LA-UR-21-22304
Approved for public release; distribution is unlimited.

Title: 2020 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

Author(s): Rodriguez, Jadzia Mira
Abeyta, Elisa Janelle

Intended for: Environmental Regulatory Document

Issued: 2021-03-25 (rev.1)

LA-UR-21-22304
March 2021
*Approved for public release;
distribution is unlimited.*

2020 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

Los Alamos
NATIONAL LABORATORY

Prepared by: **Jadzia Rodriguez and Elisa Abeyta, Environmental Protection and Compliance Division, Environmental Stewardship Group, Los Alamos National Laboratory**

An Affirmative Action/Equal Opportunity Employer

Contents

EXECUTIVE SUMMARY v
INTRODUCTION 1
METHODS 1
Field Methods for Point Count Surveys 1
Statistical Methods for Point Counts 7
Field Methods for Nestbox Monitoring 8
Statistical Methods for Nestboxes 8
RESULTS AND DISCUSSION 8
Point Count Surveys-Year 2020 8
Nestboxes 17
MANAGEMENT RECOMMENDATIONS 18
ACKNOWLEDGMENTS 18
LITERATURE CITED 19
APPENDIX 1. ALL BIRDS RECORDED AT THE THREE TREATMENT SITES FROM 2013–2020 23

Figures

Figure 1. Breeding bird survey transect and nestbox locations around TA-36 Minie Site 3
Figure 2. Breeding bird survey transect and nestbox locations around TA-39 Point 6 4
Figure 3. Breeding bird survey transect and nestbox locations around the TA-16 Burn Ground .. 5
Figure 4. All avian point count transects around LANL 6
Figure 5. 2013 – 2020 Species rarefaction and extrapolation for species richness and diversity comparing Minie and TA-39 with the PJ controls 13
Figure 6. 2013 – 2020 Species rarefaction and extrapolation for species richness and diversity comparing TA-16 with the PIPO controls 14
Figure 7. Non-metric multidimensional scaling (NMDS) of bird species and years at the TA-39 treatment site 15
Figure 8. Shepard diagram of NMDS ordination for the TA-39 treatment site 16

Tables

Table 1. The species richness, diversity, and abundance recorded at all treatment and control sites in 2020 9

Table 2. Changes in species richness over time for all treatment and control sites 9
Table 3. Changes in species diversity over time comparing Minie Site with the PJ controls....... 10
Table 4. Changes in species diversity over time comparing TA-39 with the PJ controls............. 10
Table 5. Changes in species diversity over time comparing TA-16 with the PIPO controls 11
Table 6. Top 10 most common species of birds observed at TA-39 during Early Years (2013-2015) and Later Years (2016-2020) 15
Table 7. Changes in species abundance over time for all treatment and control sites 16
Table 8. Comparison of occupancy for the treatment sites and the overall nestbox network over time. 17
Table 9. Comparison of nest success for the treatment sites and the overall nestbox network over time. 17

EXECUTIVE SUMMARY

Los Alamos National Laboratory (LANL) biologists in the Environmental Protection and Compliance Division initiated a multi-year program in 2013 to monitor avifauna (birds) at two open detonation sites and one open burn site on LANL property. In this annual report we compare monitoring results from these efforts among years to monitor trends. The objectives of this study are to 1) determine whether LANL operations impact bird species richness, diversity, or abundance and 2) examine occupancy and nest success of secondary-cavity nesting birds using nestboxes. LANL biologists completed the eighth year of this effort in 2020.

Between May and July 2020, we completed three avian point count surveys at each of the treatment sites which are the Technical Area (TA)-36 Minie site, the TA-39 point 6, and the TA-16 burn ground. We recorded a total of 1,005 birds representing 63 species at the three treatment sites and compared these results to data from their associated control sites. We also compared occupancy and nest success data from nestboxes at treatment sites with the overall avian nestbox monitoring network.

In 2020, species richness and avian abundance showed variability, but treatment and controls were trending together year to year. The species diversity at the TA-36 Minie site and TA-16 burn ground were statistically different from their associated controls. To examine this further, we prepared rarefaction and extrapolation plots for all years and over time. The species diversity at all three treatment sites has been diverging from the controls over the last few years. We determined that the diversity was higher at the treatment sites than the controls which is not alarming. Nestbox results suggest natural fluctuations year to year.

The overall results from 2020 continue to indicate that operations at the three treatment sites are not negatively affecting bird populations. This long-term project will continue to monitor for any changes over time.

This page intentionally left blank.

INTRODUCTION

As part of the Resource Conservation and Recovery Act 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; Sanchez et al. 2020). The objectives of this long-term monitoring program are to (1) determine whether LANL operations impact bird species richness, diversity, or abundance and (2) examine occupancy and nest success of secondary-cavity nesting birds using nestboxes. This involves making comparisons with control sites of similar habitat that LANL biologists have surveyed since 2011 (Hathcock et al. 2011).

LANL biologists used standard point count methodology to record avian richness, diversity, and abundance along transects at the three treatment sites and their associated control sites during the summer of 2020. 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, LANL biologists monitored nestboxes around all three treatment sites to investigate any potential impacts to occupancy rates and productivity of secondary cavity-nesting birds. Occupancy and nest success were compared to the overall avian nestbox monitoring network, which was established in 1997.

METHODS

Field Methods for Point Count Surveys

LANL biologists conducted the point count surveys 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). The habitat descriptions are 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) are monitored annually. The control sites were originally established in 2011 (Hathcock et al. 2011). Each habitat type control contained two replicate transects that LANL biologists 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 are monitored randomly.

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 four 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 five 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, surveyors should be recording the distance to each bird out to 100 m. A range finder should be used if available. Avoid re-counting individuals between points.
- While walking between points, surveyors should be recording any obvious species not recorded at the previous point that also wouldn’t be counted at the next point. 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. Surveyors should be recording other wildlife or unusual sightings that could be used for other projects.

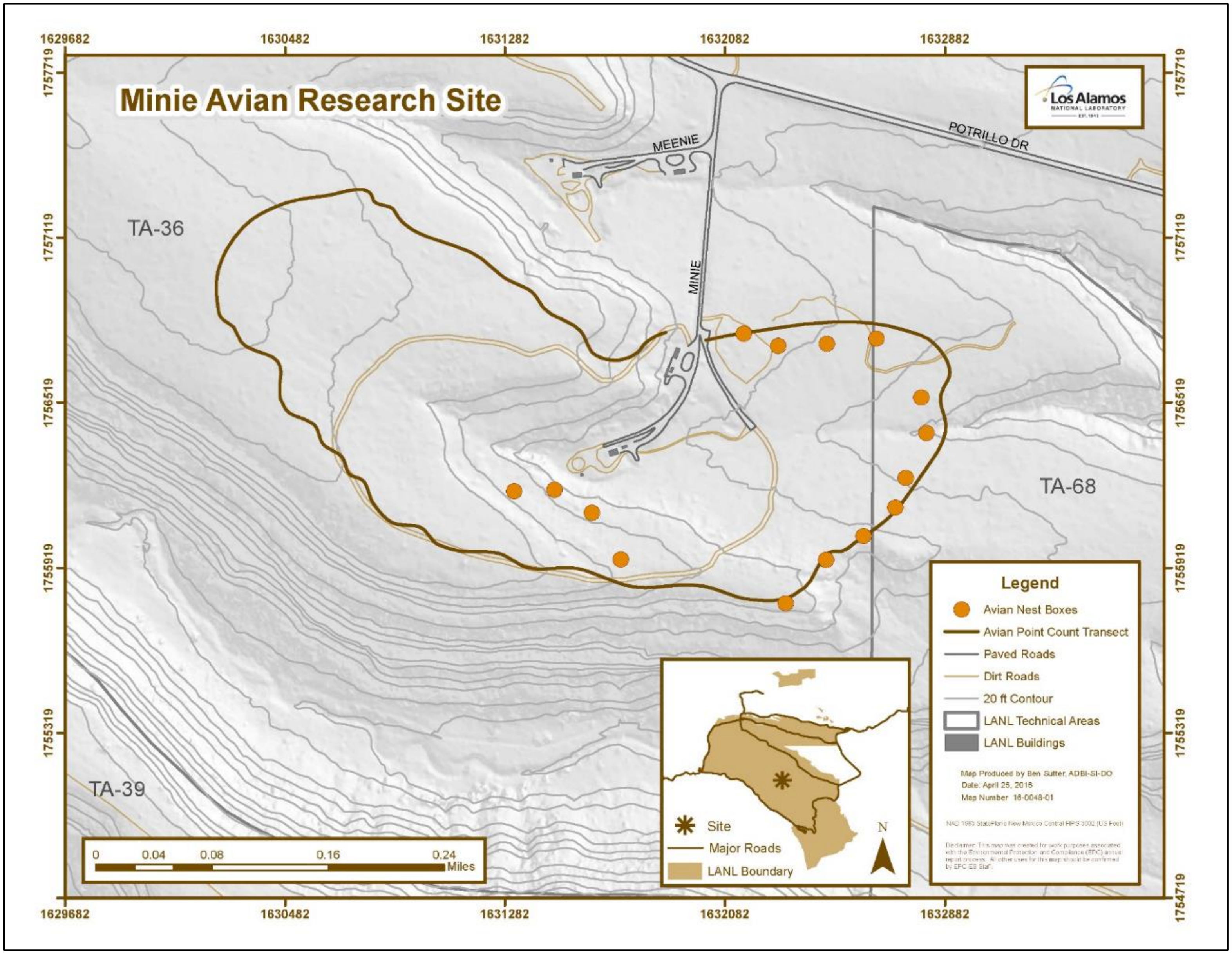

Figure 1. Breeding bird survey transect and nestbox locations around TA-36 Minie Site

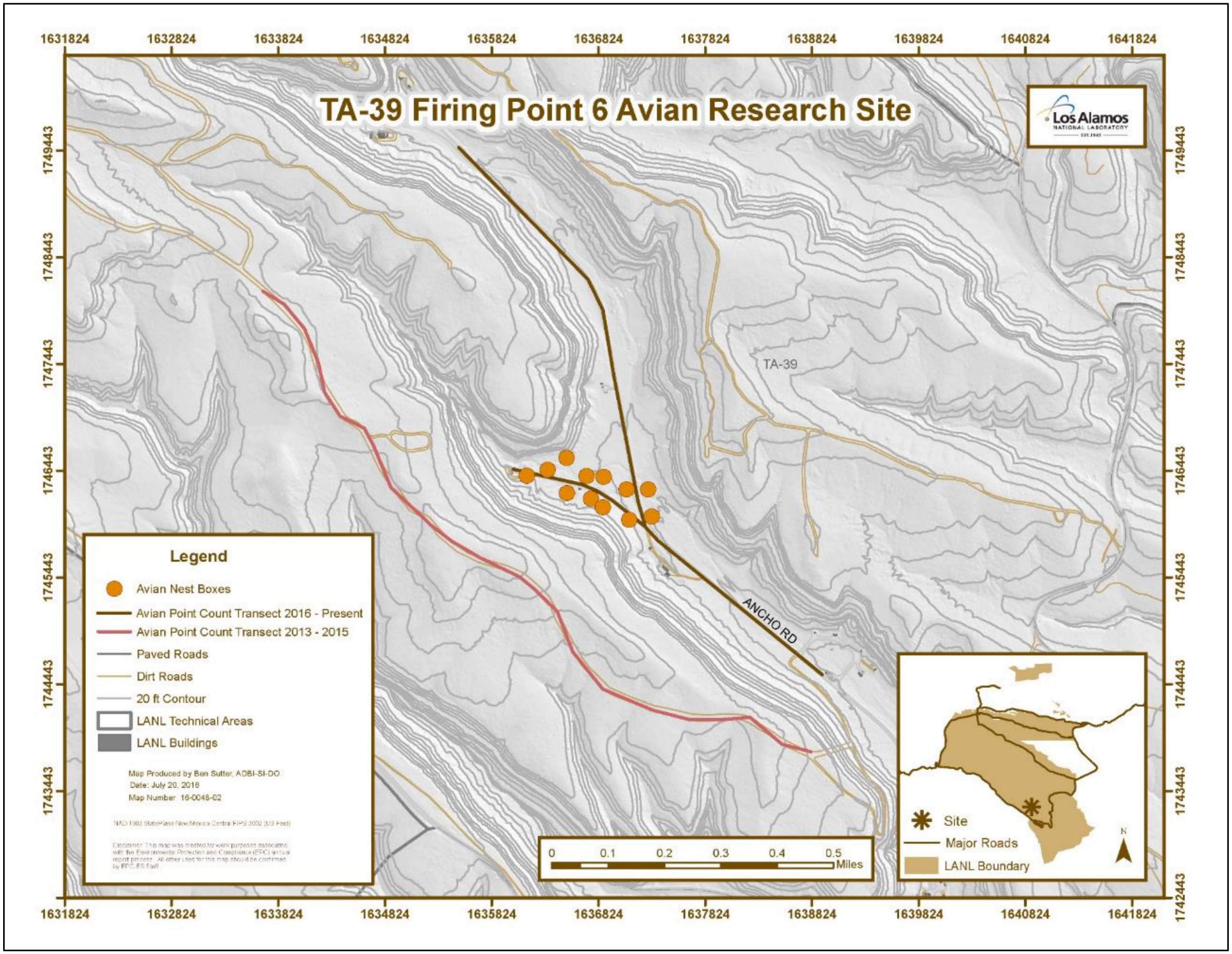

Figure 2. Breeding bird survey transect and nestbox locations around TA-39 Point 6

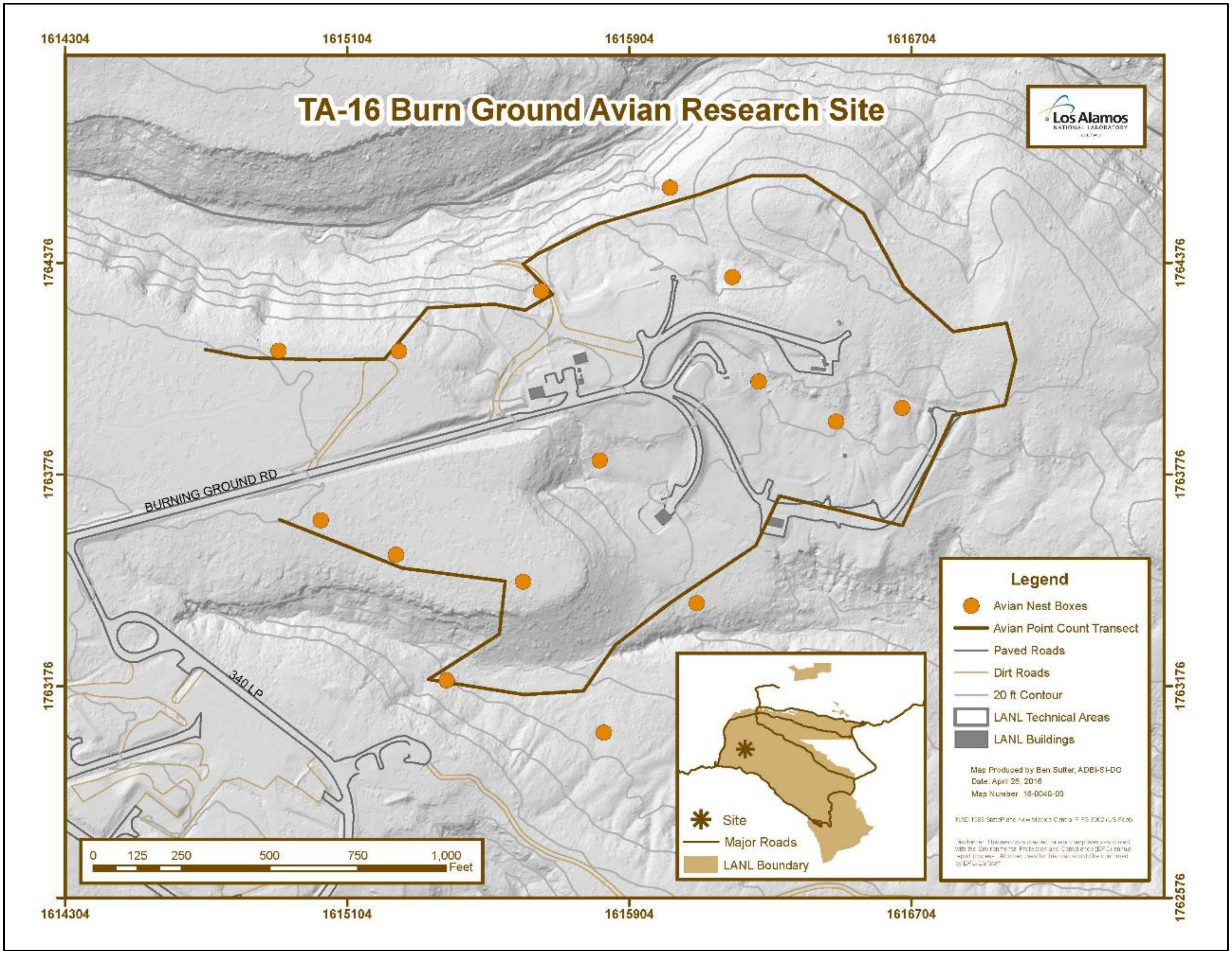

Figure 3. Breeding bird survey transect and nestbox locations around the TA-16 Burn Ground

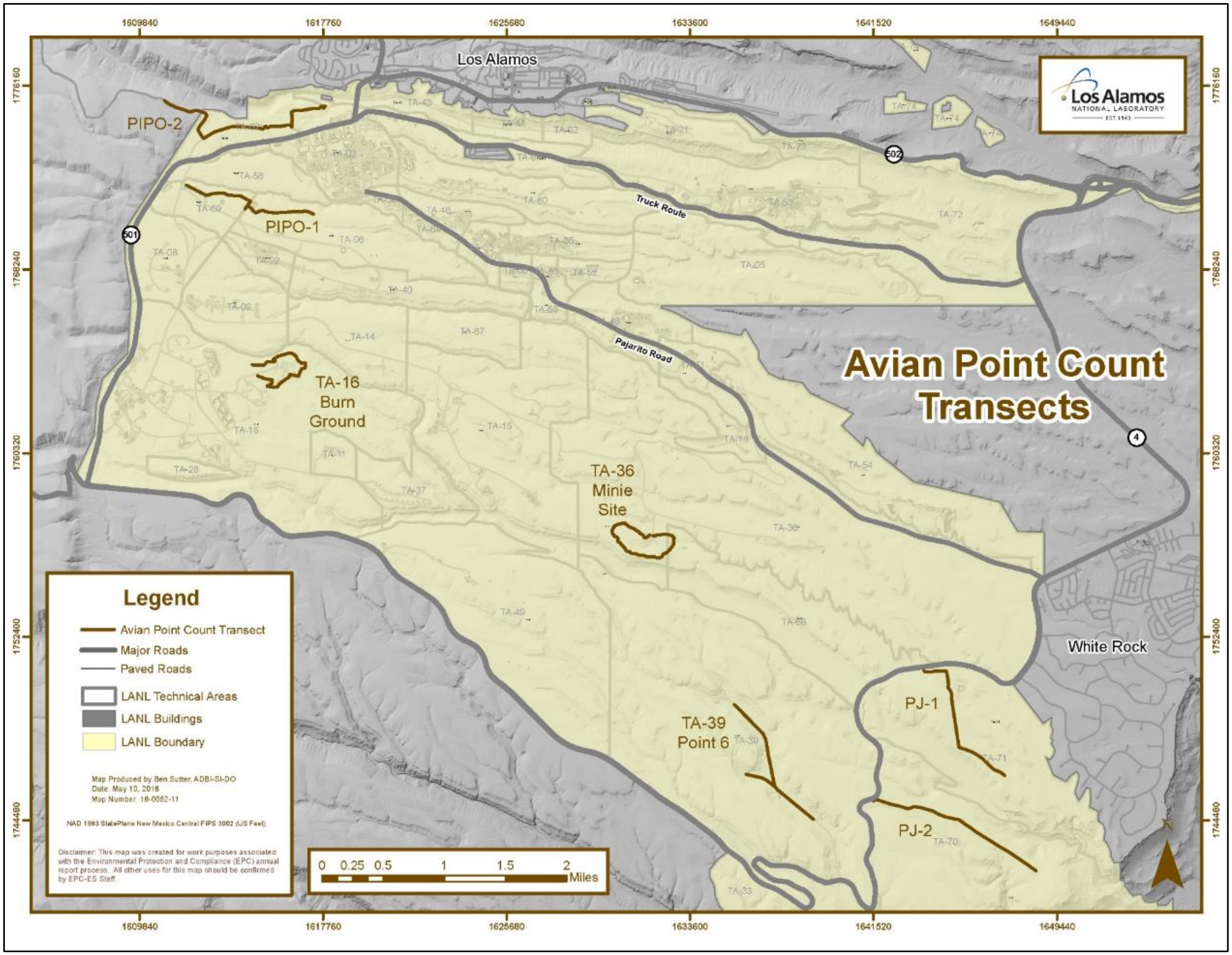

Figure 4. All avian point count transects around LANL

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

Statistical Methods for Point Counts

We summarized these data to compare species richness, diversity, and abundance between treatment and control sites and over time. We considered each treatment site and control to be individual communities. Species richness is the number of different species represented in an ecological community and is simply a count of species (Boulinier et al. 1998). Species diversity is a measure that takes into account the species richness and the overall abundance to compare evenness across a community (Tramer 1969). Shannon's diversity index measures the probability that two individuals randomly selected from a sample will belong to different species (Shannon and Weaver 1949). The abundance is the total number recorded of a given species (Gotelli and Colwell 2011).

We calculated species richness and abundance using the statistical software R (version 3.6.1; R Core Team 2019) and computed species diversity using the statistical software PAST (Hammer et al. 2001). We used the Shannon's diversity index 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. We used a diversity t-test in the PAST software to test for differences between treatment and combined control site diversity each year.

We also used the R-package 'iNEXT' to compute species rarefaction and extrapolation plots (Hsieh et al. 2016, Chao et al. 2014) that analyzed species richness and Simpson's diversity over time (Simpson 1949), which included all years of data with the control sites combined. We used the Simpson's diversity index for the interpolation and extrapolation plots of species diversity. The Simpson's diversity index differs from Shannon's diversity index because it is influenced by the dominant species in a community based on abundance (Fontana et al. 2011). Simpson's diversity is normally a measure between zero and one, with zero representing no diversity and one representing infinite diversity. This index resists drastic changes to diversity by placing more importance on species evenness. We analyzed species diversity using Hill numbers (Hsieh et al. 2016) in order to effectively report the number of dominant species in the plots.

We examined species composition at TA-39 using non-metric multidimensional scaling (NMDS) to determine dissimilarity among the years when surveys were conducted. This was done to try to explain how changing the transect location from the canyon rim to the canyon bottom affected the data over time at TA-39. We conducted an analysis of similarity (ANOSIM) using 1000 permutations to compare the species composition at TA-39 between survey years. We used the community ecology R-package 'vegan' (Dixon 2003) to complete the NMDS and ANOSIM analyses. NMDS is an ordination technique that condenses highly-dimensional multivariate datasets into a smaller number of dimensions (Dexter et al. 2018). An NMDS plot is usually reduced to two or three dimensions to observe patterns in community data between species composition and other environmental variables. The number of dimensions is used to calculate a measure of 'stress', which is the discrepancy between the rank order of distances in the actual data and the rank order of distances in the ordination. A high stress value (>0.2) indicates that the data is misleading while a low stress value (<0.1) indicates that the ordination is a good representation of the rank order of distances in the multivariate dataset (Dexter et al. 2018). Stress is reduced in an ordination by maintaining the rank order of distances while rearranging the sample points in slightly different positions (Dexter et al. 2018, De Fraga et al. 2014). A lower stress value can be attained by adding more dimensions, but too many dimensions could lead to misinterpretation of the data. We selected an NMDS plot with a low stress value and the minimum number of dimensions to minimize the distortion to the actual dataset. The R-package 'vegan' generated a Shepard diagram to display the stress in the NMDS plot. A Shepard diagram is a type of scatter plot with a fitted regression line that compares the distance between sample points in the actual data and in the ordination (Khan et al. 2020, Clarke 1993).

Field Methods for Nestbox Monitoring

In 2011, LANL biologists added nestboxes to Minie and TA-39 (Figures 1 and 2). In 2015, biologists added nestboxes to TA-16 (Figure 3). We monitored nestboxes every one to two weeks for active nests. When an active nest was found, we monitored it more frequently to determine whether the nest failed or successfully fledged young. We also banded nestlings and determined the sex after the age of 10 days. We compared the data from the nestboxes at the treatment sites to the data from the overall nestbox network at LANL. This year, due to the coronavirus pandemic (SARS-CoV-2) (Zhou et al. 2020) and its impact on personnel working together, we only managed a subset of the overall nestbox network.

Statistical Methods for Nestboxes

We calculated occupancy and nest success rates of the nestboxes at the three treatment sites and in the overall network. 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. We compared the 2020 data from the three treatment sites with the overall avian nestbox network at LANL which was established in 1997 (Fair and Myers 2002).

RESULTS AND DISCUSSION

Point Count Surveys-Year 2020

LANL biologists completed three surveys at each of the three treatment sites and the associated control sites between May and July 2020. A total of 1,005 birds representing 63 species were recorded at the three treatment sites. A full account of the 2013 – 2020 data is detailed in Appendix 1.

Table 1 details the species richness, diversity, and abundance for 2020 for each treatment and control site.

Table 1. The species richness, diversity, and abundance recorded at all treatment and control sites in 2020

	Minie	*TA-39*	*PJ Control 1*	*PJ Control 2*	*TA-16*	*PIPO Control 1*	*PIPO Control 2*
Richness	33	40	37	32	46	33	40
Diversity	3.134	3.076	2.874	2.862	3.367	2.900	3.176
Abundance	203	413	292	269	389	373	429

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. Temperatures were above average during the summer of 2020 while the winter moisture of 2019 – 2020 was below average (Weather Machine 2020). Species richness at all sites varied during 2020, which may have been influenced by the above average total precipitation Los Alamos received in the middle of March. We predict that the species richness in 2021 will be lower at several sites due to an unusually early and cold storm system that occurred in September 2020. The cold front contributed to a mass mortality event of migratory songbirds across New Mexico (NMDGF 2020), which may influence the data collected for next year's surveys.

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

	2013	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*
Minie	33	33	34	30	35	35	34	33
TA-39	31	31	39	38	34	36	38	40
PJ Control 1	29	30	33	36	37	30	30	37
PJ Control 2	30	29	37	33	39	23	33	32

TA-16	39	33	40	44	41	43	39	46
PIPO Control 1	34	34	30	40	46	40	41	33
PIPO Control 2	33	36	43	43	44	39	40	40

Tables 3 – 5 compare the species diversity over time between the treatment site and the combined controls. We combined the two control sites 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 which are indicated in bold font with a darker shading. 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*	*2020*
Minie	3.141	3.141	3.191	2.968	3.134	3.215	3.063	3.134
PJ Control	2.877	2.990	3.159	3.067	3.241	2.938	2.967	2.975
t-test	**t = -3.2012 df = 508 p = 0.001**	t = -1.8716 df = 455 p = 0.062	t = -0.52699 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	**t = -2.139 df = 502 p = 0.033**

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

	2013	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*
TA-39	3.090	3.073	3.140	3.318	3.178	3.131	3.083	3.076
PJ Control	2.877	2.990	3.159	3.067	3.241	2.938	2.967	2.975

t-test	**t = -2.527 df = 464 p = 0.012**	t = -1.0396 df = 477 p = 0.30	t = 0.26785 df = 484 p = 0.79	**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	t = -1.4646 df = 942 p = 0.14

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

	2013	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*
TA-16	3.304	3.207	3.236	3.293	3.238	3.357	3.291	3.367
PIPO Control	3.261	3.225	3.161	3.213	3.296	3.171	3.316	3.184
t-test	t = -0.66864 df = 404 p = 0.50	t = 0.26454 df = 494 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 = 0.44118 df =640 p = 0.66	**t = -3.3172 df = 824 p = 0.001**

We analyzed species richness and Simpson's diversity data between 2013 – 2020 using extrapolation curves (Figures 5A – 6B). Species rarefaction and extrapolation show a significant difference between treatment and control sites for species richness (Figure 5A). Figure 5A displays 95% confidence intervals where the TA-39 treatment site and the PJ Controls do not overlap. However, the species rarefaction and extrapolation for the PJ treatment and control sites between 2013 – 2018 did not show any significant differences for species richness (Hathcock et al. 2018). The Minie and TA-16 treatment sites and their associated controls had overlapping 95% confidence intervals for species richness (Figures 5A and 6A). The cause of the difference in species richness may be attributed to a change of transect locations at the TA-39 treatment site in 2016 (Figure 2). The original transect was located on the mesa above the treatment site and was more of a pinyon-juniper woodland while the replacement transect sited in 2016 was along the canyon bottom around the treatment site and contained more ponderosa pine trees. Slight differences in habitat structure have been shown to impact species composition (Seymour and Dean 2010). We looked at these data using an NMDS plot. Figure 7 represents the final configuration of survey years as points in the NMDS plot for TA-39 (dimensions = 2, stress = 0.0225). The Shepard diagram (Figure 8) shows minimal scatter around the regression line between the observed dissimilarity and ordination distance, which indicates that the NMDS plot has low stress (non-metric fit $R^2 = 0.999$, linear fit $R^2 = 0.997$). NMDS ordinations use the rank order of distances to show the dissimilarity between samples (Faith et al. 1987), which means samples in close proximity to one another are similar while samples that are distant from each other are not alike. Figure 7 shows how the species composition at TA-39 was more similar between years that are clustered together on the NMDS plot (Debinski et al. 2006). We separated the years when surveys occurred into early year (2013 – 2015) and later year (2016 – 2020) categories to reflect the change in habitat corresponding to the selection of a new transect location. The different species composition between the left and right and the upper and lower part of the graph (dotted lines = the reference lines) correlate with the associated categories of survey years. The NMDS plot grouped early years on the left and later years on the right (Figure 7). Our NMDS plot only displayed 16 species to improve clarity (Figure 7). These 16 species represent the top ten most commonly observed species for early years and later years (Table 6). Species that appeared in the list for both categories of survey years are in bold. The species that seem to be driving the difference between early and later years are the Juniper Titmouse, Cassin's Kingbird, and the Western Wood-Pewee. Even though the polygons for the early and later years are not closely aligned with one another and do not overlap, the categories of survey years were not statistically different from each other (ANOSIM: $R = 0.05917$, $P = 0.08$).

The rarefaction and extrapolation plots for species diversity (Figures 5B and 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. These results are similar to the 2013 – 2018 species rarefaction and extrapolation results presented in a previous report (Hathcock et al. 2018). Tables 3 – 5 show there were significant differences of diversity between the Minie and TA-16 treatment sites and their associated control sites in 2020. Since the extrapolation curves are not expected to change much between years, these will be reanalyzed every five years after this report.

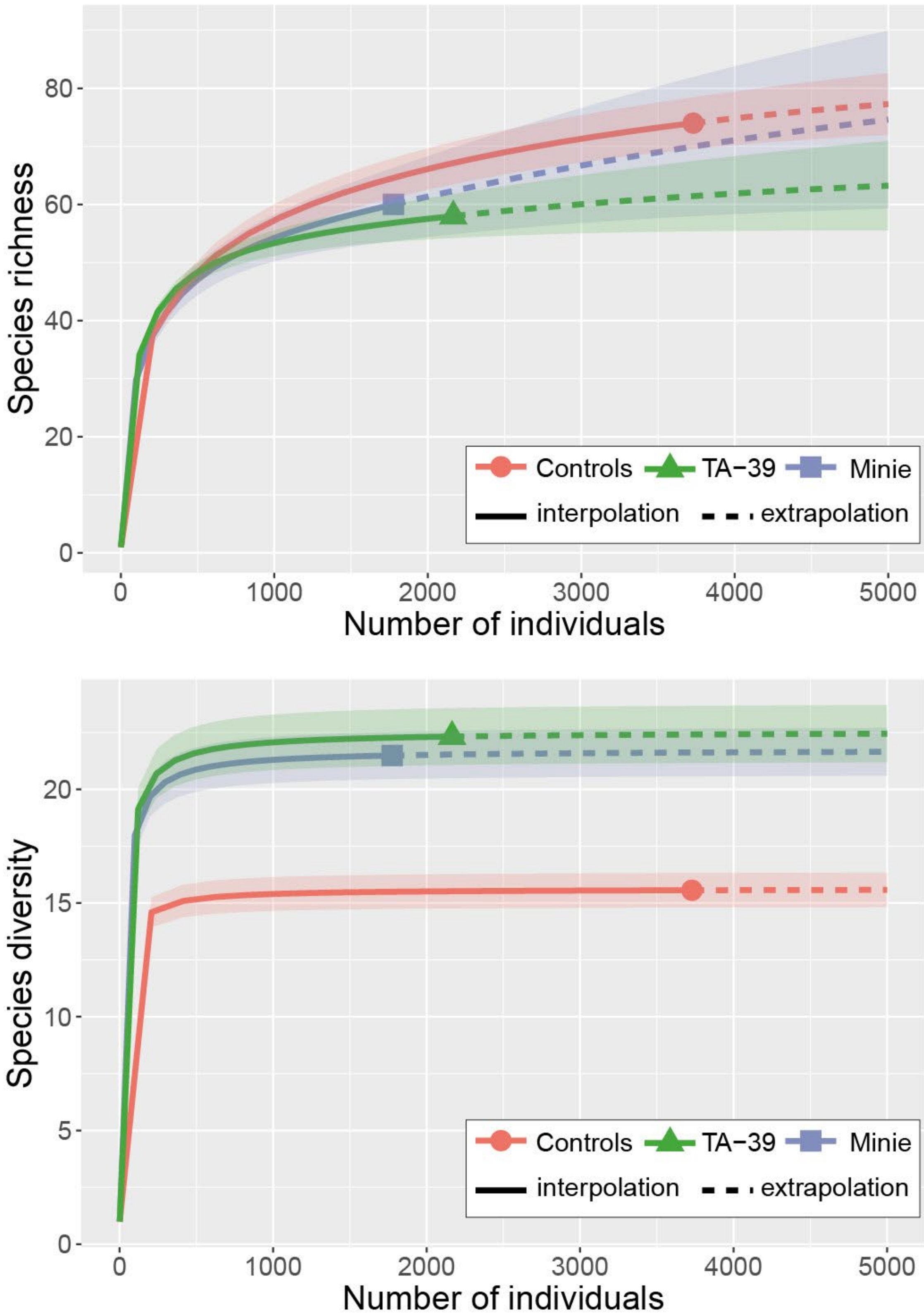

Figure 5. 2013 – 2020 Species rarefaction and extrapolation for species richness and diversity comparing Minie and TA-39 with the PJ controls. Top is "A" and bottom is "B".

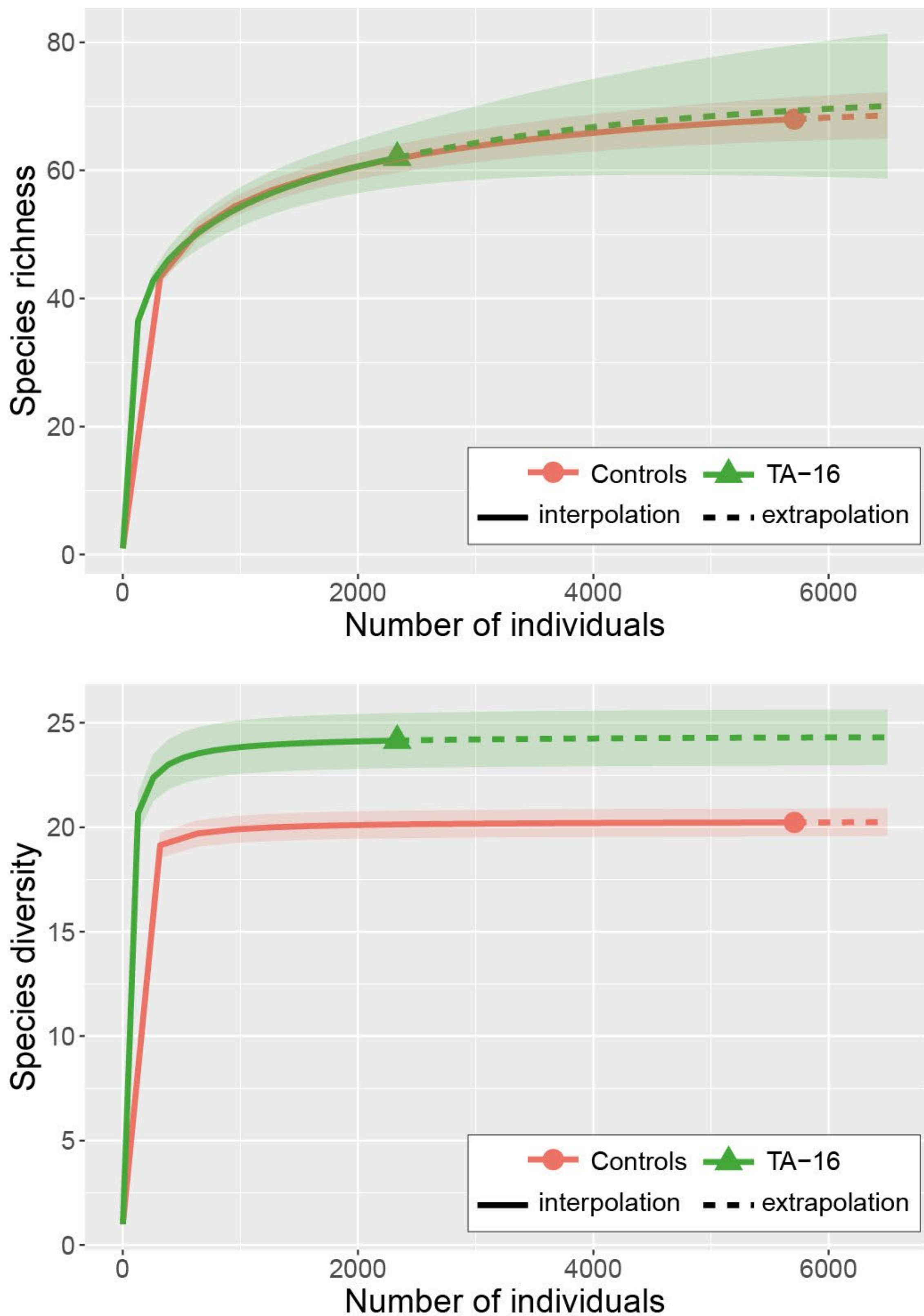

Figure 6. 2013 – 2020 Species rarefaction and extrapolation for species richness and diversity comparing TA-16 with the PIPO controls. Top is "A" and bottom is "B".

Table 6. Top 10 most common species of birds observed at TA-39 during Early Years (2013 – 2015) and Later Years (2016 – 2020)

Early Years		***Later Years***	
Species	*Abundance*	*Species*	*Abundance*
Ash-throated Flycatcher	60	**House Finch**	186
Spotted Towhee	51	Cassin's Kingbird	160
House Finch	48	Chipping Sparrow	99
Mourning Dove	45	**Lesser Goldfinch**	85
Juniper Titmouse	42	**Spotted Towhee**	79
Western Bluebird	36	Violet-green Swallow	77
Gray Flycatcher	31	Rock Wren	72
Bewick's Wren	28	**Western Bluebird**	64
Lesser Goldfinch	25	Western Wood-Pewee	59
Woodhouse's Scrub-Jay	22	White-winged Dove	53

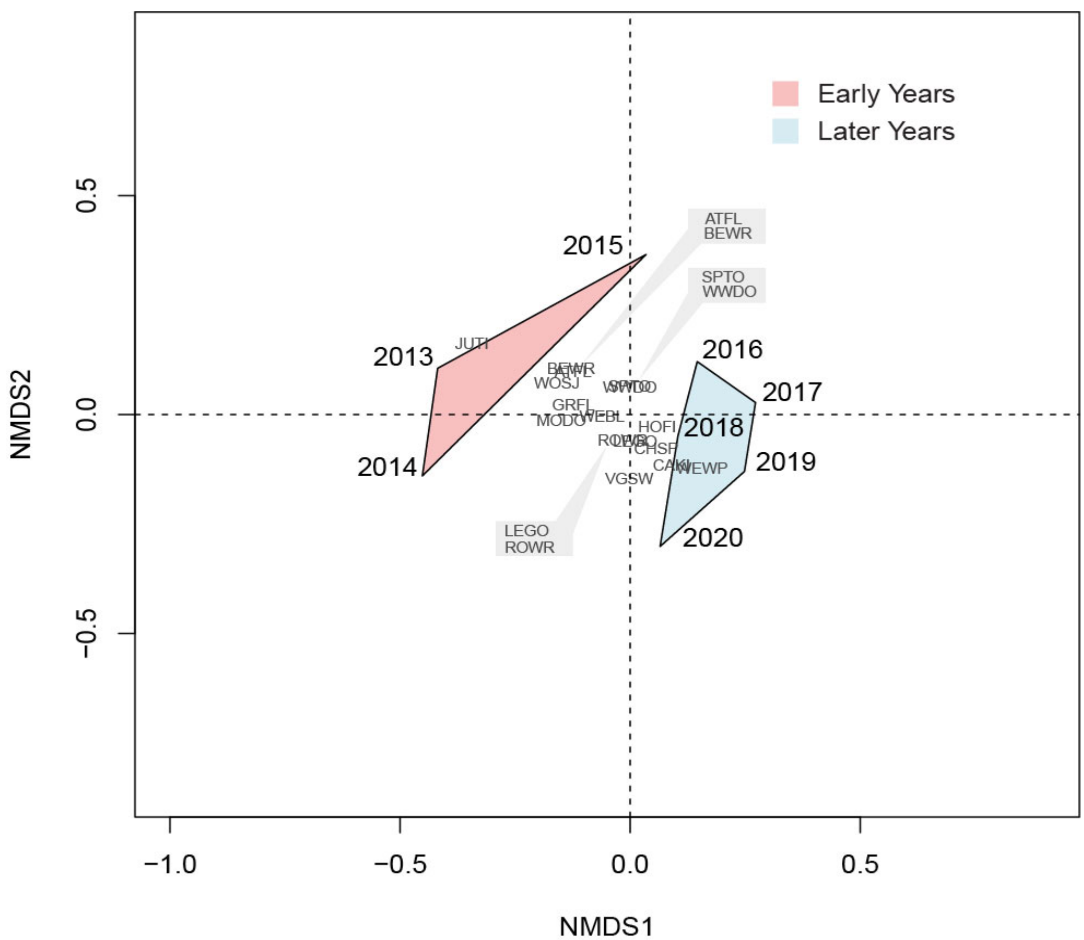

Figure 7. Non-metric multidimensional scaling (NMDS) of bird species and years at the TA-39 treatment site

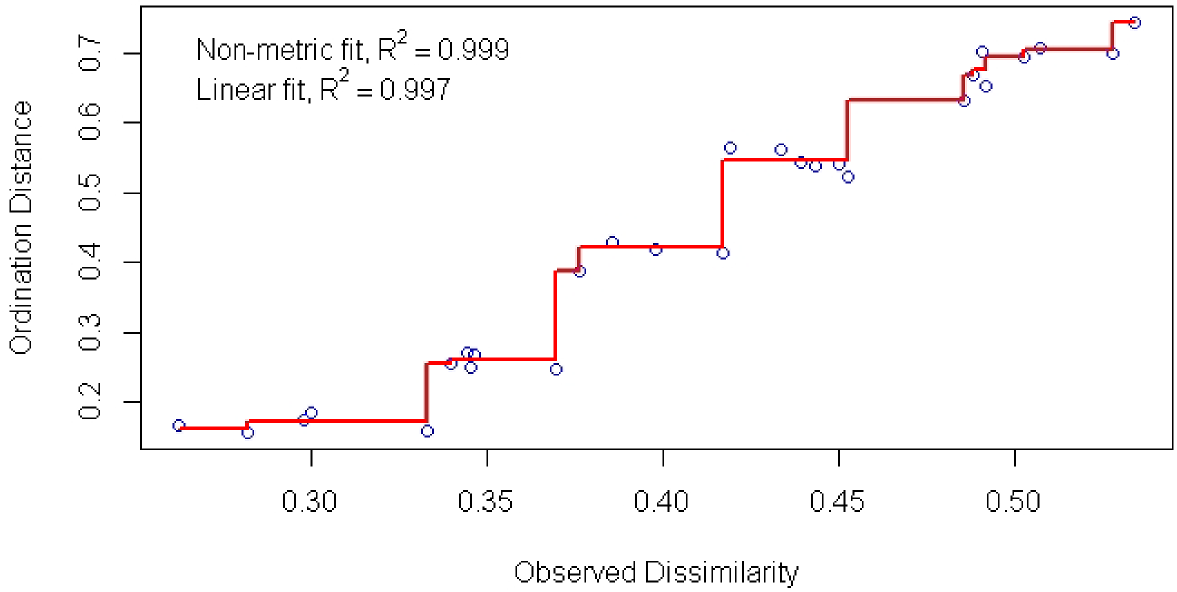

Figure 8. Shepard diagram of NMDS ordination for the TA-39 treatment site

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 when compared with the PIPO 1 and PIPO 2 control sites. Table 7 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. The abundance increased in 2020, except at Minie, despite below average moisture for the winter of 2019 – 2020.

Table 7. Changes in species abundance over time for all treatment and control sites

	2013	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*
Minie	193	186	275	210	222	242	245	203
TA-39	177	193	260	249	261	315	298	413
PJ Control 1	187	157	269	312	240	235	226	292
PJ Control 2	181	177	301	228	300	168	187	269
TA-16	220	209	347	271	302	285	310	389

PIPO Control 1	258	223	432	323	447	374	364	373
PIPO Control 2	256	254	371	396	449	366	394	429

Nestboxes

During the 2020 nesting season, LANL biologists actively monitored 15 nestboxes at each treatment site. We monitored 157 nestboxes throughout the overall avian nestbox network, without the three treatment sites. Of those, 117 contained active nests and 69 of those nests fledged young successfully. This was an overall occupancy rate of 58% with a 59% success rate.

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

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

	2015	*2016*	*2017*	*2018*	*2019*	*2020*
Overall Network	40%	45%	48%	53%	44%	58%
Minie	66%	73%	46%	20%	60%	47%
TA-39	8%	58%	20%	33%	13%	27%
TA-16	-	73%	100%	53%	87%	87%

Table 9. Comparison of nest success for the treatment sites and the overall nestbox network over time

	2015	*2016*	*2017*	*2018*	*2019*	*2020*
Overall Network	66%	69%	57%	49%	51%	59%
Minie	64%	23%	29%	33%	44%	86%
TA-39	100%	57%	0%	40%	0%	75%
TA-16	-	63%	76%	63%	54%	54%

In 2020, there were six successful nests that fledged young at Minie, three at TA-39, and seven at TA-16. Occupancy at TA-39 was low in comparison to the other treatment sites and the overall network. The nest success rate at TA-39 seemed to fluctuate in 2020 since the occupied nestboxes had a higher success rate compared to previous years. 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 2020, LANL biologists submitted nonviable eggs collected from nestboxes at the treatment sites and the rest of the nestbox network to an analytical lab for chemical analyses. These data will be presented 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 63 species detected at the three treatment sites, the Migratory Bird Treaty Act protects all but one species. The Eurasian Collared-Dove is not native and therefore not protected under the Migratory Bird Treaty Act. In addition, LANL biologists have documented sensitive species from the Sensitive Species Best Management Practices Source Document (Berryhill et al. 2020) and the Birds of Management Concern and Focal Species list (USFWS 2011) at the treatment sites. Those species are the Juniper Titmouse, Grace’s Warbler, Virginia’s Warbler, Black-throated Gray Warbler, and the Mourning Dove. Sensitive species documented at the control sites are the Cassin’s Finch and the Gray Vireo. 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.

ACKNOWLEDGMENTS

Thanks to the following individuals for technical and field support work in 2020: Andrew Bartlow, Jesse Berryhill, Chuck Hathcock, Audrey Sanchez, Jenna Stanek, Brent Thompson, Luciana Vigil-Holterman, and former staff and interns that helped in previous years.

LITERATURE CITED

Berryhill, J.T., J.E. Stanek, E.J. Abeyta, and C.D. Hathcock. 2020. Sensitive Species Best Management Practices Source Document, Revision 5. Los Alamos National Laboratory report number LA-UR-20-24514, Los Alamos, New Mexico.

Boulinier, T., J.D. Nichols, J.R. Sauer, J.E. Hines, and K.H. Polluck. 1998. Estimating species richness: the importance of heterogeneity in species detectability. Ecology 79(3):1018–1028.

Chao, A., N.J. Gotelli, T.C. Hsieh, E.L. Sander, K.H. Ma, R.K. Colwell, and A.M. Ellison. 2014. Rarefaction and extrapolation with Hill numbers: a framework for sampling and estimation in species diversity studies. Ecological Monographs 84:45–67.

Clarke, K.R. 1993. Non-parametric multivariate analyses of changes in community structure. Australian Journal of Ecology 18(1):117–143.

Clarke, K.R., R.N. Gorley, P.J. Somerfield, and R. Warwick. 2014. Change in marine communities; an approach to statistical analysis and interpretation, 3rd edition. Primer-E: Plymouth Marine Laboratory, Auckland, New Zealand. 262pp.

De Fraga, R., A.J. Stow, W.E. Magnusson, and A.P. Lima. 2014. The costs of evaluating species densities and composition of snakes to assess development impacts in Amazonia. PLoS One 9(8):e105453. https://doi.org/10.1371/journal.pone.0105453.

Debinski, D.M., R.E. VanNimwegen, and M.E. Jakubauskas. 2006. Quantifying relationships between bird and butterfly community shifts and environmental change. Ecological Applications 16(1):380–393.

Dexter, E., G. Rollwagen-Bollens, and S.M. Bollens. 2018. The trouble with stress: A flexible method for the evaluation of nonmetric multidimensional scaling. Limnology and Oceanography: Methods 16(7):434–443.

Dixon, P. 2003. VEGAN, a package of R functions for community ecology. Journal of Vegetation Science 14(6):927–930.

Fair, J.M., and O.B. Myers. 2002 Early reproductive success of western bluebirds and ash-throated flycatchers: a landscape-contaminant perspective. Environmental Pollution 118:321–330.

Faith, D.P., P.R. Minchin, and L. Belbin. 1987. Compositional dissimilarity as a robust measure of ecological distance. Vegetatio 69(1):57–68.

Fontana, S., T. Sattler, F. Bontadina, and M. Moretti. 2011. How to manage the urban green to improve bird diversity and community structure. Landscape and Urban Planning 101(3):278–285.

Gotelli, N.J. and R.K. Colwell. 2011. Estimating species richness. Biological diversity: Frontiers in Measurement and Assessment 12:39–54.

Hammer, Ø., D.A.T. Harper, and P.D. Ryan. 2001. PAST: Paleontological statistics software package for education and data analysis. Palaeontologia Electronica 4(1):1–9.

Hathcock, C.D., K. Zemlick, and B. Norris. 2011. Winter and Breeding Bird Surveys at Los Alamos National Laboratory Progress Report for 2010 to 2011. Los Alamos National Laboratory report number LA-UR-11-05054, Los Alamos, New Mexico.

Hathcock, C.D. and J.M. Fair. 2013. Avian Monitoring at the TA-36 Minie Site, TA-39 Point 6, and TA-16 Burn Grounds. Los Alamos National Laboratory report number LA-UR-13-27825, Los Alamos, New Mexico.

Hathcock, C.D. 2014. Avian Monitoring at the TA-36 Minie Site, TA-39 Point 6, and TA-16 Burn Ground at Los Alamos National Laboratory. Los Alamos National Laboratory report number LA-UR-14-28161, Los Alamos, New Mexico.

Hathcock, C.D. 2015. Avian Monitoring at the TA-36 Minie Site, TA-39 Point 6, and TA-16 Burn Ground at Los Alamos National Laboratory. Los Alamos National Laboratory report number LA-UR-15-28296, Los Alamos, New Mexico.

Hathcock, C.D., B.E. Thompson, and J.T. Berryhill. 2017. 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. Los Alamos National Laboratory report number LA-UR-17-20359, Los Alamos, New Mexico.

Hathcock, C.D., A.W. Bartlow and B.E. Thompson. 2018. 2017 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. Los Alamos National Laboratory report number LA-UR-18-22897, Los Alamos, New Mexico.

Hathcock, C.D., A.W. Bartlow, A.A. Sanchez, J. Stanek, and B.E. Thompson. 2019. 2018 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. Los Alamos National Laboratory report number LA-UR-19-24156, Los Alamos, New Mexico.

Hsieh, T.C., K.H. Ma, and A. Chao. 2016. iNEXT: an R package for rarefaction and extrapolation of species diversity (Hill numbers). Methods in Ecology and Evolution 7(12):1451–1456.

Khan, A., M. Ahmed, M.F. Siddiqi, M. Shah, E.S. Calixto, A. Khan, P. Shah, J. Iqbal, and M. Azeem. 2020. Vegetation-environment relationship in conifer dominating forests of the mountainous range of Indus Kohistan in northern Pakistan. Journal of Mountain Science 17(8):1989–2000.

McKown, B., S.W. Koch, R.G. Balice, and P. Neville. 2003. Land cover classification map for the Eastern Jemez Region. Los Alamos National Laboratory report number LA-14029, Los Alamos, New Mexico.

New Mexico Department of Game and Fish (NMDGF). 2020. Starvation, unexpected weather to blame in mass migratory songbird mortality. http://www.wildlife.state.nm.us/starvation-unexpected-weather-to-blame-in-mass-migratory-songbird-mortality/. Accessed February 2021.

R Core Team. 2019. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL http://www.R-project.org/.

Sanchez, A.A., C.D. Hathcock, and B.E. Thompson. 2020. 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. Los Alamos National Laboratory report number LA-UR-20-20436, Los Alamos, New Mexico.

Seymour, C.L. and W.R.J. Dean. 2010. The influence of changes in habitat structure on the species composition of bird assemblages in the southern Kalahari. Austral Ecology 35(5):581–592.

Shannon, C.E. and W. Weaver. 1949. The mathematical theory of communication. University of Illinois Press, Urbana, IL, USA. 127pp.

Simpson, E.H. 1949. Measurement of diversity. Nature 163:688.

Smith, J.A.M., L.R. Reitsma, and P.P. Marra. 2010. Moisture as a determinant of habitat quality for a nonbreeding Neotropical migratory songbird. Ecology 91(10):2874–2882.

Tramer, E.J. 1969. Bird species diversity: components of Shannon's formula. Ecology 50(5):927–929.

U.S. Fish and Wildlife Service (USFWS). 2011. Birds of management concern and focal species. United States Department of Interior, Fish and Wildlife Service, Migratory Bird Program, Arlington, Virginia. 15 pp.

Weather Machine. 2015. Weather Machine Climatological Monthly Summary, September 2015, http://weather.lanl.gov/climo_monthly_summary.asp.

Weather Machine. 2020. Weather Machine Climatological Monthly Summary, December 2020, https://weathermachine.lanl.gov/climo_monthly_summary.asp.

Wysner, T.E., A.W. Bartlow, C.D. Hathcock, and J.M. Fair. 2019. Long-tern phenology of two North American secondary cavity-nesters in response to changing climate conditions. The Science of Nature 106:54. doi:10.1007/s00114-019-1650-9.

Zhou, P., Yang, XL., Wang, XG., Hu, B., Zhang, L., Zhang, W., Si, HR., Zhu, Y., Li, B., Huang, CL., Chen, HD., Chen, J., Luo, Y., Guo, H., Jiang, RD., Liu, MQ., Chen, Y., Shen, XR., Wang, X., Zheng, XS., Zhao, K., Chen, QJ., Deng, F., Liu, LL., Yan, B., Zhan, FX., Wang, YY., Xiao, GF., and ZL. Shi. 2020. A pneumonia outbreak associated with a new coronavirus of probable bat origin. Nature 579 (7798):270–273. doi:10.1038/s41586-020-2012-7.

APPENDIX 1. ALL BIRDS RECORDED AT THE THREE TREATMENT SITES FROM 2013–2020

	2013	2014	2015	2016	2017	2018	2019	2020	2013	2014	2015	2016	2017	2018	2019	2020	2013	2014	2015	2016	2017	2018	2019	2020
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	5
American Crow																					1	1		1
American Kestrel				1				1	1			2												
American Robin	1	1	2		2				1	1		2		4	2		7		9	4	4	6	12	6
Ash-throated Flycatcher	11	5	14	13	13	10	17	12	19	11	30	12	8	8	6	11	3	5	6	2	3	8	4	6
Audubon's Warbler		2				5						2				5	6	5	1	6		1	11	14
Bewick's Wren	4	8	9	9	14	14	5	10	3	10	15	9	2	8	1	2								
Black-chinned Hummingbird		1	1				1	2	3	2				1	2	3	1		1		1		1	12
Black-headed Grosbeak	1	3				1	1	2		2	4	1		3	2	1			1	2		2		1
Black-throated Gray Warbler			1		2			2	5	6	4													
Blue-gray Gnatcatcher	3	14	16	8	10	9	8	11	2		7	5	4	2	13	5		6	2	1	3	6	4	9
Broad-tailed Hummingbird	2	1	3		1		3	2	3	1	2		3	1	2	9	5	11	11	5	7	10	8	
Brown Creeper																	1							
Brown-headed Cowbird	1										2			3	2	10	4	1			4	2	8	4
Bushtit		2		2		11			2	14			1	12		2								
Canada Goose											16				2									
Canyon Towhee	2		5	3	6	2	3	5	1	1	2	10	13	19	6	3	1			1		1		
Canyon Wren					1						2	3	8	6	2	4			2					
Cassin's Finch						4																		
Cassin's Kingbird	6	13	13	5	2	5	6	5	7	6	2	21	21	32	37	49				1				2
Chipping Sparrow	3	16	17	29	6	22	10	10	6	6	5	8	15	25	27	24	1	5	3	10	5	21	8	32
Clark's Nutcracker																		4		1				
Common Nighthawk	6		5	2	4	4	1	5	5	1	3	2	7	5	7	3			1	2	2			1
Common Raven	2	5	1		1	2	3		1		2	1		1	2	5	5	6	2	2	5	5	7	4
Cooper's Hawk					1												1			1			1	
Cordilleran Flycatcher																	5	10	6	3	3	1	2	4
Dark-eyed Junco														1	1		6	2	4		5	2		2
Downy Woodpecker				1								1	2		1	2		1		1	1	1		
Dusky Flycatcher				1							1		1											2
Eurasian Collared-Dove	3												4			2						1		
Evening Grosbeak	3		4								8						5		29			1		
Grace's Warbler							1							2	4	1	6	4	4	8	5	8	22	12

Species	2013	2014	2015	2016	2017	2018	2019	2020	2013	2014	2015	2016	2017	2018	2019	2020	2013	2014	2015	2016	2017	2018	2019	2020
	TA-36 Minie Site								TA-39 Point 6								TA-16 Burn Grounds							
	Pinyon-Juniper Woodland								Pinyon-Juniper Woodland								Ponderosa Pine Forest							
Gray Flycatcher	12	6	5	7	3	6	3	2	10	10	11	10	5	8	3	14								
Great Horned Owl		3							1															
Green-tailed Towhee	3	1							1															1
Hairy Woodpecker			2	1		1		1			5	3			1	1	1	1		1	1	2	1	1
Hammond's Flycatcher																	8	9	12	5	7	5	10	5
Hepatic Tanager											1	2	1	2						1				
Hermit Thrush						1												4	6	1	2	2	5	5
House Finch	16	17	26	17	12	18	17	11	21	4	23	9	30	44	50	53	16	2	5	5	12	7	12	18
House Wren															1		1	1		2	2	6	8	2
Juniper Titmouse	12		7	6	9	3	26	8	11	13	18	6	1			3								
Lesser Goldfinch	2	6	7	4	9	12	8	4	4	12	9	10	14	19	15	27	3		8	9	4	8	5	6
MacGillivray's Warbler																				1	3			1
Mountain Bluebird		2	20	10	11	1	9	3		4						2			4	4	4	7	4	5
Mountain Chickadee	5	2	1	2								1	1		1		5	8	9	6	8	9	1	4
Mourning Dove	17	17	13	5	8	8	11	9	13	22	10	3	15	11	8	10	4		1	3	17	3	5	17
Northern Mockingbird					2		1	4		1														
Northern Rough-winged Swallow						3																		
Orange-crowned Warbler																								1
Peregrine Falcon											1													
Pine Siskin	10	2		5	1			1	6		3	3					12	4	5		4	2		6
Plumbeous Vireo	10	10	7	3	9	9	15	3	1		1	6	6	5	5	12	11	16	15	14	11	18	16	24
Pygmy Nuthatch				2		2	3				2	4	12	9	11	10	11	13	26	29	41	20	16	23
Red Crossbill					1					2						1		2	9	13	9		6	26
Red-shafted Flicker	3	1	3	2	5	2	1		3	2	4	8		3	2	2	3	4	11	11	5	5	2	7
Red-tailed Hawk							1	2			1	1	1	1										
Rock Wren	3	3	4		2	10	11	10	7	10	4	12	14	14	12	20	1	2	2	6			4	1
Ruby-crowned Kinglet																						2		
Savannah Sparrow																								1
Say's Phoebe	2	1	2		2	5	1	1	2	1		5	2	4		6	1		1	3	3	4	1	1
Scaled Quail			1																					
Spotted Towhee	17	8	19	27	32	24	19	20	12	6	33	16	12	16	15	20	11	18	16	14	21	22	34	24
Steller's Jay							1										3	2	5	6	3	4	4	2
Townsend's Solitaire	1																				1			
Turkey Vulture					1			2								1	1					1		
Vesper Sparrow																							1	
Violet-green Swallow		5	7	1	3	2	1	6	6	4	1	9	6	6	9	47		2	19	2	2	4	2	7

	2013	2014	2015	2016	2017	2018	2019	2020	2013	2014	2015	2016	2017	2018	2019	2020	2013	2014	2015	2016	2017	2018	2019	2020
Species	TA-36 Minie Site								TA-39 Point 6								TA-16 Burn Grounds							
	Pinyon-Juniper Woodland								Pinyon-Juniper Woodland								Ponderosa Pine Forest							
Virginia's Warbler					1	3	1				1	2	4		5		17	11	21	13	7	5	5	8
Warbling Vireo						2											2	9	7	6	5	4	6	3
Western Bluebird	15	11	18	17	16	19	21	23	5	19	12	21	13	6	7	17	20	20	49	37	32	27	20	27
Western Tanager		2	3		1					2	1	1	2	2	6	1	2	3	7	2	4	6	16	10
Western Wood-Pewee	10	8	18	11	10	7	18	14		4	2	10	8	11	12	18	15	10	16	14	22	20	24	28
White-breasted Nuthatch	1	4	9	10	13	5	2	1			2	4	4	2	6	3	9	8	7	9	20	10	10	8
White-throated Swift										1						2								
White-winged Dove	1	5	9	2		3	2	1	7	5	6	16	15	15	5	2			1	2			1	
Woodhouse's Scrub-Jay	5	1	3	4	8	7	14	10	8	10	4	8	6	4	5		1							