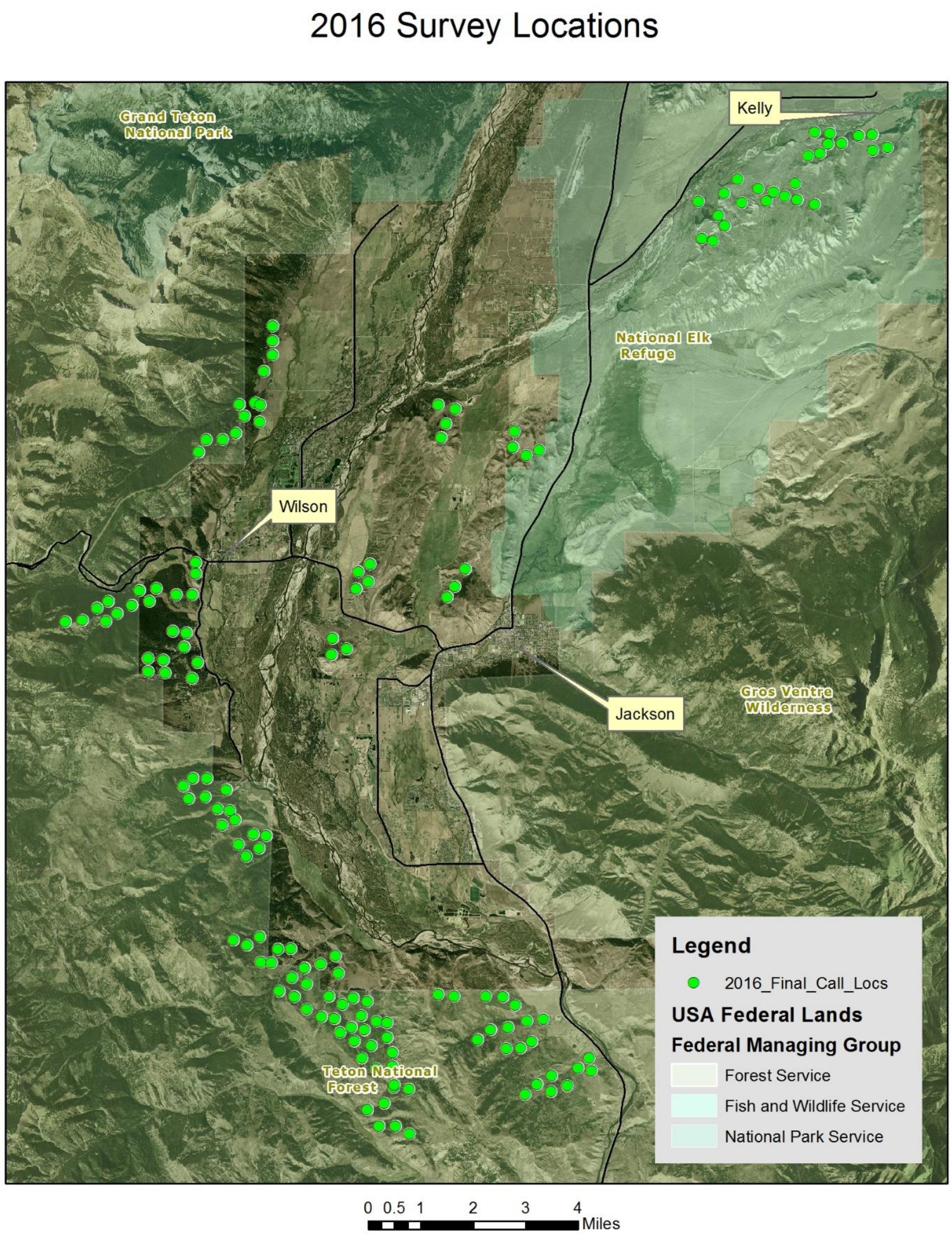


Table 1. Predominant vegetation type within survey location measured during surveys.

Estimated Habitat Type	Total	Percentage
Aspen	84	48%
Lodgepole	28	16%
Douglas Fir	13	7%
Aspen Mixed	10	6%
Spruce spp	10	6%
Sub-Alpine Fir	9	5%
Spruce Mix	8	5%
Doug Fir Mix	5	3%
Sub-Alpine Fir Mix	4	2%
Lodgepole Mix	3	2%
Willow	1	1%

Estimated Habitat Type (collapsed)	Total	Percentage
Aspen	84	48%
Conifer	60	34%
Mixed	30	17%
Other	1	1%

Figure 2. 2011 NLCD Landcover classification for total area surveyed.

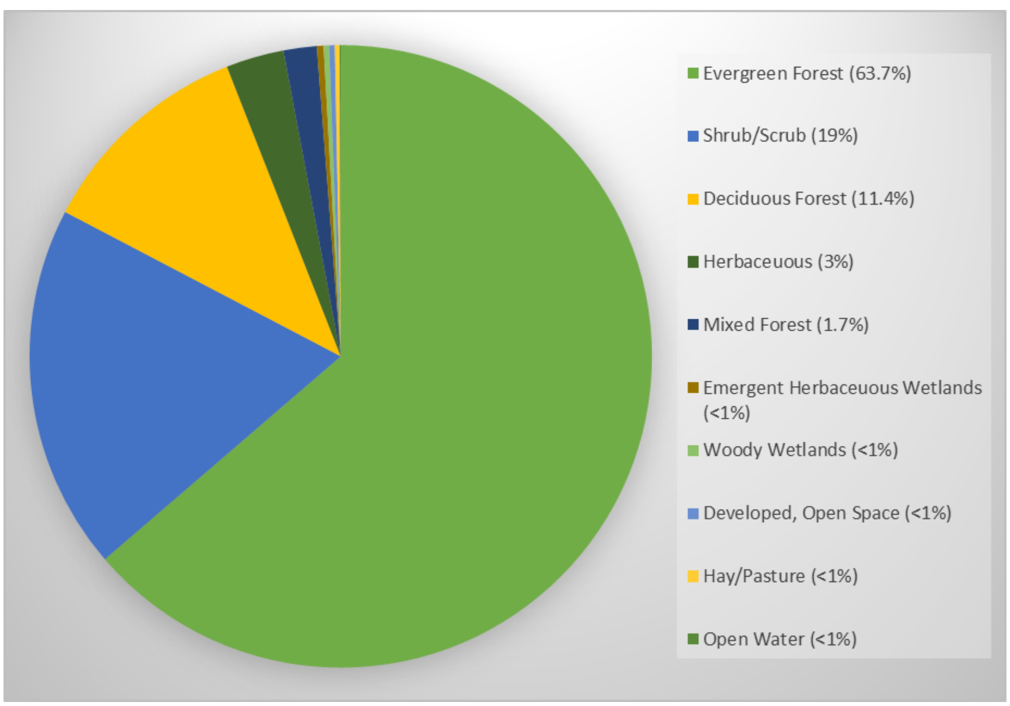


Figure 3. Locations of Flammulated Owls detected in 2016.

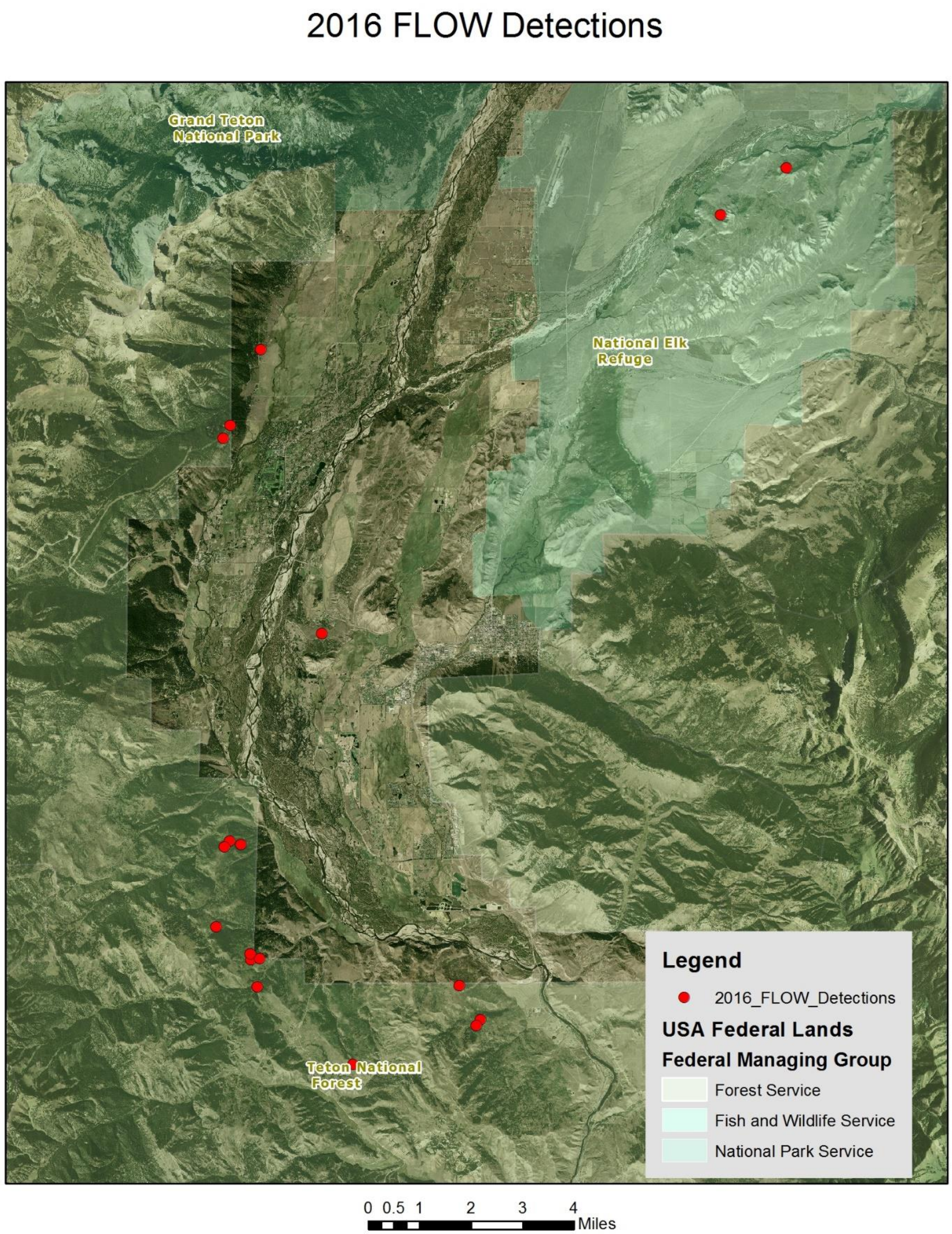


Figure 4. Habitat within 100m of FLOW detections ("used") and total habitat surveyed ("available").

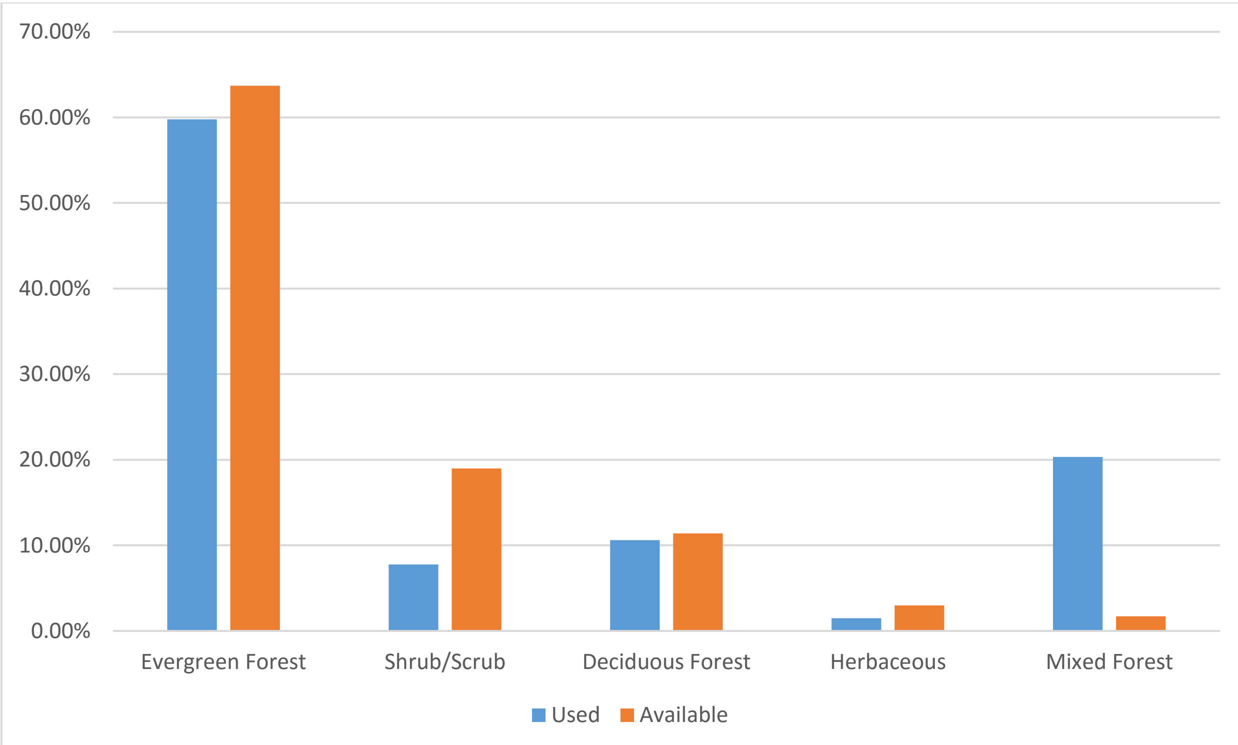


Figure 5. 2016 Common Poorwill detections.

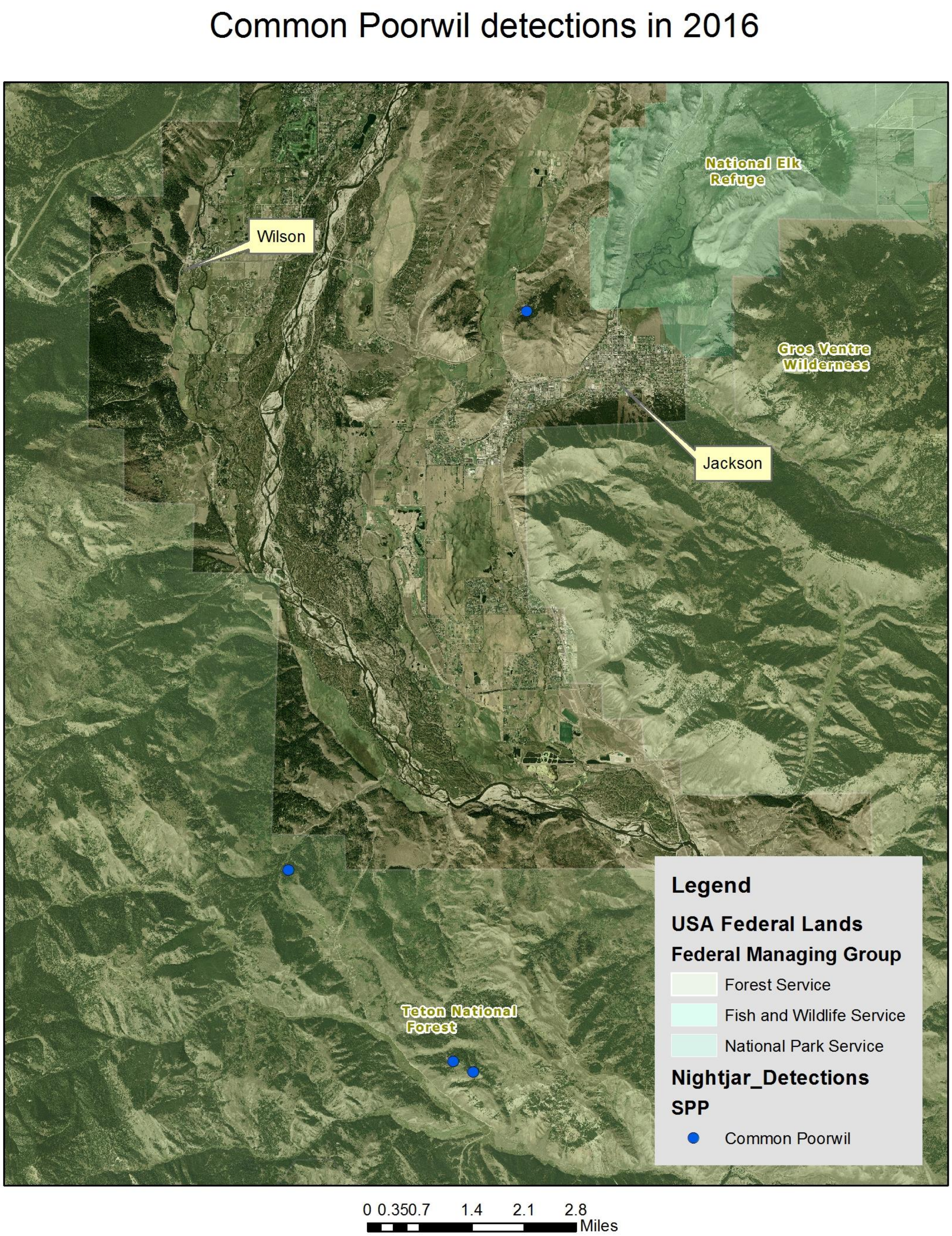


Figure 6. 2016 Boreal Toad observations and potential habitat ponds.

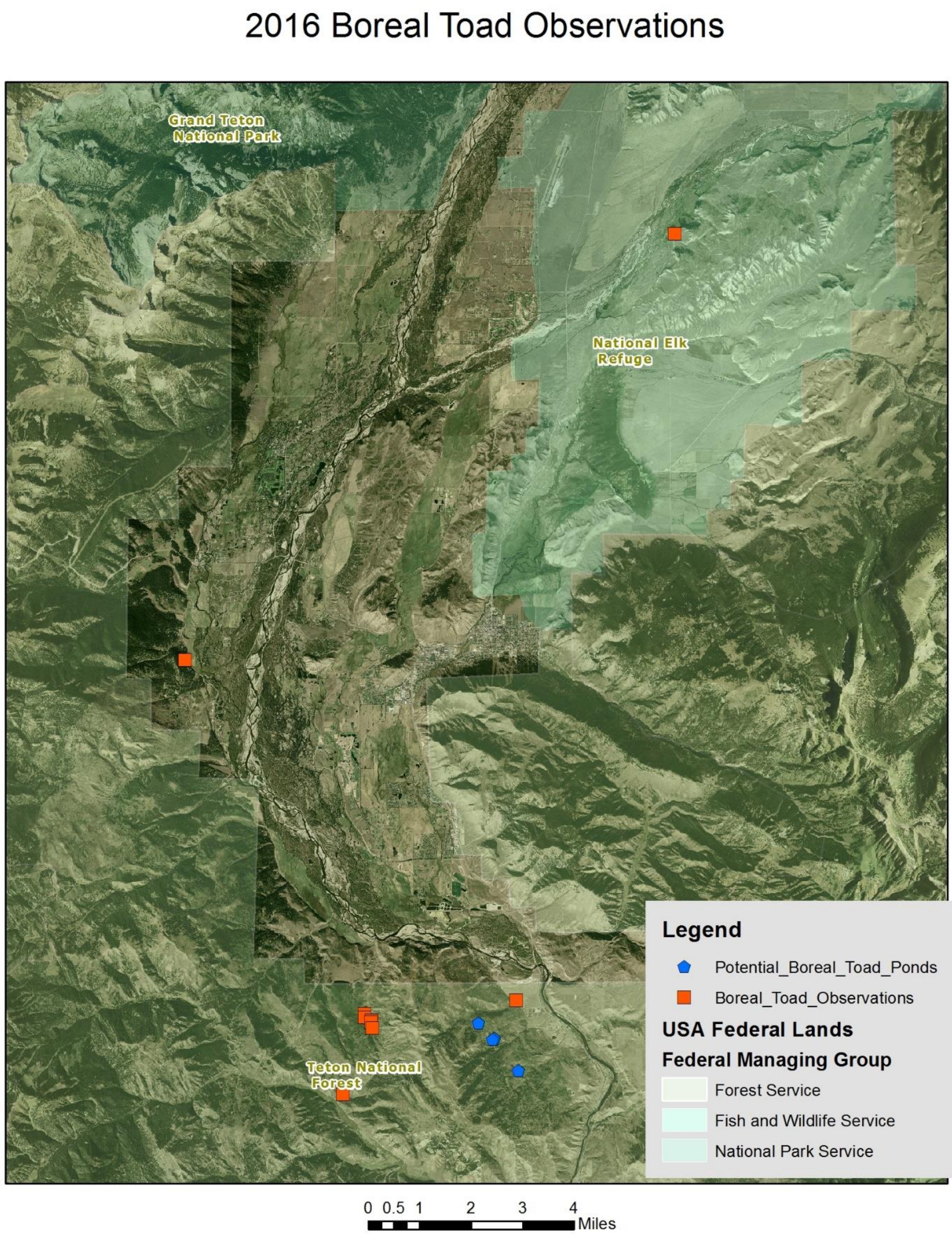


Figure 7. 2016 other owl detections.

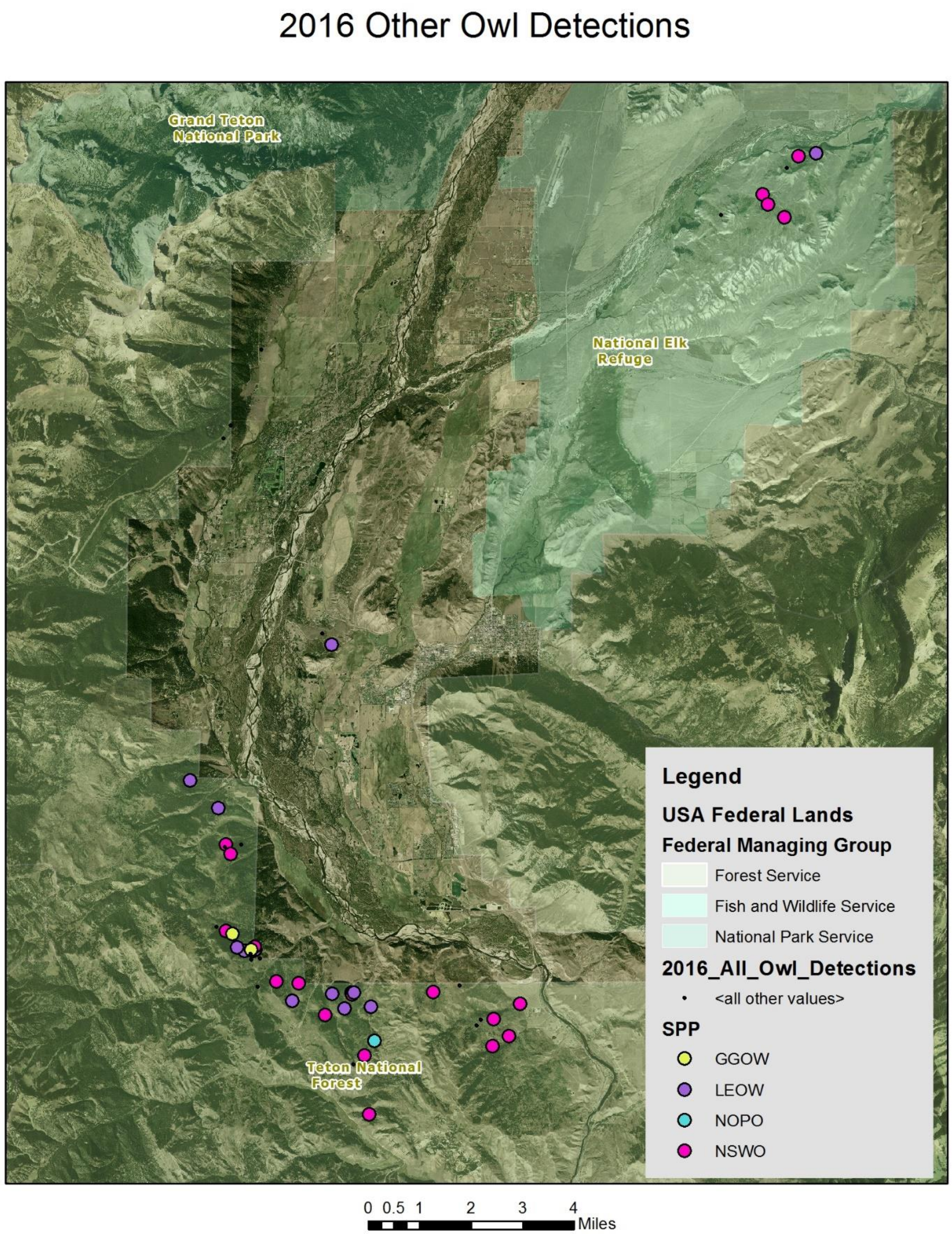
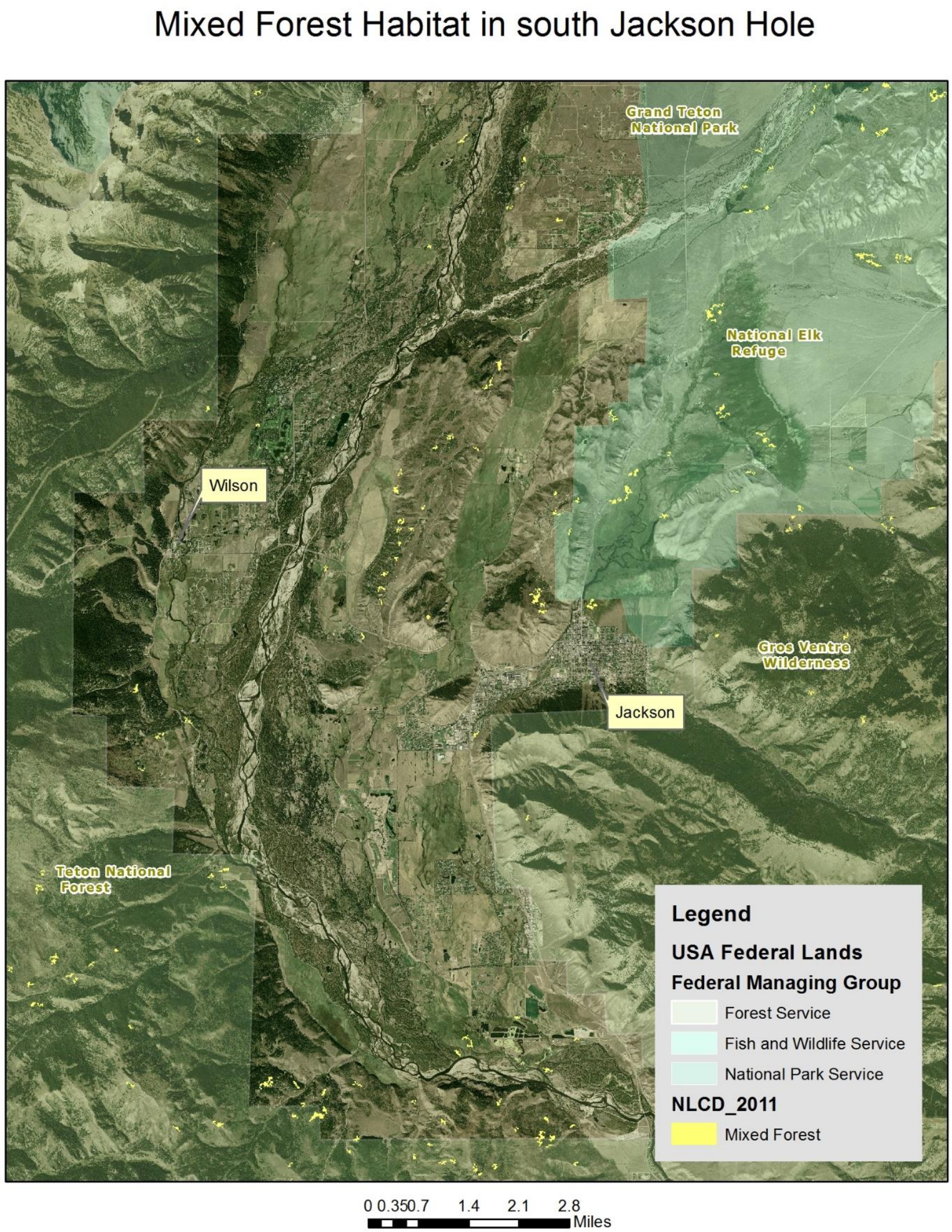


Figure 8. Mixed forest habitat type (2011 NLCD) in Teton County as a potential reference for areas to survey for Flammulated Owls.



Great Gray Owl Project Report, 2016

Principle Investigator: Bryan Bedrosian, Senior Avian Ecologist, Teton Raptor Center, bryan@tetonraptorcenter.org; 307.690.2450

Project Personnel: Katherine Gura, Nathan Hough

INTRODUCTION

In 2016 we continued a multi-year study on Great Gray Owls in northwestern Wyoming that began in 2013. Working from the vast dataset gathered on nest sites and movements of Great Gray Owls amassed over the past three years, our goal in 2016 was to continue the dataset on territory occupancy, nest initiation rates, productivity, and survival and movements of previously marked owls. In addition to long-term monitoring of these metrics, we also began three new aspects of this study in 2016. Our new objectives in 2016 were to investigate the use of automated recorders for monitoring Great Gray Owls, how snow and prey conditions relate to Great Gray Owl habitat use and nest success, and to better understand juvenile survivorship, movements, and dispersal. Snow characteristics likely have a strong influence on Great Gray demographics. Snow loads in the spring and crust hardness may affect timing of nesting, hunting success, and prey abundance. Juvenile dispersal, survivorship, movements and habitat use is not known in the Rocky Mountain regions. Great Gray Owls typically do not breed until their third year, and understanding the juvenile life stage is important to understanding the overall ecology of this species. We also began a study to investigate the efficacy of using automated recorders to monitor territory occupancy of Great Gray Owls. Details of this aspect of the study will be available in a future report because analysis of recordings will take some time.

METHODS

The primary study area in 2016 included the base of the Teton Range and the Snake River riparian corridor from the areas around Moose, WY in southern Grand Teton National Park south to the Snake River Canyon. The study area also included northern areas within Grand Teton National Park (e.g., Emma-Matilda/Two Oceans area) and Bridger-Teton National Forest (e.g., Rosie's Ridge and Blackrock areas). The typical forest habitats consisted of Douglas fir, lodgepole pine, sub-alpine fir (*Abies lasiocarpa*), and aspen (*Populus tremuloides*) surrounding the valley and mixed cottonwood (*Populus* spp.) spruce (*Picea* spp.) forests within riparian areas. Both mesic and sagebrush (*Artemesia* spp.) meadows occurred throughout the study area. Housing subdivisions are common throughout the study area but rarely extend beyond 1.5km from the valley floor.

We continued to track previously radio-tagged owls and monitor known Great Gray Owl territories through night surveys, nest-checks, and fledgling surveys. We also continued pocket gopher surveys at known territories, and we initiated snow surveys in a number of these territories as well as at locations of radio-tracked birds. We also continued to monitor nesting platforms to determine if nest sites may be limiting the number of nesting pairs.

Call-Back Surveys

During the courtship period of Great Gray Owls (mid-February – April), we conducted call-back surveys to record the presence of Great Gray Owls across the study area. In 2016, our main intent was simply to determine whether known territories were active or not, so we altered our methods from past survey years. We assigned three call-back locations per known territory in a triangular configuration, conducting the surveys at points 300m from 2015 nest sites. As soon as Great Gray Owls were detected within a territory, we ceased surveying that area for the night. We continued to follow the USFS/BLM protocol (Quitana et al. 2004) with slight modifications to better suit the study area. We played calls for both Great Gray Owls and Boreal Owls. Each calling period consisted of a two-minute listening period, Boreal Owl territorial call, one-minute listening period, Great Gray Owl territorial call, one-minute listening period, Great Gray Owl call, and a final two-minute listening period. We recorded all owl species detected, and we estimated distance to and direction of each owl. To help with distance estimates, we played owl calls at typical volumes for each species at known distances in training sessions. We conducted backcountry surveys in teams of two, typically on skis or snowshoes.

Nest Monitoring

We monitored all known Great Gray Owl territories. We considered a territory “active” only if we found direct evidence of breeding, such as an incubating female or fledglings. We considered a territory “occupied” if we documented multiple night detections or saw at least one adult owl multiple times but no active nest or fledglings were located. Once active nests were located, we checked on nesting status at least once every week to determine nest success and fledge dates. We considered fledged nests as successful. In some areas, 2015 nests were not re-used, so we conducted limited nest-searching and fledgling surveys to determine whether territories were active/successful. Fledgling surveys were conducted during August and used a mixture of contact and begging calls.

We also continued to check the 42 nesting platforms we installed in a portion of our study area in previous years to see if they are being utilized by Great Gray Owls. All platforms were checked at least once during the incubation period.

Gopher Surveys

We surveyed for pocket gopher abundance following van Ripper et al. (2013). We digitized all meadows within 500 m of known nests and randomly selected three (when available) for surveys. We started at the head of each meadow and walked 45-degree diagonal transects back and forth until reaching the end of the meadow, tallying fresh and old gopher mounds visible within 10 m of the transect. Because we are interested in relative abundance between years and among territories, we tallied total survey area (total transect length x 20 m) for each territory and divided by the total number of mounds to create an index of gopher abundance. Because we regularly observed owls hunting within forested areas, we also added a survey transect bisecting the territory through representative forest habitat. We tested for correlations between new, old, and total gopher mound abundance and between forest and meadow. We tested for relationships between years and between gopher abundance and productivity.

Tracking

We continued to radio-track Great Gray Owls that are outfitted with VHF transmitters. We attempted to relocate each marked owl once per week throughout the study. Relocations were obtained via homing techniques and locations were recorded within 100 m of the owl without disturbing it.

Snow Measurements

In the winter of 2015-2016, we began conducting snow measurements near known Great Gray Owl territories across the study area, as well as at re-location sites of radio-tagged birds. We conducted measurements at least once biweekly. We measured snow depth by placing a measuring stick vertically down through the snow until it reached the ground. We measured snow crust strength by dropping a filled 1-liter Nalgene water bottle (ca. the same weight as an adult Great Gray Owl) one meter above the top of the snow (not the ground) and measuring how far the bottle penetrated the snow. We dropped the bottle both horizontally and vertically and averaged the depths. In each territory, we measured snow characteristics in a meadow and in a forest representative of the territory. The same meadow and forest sites were consistently measured. We made sure to conduct the measurements in areas representative of the area's average snow conditions (ie. not directly in a tree well, nor in an area disturbed by human activities).

Banding

We banded fledgling Great Gray Owls immediately after they branched with a USGS and custom-made blue and white plastic alphanumeric leg flag. Fledgling captures took place within one week of fledging using a net on an extendable pole. We took standard ornithological measurements of each individual and a blood sample for later genetic analysis. Gender was determined using a small portion of the blood sample (Zoogen DNA Services, Davis, CA). We also outfitted one fledgling per brood with tarsal

VHF transmitters attached to its leg flag. The tarsal mounts last approximately three months and will aid in the relocation of fledglings for autumn captures. In September, we will target all banded juveniles to outfit them with backpack VHF transmitters once they are fully grown. Tarsal mount transmitters will be removed before outfitting with the backpack transmitter.

RESULTS

Call-Back Surveys

We surveyed a total of 15 known territories four different times from 25 of February – 5 of April 2016. The overall survey period was divided into two periods, early and late (25 Feb - 16 Mar and 17 Mar – 5 Apr, respectively). Each territory was surveyed twice in the same week to correspond to the period when reorders were deployed in the same territory for direct comparison. Five territories were surveyed each week during the early period, then they were re-surveyed in the corresponding week in the late period (i.e., if territory A was visited in week one, then it was resurveyed in week four, and if territory B was surveyed in week three, it was re-surveyed in week 6). We also conducted surveys opportunistically at additional locations within suspected, unconfirmed territories.

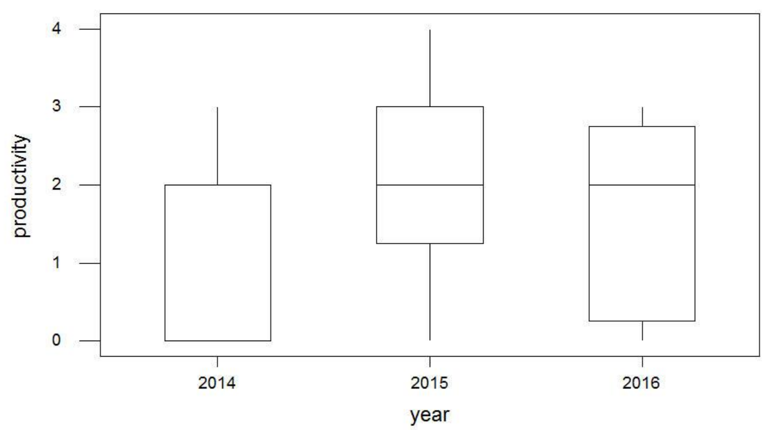
In 2016, we detected Great Gray Owls at 10 out of the 15 known territories we systematically surveyed. We detected Great Gray Owls as early as 25 February and as late as 1 April. During each round of surveys, we detected Great Gray Owls at six out of the fifteen known territories. We also detected Great Gray Owls in two new territories during spring call-back surveys. We visited 191 individual call locations total and recorded a total of 85 detections from six different owl species. We detected Boreal Owls (12), Great Gray Owls (25), Great Horned Owls (26), Long-eared Owls (2), Northern Pygmy Owls (14), and Northern Saw-Whet Owls (8).

Nest Monitoring

In 2016, we monitored 29 known Great Gray Owl territories in the study area. Of these, 27 were occupied in 2016 (we did not observe any Great Gray Owl activity at two of the territories, although access to these sites was limited until late in the breeding season). We documented 21 active nests, 17 of which successfully fledged young. The successful nests produced an average of 2.05 fledglings per nest. We calculated nest success rate based on 15 nests that we consistently monitored from the beginning of nest initiation. Of these, 11 were successful (73% apparent nest success rate). Average productivity was 1.67 fledged young/nest. We recorded accurate fledge dates for eight of the 17 nests that successfully produced young and calculated an average fledge date of 16 of June from those nests (range = 8 June - 28 of June). We documented an average initiation date of 13 of April.

Two of the occupied territories were new in 2016, located during fledgling surveys late in the breeding season. We are unsure whether eight occupied territories nested successfully because the 2015 nest sites were not reused and new nest sites were not located. Our nest-searching efforts to document alternate nest sites within these territories were inadequate to sufficiently know if these owls nested or not in 2016. We found no difference in productivity across years, from 2014-2016 (Figure 1). We also did not detect differences in nest success by year (P = 0.524).

Figure 1. Boxplots of Great Gray Owl productivity by year (P = 0.308).



Gopher Surveys

We conducted pocket gopher surveys at 16 territories between 21 of May and 17 of June. We found an average of 0.00051 fresh gopher mounds/sq m (SD = 0.00045) within meadows. Mean old and total mound abundance was 0.00352 and 0.000403 mounds/sq m, respectively. We first tested for correlations between the abundance of new, old, and total mound abundance within territories to investigate the appropriate measure. Not surprisingly, all measures were correlated (all P < 0.001), so we used the indices of fresh mounds to be consistent with van Ripper et al. 2013.

In 2016, mound abundance within forests (0.000145 mounds/sq. m, SD = 0.000161) was significantly lower to meadows (P = 0.006). Gopher abundance was also lower in 2016 compared to 2014 and 2015 (P < 0.000, Figure X). We did not find that productivity was related to gopher abundance across territories and years (P > 0.01). But we did find that failed nests had significantly fewer gophers than successful nests (Figure 2, 3).

Figure 2. ANOVA results of new gopher mound abundance by year. P < 0.000

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                    Individual 95% CIs For Mean
                    Based on Pooled StDev
Level    N    Mean     StDev  ---+---------+---------+---------+---
2014    10  9.61E-04  9.72E-04         (-----*-----)
2015    21  1.46E-03  5.96E-04              (---*----)
2016    16  1.45E-04  1.61E-04  (----*----)
                    ---+---------+---------+---------+---
Pooled StDev = 6.03E-04     0.00000   0.00060   0.00120   0.00180
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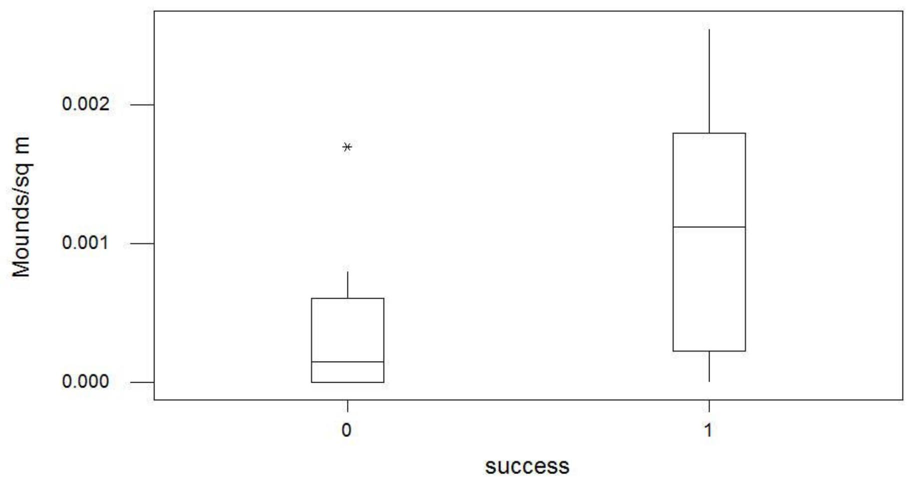
Figure 3. Boxplot of nest success by year (2014-2016, P = 0.0042). Success 0 = failed and 1 = successful nests.



Snow Measurements

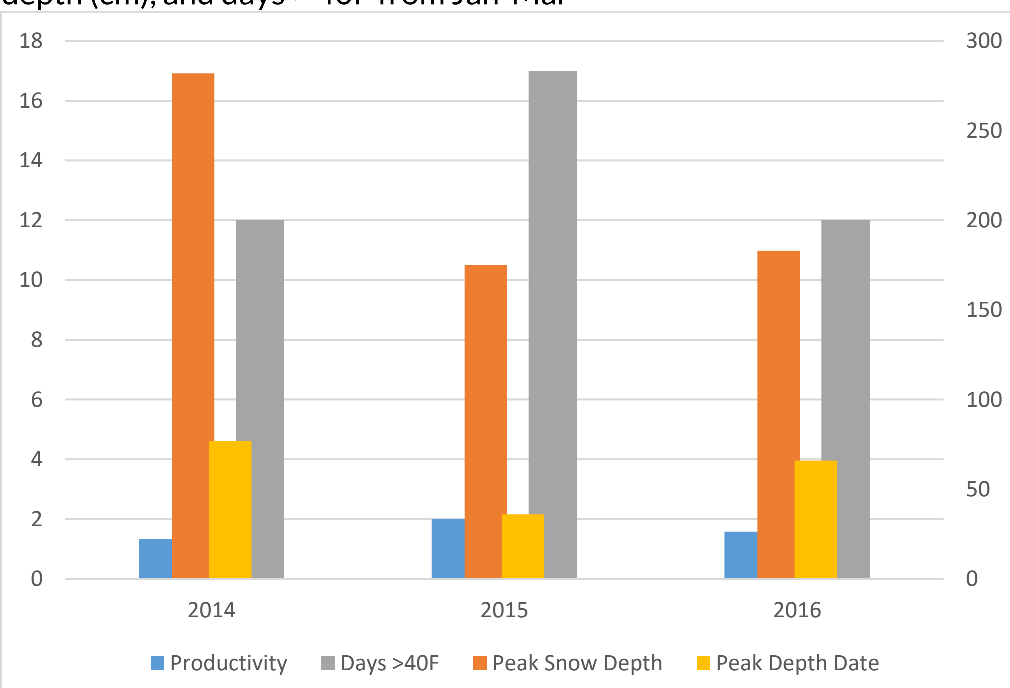
We conducted snow measurements at eighteen known Great Gray Owl territories across the study area. Measurements were taken as early as 1 of January through 20 of April. Some sites were visited more often than others due to accessibility, but we took measurements at the sites an average of 7.6 times throughout the winter. We ceased gathering snow data when there was <50% estimated snow cover within the territory.

We tested for correlations within territories between forest and meadow sites. We found that a minimum of 10 measurements over the winter were needed to detect a correlation between forests and meadows within a territory at the alpha = 0.05 level. Using the four territories where we measured at least 12 days (Murie, Munger, Granite, Death Canyon), we found that meadows had an average of 21.14 cm more snow than forest sites.

To standardize the relative amount of snow within a territory, we compared the snow depth measured at nests between February 10-12 to the snow depth at the Snowtel site on Phillips Ridge. We used this date range because we had data for almost all nests during this period and there were no snow events to influence estimates. This also generally corresponds to peak snow depths on the valley floor. We used the measure at meadow sites for comparisons. For nests which we had nest initiation rates or productivity rates, we tested to see if relative snow depth was correlated to nest success, nest initiation date, productivity, or gopher abundance. We found no evidence to suggest snow depth was related to anything tested (all $P > 0.1$). More years of data are needed to adequately test these relationships.

We also began exploring annual variation by looking at mean productivity with peak snow depth (at Phillips Ridge Snowtel site), peak depth date, and days >40 F from January – March. The only metric we looked at that exhibited a similar pattern to productivity was the number of days above 40F from January through March (Figure 4).

Figure 4. Mean annual productivity, Julian date for peak snow depth, maximum snow depth (cm), and days > 40F from Jan-Mar



Banding

We banded 17 fledglings from 11 territories immediately after they left the nest. Nine fledglings (one from each of nine different broods) were outfitted with <5g tarsal mounted VHF transmitters temporarily attached to their colored leg flags. The purpose of these transmitters was to help us relocate fledglings in the fall in order to target juveniles to outfit with VHF backpack transmitters. Range on the tarsal transmitters was weak and many of the juveniles could not be relocated via radio-tracking. However, we were able to relocate five of the banded juveniles as well as five unbanded juvenile owls, so we deployed ten VHF backpack transmitters this fall. If anymore banded juveniles from the 2016 cohort are relocated, we will target them for VHF transmitters.

CONCLUSION

Long-term monitoring of Great Gray Owls is essential in order to assess overall population health. We intend to continue nest-monitoring and prey-sampling in order to evaluate the health of Great Gray Owls in the Greater Yellowstone Ecosystem in the face of anthropogenic and natural changes over time. Snow conditions likely have an influence on Great Gray Owl winter habitat selection, seasonal movements, timing of breeding, and nest success, but these data need to be collected across years in order to adequately assess how climate affects this species. Furthermore, as Great Gray Owls are a denizen of boreal forests that will likely be effected by climate change, it is important to study how this species responds in light of rising temperatures and a changing environment.

Rough-Legged Hawk Project Report, 2016

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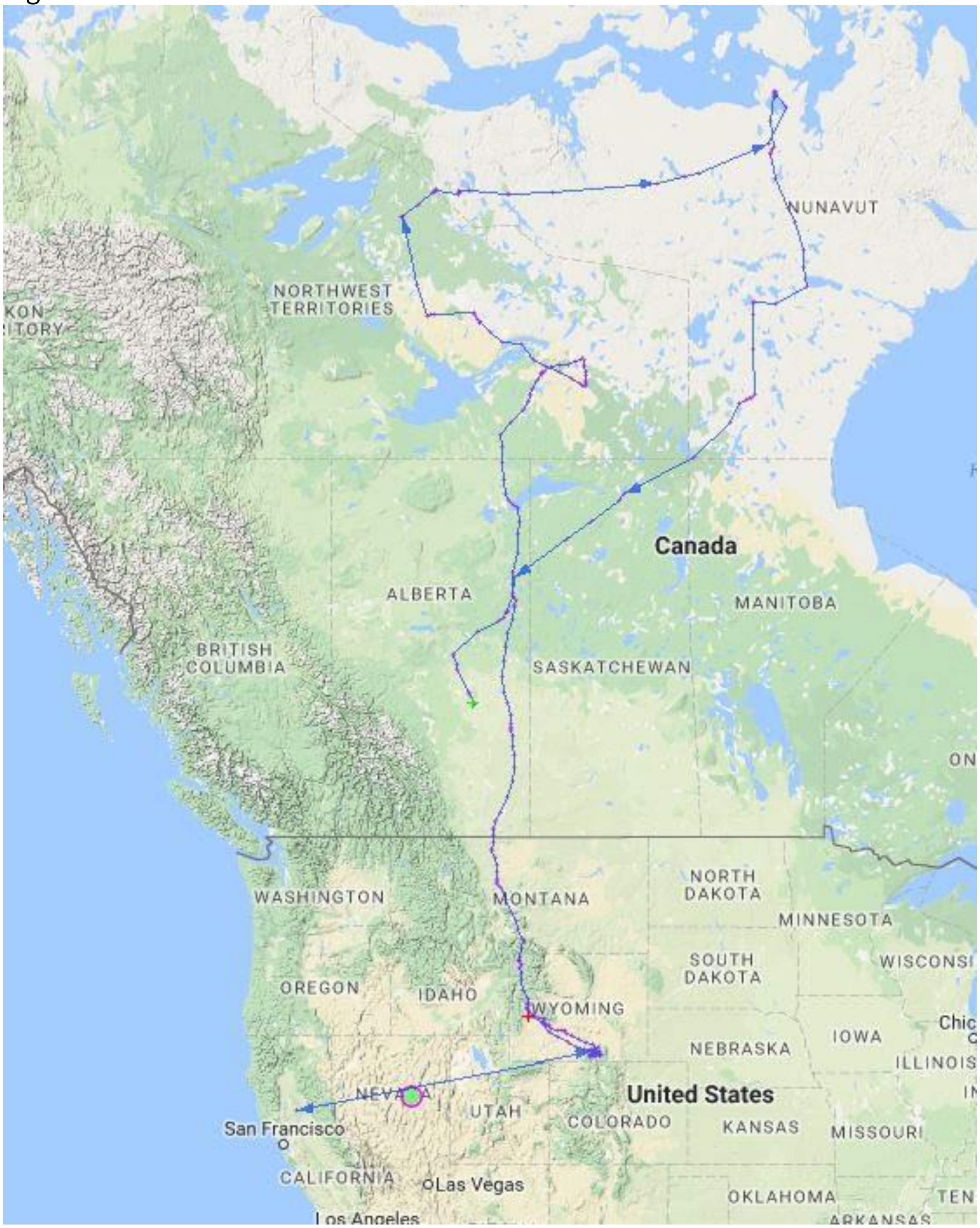
Project Personnel: Katherine Gura, Nick Ciaravelli

In the winter of 2016 we began capture efforts targeting Rough-Legged Hawks in northwestern Wyoming. Banding began 1 January 2016 and continued through 15 February 2016, and then began again 15 November 2016 through 19 December 2016. Capturing involved the use of standard bal-chatri and pan traps baited with mice.

In 2016 we captured three Rough-Legged Hawks, all of which received back-pack transmitters, and blood samples and standard ornithological measurements were taken from these three birds as well. We captured one subadult female, one adult female, and one juvenile male Rough-Legged Hawk. Both the adult female and juvenile male were outfitted with PTT satellite transmitters, and the subadult female was outfitted with an Ecotone GPS/GSM logger.

Transmitters on two of the Rough-Legged Hawks were just recently deployed in the Jackson Hole Valley in December 2016, and the third transmitter was deployed near Big Piney in January 2016. That individual migrated north through Alberta and the Northwest Territories and finally summered in Nunavut before returning south this fall through Manitoba, Saskatchewan and is currently again in Alberta (see Figure 1). The adult female captured in 2016 is currently near Cokeville, WY, and the juvenile male is currently in Rock Springs, WY. We will continue to monitor the movements of these individuals remotely via transmitters.

Figure 1.


NUNAVUT
NORTHWEST
TERRITORIES
Canada
ALBERTA
MANITOBA
BRITISH
COLUMBIA
SASKATCHEWAN
NORTH
DAKOTA
WASHINGTON
MONTANA
MINNESOTA
SOUTH
DAKOTA
OREGON
IDAHO
WYOMING
NEBRASKA
IOWA
United States
UTAH
San Francisco
COLORADO
KANSAS
MISSOURI
CALIFORNIA
Las Vegas
OKLAHOMA

MAPS Banding Report, 2016

Principle Investigator: Bryan Bedrosian, Senior Avian Ecologist, Teton Raptor Center, bryan@tetonraptorcenter.org; 307.690.2450

Project Personnel: Arthur Sanchez Jr., Katherine Gura, Nathan Hough

During this summer, Indian Springs Ranch Headquarters in Jackson (JACK) and the Teton Science School (TSS-) in Kelly were utilized as MAPS (Monitoring Avian Productivity and Survivorship) stations for the 2016 banding season. There were a total of 20 complete banding days over an eleven week period, which encompasses 1,193 net hours.

Here is a summary for each station:

JACK	**TSS-**
Total net hours= 593	Total net hours= 600
Total captures= 291	Total Captures= 405
Newly banded birds= 175	Newly banded birds= 266
Recaptures= 83	Recaptures= 93
Unbanded birds= 33	Unbanded birds= 40
Bands lost/destroyed= 0	Bands lost/destroyed= 6
Total Species= 31	Total species= 36

For both stations cooperatively, we saw:
Total net hours= 1,193
Total captures= 696
Newly banded birds= 441
Recaptures= 176
Unbanded birds= 73
Bands lost/destroyed= 6
Total Species= 43

The top five most continually captured species, in sequential order were, Yellow Warbler, American Robin, House Wren, Song Sparrow, and Cedar Waxwing. The Yellow Warbler was the most common with 134 captures including newly banded birds, unbanded birds, and recaptures. Out of the top five most frequently captured birds, Cedar waxwings are sitting at the bottom of the directory with 35 over all captures. At the bottom of the document are two tables that demonstrate captures for individual species at each banding site.

Over the entire banding season there were a total of three mortalities, including a bird that was predated by a Sharp-shinned Hawk (*Accipiter striatus)* at the JACK banding site. In addition there were five birds with old injuries, two with body injuries, two with wing injuries, one with a malformation, and one with a tongue injury. All of these birds were released and still capable of surviving in their natural habitat.

Table 1. This table demonstrates newly banded birds, unbanded birds, and recaptures for the JACK banding site at Indian Springs Ranch Headquarters in Jackson, Wyoming.

JACK New		**JACK Recapture**		**JACK Unbanded**	
Species	**#**	**Species**	**#**	**Species**	**#**
AMGO	1	AMRO	13	AMRO	5
AMRO	26	BCCH	3	BCCH	1
AUWA	2	BHGR	4	BTAH	4
BCCH	8	CEDW	1	CAHU	10
BHCO	1	DOWO	1	HOWR	1
BHGR	5	GRCA	2	LISP	1
BUOR	2	HOWR	9	MGWA	1
CEDW	25	MOCH	1	RUHU	3
CHSP	4	RSFL	1	SPSA	2
DOWO	2	SOSP	14	YEWA	5
GRCA	3	WEWP	1	**Total**	**33**
GTTO	2	YEWA	32		
HOWR	24	**Total**	**82**		
MGWA	1				
MWCS	1				
OCWA	1				
RNSA	1				
RSFL	2				
SOSP	13				
SSHA	1				
SWTH	1				
WBNU	2				
WEWP	1				
WIWA	1				
YEWA	45				
Total	**175**				

Table 2. This table demonstrates newly banded birds, unbanded birds, and recaptures for the TSS- banding site at the Teton Science School in Kelly, Wyoming.

TSS- New		**TSS- Recapture**		**TSS- Unbanded**	
Species	**#**	**Species**	**#**	**Species**	#
AMRO	27	AMRO	10	AMRO	2
AUWA	3	BHGR	2	BTAH	7
BHCO	2	CEDW	2	CAHU	6
BHGR	9	CHSP	2	GTTO	1
BRSP	3	DUFL	6	HOWR	4
CEDW	7	FOSP	5	MGWA	2
CHSP	6	GRCA	4	PSJU	2
DOWO	2	GTTO	5	RUHU	12
DUFL	15	HOWR	3	SOSP	1
FOSP	4	LISP	2	WAVI	1
GRCA	5	MGWA	10	WEWP	1
GTTO	14	MOCH	1	YEWA	1
HOWR	12	MWCS	4	**Total**	**40**
LISP	7	OCWA	2		
MGWA	11	PSJU	6		
MOBL	1	RNSA	6		
MOCH	9	SOSP	3		
MWCS	5	SWTH	2		
OCWA	8	WAVI	1		
PISI	16	YEWA	17		
PSJU	17	**Total**	**93**		
RCKI	7				
RNSA	10				
SOSP	15				
SPSA	1				
SWTH	2				
UNEM	1				
VGSW	1				
WAVI	5				
WETA	3				
WEWP	3				
WIFL	2				
YEWA	34				
Total	**267**				

Northern Goshawk Nesting Survey

2016 Teton Raptor Center Report

Teton Raptor Center, funded by Teton Conservation District, conducted nesting and fledgling surveys for Northern Goshawks (*Accipiter gentilis*) in Teton County from mid-June through mid-August 2016. The Northern Goshawk is a large forest raptor that is known to breed at low density in suitable mature forest habitat throughout Wyoming. It is considered an "uncommon" resident and ranked by the state as Native Species Status "Unknown" (NSSU) based on a lack of population trend data (Faulkner 2010, WGFD State Wildlife Action Plan 2010). The goshawk has been designated a Tier I (highest priority) SGCN (Species of Greatest Conservation Need) as its required nesting habitat, mature coniferous forest, is undergoing continued loss and fragmentation as a result of extensive beetle kill, logging, large-scale fires and climate change (WGFD 2010). The species is also known to be sensitive to human disturbance during the nesting season. Collecting needed information on this sensitive and very secretive species is greatly hampered by the ability to locate nest sites in the rugged and often remote forests in which this raptor resides. The goal of this project was to leverage existing datasets and anecdotal sightings from Teton Raptor Center, Wyoming Game and Fish Department (S. Patla), Bridger-Teton National Forest, and Grand Teton National Park in order to locate active nesting territories in Teton County as the first step for a long-term study on this raptor species. Defining territory locations is critical for understanding habitat needs and associations to create a nesting habitat model and to develop effective long-term management guidelines. This is especially important as goshawks have been shown to reoccupy the same nest stands (using a number of different nest trees) for many decades if left undisturbed. Further ecological studies including seasonal movements, prey associations, and productivity/survivorship can also be developed once an adequate number of nesting territories have been located.

Methods

Collaborator Susan Patla (Wyoming Game and Fish Department) provided known goshawk nest locations from approximately the last 15 years documented in GTNP and BTNF and we also gathered existing data from BTNF, field crews, and members of the public. We also used nest data and goshawk sightings concurrently gathered during our existing Great Gray Owl studies over the past three years. Nest searching was primarily conducted by Nathan Hough with supplemental help from TRC crew members. We first searched known, historical, and suspected nesting locations. We also searched areas that appeared to be possible habitat based on our knowledge of general habitat types and similar habitat to that surrounding other goshawk nests. Due to the limited timeframe and crew size for this project, we did not design systematic surveys, nor did we randomly survey habitat types or forest patches. We opportunistically searched prospective habitat on foot simultaneously visually locating nest structures and conducting surveys using playback calls.

We recorded all nest structures found with any signs of activity. Because the surveys were conducted after fledging for a portion of the study period, we also recorded locations of dependent juveniles and used these locations as indicators of active territories. Juveniles generally spend the first several weeks post-fledging within 200m of nest sites (McClaren et al. 2005), so these locations should be indicative of nesting habitat. Habitat characteristics were extracted from active nest locations first (if known) or the first location of fledglings. We combined nest and fledgling locations to gather information on habitat types to create a very preliminary habitat model for nesting Northern Goshawks in Teton County. Our goal was to develop preliminary models to better inform future surveys. We used DEM derived slope and aspect along with 2011 Landfire data classes canopy cover, canopy height and existing vegetation type to assess basic characteristics of goshawk locations. We found the point estimates of all covariates at nest and fledgling locations and used these estimates to define "nesting habitat."

Because nesting goshawks generally need larger, intact patches of forest for nesting, we also created an estimate of patch size to incorporate into the habitat model. We classified each 30m x 30m cell within the study area as "habitat" or "non-habitat" based on whether the criteria within that cell fell within the bounds of covariate values of known nest and fledgling locations. Using focal statistics, we then summed the number of cells within a 1000m radius of each "habitat" cell that also were "habitat." We used a 1000m radius surrounding the nest sites because ca. 95% of alternate nest sites used over several years can be located within a search radius of 1000m (Reynolds et al. 2005, Woodbridge and Hagris 2006).

Results

We conducted surveys on 44 days in 23 general areas between 21 June and 18 August, 2016, which corresponds to the suggested survey timeframe suggested by Woodbridge and Hagris (2006). We located a total of 12 confirmed, active goshawk territories in 2016 (six active nests and six fledgling locations; Figure 1). We also located an additional 11 suspected, inactive Northern Goshawk nests, two active Cooper's Hawk (*Accipiter cooperii*) nests, two active and one inactive Sharp-Shinned Hawk (*Accipiter striatus)* nests, and nine unknown stick nests (Figure 1). Of the six territories found with active nests, all successfully fledged young. Only two nests were found during the incubation stage, so overall nest success cannot be calculated. Also, six territories were located after fledging, so any mortality between fledging and location of the young is unknown. Therefore, fledging estimates should be considered a minimal count. Productivity averaged 2.0 young/territory (brood size ranged from 1-3) (Table 1).

As part of a concurrent study utilizing automated recording systems to monitor forest raptors, we deployed a grid array of 16 recorders simultaneously throughout the Beaver Creek/Windy Ridge area in GTNP. In a very brief review of the recordings at dawn for the one week (7-14 April) deployment period, we heard two Cooper's Hawk pairs and one Northern Goshawk pair vocalizing at dawn, which helped inform search efforts in that area. For Northern Goshawks, we detected dawn vocalizations at an estimated 300m (heard on multiple recorders simultaneously that were 400m apart).

We extracted values of slope, aspect, existing vegetation height, canopy cover, and canopy height from DEM and 2011 Landfire GIS layers at the 30m scale for all nest and fledgling locations (Table 1). All located nest trees were alive. Figure 2 outlines the areas classified as nesting habitat and Figure 3 is the same area color graduated in 10% quantile bins for each cell in the amount of surrounding habitat within a 1000m that is also nesting habitat. Nests located in 2016 were within all bin categories. It is important to note that quantiles should not be considered as an indicator of quality, but rather as a tool for future survey designs.

We restricted our "nesting habitat" mask to the existing vegetation types detected (Table 1), slope <30 degrees, aspects 0-60 and 30-360 when slope was >10 degrees, all aspects when slope as <10 degrees, canopy cover > 40-60%, and canopy height >10m. While we did not record any nests in aspen stands in 2016, Northern Goshawks are known to utilize this habitat type in the Teton area (Patla 1997), so we also included this vegetation type in the model.

Table 1. Northern Goshawk nests and fledgling locations detected in 2016, nest tree type, productivity, and habitat data extracted from 30m 2011 Landfire and DEM GIS datasets.

Location	Nesting Tree Sp	Fledged Young	Vegetation Type	Canopy Height	Canopy Cover	Slope	Aspect
Colter Bay	Lodgepole	1	Lodgepole	10-25m	40-50%	9	240
Leigh Lake	.	1	Lodgepole	10-25m	40-50%	1	267
Jenny Lake	Lodgepole	2	Lodgepole	10-25m	40-50%	2	236
Mosquito	Lodgepole	3	Spruce/Fir	10-25m	40-50%	23	349
Two Ocean	.	1	Spruce/Fir	10-25m	40-50%	15	13
Beaver Creek	.	1	Spruce/Fir	10-25m	40-50%	1	136
Grandview	Lodgepole	3	Aspen/Mixed Conifer	10-25m	40-50%	3	79
Snow King	.	3	Douglas Fir	10-25m	40-50%	24	8
South Fall Creek	Lodgepole	3	Douglas Fir	25-50m	40-50%	14	5
Jackson Peak	.	1	Spruce/Fir	10-25m	50-60%	4	38
Turpin	.	3	Aspen/Mixed Conifer	10-25m	50-60%	12	334
Wally World	Lodgepole	2	Douglas Fir	10-25m	50-60%	12	346

Discussion

We did not systematically search areas for nesting Northern Goshawks, but rather targeted areas suspected of hosting nesting goshawks from previous sightings, nests, or simply by habitat type. This study was not designed to assess nesting density of Goshawks, but rather establish a valuable dataset of confirmed territory locations throughout the Valley. Therefore, lack of nest sites does not indicate absence of hawks but rather areas that were not adequately searched. This study was very successful in documenting a dozen active goshawk nest sites in Teton County in 2016.

We built a preliminary model of nesting habitat for the Jackson Hole region utilizing the nest and fledgling locations documented in this study. The models were therefore built from a sample size of 12 non-randomly selected nest sites and does not incorporate any measure of use/availability. The model was designed as a tool and basis in future studies to help inform study designs.

We suggest continuing the study of goshawks in Teton County due to their sensitive status and continued threats to their habitats from fire, disease, and increased disturbance. The Bridger-Teton National Forest (BTNF) has also previously developed a nesting habitat model for forest lands. Of the five goshawk territories we located, only one was predicted habitat using the BTNF model. There is a clear opportunity to work with BTNF to refine both models and to create a model for all of Teton County, including private lands and other public lands.

Any model will greatly benefit from more detailed studies of habitat analysis based on statistically designed surveys as well as on-the-ground measurements of habitat at nest sites and within post-fledging areas. Telemetry studies of habitat use of adult breeding males will help better refine use areas year-round, size and type of habitat patches utilized, territory size, and post-fledging areas. To maximize efforts of nest searching while minimizing costs, we suggest further investigating the use of automated recording devices to detect goshawks during the courtship period. This method will provide estimates of occupancy and can be more widely dispersed and effective than traditional call-back surveys. Similarly, use of recorders to detect nestlings/fledglings should also be investigated.

Apex predators that require specialized habitats, such as Northern Goshawks, are key indicator species for forest health and should be closely monitored to assess changes in forest dynamics, both anthropogenic and natural. Our results also indicate a large percentage of the private/wildlands interface at the base of the Teton Range is potentially goshawk nesting habitat. Future projects to protect these private lands could be enhanced from knowledge gained from our results. This project has provided an invaluable platform from which to launch more detailed studies of this species in Jackson Hole since location of nest sites is often the limiting factor for researching sensitive raptors.

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Prepared by Bryan Bedrosian, Teton Raptor Center, 2016

Figure 1. All nests and fledglings located in 2016. Closed circles with stars indicate a nest was located, closed circles indicate fledgling locations, and open circles indicate old, inactive nests.

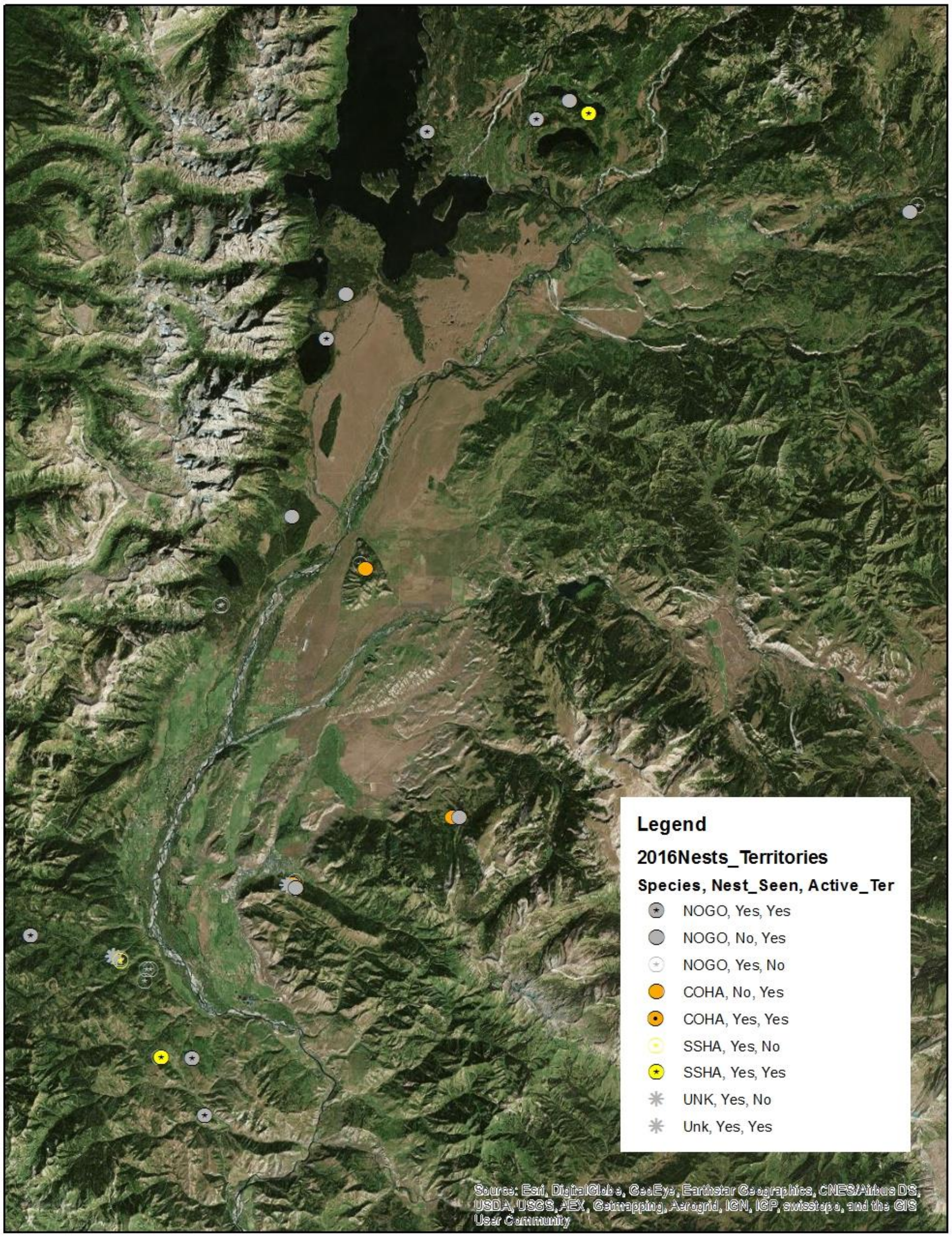

Figure 2. Predicted Northern Goshawk nesting habitat as a function of vegetation type, canopy cover, canopy height, slope and aspect (based on values extracted from 2016 nest and fledgling locations).

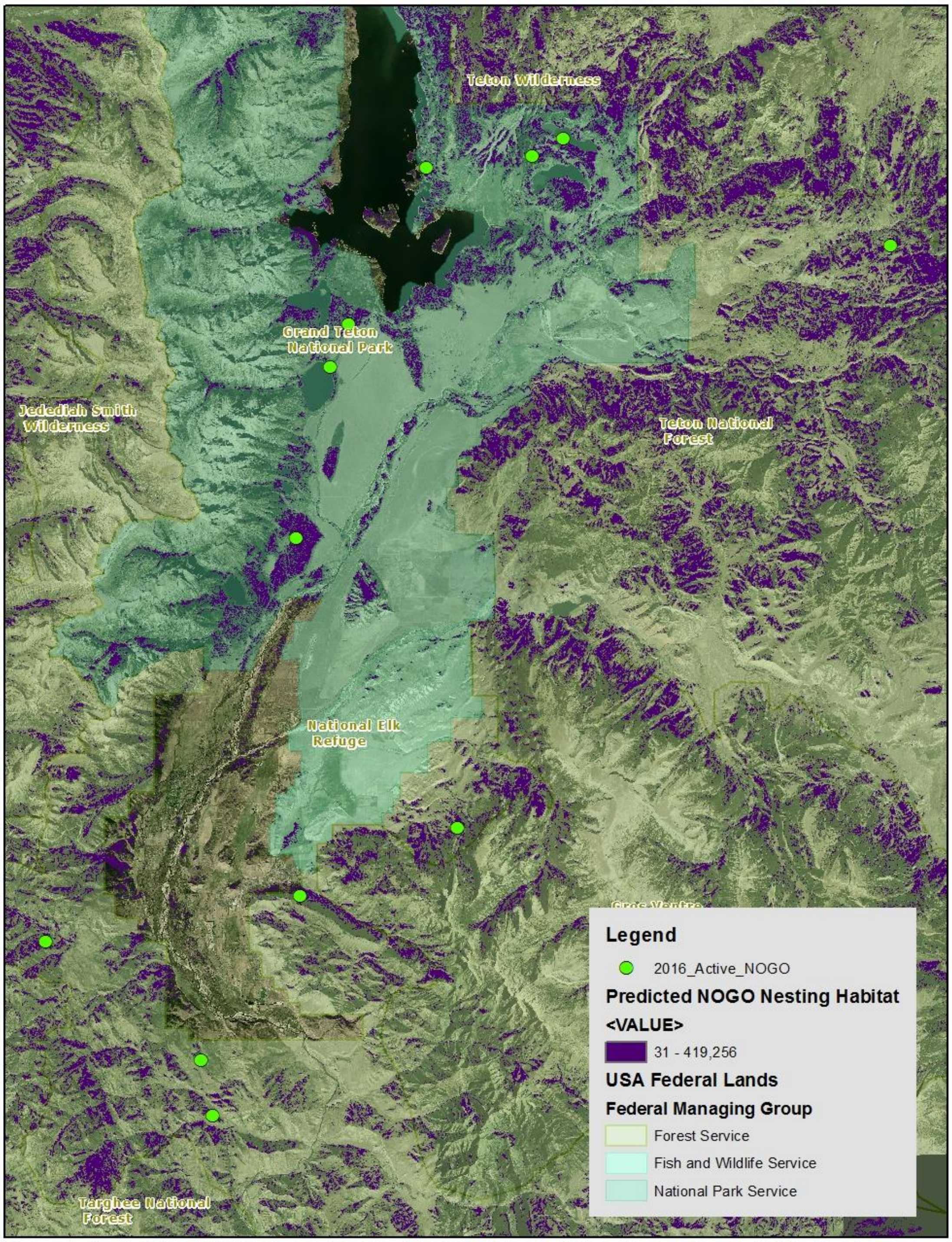

Figure 3. Predicted Northern Goshawk nesting habitat with quantile gradient coloration indicating the percentage of the surrounding 1000m that is also predicted nesting habitat.