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2019 Results for Avian Monitoring at the Technical Area 36 Minie Site, Technical Area 39 Point 6, and Technical Area 16 Burn Ground at Los Alamos National Laboratory

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Executive Summary

Los Alamos National Laboratory biologists in the Environmental Compliance and Protection Division at Los Alamos National Laboratory (LANL) initiated a multi-year program in 2013 to monitor avifauna (birds) at two open detonation sites and one open burn site on LANL property. Monitoring results from these efforts were compared among years to monitor trends. The objectives of this study were to 1) determine whether LANL operations impact bird species richness, diversity, or abundance 2) evaluate trends in species abundance by feeding guild, and 3) examine occupancy and nest success of secondary-cavity nesting birds using nestboxes. LANL biologists completed the seventh year of this effort in 2019.

Three bird point count surveys were completed at each of the treatment sites at the Technical Area (TA) 36 Minie site, the TA-39 point 6, and the TA-16 burn ground between May and July 2019. A total of 853 birds representing 53 species were recorded at the three treatment sites and compared to their associated controls. Occupancy and nest success data from nestboxes at treatment sites were compared with the overall avian nestbox monitoring network.

In 2019 the species richness and diversity at the treatment sites were not statistically different from their associated controls. Rarefaction and extrapolation plots for all years through 2018 suggest that over time the species diversity was statistically different between treatments and controls, although the diversity was higher at the treatment sites than the control sites. Avian abundance showed more variability but treatment and controls were trending together year to year. The mean number of granivores, insectivores, and omnivores varies from year to year, but there is not a significant trend at any of the treatment sites. The dominant feeding guild at the treatment sites continues to be insectivores.

The overall results from 2019 continue to indicate that operations at the three treatment sites are not negatively affecting bird populations. This long-term monitoring will continue to monitor for any changes over time.

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Introduction

As part of the Resource Conservation and Recovery Act (RCRA) permit process, Los Alamos National Laboratory (LANL) started an annual avian monitoring program in 2013. The permit was for two open detonation sites, Technical Area (TA)-36 Minie site and TA-39 point 6, and one open burn site, TA-16 burn ground (hereafter referred to as Minie, TA-39, and TA-16, or together as treatment sites) (Hathcock and Fair 2013; Hathcock 2014, 2015; Hathcock et al. 2017, 2018). This program supported a study with the objectives to (1) determine whether LANL operations impact bird species richness, diversity, or abundance (2) evaluate species abundance by feeding guilds over time and (3) examine nest success of secondary-cavity nesting birds using nestboxes. Comparisons were made with control sites of similar habitat that have been surveyed since 2011 (Hathcock et al. 2011).

Biologists at LANL used standard point count methodology to record avian richness, diversity, and abundance along transects at the three treatment sites and associated control sites during the summer of 2019. Summer surveys provide information about what birds are breeding at each site. These surveys are most valuable when they are conducted over multiple years since they provide long-term trend data that can be compared with local, regional, or national trends in bird populations. These data can also be used to test for correlations between bird communities and the natural environment, including environmental changes at LANL.

In addition to avian point counts, nestboxes were monitored around all three treatment sites to investigate any potential impacts to occupancy rates and productivity of secondary cavity-nesting birds. Occupancy and nest success data were compared with the overall avian nestbox monitoring network, which was established in 1997.

Methods

Field Methods for Point Count Surveys

The point count surveys were conducted along single transects in the forested, undeveloped land surrounding the treatment sites (Figures 1–3). The habitat types around the sites are a pinyon (*Pinus edulis*) –juniper (*Juniperus monosperma*) woodland (PJ) for Minie (Figure 1) and TA-39 (Figure 2) and a ponderosa pine (*Pinus ponderosa*) forest (PIPO) at TA-16 (Figure 3). These habitat descriptions were based on the 1/4 ha physiognomic cover classes in the LANL land cover map (McKown et al. 2003). The treatment and control sites (Figure 4) were monitored annually in ongoing surveys that have been conducted at LANL since 2011 as described in Hathcock et al. (2011). Each habitat type control contained two replicate transects that were monitored in the same way as the treatment sites, with the same number of points and during the same time periods. In each survey month, all treatment and control site transects were randomized and surveyed according to the random order.

The treatment sites at Minie and TA-39 were similar to the PJ control sites at TA-70 and TA-71 in elevation, vegetation, and proximity to developed areas; however, the transect at TA-39 was in the canyon bottom while the controls were on mesa tops. The treatment site at TA-16 was similar in elevation and overstory vegetation to the PIPO control sites and all were on mesa tops. One of the PIPO control transects was adjacent to development and the other transect was in an undeveloped area.

Transects were approximately 2.0 to 2.5 km in length with nine survey points spaced approximately 250 m apart. These survey routes and points can change slightly over time due to construction activities or access constraints. The time frame for breeding bird surveys was May 1 through August 15. Ideally, the breeding bird surveys should take place the second week of May, June, and July. This protocol required a total of three surveys per site conducted between 0.5 hours before sunrise and 4 hours after sunrise.

The following steps apply to breeding bird surveys:

- Each survey consists of nine points along a transect spaced approximately 250 m apart.
- The surveyor looks and listens for 5 minutes, recording all birds encountered at each point on a data sheet. For each observation, the minimum data collected should be point number, time, species, number of individuals, and distance from the point. The observation distance is considered as an “unlimited-distance circular plot”; however, the distance to each bird out to 100 m should be recorded. A range finder should be used if available. Avoid re-counting individuals between points.
- While walking between points, any obvious species not recorded at the previous point that also wouldn’t be counted at the next point should be recorded. The surveyor should not spend excess time looking for birds between points.
- Do not conduct surveys during rain events or winds greater than 24 kph.
- Use the “NOTES” section to indicate any additional information about the survey that may affect the data. Examples include excess noise from nearby equipment, vehicles, or aircraft that make it hard to hear the birds. Other wildlife or unusual sightings that could be used for other projects should be recorded.

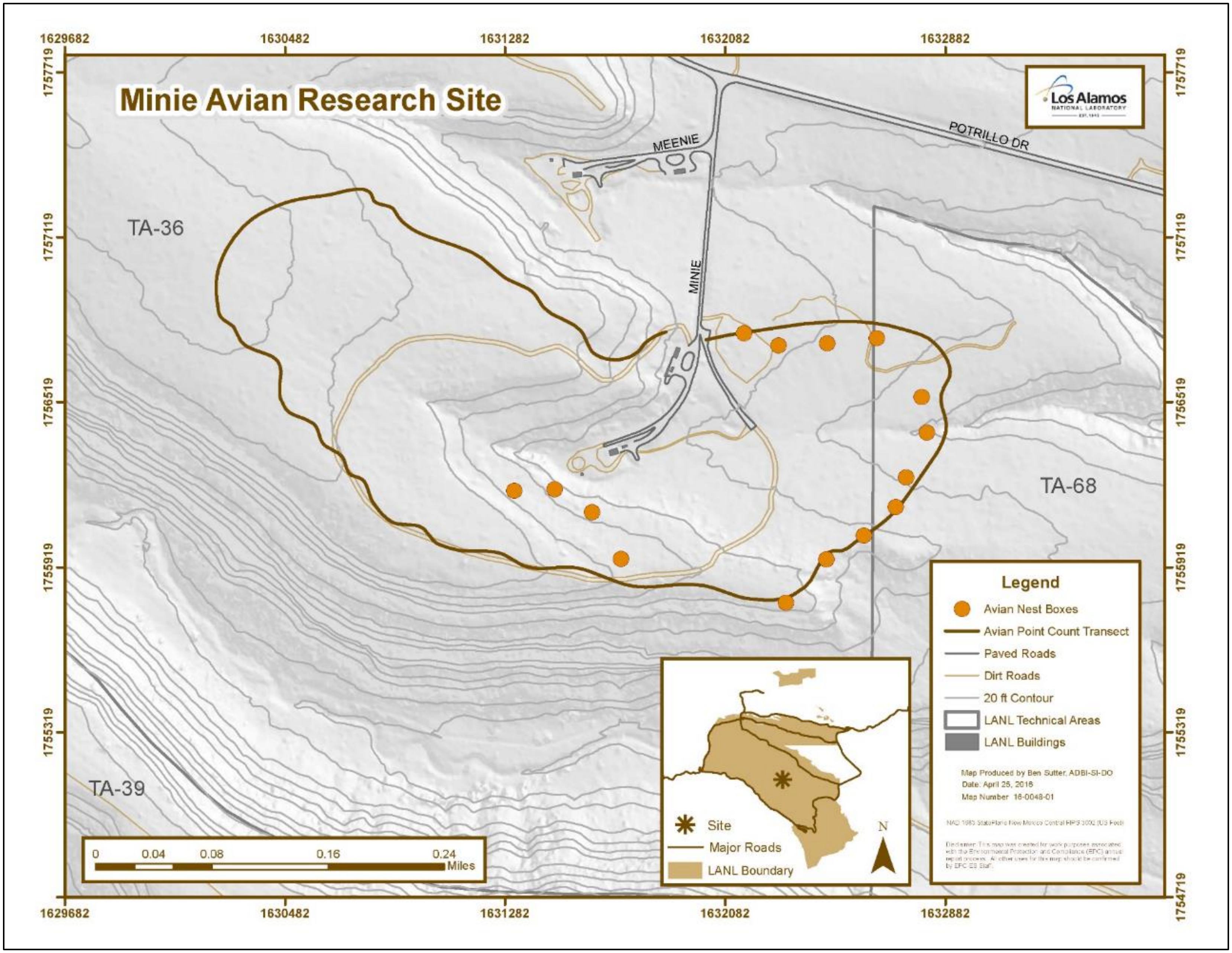

Figure 1. Breeding bird survey transect and nestbox locations around TA-36 Minie site

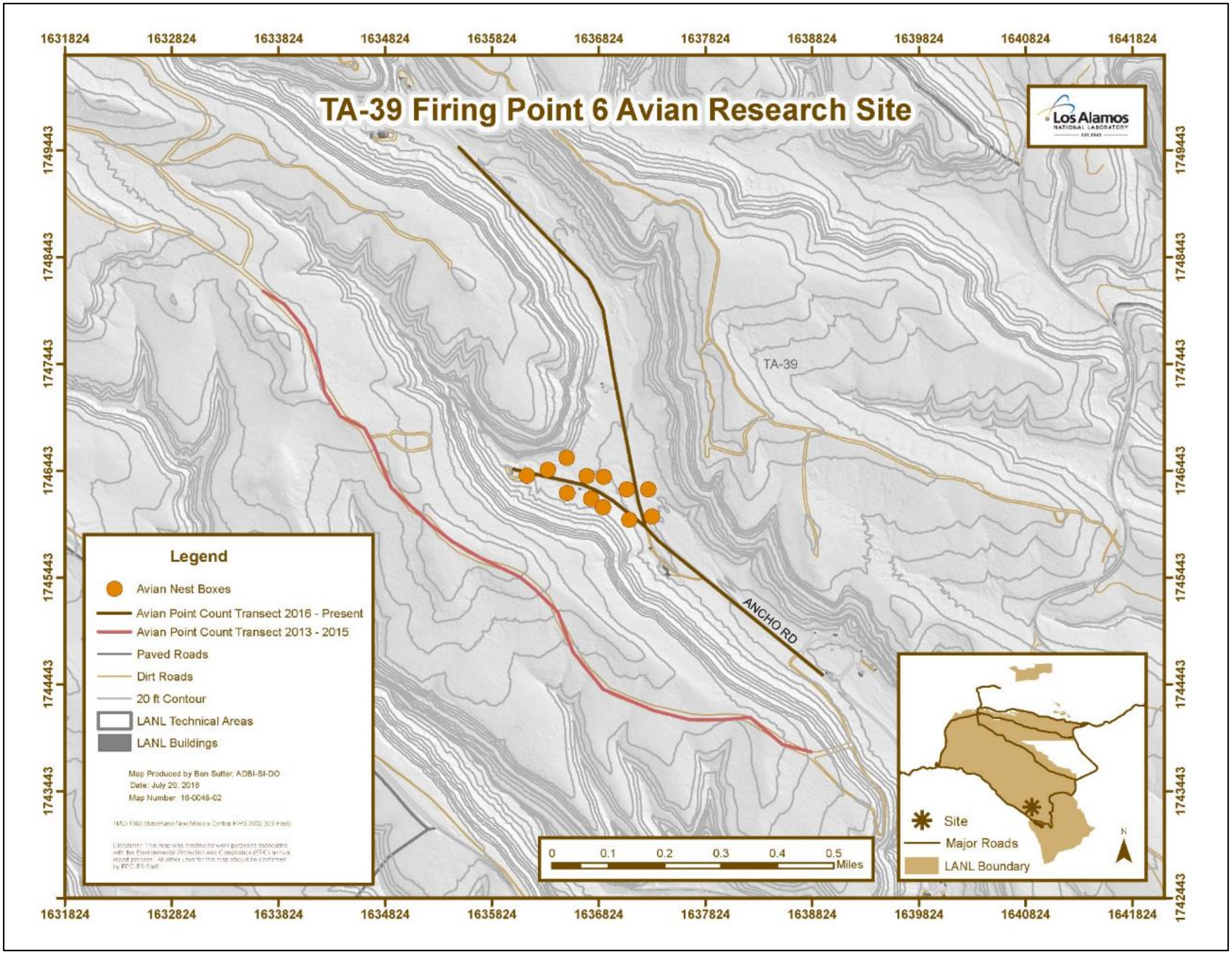

Figure 2. Breeding bird survey transect and nestbox locations around TA-39 point 6

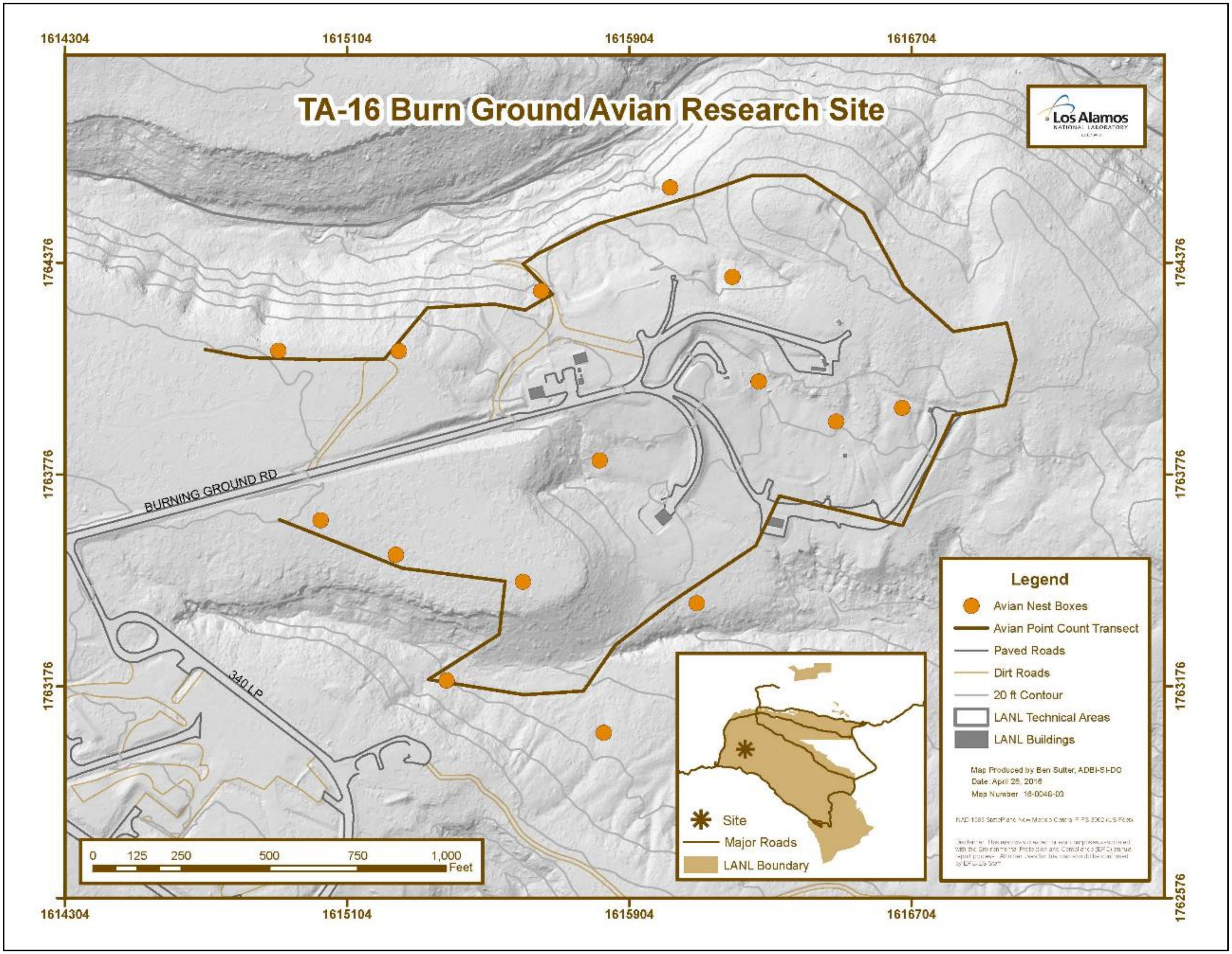

Figure 3. Breeding bird survey transect and nestbox locations around the TA-16 burn ground

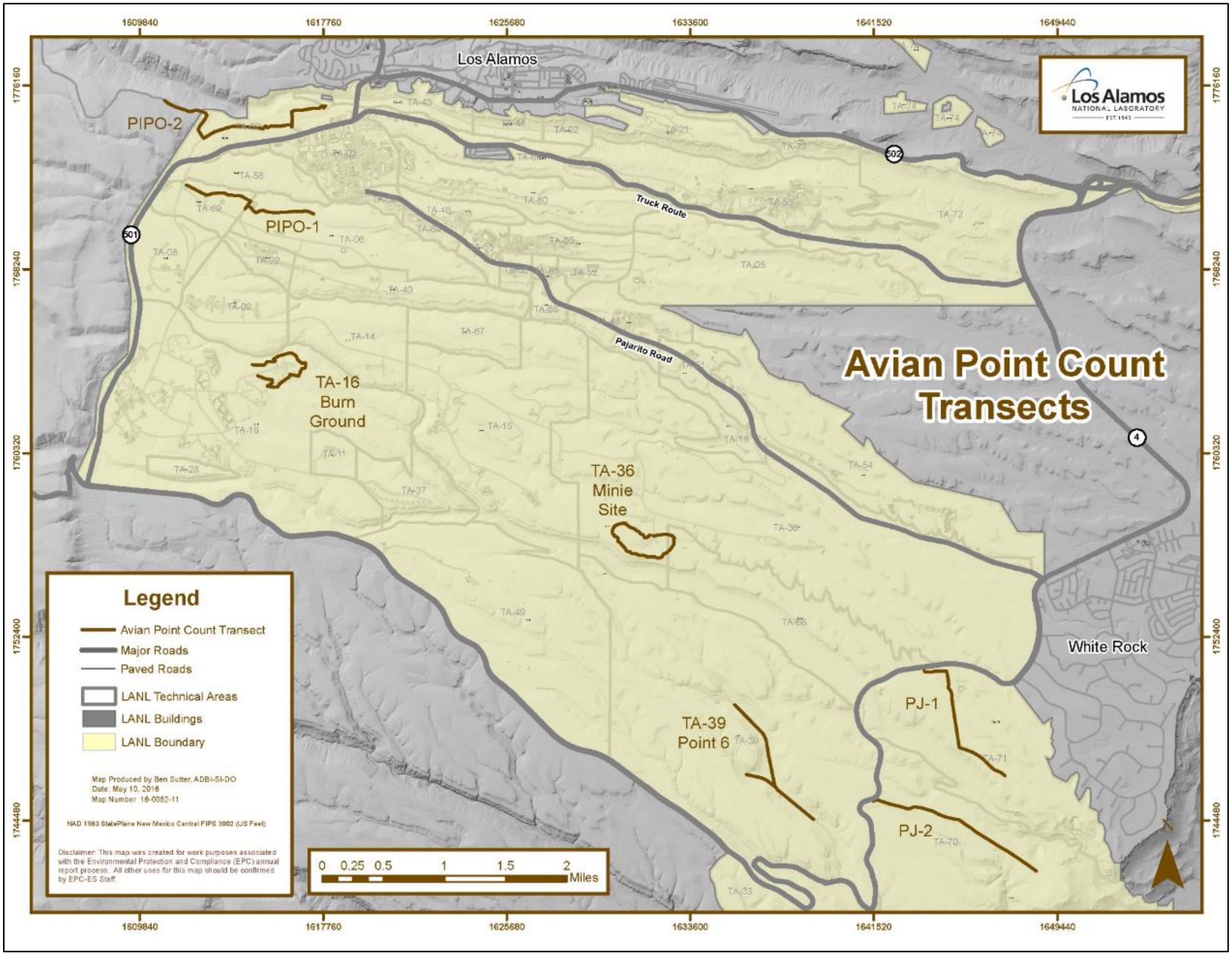

Figure 4. All avian point count transects around LANL

PIPO: ponderosa pine forest, PJ: pinyon-juniper woodland

Statistical Methods for Point Counts

These data were summarized to compare species richness, diversity, and abundance between treatment and control sites and over time. Species richness and abundance were calculated in Microsoft Excel©, and species diversity was computed using the statistical software PAST (Hammer et al. 2001). The Shannon's diversity index (Shannon and Weaver 1949) was used to compare diversity between habitats (Clarke et al. 2014). Shannon's diversity ranges for most ecological systems are between 1.5 and 3.5, and are rarely greater than 4.5, where high values indicate high diversity. A t-test was used to test for differences between treatment and control site diversity each year.

In addition, these data were summarized to compare species of three feeding guilds at each transect over time. The three feeding guilds included granivores, insectivores, and omnivores. Since there are three surveys completed at each transect per year, these data at each transect were averaged and compared over time.

Field Methods for Nestbox Monitoring

In 2011, nestboxes were added to Minie and TA-39 (Figures 1 and 2). In 2015, nestboxes were added to TA-16 (Figure 3). Nestboxes were monitored every one to two weeks for active nests. When an active nest was found, it was monitored more frequently to determine whether the nest failed or successfully fledged young. Nestlings were also banded and the sex was determined after the age of 10 days.

Statistical Methods for Nestboxes

Occupancy and nest success rates of the nestboxes at the three treatment sites and in the overall network were calculated. For any single site or overall, the occupancy rate was the number of active nestboxes divided by the total number of nestboxes. Similarly, the nest success rate was the number of nestboxes that successfully fledged young divided by the number of active nestboxes. Annually, data from the three treatment sites were compared with the overall avian nestbox network at LANL which was established in 1997.

Results and Discussion

Point Count Surveys-Year 2019

Three surveys were completed at each of the three treatment sites and the associated control sites between May and July 2019. A total of 853 birds representing 53 species were recorded at the three treatment sites. A full account of the 2013–2019 data is detailed in Appendix 1.

Species richness is the number of different species represented in an ecological community and is simply a count of species. In this case, each treatment site and control are individual communities. Species diversity is a measure that takes into account the species richness and the overall abundance to compare evenness across a community. Here we used the Shannon's diversity index, which measures the probability that two individuals randomly selected from a sample will belong to different species. The abundance is the total number recorded of a given species. Tables 1 and 2 detail the species richness, diversity, and abundance for 2019 for each treatment and control site.

Table 1. The species richness, diversity, and abundance recorded at all treatment and control sites in 2019

	Minie	*TA-39*	*PJ Control 1*	*PJ Control 2*	*TA-16*	*PIPO Control 1*	*PIPO Control 2*
Richness	34	38	30	33	39	41	41
Diversity	3.063	3.083	2.755	2.901	3.291	3.127	3.292
Abundance	245	298	226	187	310	364	394

Table 2 outlines the species richness over time at the treatment and individual control sites. The three treatment sites were maintaining a steady species richness over time with almost all indicating a slight increase in the number of species in 2015. Precipitation at LANL from January through July 2015 was the most precipitation since 1949 (Weather Machine 2015). The increases in richness, diversity, and abundance in 2015 were most likely attributed to the increased precipitation. Links between moisture and habitat quality for migratory birds have been documented (Smith et al. 2010) and may be a causal factor. In addition, the winter of 2015 and into early 2016 was drier. The moisture for the winter of 2018–2019 was at or slightly above normal, but the species richness at all sites was similar to the previous year.

Table 2. Changes in species richness over time for all treatment and control sites

	2013	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*
Minie	33	33	34	30	35	35	34
TA-39	31	31	39	38	34	39	38
PJ Control 1	29	30	33	36	37	30	30
PJ Control 2	30	29	37	33	39	23	33
TA-16	33	33	40	44	41	43	39

PIPO Control 1	34	34	30	41	41	37	41
PIPO Control 2	33	36	43	43	44	40	41

Tables 3–5 compare the species diversity over time between the treatment site and the combined control. The two control sites were combined to analyze diversity because we were interested in the relative abundances among species and not the actual numbers. There have been some significant differences at times over the course of this study. In these cases, the diversity was significantly higher at the treatment site than the combined controls. Even though we see significant differences, the bird diversity at all sites is around 3, which compared with ecological systems in general is very high.

Table 3. Changes in species diversity over time comparing Minie Site with the PJ controls

	2013	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*
Minie	3.141	3.141	3.161	2.968	3.134	3.220	3.060
PJ Control	2.895	2.990	3.159	3.075	3.241	2.940	2.970
t-test	**t = -3.2012** **df = 508** **p = 0.001**	t = -1.8716 df = 455 p = 0.06	t = -0.5269 df = 663 p = 0.60	t = 1.291 df = 460 p = 0.20	t =1.4637 df = 498 p = 0.14	**t =-3.907** **df = 588** **p < 0.01**	t =-1.2465 df = 626 p = 0.21

Table 4. Changes in species diversity over time comparing TA-39 with the PJ controls

	2013	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*
TA-39	3.090	3.073	3.143	3.318	3.178	3.130	3.080
PJ Control	2.895	2.990	3.159	3.075	3.241	2.940	2.970
t-test	**t = -2.527** **df = 464** **p = 0.012**	t = -1.0396 df = 477 p = 0.30	t = 0.2166 df = 483 p = 0.83	**t = -3.7477** **df =664** **p <0.01**	t = 0.95934 df = 675 p = 0.34	**t = -2.7474** **df = 699** **p = 0.006**	t = -1.4205 df = 670 p = 0.16

Table 5. Changes in species diversity over time comparing TA-16 with the PIPO controls

	2013	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*
TA-16	3.304	3.207	3.236	3.293	3.238	3.360	3.290
PIPO Control	3.261	3.225	3.161	3.216	3.296	3.170	3.320
t-test	t = -0.66864 df = 404 p = 0.50	t = 0.26454 df = 495 p = 0.79	t = -1.2603 df = 689 p = 0.21	t = -1.1396 df = 511 p = 0.25	t = 0.88237 df = 539 p = 0.38	**t = -2.9553** **df = 578** **p = 0.003**	t = 0.51719 df =648 p = 0.61

To further analyze richness and Simpson's diversity (Simpson 1949) over time, species rarefaction and extrapolation plots (Hsieh et al. 2016, Chao et al. 2014) were developed in 2018 that included all years of data with the control sites combined. Species rarefaction and extrapolation show no differences between treatment and control sites for species richness. There were overlapping 95% confidence intervals for species richness (Figures 5A–6A) for all three treatments and their controls. Simpson's diversity is normally a measure between 0 and 1, but when analyzed using Hill numbers (Hsieh et al. 2016) it effectively reports the number of dominant species. The rarefaction and extrapolation plots for species diversity (Figures 5B–6B) were significantly different since the 95% confidence intervals did not overlap. In these cases, the treatment sites were higher in diversity than the controls with a higher number of dominant species. Tables 3-5 show there were no significant differences of diversity between treatment and control sites in 2019. Since the extrapolation curves are not expected to change much between years, these will be reanalyzed every five years.

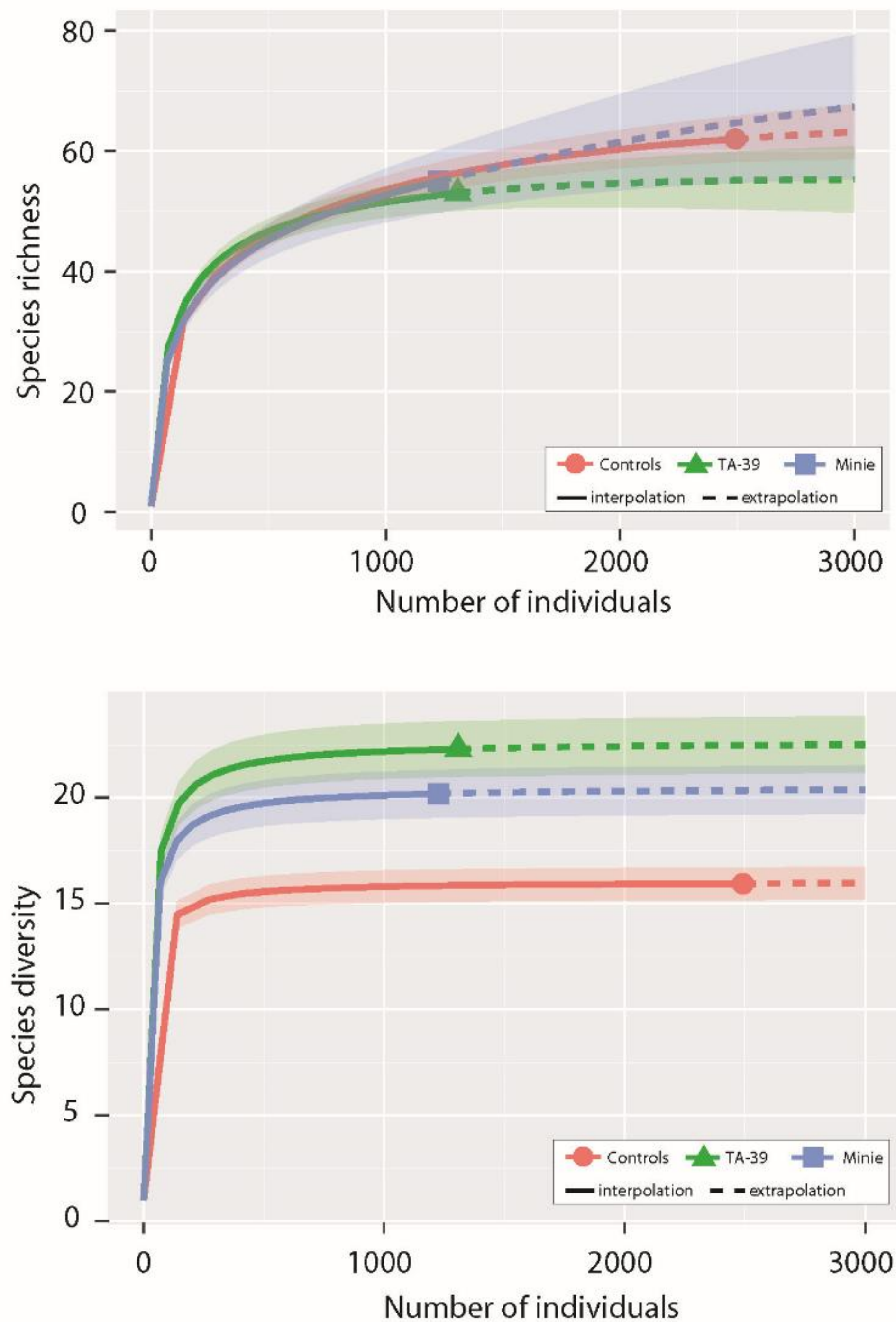

Figure 5. 2013 – 2018 Species rarefaction and extrapolation for species richness and diversity comparing Minie and TA-39 with the PJ controls

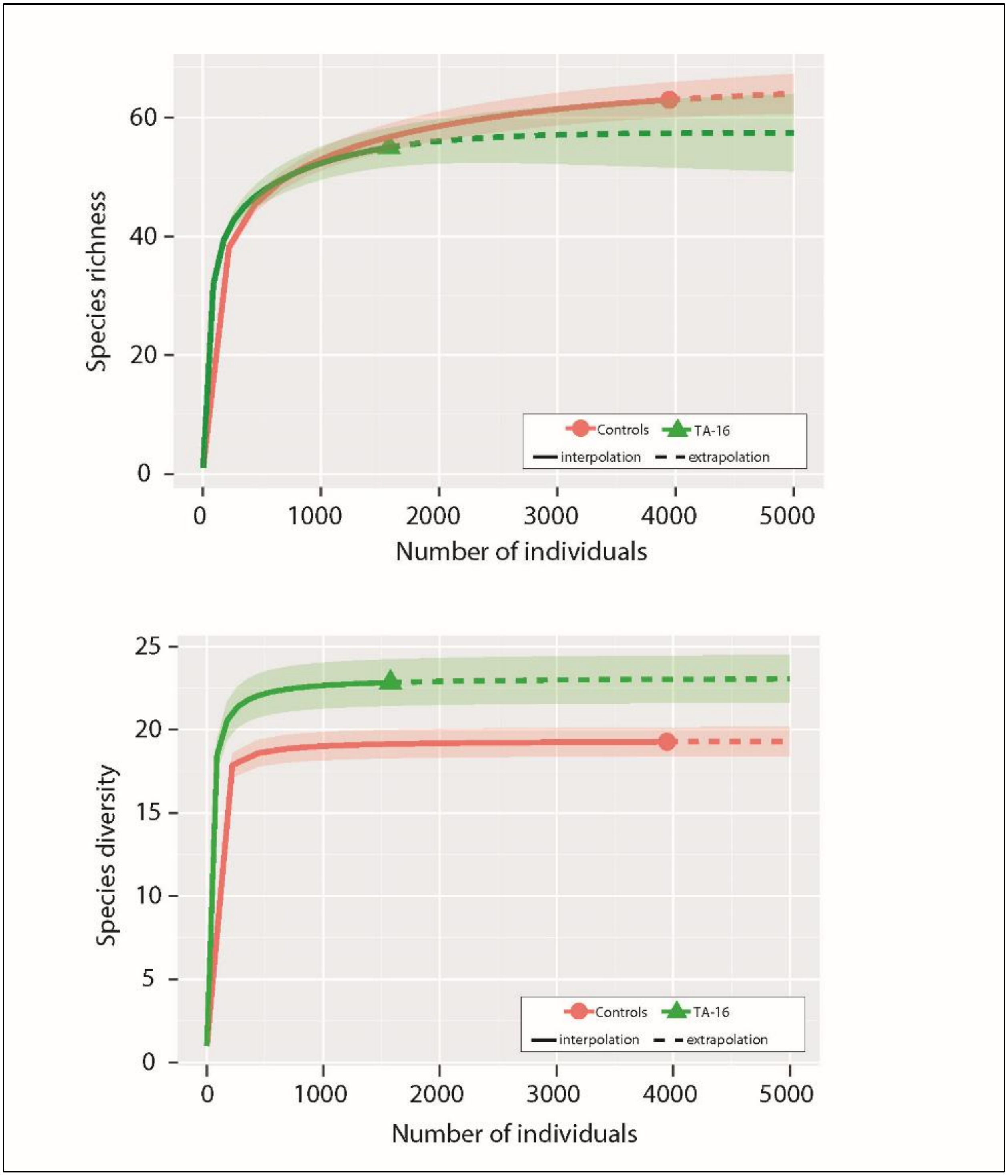

Figure 6. 2013 – 2018 Species rarefaction and extrapolation for species richness and diversity comparing TA-16 with the PIPO controls

The overall abundance of birds is trending the same for all treatment sites compared with the controls. At TA-16, the overall abundance is lower, but the percent abundance is similar year to year when compared with the control sites. Table 6 compares the abundance between the treatment and control sites over time. Similar to the species richness trends, there was an increase in abundance in 2015. The fluctuations in bird abundances were not alarming, and the differences between the treatment sites and control sites were not biologically significant. The moisture for the winter of 2018–2019 was at or slightly above normal, but the species abundance at all sites were similar to previous years.

Table 6. Changes in species abundance over time for all treatment and control sites

	2013	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*
Minie	193	186	275	210	222	242	245
TA-39	177	193	259	249	261	315	298
PJ Control 1	187	157	269	312	240	235	226
PJ Control 2	181	177	301	228	300	168	187
TA-16	220	209	347	271	302	285	310
PIPO Control 1	258	223	432	323	447	374	364
PIPO Control 2	256	254	371	396	449	366	394

Figures 7-9 summarize the feeding guild trends over time at the treatment sites and the combined control sites. Overall, there are fewer granivores at all transect locations. Most of the species documented are insectivores and omnivores. Tracking bird abundance by feeding guild is important, because recent studies have shown changes in food sources, specifically for insectivores, have cascading effects on bird populations (Hallmann et al. 2017). Although there are periods of significant differences between years, they tend to follow the fluctuations in abundance and species richness.

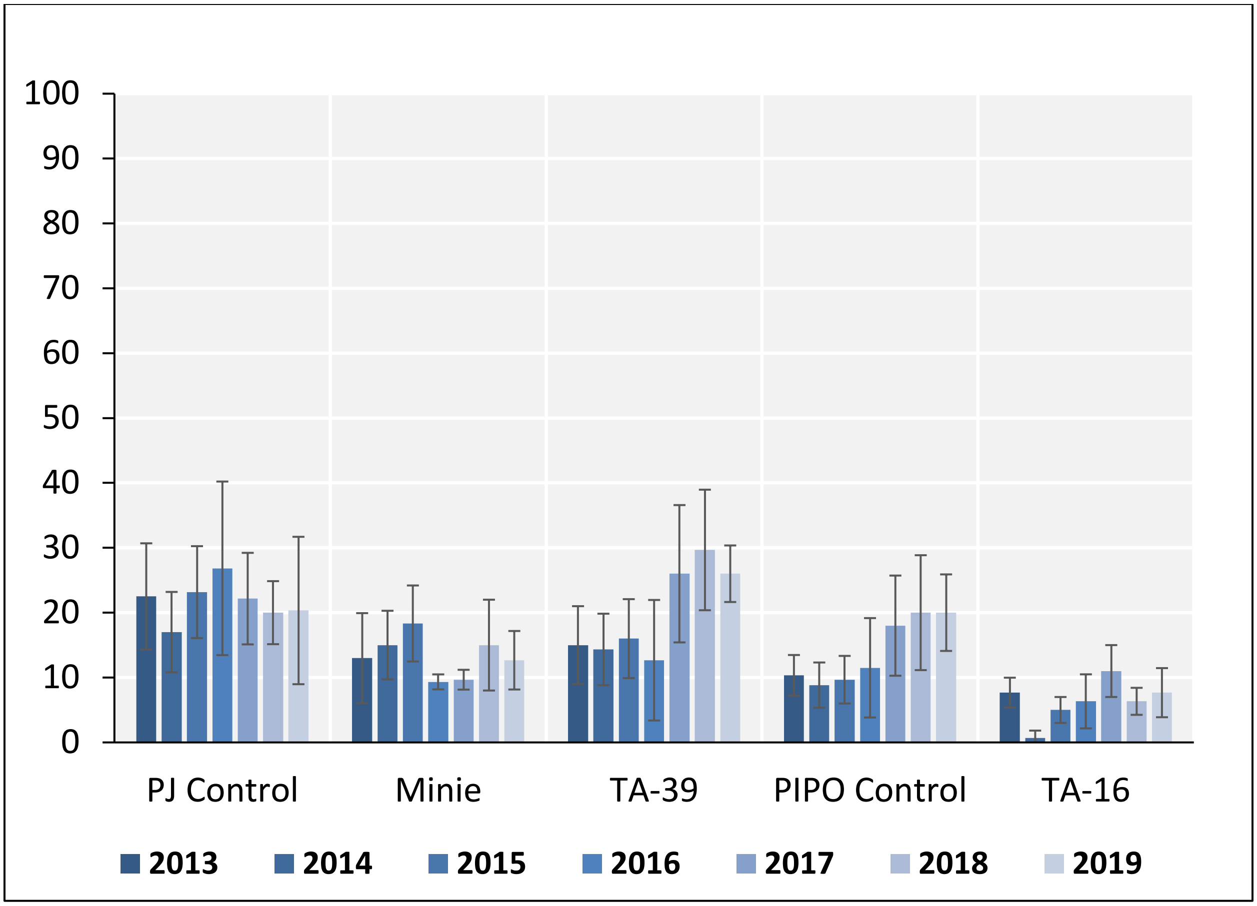

Figure 7. Average number of granivores +/- 1 standard deviation during breeding bird surveys at treatment sites and combined control sites over time.

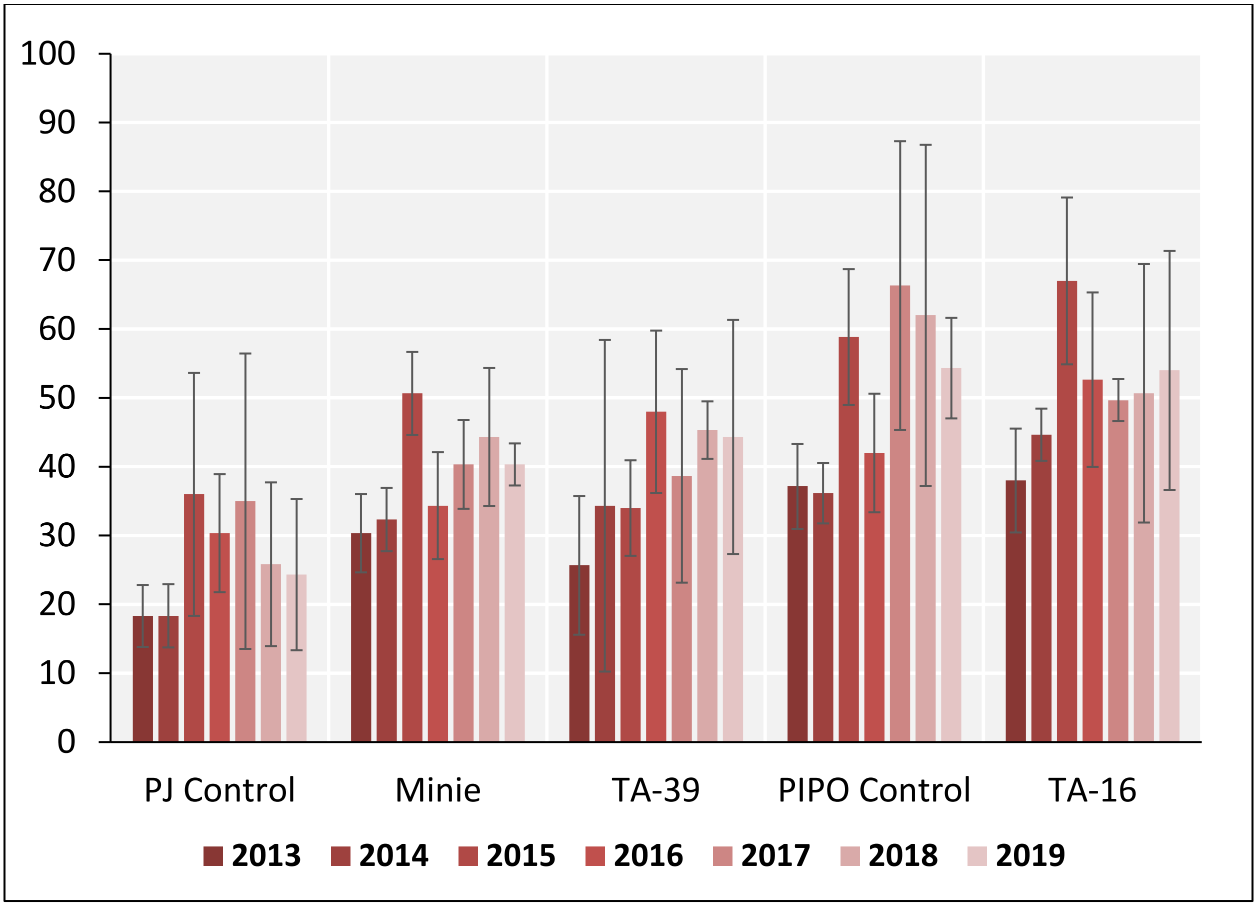

Figure 8. Average number of insectivores +/- 1 standard deviation during breeding bird surveys at treatment sites and combined control sites over time.

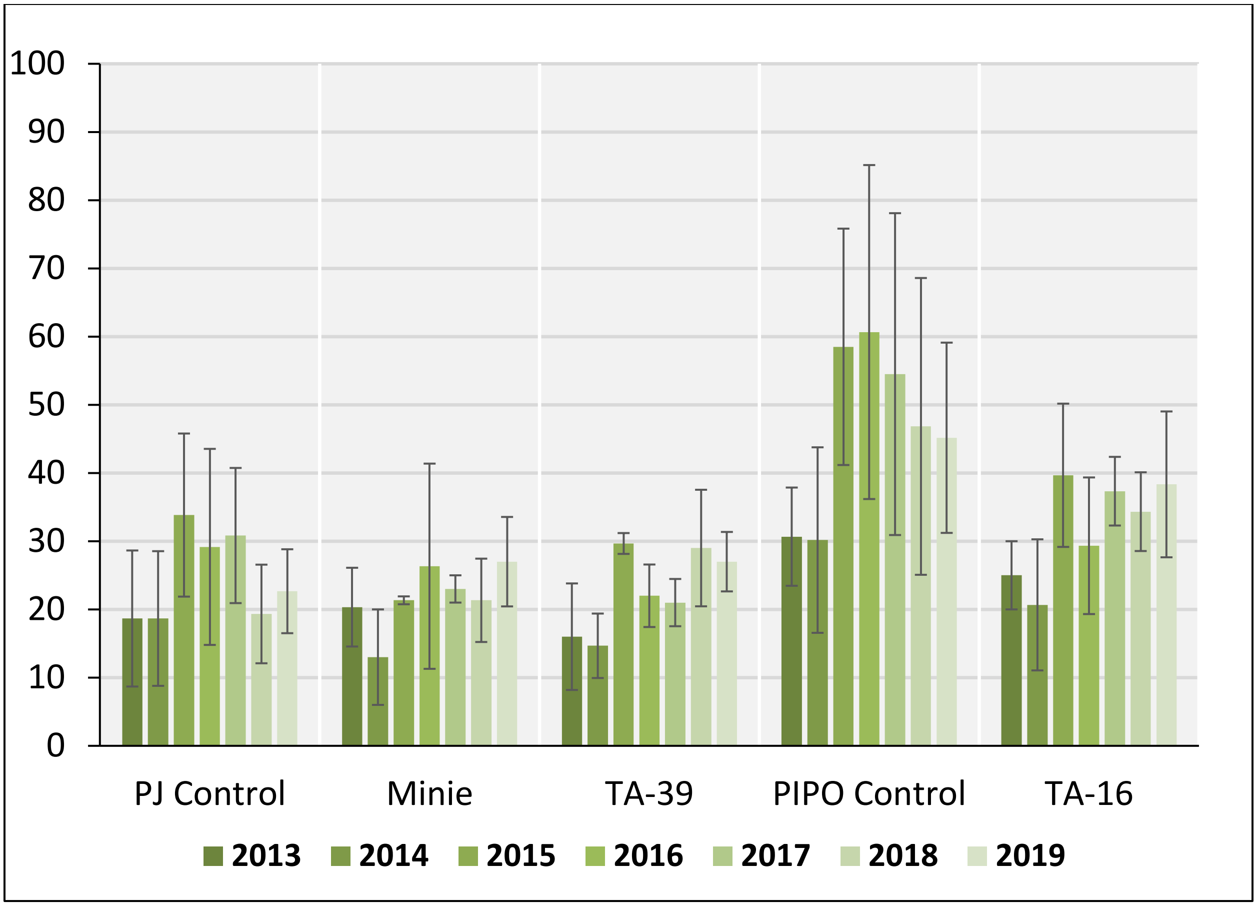

Figure 9. Average number of omnivores +/- 1 standard deviation during breeding bird surveys at treatment sites and combined control sites over time.

The number of granivores at TA-16 in comparison with the PIPO controls is lower overall. TA-16 is located on a mesa top surrounded by canyons with rocky cliff faces. Perhaps there is less understory vegetation on the cliff faces surrounding TA-16, resulting in less food for granivores. More study on habitat components between TA-16 and the PIPO control is needed to determine potential causes of the granivore variation.

Nestboxes

During the 2018 season, the overall avian nestbox network was managed at lower levels. Treatment sites were maintained at previous years' effort, but site-specific constraints from increased fire restrictions in 2018 limited the overall network management. In 2019, there were no restrictions and the nestbox network was managed throughout the breeding season with no limitations.

During the 2019 nesting season, 15 nestboxes at each treatment site were actively monitored. The overall avian nestbox network, without the three treatment sites, contained 378 nestboxes in

2019. Of those, 167 contained active nests and 85 of those nests fledged young successfully. This was an overall occupancy rate of 44% with a 51% success rate.

Tables 7 and 8 compare the occupancy and success rates for each treatment site and the overall nestbox network since 2015.

Table 7. Comparison of occupancy for the treatment sites and the overall nestbox network over time.

	2015	*2016*	*2017*	*2018*	*2019*
Overall Network	40%	45%	48%	53%	44%
Minie	66%	73%	46%	20%	60%
TA-39	8%	58%	20%	33%	13%
TA-16	-	73%	100%	53%	87%

Table 8. Comparison of success for the treatment sites and the overall nestbox network over time.

	2015	*2016*	*2017*	*2018*	*2019*
Overall Network	66%	69%	57%	49%	51%
Minie	64%	23%	29%	33%	44%
TA-39	100%	57%	0%	40%	0%
TA-16	-	63%	76%	63%	54%

In 2019, there were four successful nests that fledged young at Minie, zero at TA-39, and seven at TA-16. Both occupancy and success rates at TA-39 were low in comparison to the other treatment sites and the overall network. TA-39 is the lowest elevation treatment site and occupancy has been decreasing over time at this site and surrounding areas of the avian nestbox network. Wysner et al. (2019) found that Western Bluebirds, one of the target species of the network, have increased their nesting elevation over time in the study area. Western Bluebirds have the highest occupancy rates throughout the nestbox network, and the shift in nesting elevation could be driving the lower occupancy rates at TA-39. Occupancy and success rates at the other two treatment sites seem to be fluctuating naturally in comparison to the overall network and have not displayed a decreasing trend over time.

In 2019, nonviable eggs collected from nestboxes at the treatment sites and the rest of the nestbox network were submitted to an analytical lab for chemical analyses. These data will be reported in a separate report.

Management Recommendations

In addition to supporting federally protected bird species such as the Mexican Spotted Owl and the Southwestern Willow Flycatcher, LANL lands are important for migratory bird conservation. Of the 53 species detected at the three treatment sites, all are protected under the Migratory Bird Treaty Act. In addition, sensitive species from the Birds of Conservation Concern Region 16 list, the Southern Rockies/Colorado Plateau region (USFWS 2008), the New Mexico Avian Conservation Partners Species Conservation Level One List (NMACP 2019), and the Birder's Conservation Handbook (Wells 2007) have been documented at the treatment sites. Those species are the Juniper Titmouse, Grace's Warbler, Virginia's Warbler, and the Woodhouse's Scrub Jay. The primary statutory authority for Birds of Conservation Concern is the Fish and Wildlife Conservation Act of 1980 (16 United States Code § 2901).

Continuing the research reported herein will provide a long-term dataset for the ecological health of avifauna at the three treatment sites at LANL. In addition, this research contributes to meeting the Department of Energy's commitments under the Migratory Bird Treaty Act and associated memorandum of understanding with the U.S. Fish and Wildlife Service, and it allows LANL to contribute to national goals in avian conservation monitoring and research.

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Appendix 1. All birds recorded at the three treatment sites from 2013–2019

	2013	2014	2015	2016	2017	2018	2019	2013	2014	2015	2016	2017	2018	2019	2013	2014	2015	2016	2017	2018	2019
Species	TA-36 Minie Site							TA-39 Point 6							TA-16 Burn Grounds						
	Pinyon-Juniper Woodland							Pinyon-Juniper Woodland							Ponderosa Pine Forest						
Acorn Woodpecker															5		3	2	3	5	3
American Crow																			1	1	
American Kestrel				1				1			2										
American Robin	1	1	2		2			1	1		2		4	2	7		9	4	4	6	12
Ash-throated Flycatcher	11	5	14	13	13	10	17	19	11	29	12	8	8	6	3	5	6	2	3	8	4
Audubon's Warbler		2				5					2				6	5	1	6		1	11
Bewick's Wren	4	8	9	9	14	14	5	3	10	15	9	2	8	1							
Black-chinned Hummingbird		1	1				1	3	2				1	2	1		1		1		1
Black-headed Grosbeak	1	3				1	1		2	4	1		3	2			1	2		2	
Black-throated Gray Warbler			1		2			5	6	4											
Blue-gray Gnatcatcher	3	14	16	8	10	9	8	2		7	5	4	2	13		6	2	1	3	6	4
Broad-tailed Hummingbird	2	1	3		1		3	3	1	2		3	1	2	5	11	11	5	7	10	8
Brown Creeper															1						
Brown-headed Cowbird	1									2			3	2	4	1			4	2	8
Bushtit		2		2		11		2	14			1	12								
Canada Goose										16				2							
Canyon Towhee	2		5	3	6	2	3	1	1	2	10	13	19	6	1			1		1	
Canyon Wren					1					2	3	8	6	2			2				
Cassin's Finch						4															
Cassin's Kingbird	6	13	13	5	2	5	6	7	6	2	21	21	32	37				1			
Chipping Sparrow	3	16	17	29	6	22	10	6	6	5	8	15	25	27	1	5	3	10	5	21	8

	2013	2014	2015	2016	2017	2018	2019	2013	2014	2015	2016	2017	2018	2019	2013	2014	2015	2016	2017	2018	2019
Species	TA-36 Minie Site							TA-39 Point 6							TA-16 Burn Grounds						
	Pinyon-Juniper Woodland							Pinyon-Juniper Woodland							Ponderosa Pine Forest						
Clark's Nutcracker																4		1			
Common Nighthawk	6		5	2	4	4	1	5	1	3	2	7	5	7			1	2	2		
Common Raven	2	5	1		1	2	3	1		2	1		1	2	5	6	2	2	5	5	7
Cooper's Hawk					1										1			1			1
Cordilleran Flycatcher															5	10	6	3	3	1	2
Dark-eyed Junco													1	1	6	2	4		5	2	
Downy Woodpecker				1							1	2		1		1		1	1	1	
Dusky Flycatcher				1						1		1									
Eurasian Collared-Dove	3											4								1	
Evening Grosbeak	3		4							8					5		29			1	
Grace's Warbler							1						2	4	6	4	4	8	5	8	22
Gray Flycatcher	12	6	5	7	3	6	3	10	10	11	10	5	8	3							
Great Horned Owl		3						1													
Green-tailed Towhee	3	1						1													
Hairy Woodpecker			2	1		1				5	3			1	1	1		1	1	2	1
Hammond's Flycatcher															8	9	12	5	7	5	10
Hepatic Tanager										1	2	1	2					1			
Hermit Thrush						1										4	6	1	2	2	5
House Finch	16	17	26	17	12	18	17	21	4	23	9	30	44	50	16	2	5	5	12	7	12
House Wren														1	1	1		2	2	6	8
Juniper Titmouse	12		7	6	9	3	26	11	13	18	6	1									
Lesser Goldfinch	2	6	7	4	9	12	8	4	12	9	10	14	19	15	3		8	9	4	8	5
MacGillivray's Warbler																		1	3		
Mountain Bluebird		2	20	10	11	1	9		4								4	4	4	7	4
Mountain Chickadee	5	2	1	2							1	1		1	5	8	9	6	8	9	1

	2013	2014	2015	2016	2017	2018	2019	2013	2014	2015	2016	2017	2018	2019	2013	2014	2015	2016	2017	2018	2019
Species	TA-36 Minie Site							TA-39 Point 6							TA-16 Burn Grounds						
	Pinyon-Juniper Woodland							Pinyon-Juniper Woodland							Ponderosa Pine Forest						
Mourning Dove	17	17	13	5	8	8	11	13	22	10	3	15	11	8	4		1	3	17	3	5
Northern Mockingbird					2		1		1												
Northern Rough-winged Swallow						3															
Peregrine Falcon										1											
Pine Siskin	10	2		5	1			6		3	3				12	4	5		4	2	
Plumbeous Vireo	10	10	7	3	9	9	15	1		1	6	6	5	5	11	16	15	14	11	18	16
Pygmy Nuthatch				2		2	3			2	4	12	9	11	11	13	26	29	41	20	16
Red Crossbill					1				2							2	9	13	9		6
Red-shafted Flicker	3	1	3	2	5	2	1	3	2	4	8		3	2	3	4	11	11	5	5	2
Red-tailed Hawk							1			1	1	1	1								
Rock Wren	3	3	4		2	10	11	7	10	4	12	14	14	12	1	2	2	6			4
Ruby-crowned Kinglet																				2	
Say's Phoebe	2	1	2		2	5	1	2	1		5	2	4		1		1	3	3	4	1
Scaled Quail			1																		
Spotted Towhee	17	8	19	27	32	24	19	12	6	33	16	12	16	15	11	18	16	14	21	22	34
Steller's Jay							1								3	2	5	6	3	4	4
Townsend's Solitaire	1																		1		
Turkey Vulture					1										1					1	
Vesper Sparrow																					1
Violet-green Swallow		5	7	1	3	2	1	6	4	1	9	6	6	9		2	19	2	2	4	2
Virginia's Warbler					1	3	1			1	2	4		5	17	11	21	13	7	5	5
Warbling Vireo						2									2	9	7	6	5	4	6
Western Bluebird	15	11	18	17	16	19	21	5	19	12	21	13	6	7	20	20	49	37	32	27	20
Western Tanager		2	3		1				2	1	1	2	2	6	2	3	7	2	4	6	16
Western Wood-Pewee	10	8	18	11	10	7	18		4	2	10	8	11	12	15	10	16	14	22	20	24

	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Species	TA-36 Minie Site							TA-39 Point 6							TA-16 Burn Grounds						
	Pinyon-Juniper Woodland							Pinyon-Juniper Woodland							Ponderosa Pine Forest						
White-breasted Nuthatch	1	4	9	10	13	5	2			2	4	4	2	6	9	8	7	9	20	10	10
White-throated Swift									1												
White-winged Dove	1	5	9	2		3	2	7	5	6	16	15	15	5			1	2			1
Woodhouse's Scrub-Jay	5	1	3	4	8	7	14	8	10	4	8	6	4	5	1						