

Relating Songbird Territories to Habitat Conditions in Woody Draws on the MPG Ranch



2015

Annual Report

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Introduction

Woody draw habitats perform critical ecological functions similar to riparian systems, including erosion control and water retention, and support diverse vegetative communities that provide essential habitat to high concentrations of wildlife (Bjugstad and Gerard 1985). Like riparian systems throughout the western United States, improper land management practices have had a negative impact on woody draw habitats, from overstocking livestock to active shrub removal



and herbicide application. The MPG Ranch, a large conservation property in western Montana, has undertaken active restoration of woody draws on the property to stabilize erosion, reduce invasive species, and improve wildlife habitat. Integral to restoration is the inclusion of monitoring to evaluate the ecological success of the project, provide feedback for management, and guide future restoration design (Block et al 2001).

Birds are ideal indicators of environmental conditions because they have diverse habitat requirements, are relatively

abundant in a small area, and provide feedback from an entire community rather than a single species (Carigan & Villard 2002, Hutto 1998). The spatial arrangement of habitats within landscapes influences the abundance, distribution, and dynamics of bird populations (Chamberlain and Fuller 1999). Therefore, mapping the distribution of birds in relation to land features can provide information on restoration outcomes for associated bird species (Hinsley et al 2010). Territory mapping is particularly useful in small, constrained habitats such as riparian systems and is well-suited to sites where there is high turnover in vegetation and associated bird communities in a small area, such as along an elevation or hydrologic gradient, since evaluation of use within the site may be more meaningful than the single estimate of density provided by point-based methods.

Although territory mapping has long been used for studying bird populations, new technology has permitted improved precision in recording bird locations through the use of geographic positioning systems (GPS). Spatially explicit habitat use can be measured by overlaying territory locations collected using GPS with digital maps in a Geographic Information System (GIS), improving our understanding of species distribution in space (Whitham and Kimball 1996, Sirami et al 2011).

Restoration of the MPG Ranch's woody draws provides an excellent opportunity for applying spatially-explicit bird territory monitoring, given the constrained and linear nature of the habitat, and the scale of planned restoration activities. In 2012, we worked with MPG Ranch staff and GCS Research to develop a software application to streamline mapping of bird locations using a handheld GPS-enabled device loaded with high-resolution aerial imagery, and piloted the application's utility by mapping bird locations and breeding activity for five focal species within woody draws on MPG Ranch. In 2013 and 2014, we completed more intensive mapping of 5 focal species and conducted systematic searches for nests. We combined bird mapping and

breeding information to delineate territories. This year, we commenced bird mapping earlier in the season to document territory establishment and obtain a more complete picture of early breeding activities for focal species. We also limited nest searching efforts to a single focal species, the Spotted Towhee, to focus nest monitoring on a species with sufficient nesting densities to obtain the sample sizes needed for analysis of reproductive success, and to increase nests found by allocating effort to a single species.

The results of this effort will be used to evaluate breeding bird response to fine-scale habitat changes associated with restoration activities, providing measurable ecological outcomes for restoration efforts over time.

2015 Objectives

1. Collect a fourth year of information on focal species presence, distribution, and breeding activity within woody draw habitats of the MPG Ranch relative to restoration;
2. Conduct early spring surveys to document the timing of territory establishment, and determine if patterns of establishment are associated with habitat quality;
3. Conduct nest searching and monitoring for a single species, Spotted Towhee, to evaluate breeding success within draw habitats on MPG Ranch;
4. Provide spatially explicit territory maps showing estimated bird territories relative to habitat features, and evaluate changes in territory size and placement across years.

Methods

Study Area & Design

The study is located on the MPG Ranch, a large conservation property in Western Montana. The property includes narrow deciduous woody draws extending from bottomland riparian habitats of the Bitterroot River floodplain through uplands of grassland and sagebrush-steppe to mixed conifer at higher elevation. Past livestock use and herbicide application had resulted in substantial habitat degradation of the woody draws and surrounding upland habitats, including loss of shrub cover, erosion and gully, and introduction of non-native grasses and forbs. Restoration efforts by MPG Ranch include prescribed burning of invasive plants followed by targeted herbicide applications, installing erosion control devices, planting and watering native shrub and tree species, and fencing.

The study design follows a before-after, control-impact (BACI) design, which will permit comparison of the *Before* (pre-restoration baseline) and *After* (post-restoration) conditions, as well as applying a *Control* (comparable unchanged site) and *Impact* (restoration site) comparison to separate restoration effects from natural variability and underlying trends in the larger region.

Site selection focused on draws under active restoration, with adjacent unrestored draws as controls. We delineated survey sites from the mouth of each draw to tree line, where a distinct transition in vegetation occurs. Vegetation conditions vary along both control and restoration sites, from areas dominated by invasive herbaceous cover with few remaining shrubs to patches of dense woody vegetation, small Quaking Aspen patches, and scattered Ponderosa Pine trees.

Table 1. Woody draw sites selected for territory mapping and nest monitoring in 2015.

Site	Status	Length (km)
Partridge Alley	Restoration	2.6
Lower Sheep Camp	Restoration	1.2
Tongue	Restoration	3.6
Baldy	Control	2.6
North Sheep Camp	Control	1.9
Sapphire	Control	2.8
Upper Sheep Camp	Control	1.7

In 2014, we expanded the study area to include another restored draw, Partridge Alley, bringing the total survey area to 16.4 linear km (Table 1; Figure 1). We also split Sheep Camp draw into two sites because restoration activities are restricted to the area below the confluence with North Sheep Camp.

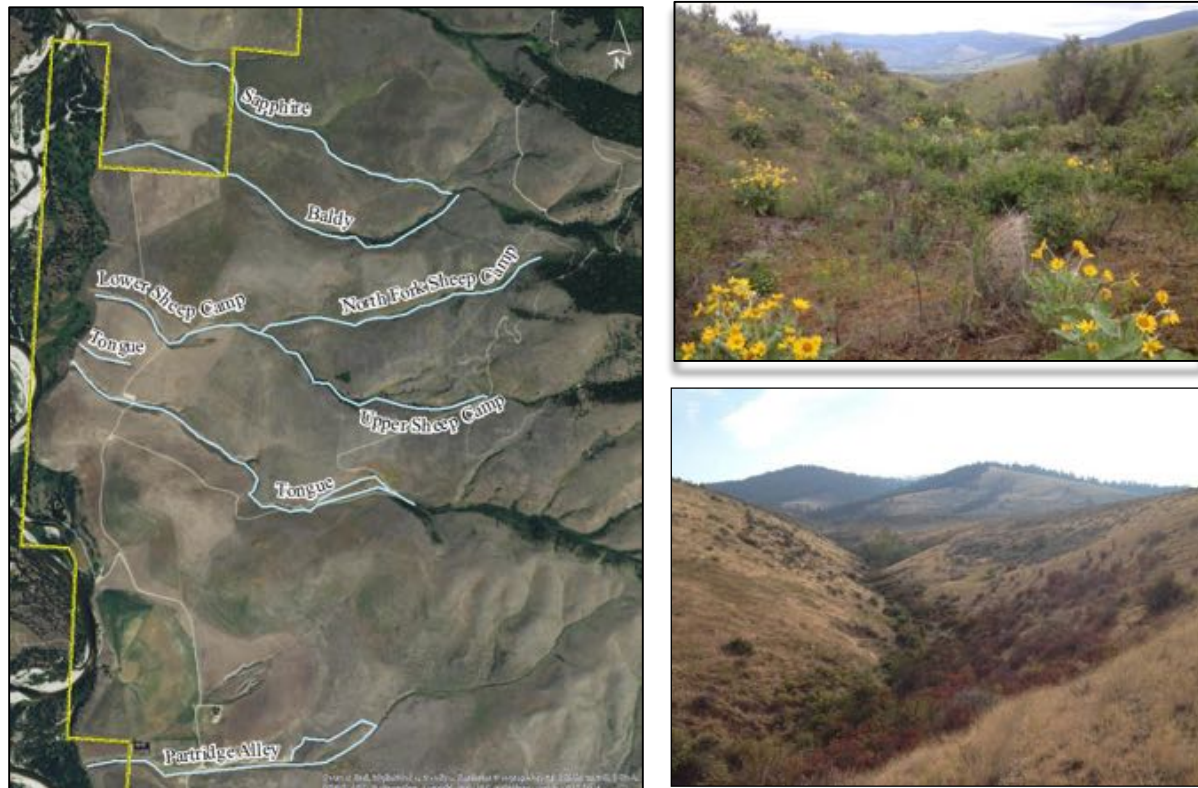


Figure 1. Location of woody draw sites surveyed in 2015 (left). Arrowleaf Balsamroot blooming in Sapphire Draw (upper right). Mature shrub community on North Sheep Camp draw (lower right).

Data Collection Device & Software

We continued collecting data with an Apple iPad and the project-specific data collection application developed by GCS Research. We also used the new data collection tool named “Landmarks” within the software application that allows the user to view marked locations during subsequent sampling sessions, collect information across repeated visits, and link digital photos.

Bird Mapping

Bird mapping entailed walking sites and recording locations of birds and behavioral observations during the first five hours after dawn. Along with the location of each bird sighted, we recorded species, sex, age, behavior and cues, and substrate. Behavior and cues included visual, song, call, territorial, copulating, with nesting material, on nest, or with food. We also recorded interactions with nearby birds as male-female pairs or male-male territorial interactions.

Data was collected for five focal species that breed in shrub habitats and are known to occur in the woody draws of MPG Ranch based on previous point count surveys (data provided by K. Stone; see Table 2). We mapped additional species if they were of specific interest to MPG staff or represented an unusual sighting. In addition, we recorded all bird species observed in restored draws where focal species densities remain very low.

Table 2. *Selected focal bird species, habitat preferences, and nest location information.*

Bird Species	Breeding Habitat	Nest Location
Dusky Flycatcher	scrub, brushy areas, thickets, aspen groves, open coniferous forests, and mountain chaparral	shrub
Gray Catbird	dense shrubs, vine tangles, and thickets of young trees	shrub
Lazuli Bunting	bushy hillsides, riparian habitats, sagebrush, chaparral, open scrub	shrub
Orange-crowned Warbler	streamside thickets, woodland groves	ground
Spotted Towhee	dry thickets, brushy tangles, forest edges, chaparral, coulees, and canyon bottoms	ground

Habitat Features

We recorded the substrate where birds were observed to investigate relative use of specific habitat features within the draws. Substrate was classified as: 1) shrub (identified to species or as dead), 2) tree (identified to species or snag), 3) grass (exotic or native), 4) woody debris, 5) log, 6) ground, or 7) man-made object.

Analysis of Density and Territory Size

We calculated focal species densities for each draw site as the total number of individuals detected during a mapping session divided by the length of the site. To estimate territory size, we followed standard methods described by Robbins (1970) and Bibby (1997) where a minimum of three territorial sightings or confirmation of a nest constitutes a territory. Behavioral and territorial information recorded with each sighting was used to inform territory delineations. Adjacent observations were lumped unless independent singing males were recorded on the same day. Individuals were determined to be non-territorial if singing and/or breeding activity was observed across fewer than three survey days. Spatially-explicit maps of individual territory locations were generated using Geographical Information Systems (GIS). We created convex hull polygons that connected each of the observed locations using ArcGIS 10 Spatial Analyst. The areas of the convex hulls were treated as the observed territory size. To estimate territory density for a site, we divided the total number of territories for the species by the length of the site.

Breeding Activity

We documented all evidence of breeding behavior for focal species during territory mapping sessions as:

- 1) Singing or territorial
- 2) With nest material/building nest
- 3) Copulating
- 4) Incubating
- 5) With food/feeding young
- 6) With fledglings

In addition to breeding activities recorded during territory mapping sessions, we conducted weekly nest searches targeting Spotted Towhees following methods from the national Breeding Biology Research & Monitoring Database (BBIRD). We monitored all nests for outcome every 2-3 days until fate was determined, and measured nest area vegetation characteristics at all nest locations.



Results

Digital Device and Software Application

This year we had more time to test the utility of the new Landmarks tool for collecting nest monitoring data. We found that the Landmarks tool not only assisted nest monitoring by storing nest locations and streamlining data entry across visits, but was also useful for tracking and sharing nest searching effort. We used the tool to make “landmarks” for breeding activity that could be viewed and shared among devices during subsequent visits to search the same area. This improved our ability to focus nest searching in the most promising locations and allowed us to build upon nesting evidence across multiple days and among field staff, thereby improving nest searching efficiency and effectiveness.



Mapping bird locations using an iPad in Sapphire Draw, May 2015

Bird Mapping

Early Season Detections

We conducted early season territory mapping sessions in each draw at least once from April 2nd to April 17th (Table 3). As anticipated, the only focal species detected was the Spotted Towhee.

Table 3. Early season survey effort, number of Spotted Towhee detections, and pair density.

Site	Survey Date	<u>Number of Detections</u>			Pair Density (per km)
		Singing	Pairs	Total	
<u>Restored</u>					
Partridge Alley	2-Apr			0	0
	15-Apr			0	
Lower Sheep	3-Apr			0	0
	17-Apr			0	
Tongue	2-Apr	1	1	11	0.3
	15-Apr			4	
<u>Control</u>					
Baldy	9-Apr	1	3	11	1.2
North Sheep	3-Apr		4	12	1.6
	17-Apr	1	3	10	
Sapphire	9-Apr	1	5	13	1.8
Upper Sheep	3-Apr	2	3	17	1.8
	17-Apr	1		5	

Sources: Esri, DigitalGlobe, GeoEye, Earthstar OpenSource, CNES/Airbus DS, USDA, USGS, AeroVIG, Swire, Bing, Mapbox, and the GIS User Community

0 120 240 480 Meters

10

For draws surveyed more than once, total detections declined with the second visit. This may seem surprising, but the majority of birds observed during the second survey were male, suggesting that females may have already begun incubating by mid-April.

Breeding Season Detections

We conducted territory mapping sessions from May 15th to July 1st on days with minimal precipitation and wind. We visited all sites 6 times (Table 4). We mapped a total of 1,851 bird locations for 44 bird species. Focal species accounted for 78% of detections (i.e., Dusky Flycatcher, Gray Catbird, Lazuli Bunting, Orange-crowned Warbler, and Spotted Towhee). In addition to focal species, we mapped all birds observed on recently restored draw sites (i.e. lower Sheep Camp, Partridge Alley, and Tongue). We also mapped additional species in any site if they were of specific interest to MPG staff or represented an unusual sighting. For example, Lewis' Woodpeckers were mapped on several occasions in Upper Sheep Camp.

Table 4. Survey effort and number of detections of focal and non-focal bird species at woody draw sites during 2015 breeding season.

Site	# Surveys	Number of Detections						Total
		Lazuli Bunting	Dusky Flycatcher	Gray Catbird	Orange-crowned Warbler	Spotted Towhee	Other Spp.	
<i>Restored</i>								
Partridge Alley	6	24		19			210	253
Lower Sheep	6	7	1			3	60	71
Tongue	6	8		4		5	128	145
<i>Control</i>								
Baldy	6	152	48	12	16	298	2	528
North Sheep	6	92	14		9	233		348
Sapphire	6	45	3	11	3	234	2	298
Upper Sheep	6	36	9	3	2	157	1	208
Total	36	364	75	49	30	930	403	1,851

As in previous years, focal species distributions varied by species and site (Table 4). Orange-crowned Warblers were the least commonly observed and, along with Dusky Flycatchers, were the most restricted. These results differ from 2014, when Gray Catbirds were only detected on a few occasions in a single draw (Sapphire). Interestingly, while catbirds still had a low number of total detections in 2015, they were detected in every draw except North Sheep Camp. We spent additional training time with Sharon Fuller on identification and detection strategies, so the apparent expansion may be due, at least in part, to increased proficiency of our field technicians to detect this secretive bird. Lazuli Buntings were detected in every draw surveyed, including Tongue and Partridge Alley. Spotted Towhees were once again the most commonly observed focal species, with 930 total detections across all draws except Partridge Alley.

Focal species detections remain concentrated in the upper portions of the draws with continuous mature shrub cover (Figure 3). However, species observations have expanded since 2014. Two focal species (Dusky Flycatcher and Lazuli Bunting) were sighted in Lower Sheep Camp for the first time this year, where shrub vegetation is primarily limited to recent plantings. Three focal species were observed on Tongue draw (Gray Catbird, Lazuli Bunting, and Spotted Towhee), up from only Spotted Towhees in previous years. And, both Lazuli Buntings and Gray Catbirds were observed in Partridge Alley—the first detections of focal species in this draw.

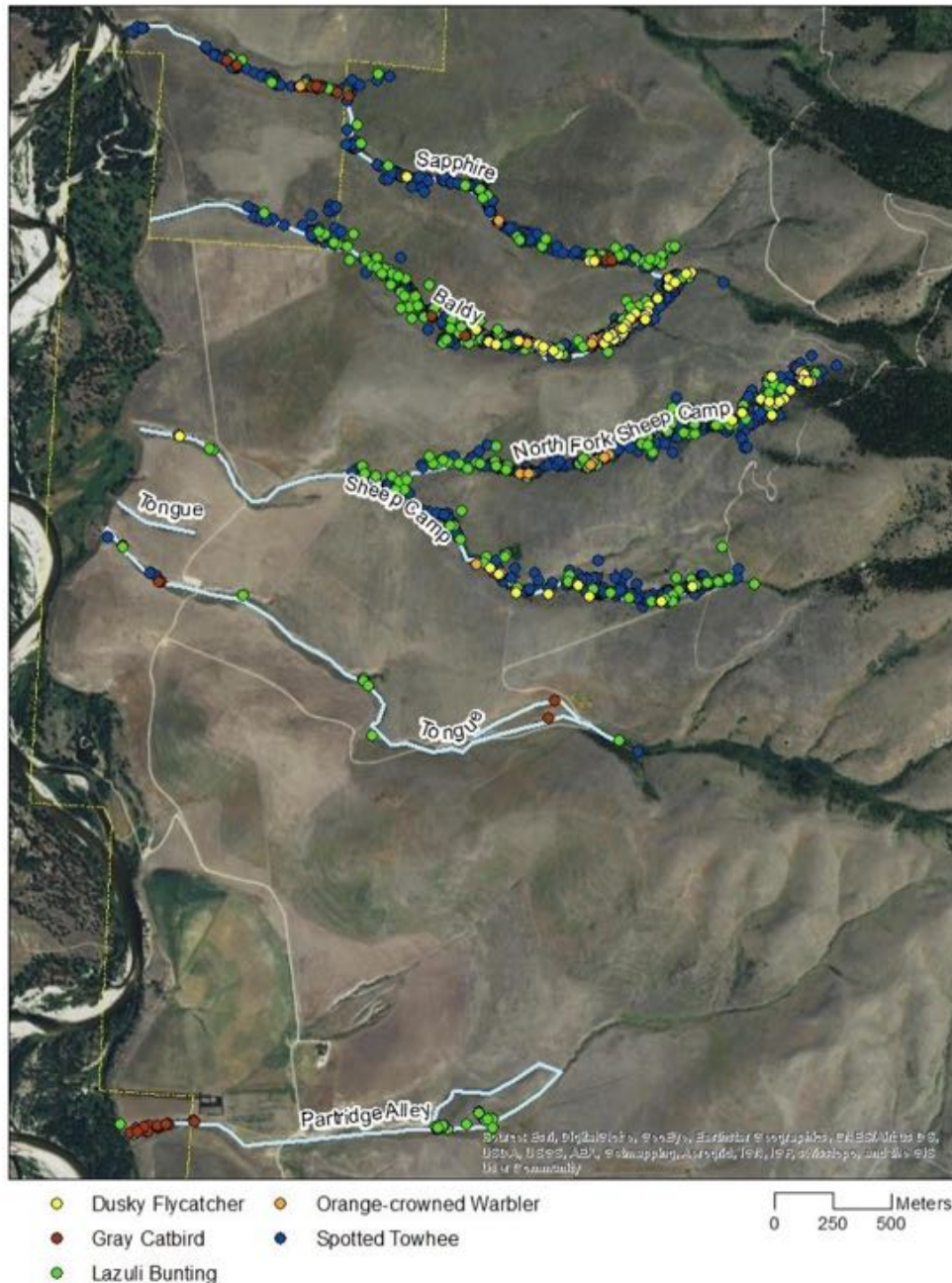
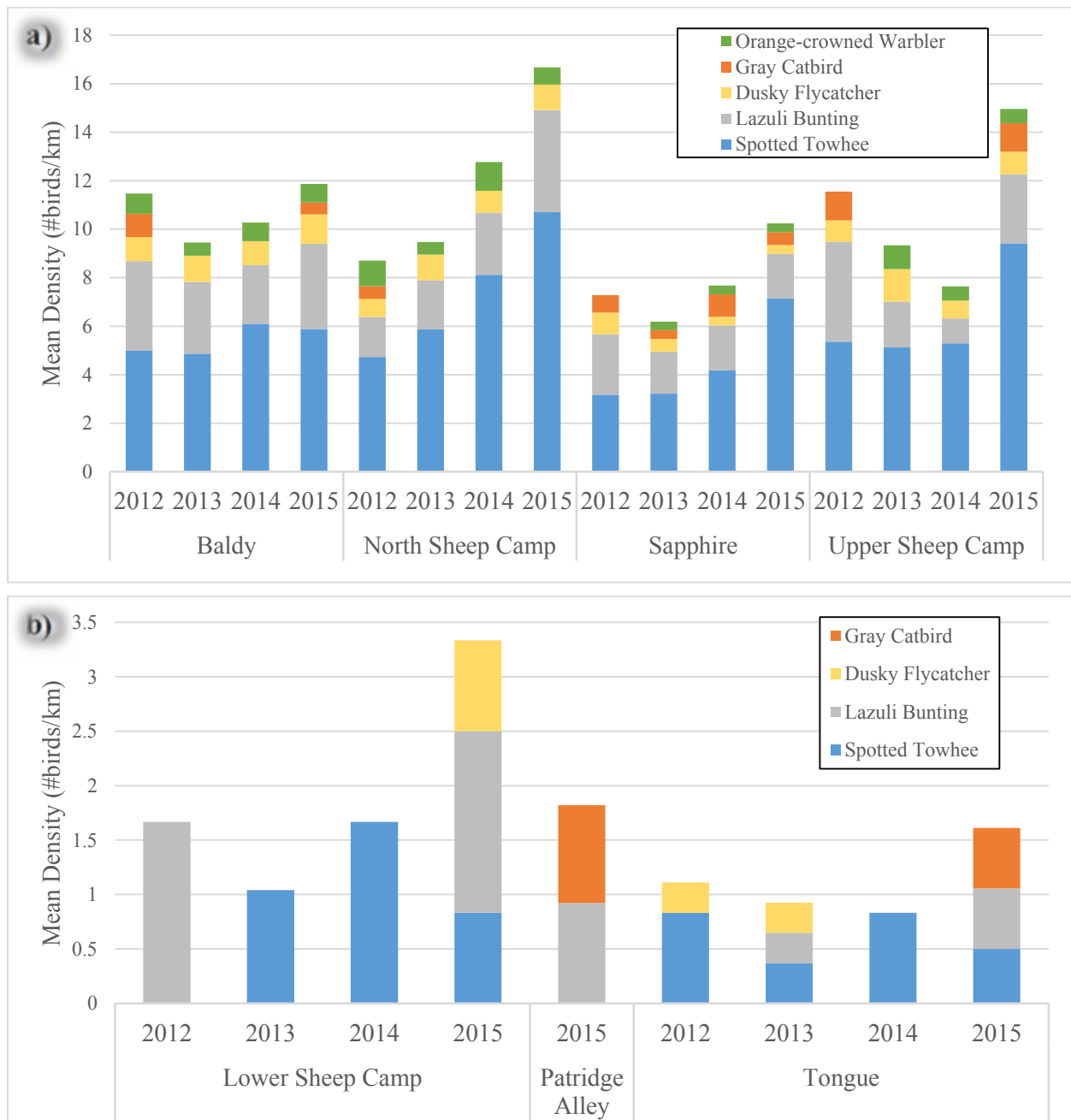


Figure 2. Focal bird species observations in woody draws during breeding season 2015.

By estimating bird densities (birds/km), we can directly compare species use across sites of different lengths. Overall, species densities were higher in every site in 2015 than in any previous surveyed year (Figure 4a and 4b). Total focal species densities remain substantially higher in control sites than restored sites, and there was more annual variation in density and presence in restored sites.



Figures 4a and 4b. Mean densities of focal species detected at control sites (a) and restored sites (b) during mapping sessions from 2012-2015 (Note: scales on y-axis differ).

Although focal species numbers remain limited in recently restored draws, many other bird species utilize these areas during the breeding season (Figure 5). In Lower Sheep Camp, we mapped 71 individual bird locations for 18 species, including Lewis' Woodpecker and Eastern Kingbird. In Tongue Draw, we observed 145 individuals and 27 bird species, including Bullock's Oriole and Black-headed Grosbeak. In Partridge Alley, we mapped 253 individual birds and 35 species during the breeding season, including Lark Sparrow and Warbling Vireo. Non-focal species densities have increased across all restored sites since 2012 (Figure 6). In Partridge Alley mean densities of non-focal species jumped from 6.20 (± 0.51 SE) detections/km in 2014 to 10.21 (± 1.46 SE) detections/km in 2015.

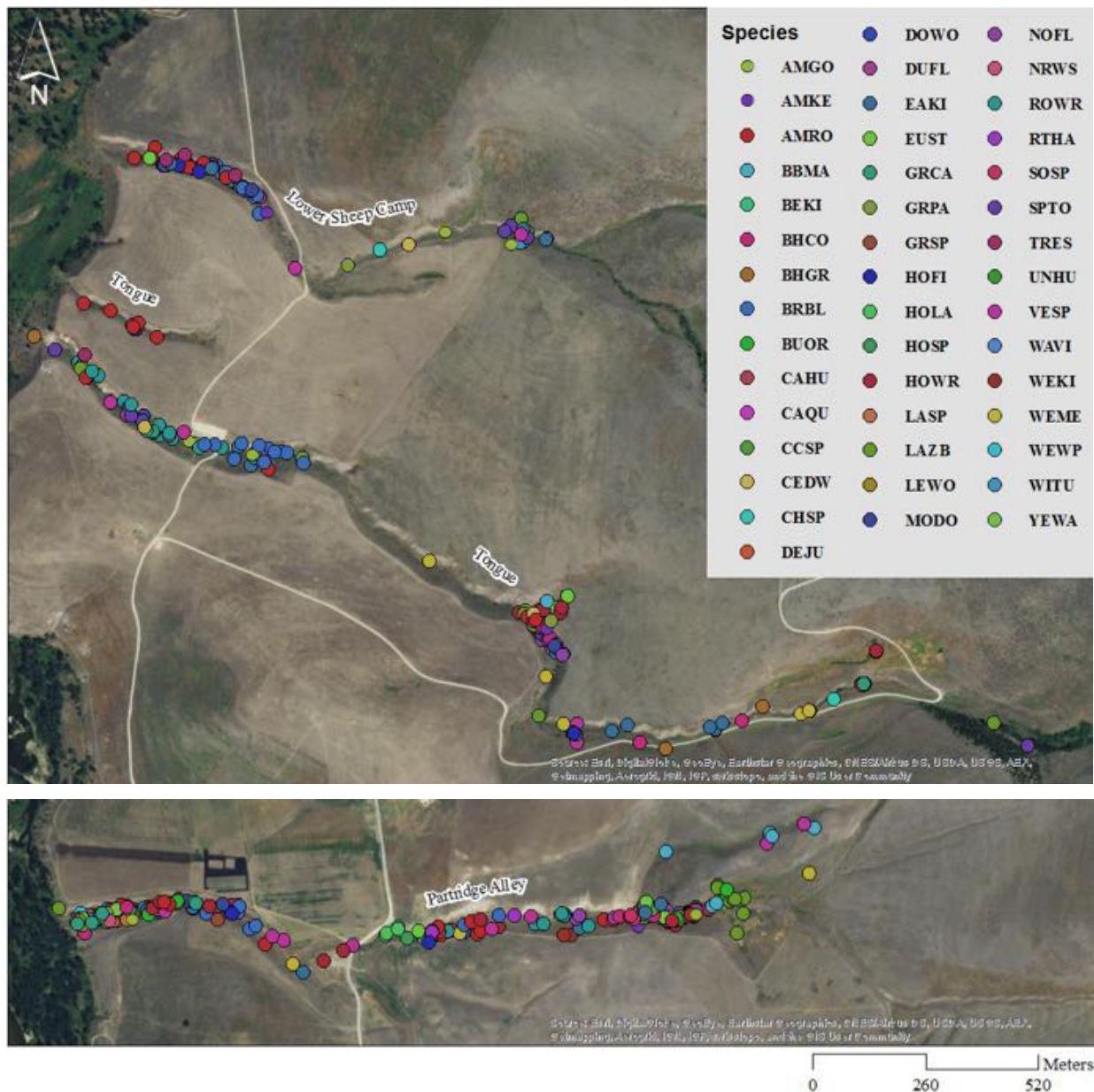


Figure 5. Observations recorded for non-focal bird species within lower Sheep Camp and Tongue (upper), and Partridge Alley (lower) draws during the 2015 breeding season (note: bird codes are intended to demonstrate diversity not to identify individual species).

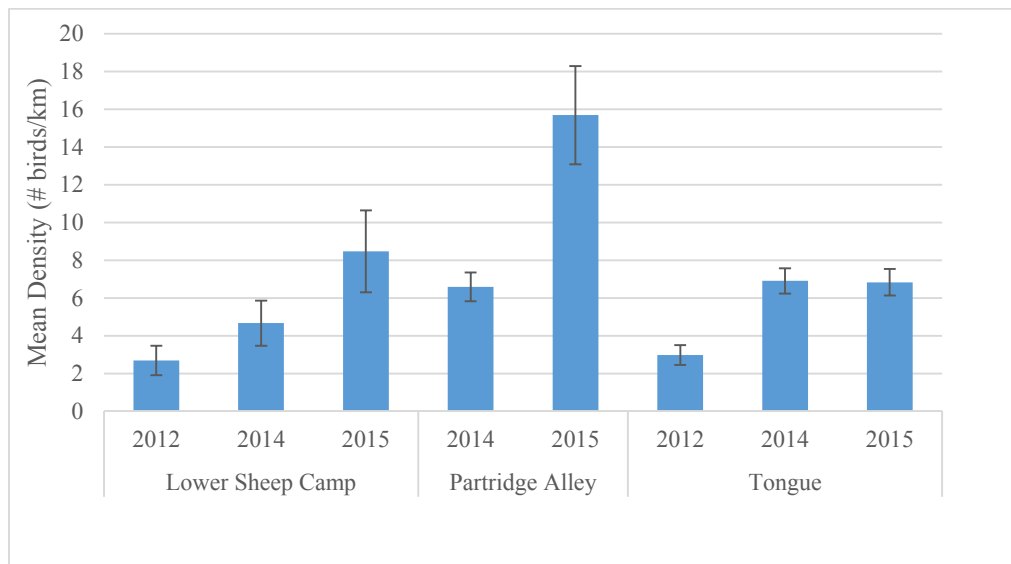


Figure 6. Mean density of non-focal bird species detected at restored sites during breeding surveys from 2012-2015.

Habitat Features

The type of substrate where birds were detected was recorded for 91% of observations during territory mapping surveys. Bird observations were predominantly associated with mature shrub shrubs (71%), followed by trees (11%) and dead shrubs (6%) (Figure 7a). We observed focal species using a diversity of shrub species (Figure 7b). Focal species were most often mapped in chokecherry and mountain maple, which are the most commonly occurring shrub in the draws.

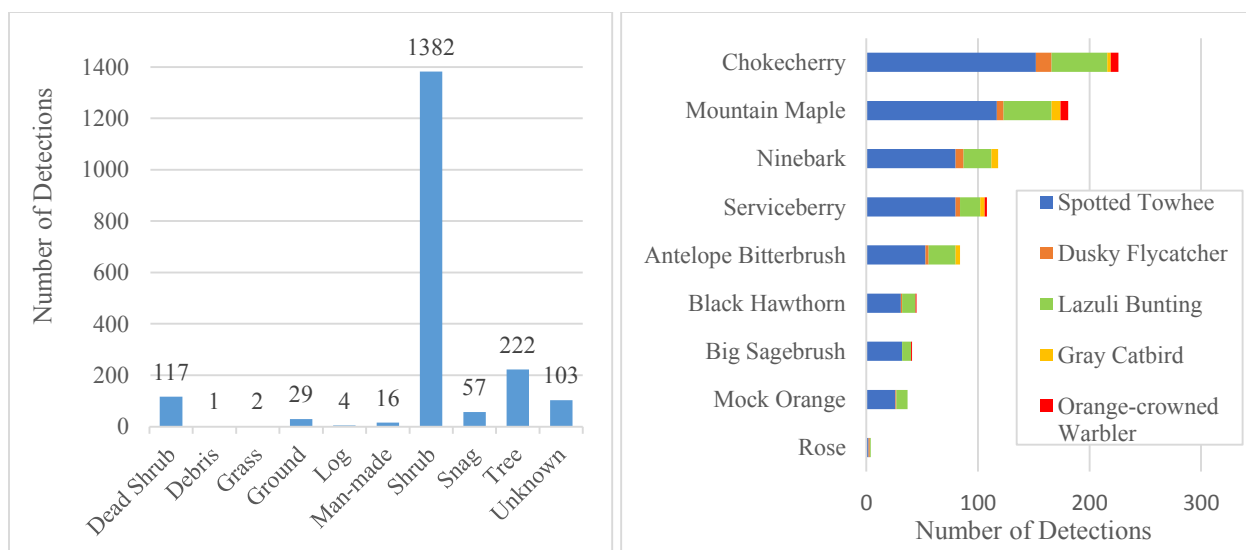


Figure 7a & b. Summary of a) substrate type where birds were detected, and b) shrub species where focal species were observed within woody draws in 2015.

Breeding Activity & Territory Locations

During bird mapping sessions, we observed territorial behavior (ie. Singing, pairs) for all focal species and nesting and rearing activities (i.e. nest building, incubating, or feeding young) for all focal species, except Orange-crowned Warblers (Table 5). Across all draws, breeding detections comprised 79% of focal species detections. We observed the majority of breeding activity in control sites (97%), but we also found evidence of focal species breeding in two restored sites (see species specific accounts below for details).

Table 5. Total evidence of breeding activity observed for focal species during bird mapping sessions in 2015.

Breeding Activity	Dusky Flycatcher	Gray Catbird	Lazuli Bunting	Orange-crowned Warbler	Spotted Towhee
Singing, Territorial	54	23	258	20	554
Copulating, Paired	1	6	37		76
Building Nest	1		2		1
Incubating					17
With Food		5	8		51
With Fledglings			2		48

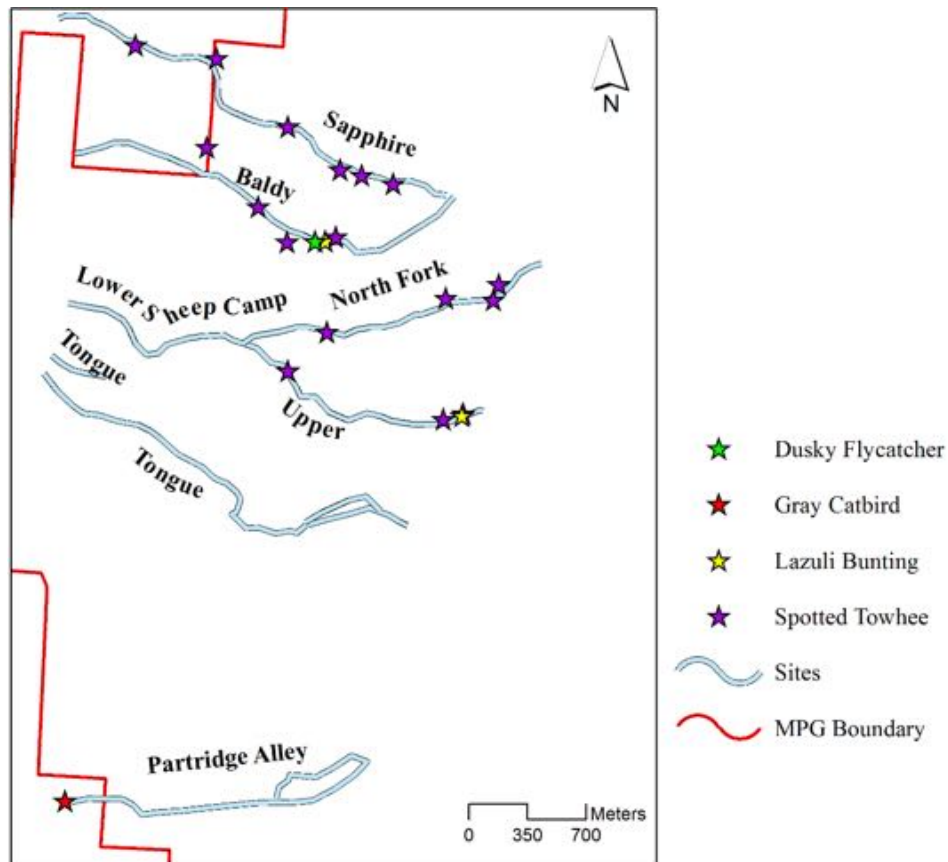


Figure 8. *Locations of focal species nests found along woody draw sites on MPG Ranch in 2015.*

This year, we focused nest searching efforts on Spotted Towhees. Nevertheless, we documented nest locations for four focal species during bird mapping sessions and weekly nest searching sessions. We found 19 Spotted Towhee nests, up from 4 in 2014 (Figure 8). The highest concentration of focal species nests were found on Sapphire and Baldy Draws.

Using mapped breeding activity and nest locations, we delineated a total of 94 territories for focal species in 2015 (Table 6). Estimated numbers of territories were higher than previous years for Lazuli Bunting and Spotted Towhee. Two territories were located in restored sites, including one confirmed nest, the rest were located in control sites. Across years, mean territory density (territories/km), are higher in control than restored sites (Figure 9).

Table 6. *Number of delineated territories for focal species across all woody draws from 2012-2015.*

Species	Number of Territories			
	2012	2013	2014	2015
Dusky Flycatcher	10	8	5	7
Gray Catbird	4	0	2	2
Lazuli Bunting ¹	-	17	15	23
Orange-crowned Warbler	3	5	9	2
Spotted Towhee ¹	-	38	45	60
Total	-	68	76	94

¹Bird mapping did not provide sufficient information to accurately delineate territories in 2012.

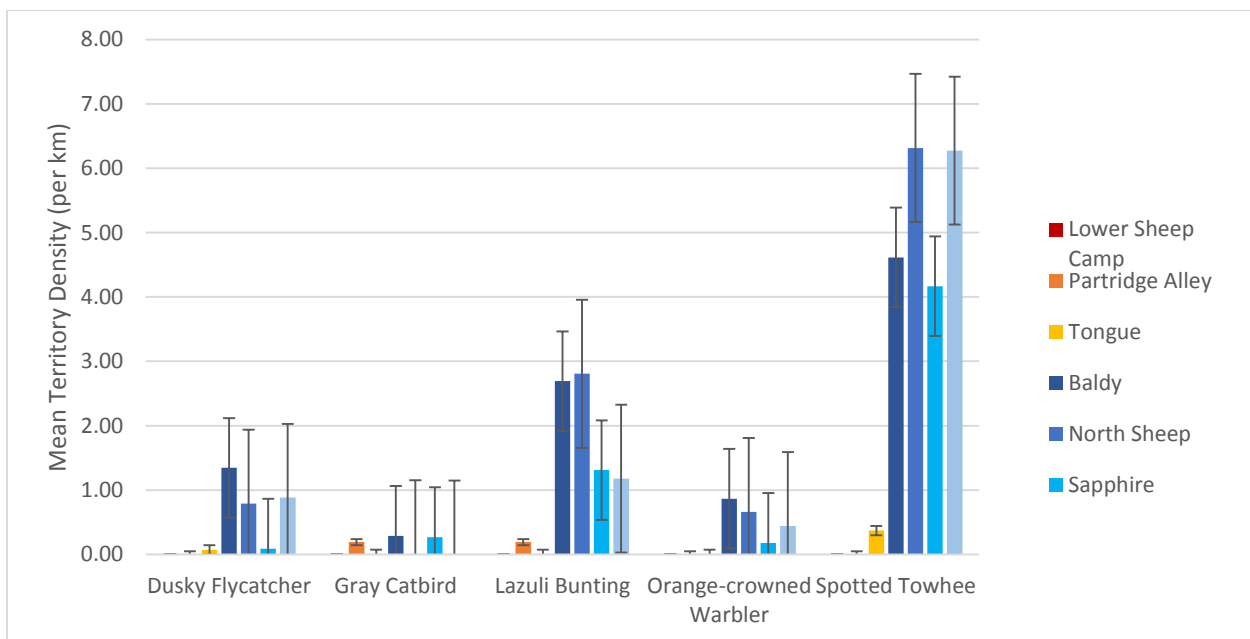


Figure 9. *Mean territory densities for focal species across woody draw sites from 2012-2015 (error bars represent \pm SE). Restored sites are shown in warm colors and controls in blue.*

Dusky Flycatcher

We delineated seven Dusky Flycatcher territories in 2015 (Figure 10), representing an increase from 2014 but less than previous years (Table 6). Territories were located in the same places as in previous years on Baldy, North Sheep Camp, and Upper Sheep Camp draws. However, the only confirmed pairs were observed on two territories in Baldy. As in 2014, a male was observed singing in upper Sapphire for two days in June, but there were not sufficient detections to delineate a territory. We also recorded visual and aural detections in lower Sheep Camp, but there was insufficient evidence to delineate territories.

Nesting Evidence~ We observed a pair of Dusky Flycatchers building a nest in the middle section of Baldy draw, but we did not monitor it to determine nest fate. There was no other evidence of breeding activity in 2015 for Dusky Flycatchers.

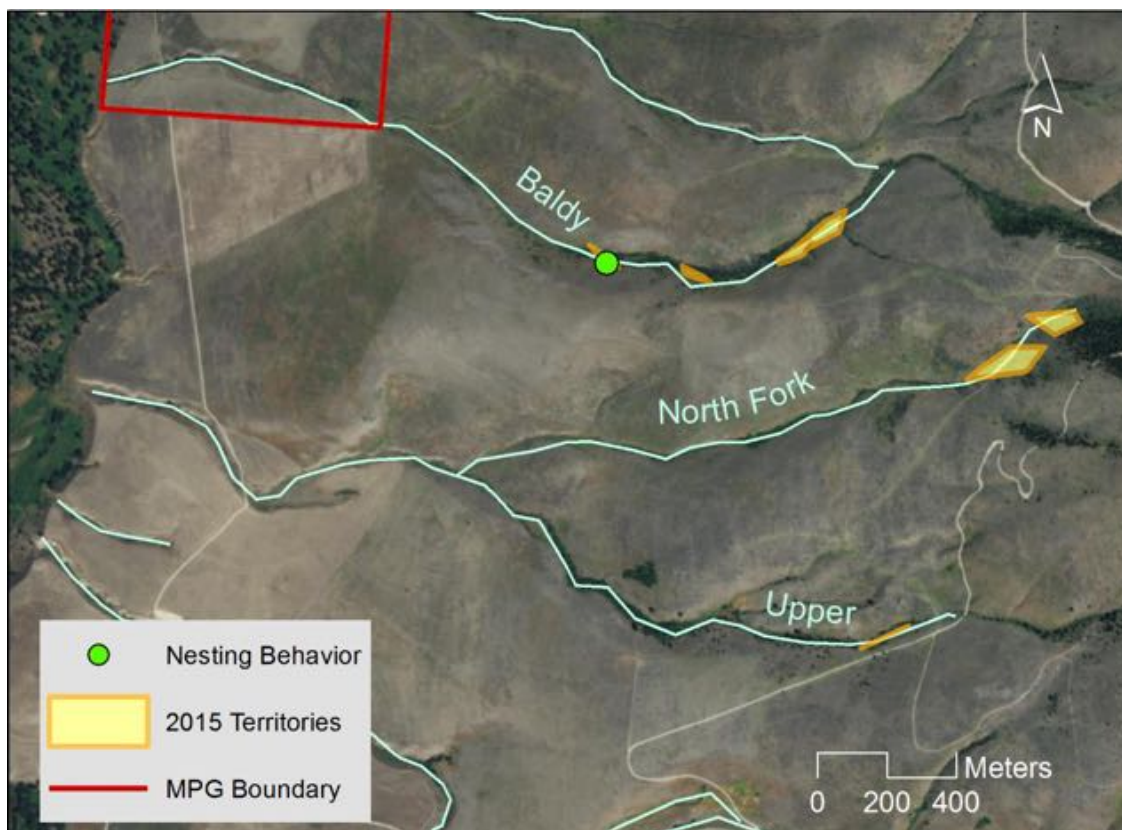


Figure 10. *Dusky Flycatcher nesting evidence and estimated territories on woody draws in 2015.*

Gray Catbird

A total of two Gray Catbird territories were mapped in 2015--the same as 2014 (Table 6). In 2014, both territories were located in lower Sapphire draw. In 2015, we delineated one territory in upper Baldy and one in Partridge Alley (Figure 11). This is the first Gray Catbird territory located in a restored draw. However, only a portion of the territory was within the study site, with the remaining territory in mature riparian habitat of the floodplain.

Nesting Evidence~ A Gray Catbird nest was found in Partridge Alley near the bottom of the draw in a mature chokecherry. The nest was found during the nestling stage, and successfully fledged four young. No other nesting activity was observed by Gray Catbirds.



Gray Catbirds nestlings observed in Sapphire Draw in 2014.

Lazuli Bunting

We observed a continued increase and expansion in Lazuli Bunting territories since 2013 (Table 6). We documented territories in all sites except Tongue and Lower Sheep Camp, including one in Partridge Alley, the first in a restored area (Figure 12).

Nesting Evidence~ We found one Lazuli Bunting nest in Upper Sheep Camp and a second nest in Baldy draw. As in previous years, both nests were located in Mallow Ninebark. We did not monitor the nests to determine fate. We also observed nesting behavior (e.g. feeding young) two additional territories in Baldy, one territory in Sapphire and the first recorded nesting evidence at the territory in Partridge Alley.

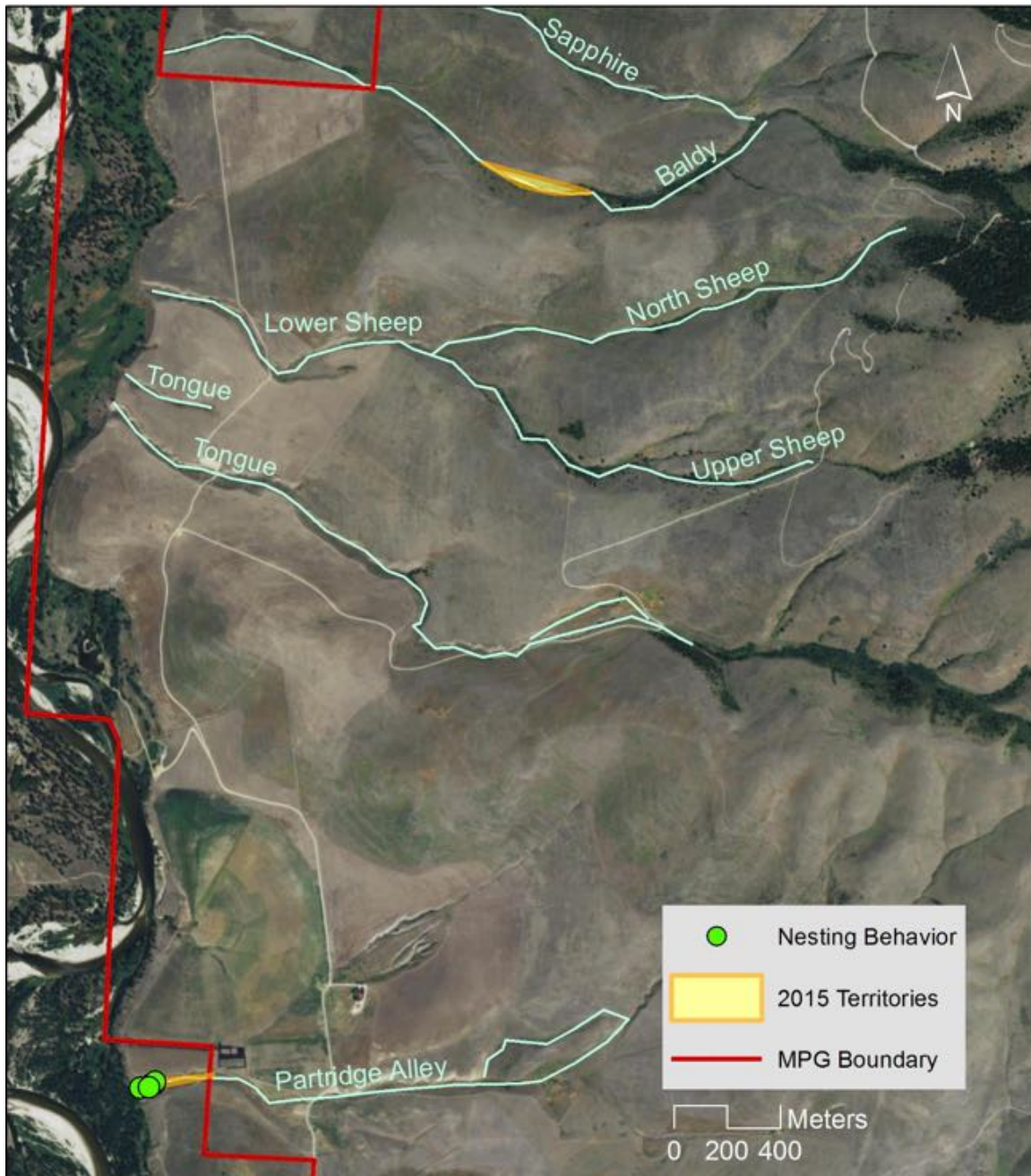


Figure 11. *Gray Catbird nesting evidence and estimated territories along woody draws in 2015.*

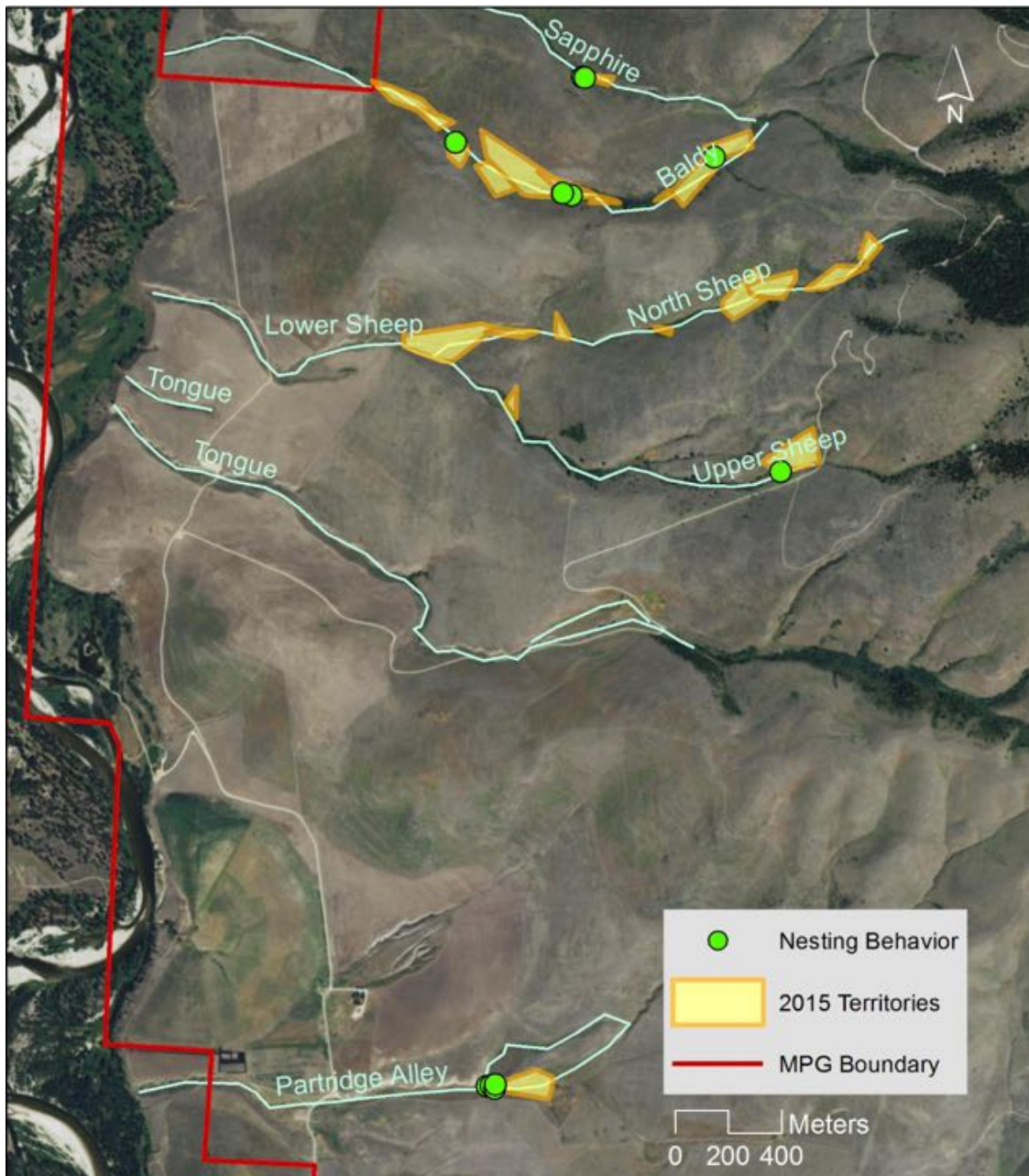


Figure 12. Lazuli Bunting nesting evidence and estimated territories along woody draws in 2015.

Orange-crowned Warbler

The number of Orange-crowned territories decreased in 2015, after expanding and increasing for the previous two years (Table 6). Territory locations in 2015 were similar to 2012, with Orange-crowned Warbler observations restricted to upper Baldy draw (Figure 13).

Nesting Evidence~ We observed no evidence of nesting behavior in any of the draws in 2015.

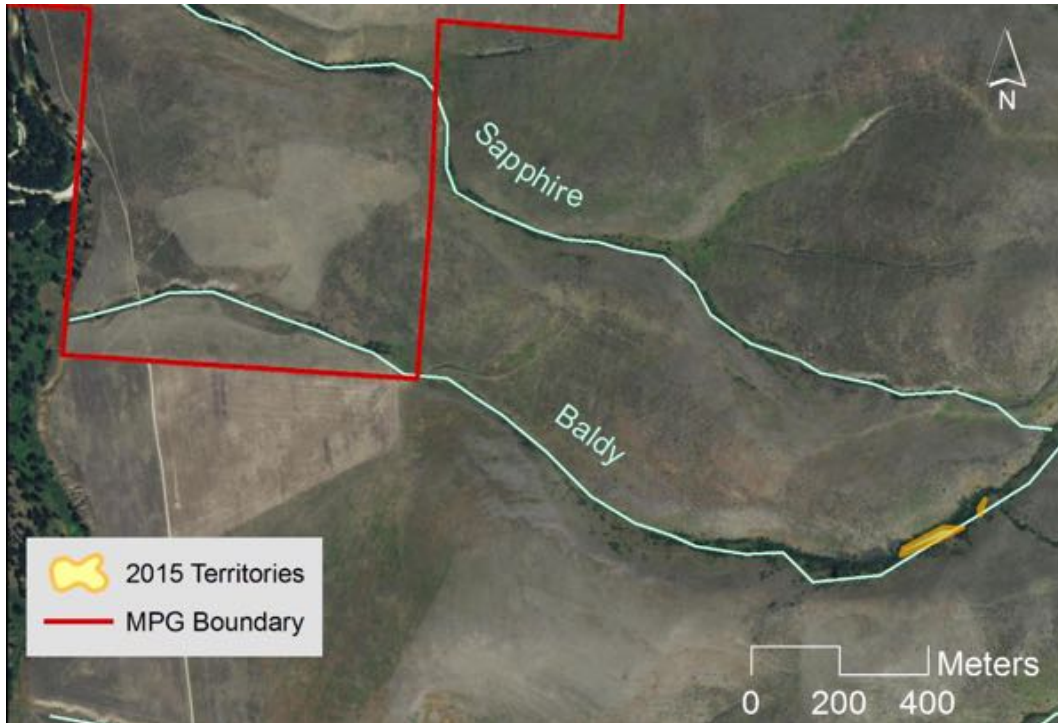


Figure 13. *Orange-crowned Warbler estimated territories along woody draws in 2015.*

Spotted Towhee

We delineated 60 breeding territories in 2015, representing an increase in territory numbers each year since 2013 (Table 6). Territories were located in similar areas as previous years (Figure 14), with the exception of Tongue draw. In 2014, we delineated three territories and found a nest in Tongue draw, which successfully fledged young birds. This year, we did not have enough detections to delineate any territories in Tongue draw, although we detected individuals on early-season surveys, and observed fledglings late in the season, suggesting that at least one successful territory was missed.

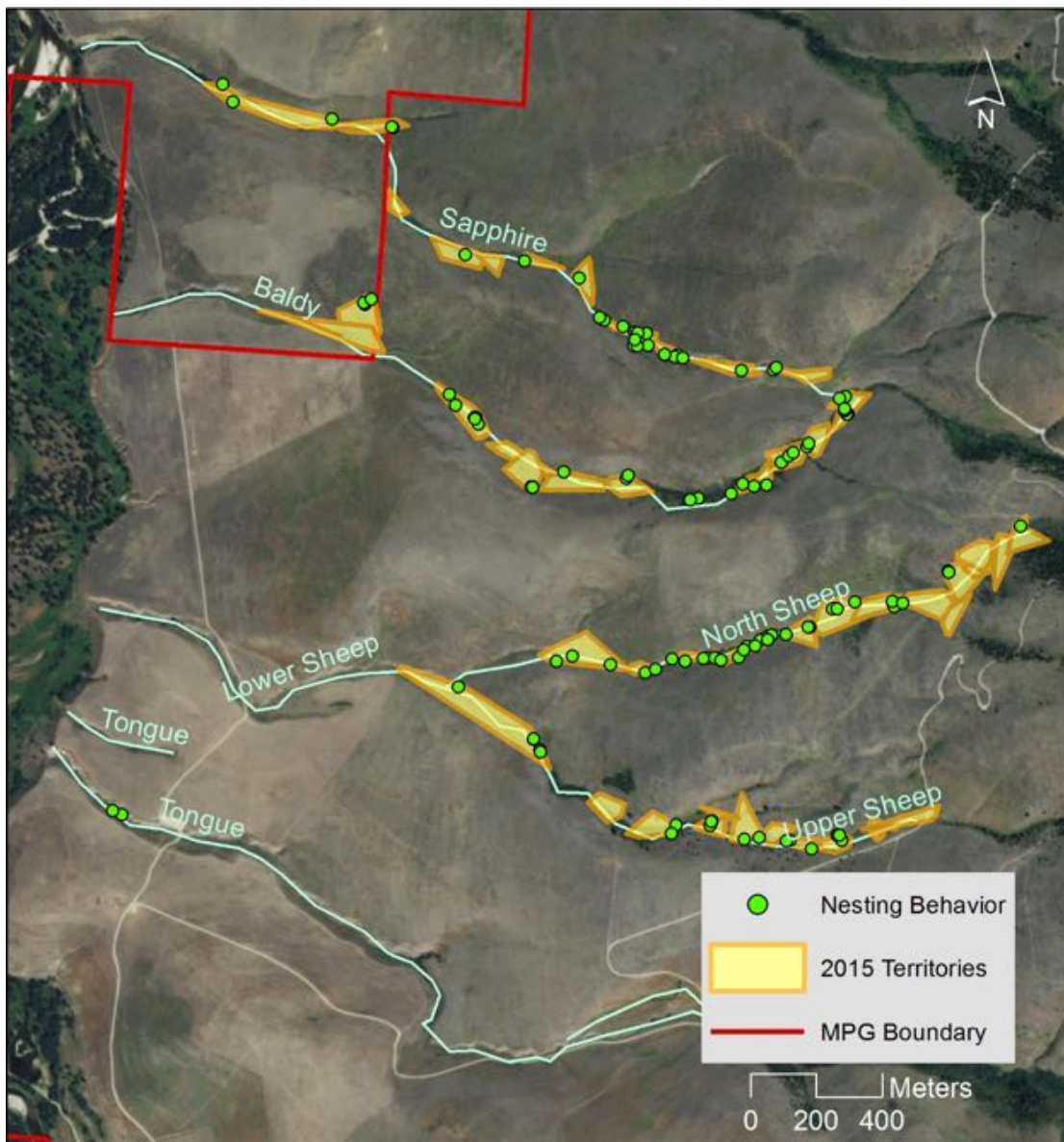


Figure 14. *Spotted Towhee nesting evidence and estimated territories along woody draws in 2015.*

Nesting Evidence~ We found seventeen Spotted Towhee nests, and documented nesting activities in 25 additional territories. Nesting evidence was concentrated in the upper draws, with the highest number of observed nesting attempts in North Sheep Camp. Nest success for Spotted Towhees was 76%, with 13 nests successfully fledging at least one young. Two nests contained Brown-headed Cowbird eggs, but were still successful in fledging towhee young (see images below). Of the four nests that failed, two were located in Sapphire draw (one with evidence of predation and one desertion) and two were located in North Sheep Camp (causes unknown).



Spotted Towhee nest with two Brown-headed Cowbird eggs found in Upper Sheep Camp (left), and Spotted Towhee young beneath two Brown-headed Cowbird nestlings (right), 2015.

Breeding Success, Territory Size, and Occupancy Patterns

Across years, restored sites had higher total nest success than controls (100% and 67%, respectively), but it's important to note that only 2 of 32 total Spotted Towhee nests found to date were in restored sites (Figure 15).

To evaluate territory size among sites with sufficient data (e.g. controls), we used delineated territories for Spotted Towhees, the most widespread focal species in the study area. We found little difference in the mean territory size among sites, but within sites territory size was highly variable, with territories ranging from 0.5 ha to over 4 ha in Sapphire (Table 7). If territory size is related to habitat quality, these results suggests habitat conditions vary substantially within control sites.

To evaluate whether patterns in territory establishment are associated with breeding success for Spotted Towhees in the study area, we compared territories occupied during early surveys to all other territories delineated during the breeding season. We found nests in 10 (71%) of territories

occupied during early spring surveys, and observed nesting activity in all territories established early. Nest initiation dates in territories occupied early averaged 11 days earlier than other nests found. Nest success was 80% at early territories, compared to 71% success for other nests (Figure 16). One of the failed early territories had an apparent successful re-nest later in the season.

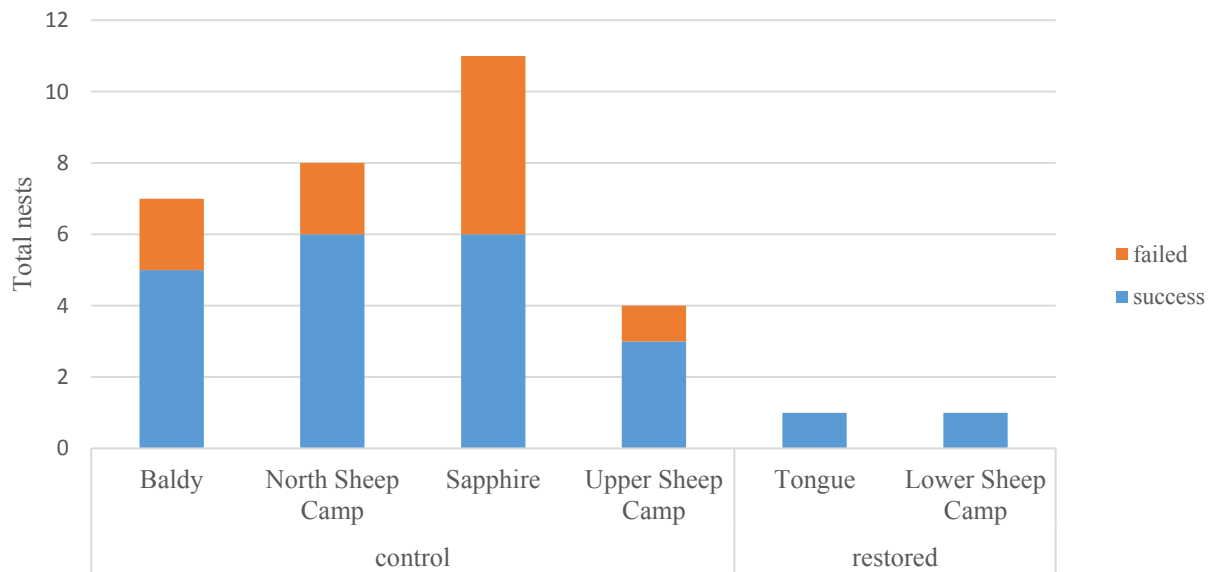


Figure 15. *Spotted Towhee nest success in restored and control woody draw sites from 2012-2015.*

Table 7. *Summary of Spotted Towhee territory sizes across woody draw sites from 2013-2015 (note: territories were not calculated in 2012 for this species).*

Site	n	Mean	Territory Size (ha)	
			Minimum	Maximum
Baldy	36	0.59	<0.01	1.68
North Sheep Camp	36	0.59	0.05	1.69
Sapphire	35	0.71	0.05	4.02
Upper Sheep Camp	32	0.58	0.04	2.89

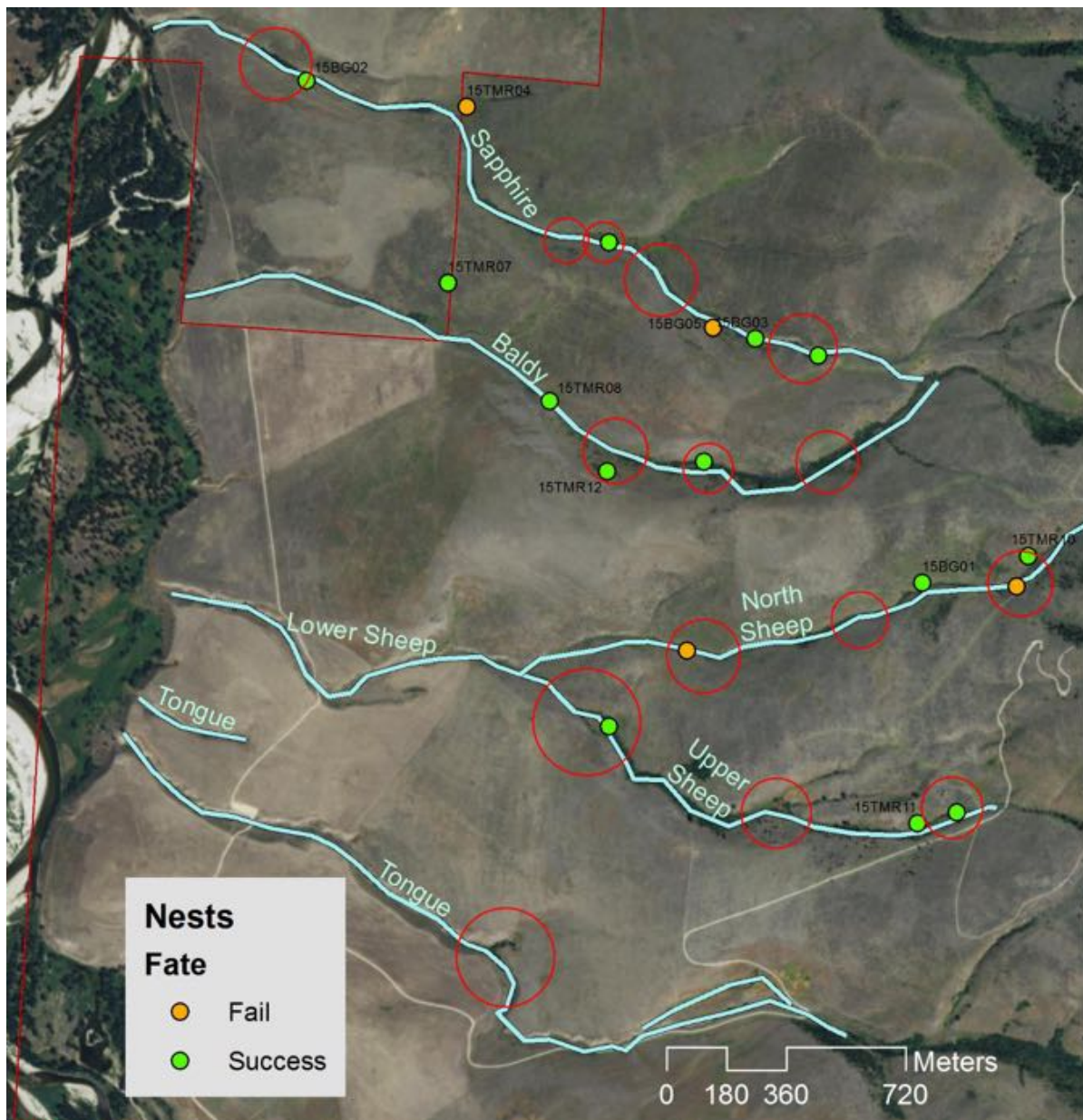


Figure 16. Locations of Spotted Towhee nests found in 2015 in relation to early territory establishment observed during early season surveys.

Conclusions

Since this project began in 2012, we have successfully implemented one pilot season and three complete seasons of field data collection targeting five focal species that occur in the woody draws of MPG Ranch (Dusky Flycatcher, Gray Catbird, Lazuli Bunting, Orange-crowned Warbler, and Spotted Towhee), and collaborated with MPG staff and GCS Research to develop a specialized software application for the Apple iPad. In 2015, we worked to minimize our presence in the draws to avoid potential wildlife impacts by limiting breeding season mapping to the minimum required (6 visits), coordinating our field effort with Sharon Fuller's Gray Catbird study, providing a field schedule to MPG staff, focusing nest searching in smaller areas of each draw, and combining nest checks with territory mapping when possible.

We successfully mapped locations for all 5 focal species across woody draws, including Partridge Alley and additional draw habitat adjacent to Tongue. Focal species territory locations and breeding activity continue to concentrate in the upper reaches of the draws, in areas with mature mixed shrub vegetation. However, we are seeing increasing use by focal species of the recently restored sections of the woody draws, including established territories and nesting attempts by two species on Partridge Alley for the first time. Breeding bird densities appear to have increased across the study area since the start of the project. This is an interesting trend, and could be influenced by management practices in adjacent upland habitats by MPG Ranch.

Mapping all bird species in restored sections of draws, revealed a diversity of species already utilizing restored draws at some time during the breeding season. We recommend continuing all bird mapping in these draw sections to increase our understanding of bird community changes following restoration.

Targeting a single species, Spotted Towhee, for nest searching and monitoring resulted in a three-fold increase in nests found for this species over previous years. We had two technicians dedicated full time to the project for the first time, which likely also contributed to improved nest searching. Spotted Towhee nest success remains high in woody draws. These findings are unusual for a ground nesting species. There are limited published information on Spotted Towhees nesting, but in a study in California, nest success across 5 years of study was 42% (n=265; Small 2005).

Previous studies have shown that both the timing of occupancy (e.g. how early a location is occupied) and the frequency of occupancy (e.g. how often across years is a location occupied) are correlated with habitat quality, meaning that species will select territories with the highest quality habitat first, and that these territories will be occupied more often than locations with lower habitat quality (Manuwal et al 2014). During early mapping sessions, we found singing Spotted Towhees males and established pairs in most of the woody draws. This year's results suggest territories occupied early have more nesting activity and higher nesting success. Based on these findings, we recommend beginning breeding surveys & nest searching efforts earlier in the season to better document early nesting activity and territory establishment by Spotted Towhees.

Continuing this project in future years will allow us to track shifts in bird territory placement and species' densities over time relative to changes in the underlying habitat following restoration.

The information generated from this study will help answer the following questions:

- Are restoration activities in woody draws resulting in measurable benefits for associated bird species during the breeding season?
- What habitat features are associated with density, breeding activity, and reproductive success in woody draws?
- Are patterns of habitat occupancy (timing and location of territory establishment) associated with habitat conditions and reproductive success in woody draws?
- What factors influence brood parasitism rates in woody draws (e.g. landscape context, habitat condition, nest location), and does vulnerability vary across the breeding season?
- What is the phenology and breeding biology of Spotted Towhee populations of the interior West?

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