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Author(s):	Hathcock, Charles Dean Thompson, Brent E. Berryhill, Jesse Tobias
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2016 Results for Avian Monitoring at the TA-36 Minie Site, TA-39 Point 6, and TA-16 Burn Ground at Los Alamos National Laboratory

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Prepared by: Charles D. Hathcock, Brent E. Thompson, and Jesse T. Berryhill.
Environmental Stewardship Services, Los Alamos National Laboratory

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Executive Summary

Los Alamos National Security, LLC (LANS) biologists in the Environmental Compliance and Protection Division at Los Alamos National Laboratory (LANL) initiated a multi-year program in 2013 to monitor avifauna at two open detonation sites and one open burn site on LANL property. Monitoring results from these efforts are compared among years and with avifauna monitoring conducted at other areas across LANL. The objectives of this study are to determine whether LANL firing site operations impact bird abundance or diversity. LANS biologists completed the fourth year of this effort in 2016. The overall results from 2016 continue to indicate that operations are not *negatively* affecting bird populations. Data suggest that community structure may be changing at some sites and this trend will continue to be monitored.

Three avian point count surveys were completed at each of the study sites at the Technical Area (TA) 36 Minie site, the TA-39 point 6, and the TA-16 burn ground (hereafter referred to as Minie site, TA-39, and TA-16) between May and July 2016. A total of 730 birds representing 54 species were recorded at the study sites. Three avian point count surveys were also completed at each of the control sites between May and July 2016.

The data were analyzed to determine abundance using an estimate of birds detected per hour, and to calculate the species diversity. The number of birds detected in three different feeding guilds were compared to examine functional community differences among areas.

Results from 2016 monitoring indicate a slight decrease from 2015 in bird abundances in pinyon-juniper (PJ) habitat and a small increase in bird abundances in mixed conifer (MC) habitat across LANL. The decrease is likely indicative of effects from below-average precipitation in the winter of 2015 into the spring and early summer of 2016. Precipitation drives habitat suitability, which can potentially drive animal populations using the resources. The link between moisture and habitat quality for a migratory bird indicates that the availability of high-quality habitats is dynamic due to variation in precipitation among seasons and years (Smith et al. 2010). Mixed conifer habitat is wetter than PJ, which may account for the small increase in bird abundance in the MC habitat. This increase in bird abundance was significantly higher ($p = 0.03$) in the MC control habitat compared with TA-16. There were no significant differences in bird abundance for the other two sites when comparing their respective controls.

The species diversity indices at Minie site were significantly less ($p = 0.01$) than its PJ control, with fourteen fewer species present. The TA-16 bird diversity was also significantly less ($p < 0.01$) than its MC control, with seven fewer species present. The fluctuations in bird abundances are not alarming and the differences between the study sites and control sites are not biologically significant. The 2016 results at the three study sites are still higher than the first two years of the study. The significant drop in species diversity at Minie site may be indicative of a change in community structure. Due to increased fuels reduction, including more tree removals, the habitat availability is changing. The site is becoming more grassland-like than PJ. There are currently no control sites for grasslands at LANL and this may be needed in the future.

In addition to avian point counts, nestboxes were monitored around all three study sites. These data are compared with the overall avian nestbox monitoring network. This network was established in 1997 to investigate the occupancy rates and reproductive success of cavity-nesting bird populations at LANL. The total number of boxes in the network in 2016 was 416, with another 42 placed around the three study sites. In 2016 there was an overall occupancy rate of 47% with a 65% success rate for the avian nestbox network at LANL. The percent occupancy and nest success at both Minie site and TA-16 were similar to the overall rate, suggesting that the firing site operations are not negatively affecting nest success. Further study is needed at TA-39 to ascertain if the 2016 re-deployment of some nestboxes within the more open habitat east of point 6 continues to lead to increased occupancy. An additional three boxes are needed at TA-39 to maintain even numbers at all three sites.

Introduction

As part of the Resource Conservation and Recovery Act permitting process at LANL for two open detonation sites (TA-36 Minie site and TA-39 point 6), and one open burn site, (TA-16 burn ground), an avian monitoring program was started at these locations in 2013 (Hathcock and Fair 2013). The goal is to compare avian abundance, diversity, and productivity at these sites with other locations at LANL of the same habitat type. Comparisons are made with control sites that have been surveyed since 2011 (Hathcock et al. 2011).

LANS biologists used standard point count methodology to record avian abundance and diversity along transects at the three study sites and associated control sites during the summer of 2016. Summer surveys provide information about what birds are breeding at the sites. 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. They also can be correlated to changes in the natural environment at LANL.

In addition to avian point counts, nestboxes are monitored around all three study sites to investigate any potential impacts to occupancy rates and productivity of cavity-nesting birds. These data are compared with the overall LANL avian nestbox monitoring network established in 1997.

Methods

Field Methods for Point Count Surveys

The point count surveys are conducted along single transects in the forested, undeveloped land surrounding the study sites (Figures 1–3). The habitat types around the sites are PJ for the sites at TA-36 and TA-39 and MC at TA-16. These habitat descriptions are based on the 1/4 ha physiognomic cover classes in the LANL land cover map (McKown et al. 2003). The three study sites were compared with control sites at LANL of the same habitat type. The control sites (Figure 4) are monitored annually in ongoing surveys that have been conducted at LANL since

2011 as described in Hathcock et al. (2011). Each habitat type control contains two replicate transects that are monitored in the same way as the study sites with the same number of points and during the same time periods. In each survey month, all study site and control site transects are randomized and surveyed following the random order.

The PJ study sites at Minie site and TA-39 are similar to the PJ control sites at TA-70 and TA-71 in elevation, vegetation, proximity to developed areas, and in being situated on the mesa top. The MC study site at TA-16 is similar in elevation and overstory vegetation to the MC control sites, but is dissimilar in that the study site is located on a mesa top and the control sites are located in the bottom of a canyon in TA-43, TA-2, and TA-21. Being the bottom of a canyon, there are some differences in understory vegetation with a greater understory present at the control sites.

Transects are approximately 2.0 to 2.5 km in length and allow for nine survey points spaced approximately 250 m apart. These survey routes and points may change slightly over time due to construction activities or access constraints. The time frame for breeding bird surveys is May 1 through August 15. Ideally, the breeding bird surveys should take place the second week of May, June, and July. This protocol requires a total of three surveys per study site and surveys should be 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 the transect spaced approximately 250 m apart.
- The surveyor will look and listen for 5 minutes, noting any birds encountered at each point. The distance for observations is considered as an "unlimited-distance circular plot"; however, the distance to each bird out to 100 m should be noted. Care is needed to ensure that individual birds are not re-counted from point to point. Use a range finder when possible for measuring the distance.
- While walking between points, note any birds encountered that have not otherwise been counted from a previous point or future point. The surveyor's main focus is counting birds from each point and not spending unnecessary time looking for additional birds between points.
- Do not conduct surveys during rain events or winds greater than 15 mph.
- Record all birds encountered on the data sheet. For each observation, the minimum data collected should be point number, time, species, number of individuals, and distance from the point.
- Use the "NOTES" section to indicate any potentially important aspects of the survey that may affect the data. Examples include excess noise from nearby equipment and vehicles or aircraft that make it hard to hear the birds. Also, noting other wildlife or evidence of wildlife that could be used for further reference should be recorded.

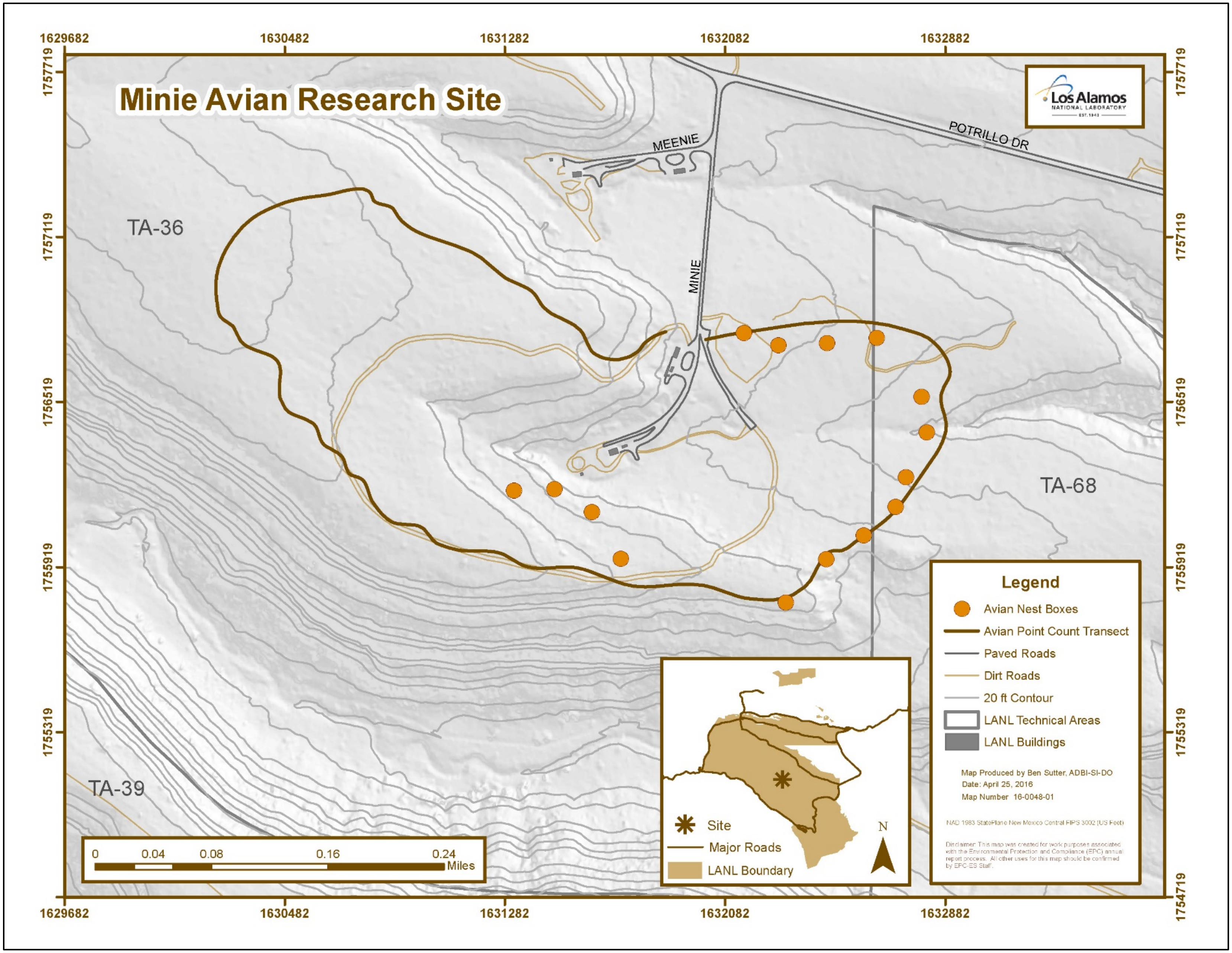

Figure 1. Breeding bird survey transect and nestbox locations around TA-36 Minie site.

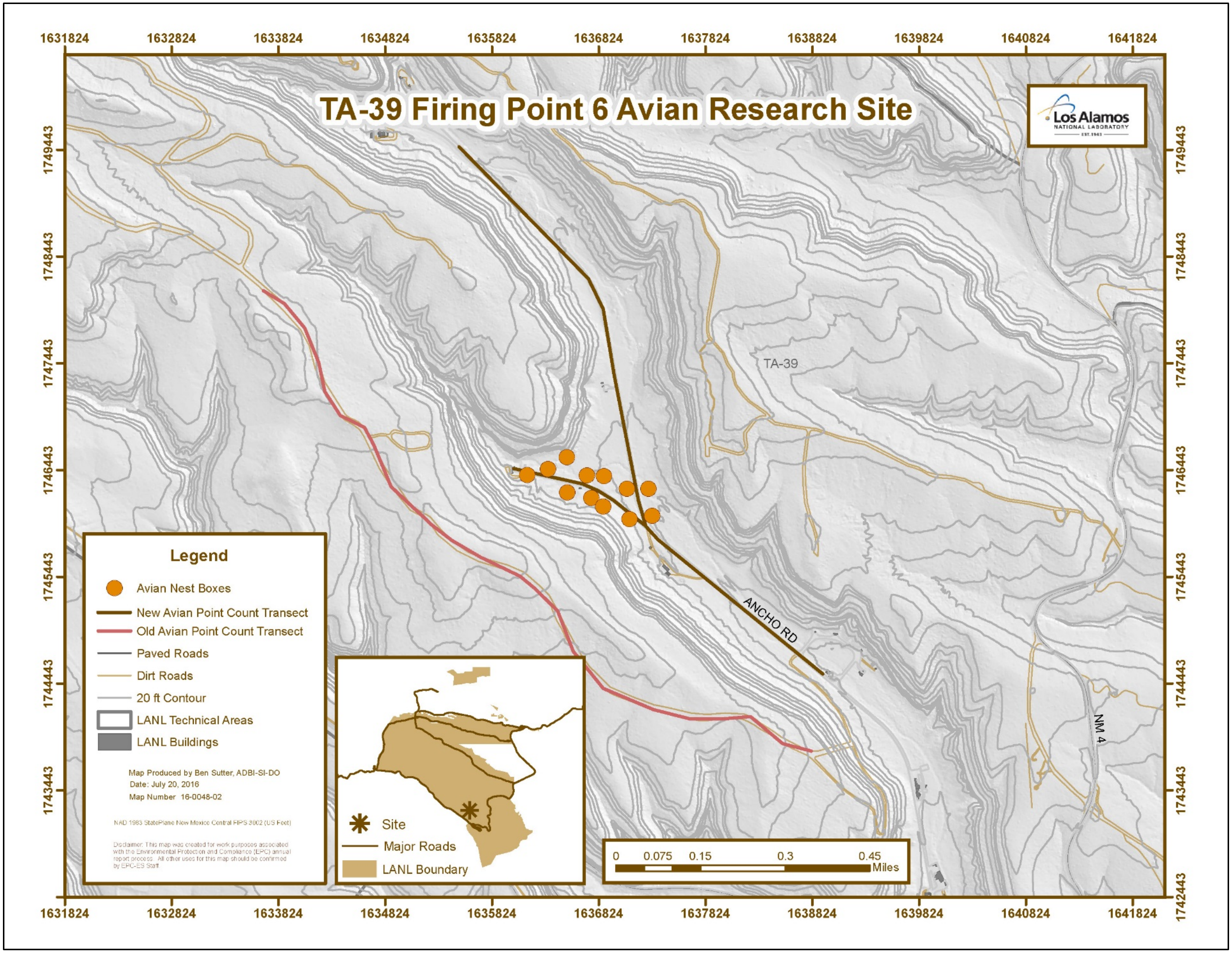

Figure 2. Breeding bird survey transect and nestbox locations around TA-39 point 6.

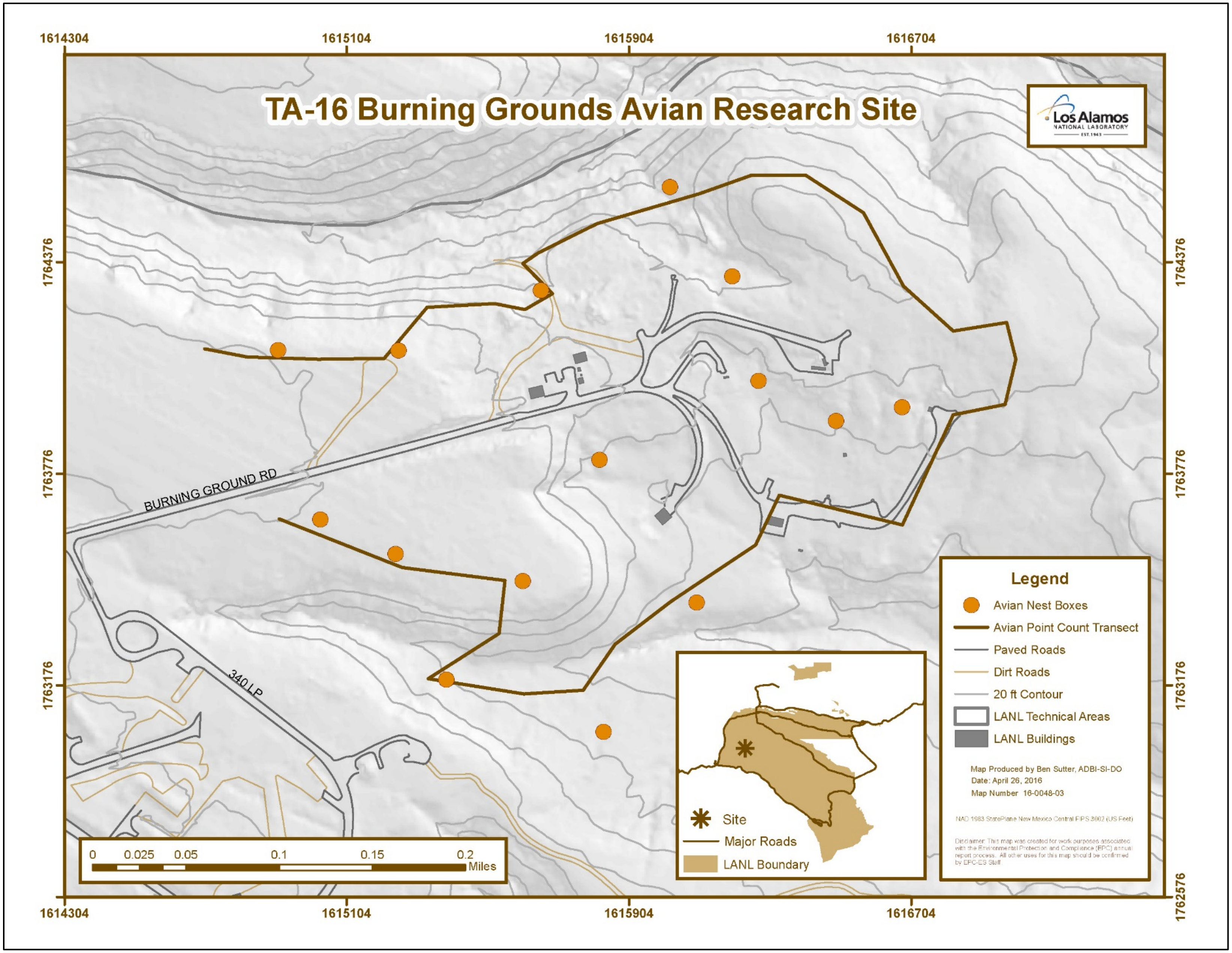

Figure 3. **Breeding bird survey transect and nestbox locations around the TA-16 burn ground.**

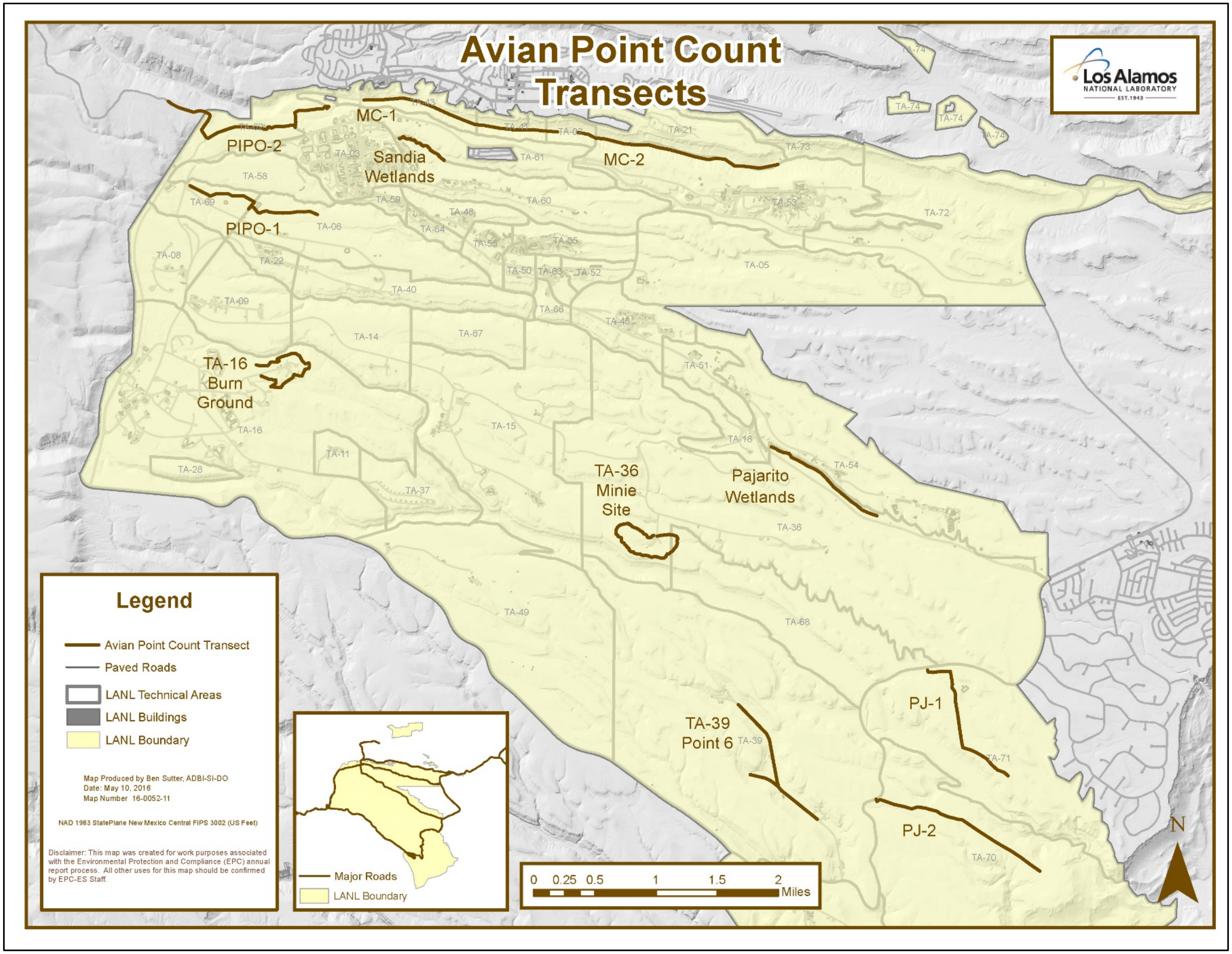

Figure 4. All avian point count transects around LANL.

MC: Mixed Conifer Forest, PIPO: Ponderosa Pine Forest, PJ: Pinyon-Juniper Woodland.

Field Methods for Nestbox Monitoring

In 2011, nestboxes were added to Minie site and TA-39 (Figures 1 and 2) and in 2015 nestboxes were added to TA-16 (Figure 3). Data from the three study sites are compared with the overall avian nestbox network at LANL that was established in 1997.

Nestboxes are monitored every 1 to 2 weeks for active nests. When an active nest is found, it is monitored more closely to determine whether the nest fails or successfully fledges young.

Statistical Methods

The data were summarized to look at trends in avian abundance and diversity for the three study sites and the control sites. To compare relative abundances between years and sites, the birds per hour (BPH) was calculated for each site by taking the total number of birds detected per survey and dividing by the total number of minutes surveyed. The result is multiplied by 60 to get the BPH. The BPH of the study sites and control sites were compared using the Mann-Whitney U non-parametric two-sample test because the data were not normally distributed. Probability values of 0.05 or less were considered significant.

The Shannon's diversity index (*H*) (Shannon 1948) was used to examine avian diversity for the study and control sites. The Shannon's *H* can range from 0.0 to 4.6, where larger values represent increasing diversity. *H* is calculated using the following formula:

$$H = -1 (p_i (\ln (p_i))$$

Where p_i is a percentage value of a specific species in the total population and ln is the natural log.

To compare indices, a Shannon *t* test was used. As described in Magurran (1988), the variance of *H* is determined, which then allows the determination of the *t* value and degrees of freedom. Probability values of 0.05 or less indicated a significant difference in *H* between the two samples. The diversity indices and Shannon's *t* test were computed using PAST version 3.08 statistical software (Hammer et al. 2001).

Birds were categorized into feeding guilds based on the work of De Graaf et al. (1985). For food type, they did not necessarily include all foods taken by each species, only the major food items (20% of diet during a given period).

- Carnivore: vertebrates
- Crustaceovore: crustaceans
- Frugivore: fruits
- Granivore: nuts
- Herbivore: plants (leaves, stems, roots)

- Insectivore: insects
- Moltuscovore: mollusks
- Omnivore: a variety of foods including both animal and plant foods (the less common food group makes up 10% of diet)
- Piscivore: fish
- Vermivore: sandworms, earthworms, etc.

The guilds were customized to account for some bird species being split since the publication. Other changes were made to make it more suited to this study. All woodpeckers were changed from frugivores to omnivores; vermivores (American Robins in this study) were changed to omnivores; hummingbirds were changed from omnivores to nectarivores; Cassin's and House finches were changed from frugivores to granivores. Nectarivores and carnivores were dropped from the analysis due to low samples sizes, leaving granivores, insectivores, and omnivores for this report. The mean number of birds and standard deviation were calculated for each feeding guild. The means of the study sites and control sites were compared using the Mann-Whitney U non-parametric two-sample test because the data were not normally distributed. Probability values of 0.05 or less were considered significant. All significant values in tables are bolded and shaded gray.

Occupancy rate and nest success rate of the nestboxes at the three study sites and in the overall network were calculated. For any single site or overall, the number of active nestboxes divided by the total number of nestboxes is the occupancy rate. Similarly, the number of nestboxes that successfully fledged young divided by the number of active nestboxes is the nest success rate.

Results and Discussion

Three surveys were completed at each of the three study sites and the associated control sites between May and July 2016. A total of 730 birds representing 54 species were recorded at the three study sites. A full account of the 2013–2016 data is detailed in Appendix 1.

The mean BPH abundance values with error bars corresponding to +/- 1 standard deviation for each site by year are represented in Figure 5. The BPH was compared between study sites and their control site for each year using the Mann-Whitney U non-parametric two sample test (Table 1). These results indicate that in 2016 the relative abundance of the bird communities at Minie Site and TA-39 was similar to its respective control site. The MC control site was significantly ($p = 0.03$) higher than TA-16.

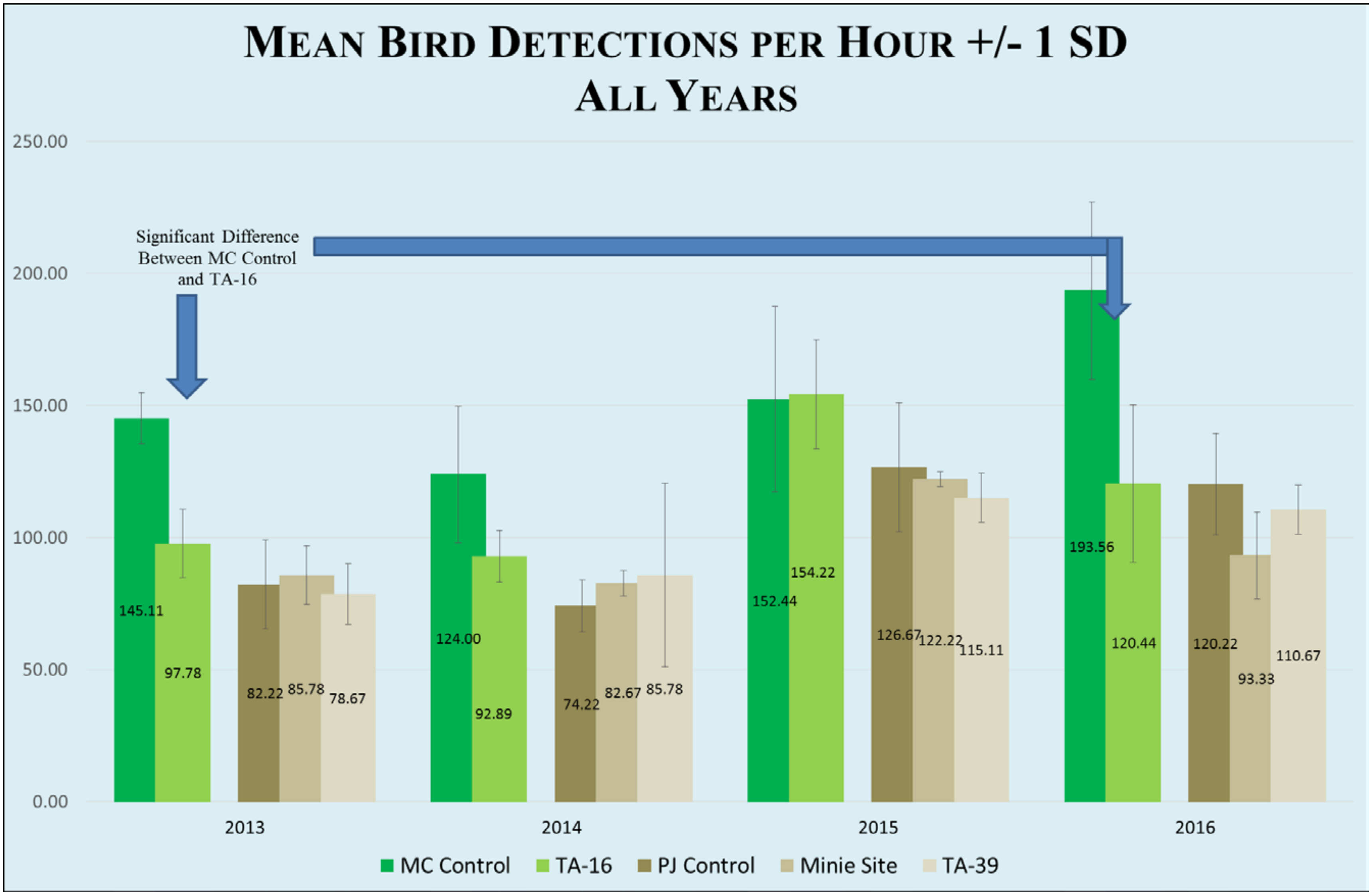

Figure 5. Birds per hour for the study and control sites. Error bars are +/- 1 standard deviation.
MC Control: Mixed conifer habitat, PJ control: Pinyon-juniper habitat

Table 1. Comparisons of BPH between study sites and control sites among years.

Years	MC Control to TA-16	PJ Control to TA-39	PJ Control to Minie Site
2013	**Z = -2.203 (p = 0.03)**	Z = -0.1313 (p = 0.89)	Z = 0.3889 (p = 0.69)
2014	Z = -1.6853 (p = 0.09)	Z = -0.3889 (p = 0.69)	Z = 1.1818 (p = 0.23)
2015	Z = 0.1291 (p = 0.89)	Z = -0.1296 (p = 0.89)	Z = 0.3939 (p = 0.69)
2016	**Z = -2.194 (p = 0.03)**	Z = -0.6482 (p = 0.52)	Z = -1.1668 (p = 0.24)

Note: statistically significant results are shaded.

Precipitation at LANL from January through July 2015 was the most precipitation since 1949 (Weather Machine 2015). The increases in BPH in 2015 were attributed to the increased precipitation. Links between moisture and habitat quality for a migratory bird have been documented (Smith et al. 2010) and may be a causal factor. The winter of 2015 and into early 2016 was drier. The fluctuations in bird abundances are not alarming and the differences between the study sites and control sites are not *biologically* significant. The 2016 results at the three study sites are still higher than the first two years of the study. The data suggest that LANL operations are not negatively affecting the bird abundances at the three study sites.

The species diversity was determined using the Shannon's diversity index for each of the three study sites as well as the comparable habitat type control sites. The Shannon's diversity values for each site by year are represented in Figure 6. The bird diversity was compared between study sites and their control site for each year using the *t* test (Table 2).

Table 2. Shannon values for the study sites and control sites.

Years	MC Control and TA-16	PJ Control and Minie Site	PJ Control and TA-39
2013	t = 1.4194, df = 376, p = 0.15	**t = 2.9717, df = 510, p < 0.01**	**t = 2.3053, df 466, p = 0.02**
2014	t = 1.9235, df 412, p = 0.06	t = 1.8716, df = 455, p = 0.06	t = 1.0396, df = 477, p = 0.29
2015	**t = 4.4626, df = 653, p < 0.01**	t = 0.52699, df = 663, p = 0.59	t = -0.2166, df = 482, p = 0.82
2016	**t = -2.6496, df 501, p < 0.01**	**t = 2.5304, df = 489, p = 0.01**	t = -1.587, df = 515, p = 0.11

Note: statistically significant results are shaded.

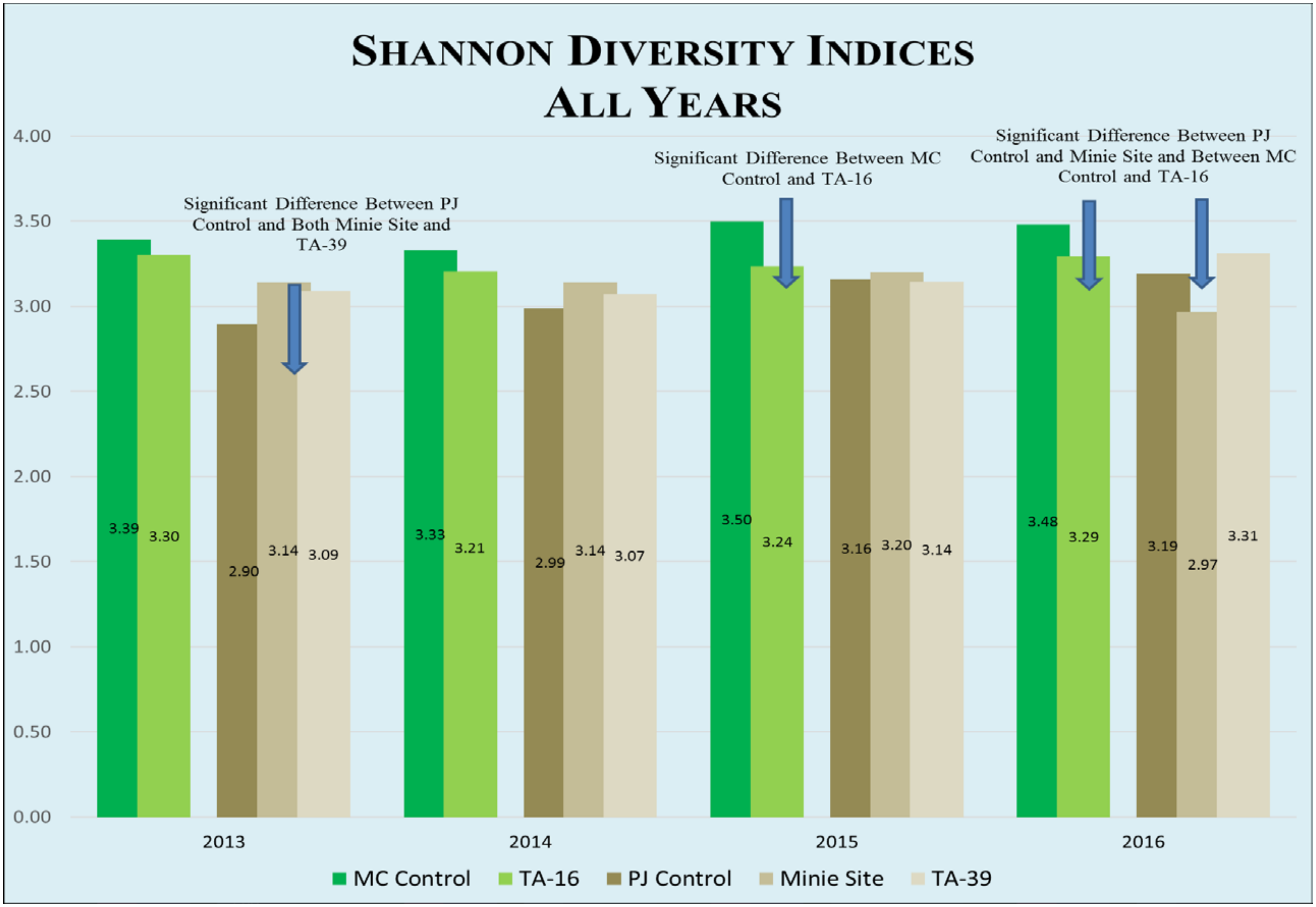

Figure 6. **Shannon's diversity indices for the study and control sites.**
MC Control: Mixed conifer habitat, PJ control: Pinyon-juniper habitat.

The 2013 results indicated that the bird diversities in the PJ control sites were significantly less than Minie site ($p < 0.01$) and TA-39 ($p = 0.02$) trending toward similarity in following years. The results also indicate that in 2015 the bird diversity at TA-16 was significantly lower ($p < 0.01$) than the MC control. Hathcock and Fair (2013) discussed this issue and attributed it to the circumstance that the MC control sites were located in a canyon bottom closer to the townsite compared with TA-16 located on a mesa top.

In 2016, the species diversity indices at Minie site were significantly less ($p = 0.01$) than its PJ control, with 14 fewer species present. The TA-16 bird diversity was also significantly less ($p < 0.01$) than its MC control, with seven fewer species present. The significant drop in species diversity at Minie site may be indicative of a change in community structure. Due to increased fuels reduction, including more tree removals, the habitat availability is changing. The site is becoming more grassland-like than PJ. There are currently no control sites for grasslands at LANL but additional control sites may be needed in the future. The 2016 data also show that species diversity was again significantly less at TA-16 than the MC control sites. This trend will continue to be monitored and new research may be warranted to investigate changes in habitat structure and quality.

A new analysis was started in 2015 for this study. Bird species were categorized into feeding guilds based on the work of De Graaf et al. (1985). Only granivores, insectivores, and omnivores are presented in this report. The mean number of birds for these three feeding guilds with error bars corresponding to +/- 1 standard deviation for each site by year are represented in Figures 7–9. Insectivores have consistently been the largest feeding guild, followed by the omnivores and the granivores.

The mean number of birds in 2016 were compared between years and among feeding guilds by study site using the Mann-Whitney U non-parametric two-sample test (Table 3). These results indicate that omnivores increased in the MC control and were significantly higher ($p = 0.03$) than at TA-16. Additionally, the overall number of granivores increased in the PJ control and were significantly higher ($p = 0.03$) than at Mine site. The control sites were analyzed similarly and trends very generally indicate that the mean numbers dropped slightly from 2013 to 2014, increased dramatically in 2015 and then decreased slightly in 2016. This fits well with the precipitation discussion earlier with the BPH differences.

Feeding guilds are also useful to monitor for habitat changes. From Figure 7 it is apparent that granivores are more prevalent in PJ habitats compared with MC. The opposite is seen in Figure 8 as insectivores are much higher in MC habitat than PJ. The omnivores are more evenly distributed among both habitats (Figure 9), which is indicative of their generalist nature, although the MC habitat does still have higher numbers of these birds.

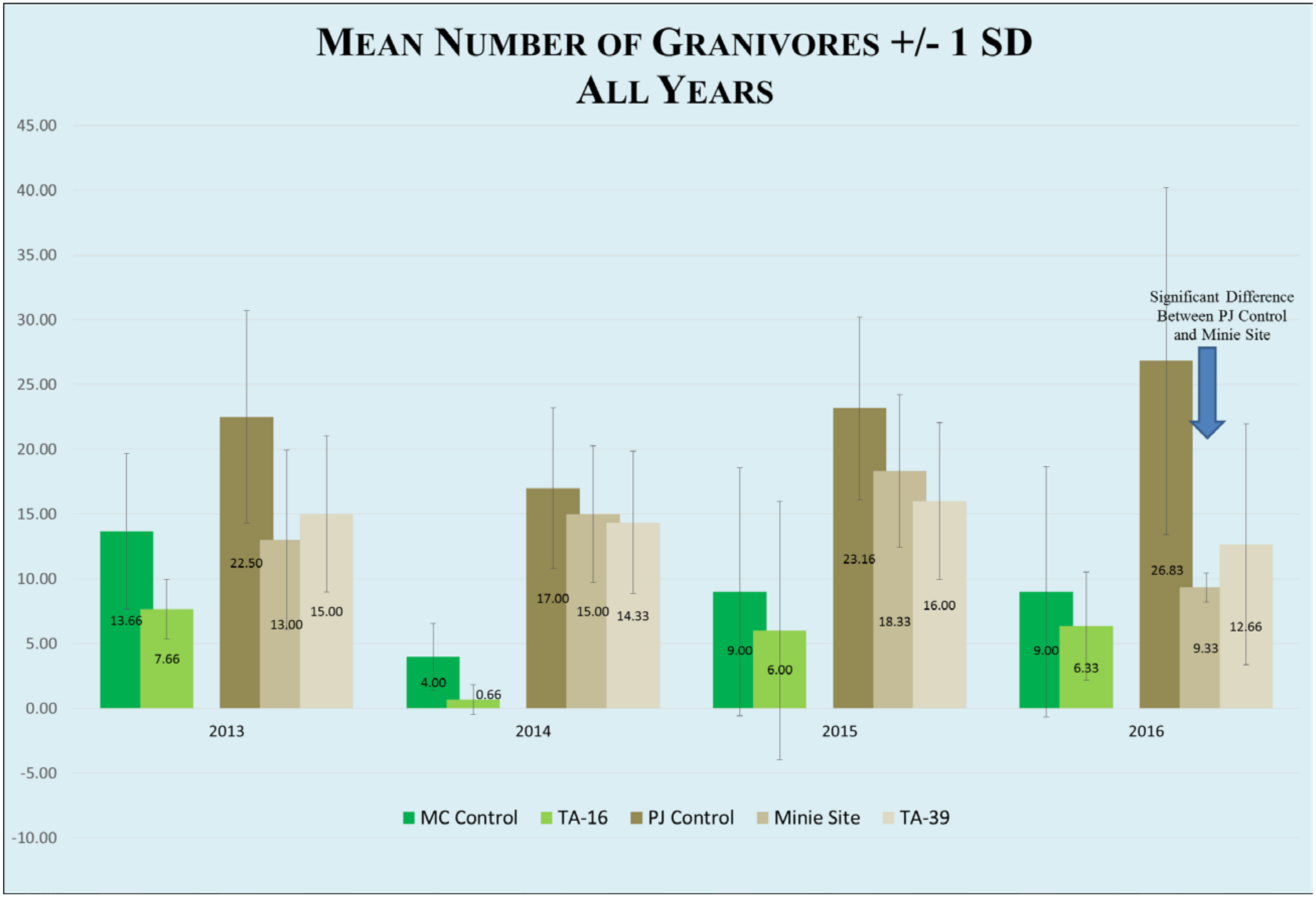

Figure 7. **Mean number of granivores for the study and control sites. Error bars are +/- 1 standard deviation.**
MC Control: Mixed conifer habitat, PJ control: Pinyon-juniper habitat

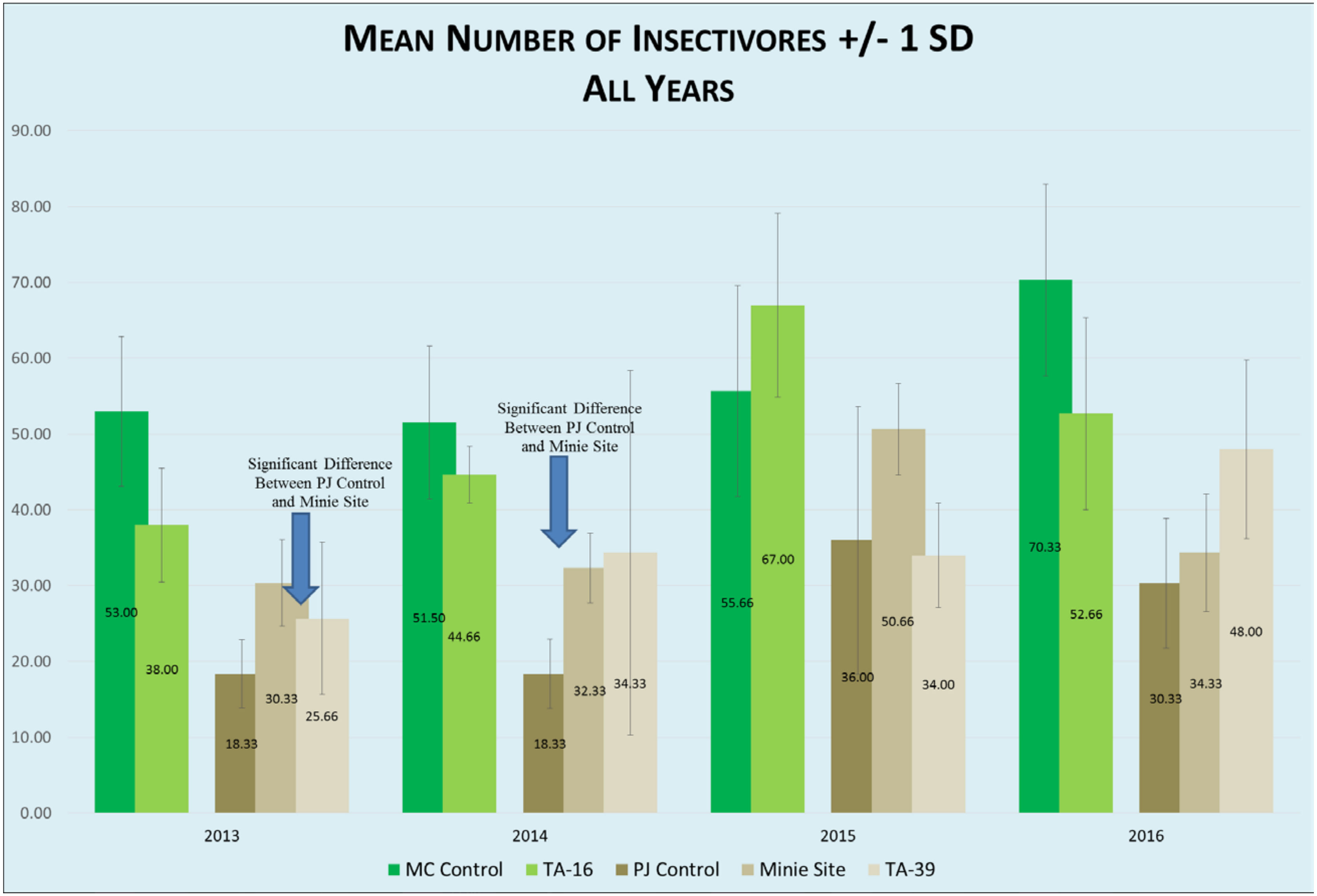

Figure 8. **Mean number of insectivores for the study and control sites. Error bars are +/- 1 standard deviation.**
MC Control: Mixed conifer habitat, PJ control: Pinyon-juniper habitat

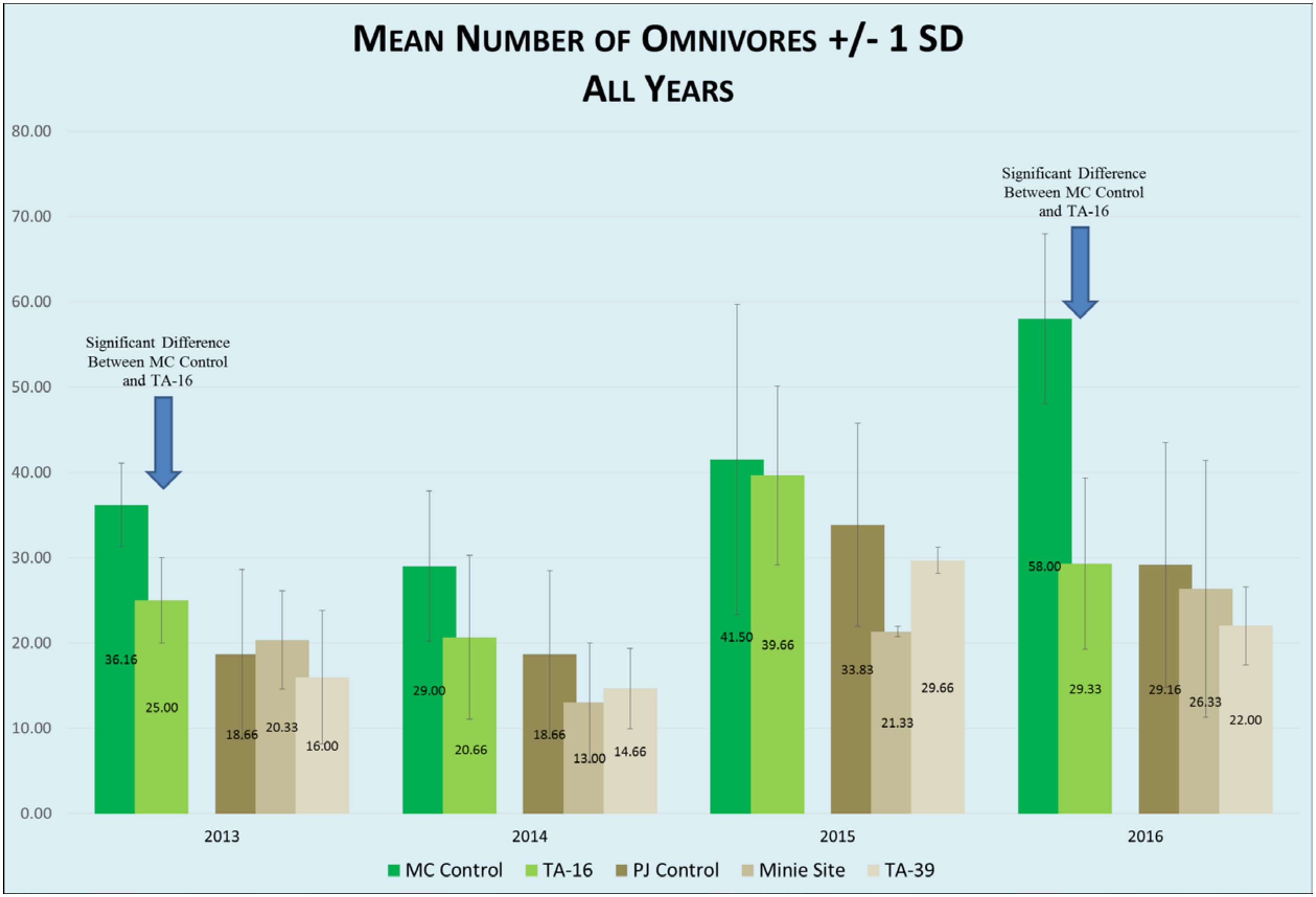

Figure 9. Mean number of omnivores for the study and control sites. Error bars are +/- 1 standard deviation.
MC Control: Mixed conifer habitat, PJ control: Pinyon-juniper habitat

Table 3. Comparing the mean number of birds between study sites and their control by feeding guilds for each year.

	2013			2014		
Site Comparisons	**Granivore**	**Insectivore**	**Omnivore**	**Granivore**	**Insectivore**	**Omnivore**
MC Control and TA-16	Z = -1.1921 (p = 0.23)	Z = -1.6783 (p = 0.09)	**Z = -2.2039 (p = 0.03)**	Z = -1.8226 (p = 0.07)	Z = -0.9113 (p = 0.36)	Z = -0.9037 (p = 0.36)
PJ Control and Minie Site	Z = -1.1717 (p = 0.24)	**Z = 1.9696 (p = 0.05)**	Z = 0.3956 (p = 0.69)	Z = -0.2593 (p = 0.79)	**Z = 2.2132 (p = 0.03)**	Z = -0.7811 (p = 0.43)
PJ Control and TA-39	Z = -1.1668 (p = 0.24)	Z = 0.9191 (p = 0.35)	Z = -0.3939 (p = 0.69)	Z = -0.5186 (p = 0.60)	Z = 1.0415 (p = 0.29)	Z = -0.6482 (p = 0.51)

Note: statistically significant results are shaded.

(Continued)	2015			2016		
Site Comparisons	**Granivore**	**Insectivore**	**Omnivore**	**Granivore**	**Insectivore**	**Omnivore**
MC Control and TA-16	Z = -0.5208 (p = 0.60)	Z = 0.7778 (p = 0.43)	Z = 0.1291 (p = 0.89)	Z = 0.0000 (p = 1.00)	Z = -1.6783 (p = 0.09)	**Z = -2.1947 (p = 0.03)**
PJ Control and Minie Site	Z = -1.0371 (p = 0.29)	Z = 1.4201 (p = 0.15)	Z = -1.4260 (p = 0.15)	**Z = -2.2039 (p = 0.03)**	Z = 0.3873 (p = 0.69)	Z = -0.2593 (p = 0.79)
PJ Control and TA-39	Z = -1.1619 (p = 0.24)	Z = 0.0000 (p = 1.0)	Z = -0.5186 (p = 0.60)	Z = -1.2964 (p = 0.19)	Z = 1.6783 (p = 0.09)	Z = -0.2593 (p = 0.79)

Note: statistically significant results are shaded.

During the 2016 nesting season, fifteen nestboxes each at Minie site and TA-16 and twelve nestboxes at TA-39 were actively monitored. The overall avian nestbox network without the three study sites contained 416 nestboxes in 2016. Of those, 188 contained active nests and 130 of those nests fledged young successfully. This was an overall occupancy rate of 45% with a 69% success rate.

At Minie site, thirteen nests were found and three of the nests fledged young successfully. Only eleven nestboxes were occupied, but two of those nestboxes had a second clutch. This was an occupancy rate of 73% with a 23% success rate.

At TA-39, seven nests were found. This was an occupancy rate of 58% with a 57% success rate. These nestboxes at TA-39 were relocated in 2016, and their occupancy increased seven-fold. The firing site at TA-39 is in a small narrow canyon and the nestboxes were moved a little further out to a more open area to increase nesting attractiveness. The number of nestboxes in 2016 will also increase to 15 to be consistent.

At TA-16, eleven nests were found and seven of the nests fledged young successfully. This was an occupancy rate of 73% with a 63% success rate.

The occupancy rates at Minie site and TA-16 were greater than the results in the overall network. Yet, the nest success rates of these sites dropped well below the average of the rest of the network. This was largely due to an increase in predation. The redeployment of nestboxes within TA-39 also led to higher occupancy and nest success over previous years' placement. However, more years of data are needed to begin to look at the results in a more robust manner.

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 54 species detected at the three study sites, all are protected under the Migratory Bird Treaty Act. Additionally, two of the species detected at the three study sites are on the Birds of Conservation Concern Region 16 list, the Southern Rockies/Colorado Plateau region (USFWS 2008). Those two species are the Juniper Titmouse and Grace's Warbler. The primary statutory authority for Birds of Conservation Concern is the Fish and Wildlife Conservation Act of 1980 (16 United States Code § 2901). Another conservation tool used in migratory bird management is the Birder's Conservation Handbook (Wells 2007), which lists the top 100 birds most at risk in North America. Two species detected at the three study sites are on the top 100 list. They are the Virginia's Warbler and Grace's Warbler.

Management Recommendations

Continuing the research reported herein will provide a long-term dataset on the ecological health of LANL's avifauna at the three study sites, contribute 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 allow LANS to contribute to national goals in avian conservation monitoring and research.

Acknowledgments

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Appendix 1. All birds recorded at the three study sites from 2013–2016.

Species	2013	2014	2015	2016	2013	2014	2015	2016	2013	2014	2015	2016
	TA-36				TA-39				TA-16			
	Pinyon-Juniper Woodland				Pinyon-Juniper Woodland				Mixed Conifer Forest			
Acorn Woodpecker									5		3	2
American Kestrel				1	1			2				
American Robin	1	1	2		1	1		2	7		9	4
Ash-throated Flycatcher	11	5	14	13	19	11	29	12	3	5	6	2
Audubon's Warbler		2						2	6	5	1	6
Bewick's Wren	4	8	9	9	3	10	15	9				
Black-chinned Hummingbird		1	1		3	2			1		1	
Black-headed Grosbeak	1	3				2	4	1			1	2
Black-throated Gray Warbler			1		5	6	4					
Blue-gray Gnatcatcher	3	14	16	8	2		7	5		6	2	1
Broad-tailed Hummingbird	2	1	3		3	1	2		5	11	11	5
Brown Creeper									1			
Brown-headed Cowbird	1						2		4	1		
Bushtit		2		2	2	14						
Canada Goose							16					
Canyon Towhee	2		5	3	1	1	2	10	1			1
Canyon Wren							2	3			2	
Cassin's Kingbird	6	13	13	5	7	6	2	21				1
Chipping Sparrow	3	16	17	29	6	6	5	8	1	5	3	10
Clark's Nutcracker										4		1
Common Nighthawk	6		5	2	5	1	3	2			1	2
Common Raven	2	5	1		1		2	1	5	6	2	2
Cooper's Hawk									1			1

	2013	2014	2015	2016	2013	2014	2015	2016	2013	2014	2015	2016
Species	TA-36				TA-39				TA-16			
	Pinyon-Juniper Woodland				Pinyon-Juniper Woodland				Mixed Conifer Forest			
Cordilleran Flycatcher									5	10	6	3
Dark-eyed Junco									6	2	4	
Downy Woodpecker				1				1		1		1
Dusky Flycatcher				1			1					
Eurasian Collared-Dove	3											
Evening Grosbeak	3		4				8		5		29	
Grace's Warbler									6	4	4	8
Gray Flycatcher	12	6	5	7	10	10	11	10				
Great Horned Owl		3			1							
Green-tailed Towhee	3	1			1							
Hairy Woodpecker			2	1			5	3	1	1		1
Hammond's Flycatcher									8	9	12	5
Hepatic Tanager							1	2				1
Hermit Thrush										4	6	1
House Finch	16	17	26	17	21	4	23	9	16	2	5	5
House Wren									1	1		2
Juniper Titmouse	12		7	6	11	13	18	6				
Lesser Goldfinch	2	6	7	4	4	12	9	10	3		8	9
MacGillivray's Warbler												1
Mountain Bluebird		2	20	10		4					4	4
Mountain Chickadee	5	2	1	2				1	5	8	9	6
Mourning Dove	17	17	13	5	13	22	10	3	4		1	3
Northern Flicker								3				
Northern Mockingbird						1						
Peregrine Falcon							1					

	2013	2014	2015	2016	2013	2014	2015	2016	2013	2014	2015	2016
Species	TA-36				TA-39				TA-16			
	Pinyon-Juniper Woodland				Pinyon-Juniper Woodland				Mixed Conifer Forest			
Pine Siskin	10	2		5	6		3	3	12	4	5	
Plumbeous Vireo	10	10	7	3	1		1	6	11	16	15	14
Pygmy Nuthatch				2			2	4	11	13	26	29
Red Crossbill						2				2	9	13
Red-shafted Flicker	3	1	3	2	3	2	4	5	3	4	11	11
Red-tailed Hawk							1	1				
Rock Wren	3	3	4		7	10	4	12	1	2	2	6
Say's Phoebe	2	1	2		2	1		5	1		1	3
Scaled Quail			1									
Spotted Towhee	17	8	19	27	12	6	33	16	11	18	16	14
Steller's Jay									3	2	5	6
Townsend's Solitaire	1											
Turkey Vulture									1			
Violet-green Swallow		5	7	1	6	4	1	9		2	19	2
Virginia's Warbler							1	2	17	11	21	13
Warbling Vireo									2	9	7	6
Western Bluebird	15	11	18	17	5	19	12	21	20	20	49	37
Western Scrub-Jay	5	1	3	4	8	10	4	8	1			
Western Tanager		2	3			2	1	1	2	3	7	2
Western Wood-Pewee	10	8	18	11		4	2	10	15	10	16	14
White-breasted Nuthatch	1	4	9	10			2	4	9	8	7	9
White-throated Swift						1						
White-winged Dove	1	5	9	2	7	5	6	16			1	2
Grand Total	**193**	**186**	**275**	**210**	**177**	**193**	**259**	**249**	**220**	**209**	**347**	**271**