Surveys for Nesting Pinyon Jays at

Rio Grande del Norte National Monument

Final Report

Kristine Johnson[1], Nathan Petersen[1], Jacqueline Smith[1], and Giancarlo Sadoti[2]

[1] *Biology Department, University of New Mexico*
[2] *Department of Geography, University of Nevada Reno*
Natural Heritage New Mexico Report #410
September 2018

Table of Contents

Table of Figures

List of Tables

Summary

The Pinyon Jay (*Gymnorhinus cyanocephalus*), a New Mexico BLM Sensitive Species, has experienced significant population declines over the past 50 years. In 2017, the Taos BLM Field Office requested that Natural Heritage New Mexico survey for breeding Pinyon Jays at the Rio Grande del Norte National Monument; 2017 surveys focused on North Guadalupe Mountain, the site of a proposed woodland treatment. In 2018, we conducted additional Pinyon Jay surveys at Cerro Chiflo, Cerro Montoso, Cerro de la Olla, North Guadalupe Mountain, South Guadalupe Mountain, and Ute Mountain. In 2018, we found 68 nests at all sites: 22 new, 34 old, and 12 platforms that we called nest starts or courtship nests. These nests represent six definite colonies on five different mountains; five colonies were newly detected in 2018.

Tree density at untreated points did not change significantly between 2010 and 2018 but was reduced by the 2018 treatments at North Guadalupe Mountain, from a mean of 1893 trees per hectare to a mean of 248 trees per hectare, an 87% reduction. Root crown diameter (RCD) increased slightly from 2010 to 2018, likely due to tree growth, but it increased significantly more on points in treated areas, indicating that treatment disproportionately removed smaller trees. Basal area increased slightly from 2010 to 2018 in untreated areas but decreased non-significantly on treated points.

In 2018, tree density was significantly higher at nests and untreated areas than in treated areas, indicating that Pinyon Jays nest in patches of higher tree density. RCD was significantly greater on treated than in untreated areas and at nests, again indicating that the treatment retained larger trees. Similarly, basal area was significantly higher at nests than in untreated areas, which was higher than in treated areas.

The 2018 treatment at North Guadalupe Mountain affected approximately 21% of the traditional Pinyon Jay nesting colony. Eleven nests from 2017 and earlier were within areas subsequently treated, indicating that suitable nesting habitat was treated. In 2018, we found 20 nests at North Guadalupe Mountain, eight new 2018 nests, six old nests we had not found in 2017, and six small platforms we classified as nest starts. None of the nests found in 2018 was within a treated polygon. Reductions in tree density in treated areas apparently reduced habitat quality such that Pinyon Jays avoided nesting in treated areas. However, Pinyon Jays did nest near the treatment polygons in 2018, suggesting that they avoid treated polygons but prefer to stay in a traditional colony site if sufficient suitable habitat remains within the traditional site. Management recommendations for Pinyon Jays and their habitats are outlined.

Introduction

Pinyon Jays (*Gymnorhinus cyanocephalus*) are year-round residents in piñon-juniper (*Pinus edulis, P. monophylla, Juniperus* spp.) habitats across the southwestern US. They also occur in Idaho, Montana, Wyoming, and central Oregon, where they may also inhabit woodlands and

scrublands containing ponderosa pine (*P. ponderosa*), juniper, and chaparral vegetation (Balda 2002). The Pinyon Jay has a mutualistic relationship with piñon pines. Piñon trees are masting species; they produce highly nutritional seeds in large crops that historically occurred at irregular intervals, from one to three crops every ten years (Forcella 1981). These abundant seeds can sustain Pinyon Jays over winter, support successful nesting, and influence their population viability (Marzluff and Balda 1992). Following mast years, Pinyon Jay nesting and fledging success are higher than in non-mast years (Ligon 1978, Marzluff and Balda 1992), and adult survivorship is highest after moderate cone crops (Marzluff and Balda 1992). In turn, Pinyon Jays serve as the primary long-distance seed disperser for piñon trees within the bird's range. In a piñon mast year, a flock of Pinyon Jays can potentially harvest and cache millions of seeds (Ligon 1978). These strong fliers transport piñon seeds to caching areas several kilometers from the source woodland and cache them in sites favorable for germination (Ligon 1978). Due to the Pinyon Jay's unique mutualism with piñon trees, declining woodland conditions negatively impact the jay's populations and nesting behavior (Johnson et al. 2017a), and the Pinyon Jay can thus serve as an indicator of piñon-juniper woodland conditions.

Pinyon Jays are highly social. They flock in winter and nest colonially, sometimes cooperatively, on traditional nesting grounds (Marzluff and Balda 1992). Home ranges are large, typically 3500 ha (8645 ac) or more (Johnson et al. 2016, 2017b). Unlike territorial birds, their nests are spatially clumped, and a nesting colony can cover 35 ha (86 ac) or more (Johnson et al. 2014, 2015). A flock of Pinyon Jays thus requires thousands of hectares of habitat for its home range (Johnson et al. 2016, 2017b) and tens of hectares for each nesting colony.

Most recent studies of Pinyon Jay nesting habitat use have been conducted in New Mexico. In one study, Pinyon Jays placed their nests in larger-than-average diameter trees in patches of woodland having higher canopy cover and higher litter cover than random points within colonies (Johnson et al. 2014). At another site, the jays nested in trees which were on average taller and larger in diameter than random trees in the colony area, but they avoided the very largest, emergent trees (Johnson et al. 2015). A two-covariate model including canopy cover and tree diameter was effective in distinguishing nest from random plots at four sites across New Mexico (Johnson and Sadoti ms.). Mean tree density at 0.04-ha plots around nests at nine colony sites in piñon-juniper habitat was 884 trees ha^{-1} (range 75-2725 trees/ha, n = 140 nests)(Johnson et al. 2014, 2015). In addition to tree size, condition of trees; i.e., thickness and health of foliage, can affect choice of nest sites (Johnson et al. 2017a). Recent studies also address landscape- and colony-scale habitat use (Johnson et al. 2014, 2016, 2017b).

Breeding Bird Survey data indicate that Pinyon Jay populations have declined significantly range-wide over 50 years (Sauer et al. 2017). Due to concerns about the species' status, New Mexico Avian Conservation Partners lists Pinyon Jay as a Conservation Species 1, meaning it is among the birds of highest conservation concern in the state. It is also classified as vulnerable on the International Union for Conservation of Nature (IUCN) Red List (IUCN 2018) and is on the Partners in Flight Watch List (Partners in Flight 2017), a US Fish and Wildlife Service (USFWS)

Bird of Conservation Concern (USFWS 2008), a New Mexico Species of Greatest Conservation Need (New Mexico Department of Game and Fish 2017), and a New Mexico Bureau of Land Management (BLM) Sensitive Species (USDI BLM 2012a).

Recent, climate-related impacts to piñon-juniper woodlands include large-scale mortality of piñon pines (Breshears et al. 2005, 2008), significant reductions in canopy cover (Clifford et al. 2011), and declines in piñon cone production (Redmond et al. 2012, Zlotin and Parmenter 2008). Climate models predict distributional changes of piñon-juniper habitat (Cole et al. 2008) and massive, widespread piñon and juniper mortality across the southwestern US (McDowell et al. 2016). In addition, widespread thinning treatments are being conducted in piñon-juniper woodlands for fuels reduction, wildlife habitat, or other purposes. These impacts have raised concern over the future of the Pinyon Jay and other wildlife of piñon-juniper ecosystems because of the potential to impact their habitat (Boone et al. in press; see status listings above).

For example, a recent study on the Pajarito Plateau, NM found a 73% decrease in bird abundance and a 45% decrease in bird species richness following extreme, drought-related piñon mortality in 2000-2002 (Fair et al. 2018). In that study, bird abundance and species richness declined faster in thinned sites than un-thinned sites, suggesting that thinning may accelerate impacts to birds in areas also impacted by climate. In another study, Pinyon Jays moved their nesting colony, apparently in response to drought-related decline in piñon tree vigor (Johnson et al. 2017a). That study emphasizes that large-scale tree mortality is not necessary for wildlife to be impacted by climate, and incremental changes in tree health have potential to impact wildlife habitat quality.

BLM policy mandates that BLM manage Bureau Sensitive Species "consistent with species and habitat management objectives in land use and implementation plans to promote their conservation and to minimize the likelihood and need for listing under the ESA" (USDI BLM 2012a). The Taos BLM Resource Management Plan includes the following goals and objectives relative to Bureau Sensitive Species (USDI BLM 2012b):
Goals

- Prevent the Federal listing of federally proposed and Bureau Sensitive Species, which include both Federal candidate species and delisted species within five years of delisting, through management prescriptions that will conserve, enhance, or restore habitat, and minimize adverse effects from actions.
- Minimize or eliminate threats affecting BLM Sensitive Species and improve condition of the species' habitat, including ecosystem management and conservation of native biodiversity to reduce the chance of native species requiring BLM Sensitive Species status.

Objectives

- Achieve “no net loss” of special status species habitats.
- Determine long-term trends in distribution, abundance, and threats or other limiting factors of selected special status species on BLM lands and evaluate the significance of those lands in the conservation of the species.
- Incorporate BMPs, standard operating procedures, conservation strategies and measures, and design criteria to mitigate specific threats during planning and implementation, including the use of Guidelines for Livestock Grazing Management until site-specific management plans or conservation strategies are developed.
- Assist in the preparation and implementation of recovery or other special status species management plans.
- Monitor populations and habitats to ensure that objectives for special status species habitat development and protection are being met.
- Conduct special status species habitat inventories and studies to provide data for multiple-use planning, habitat management plans, and resolution of conflicts involving resource development and protection activities.
- Prepare and implement habitat management plans to address special status species habitat development and protection needs, including riparian, giving priority to the Rio Grande corridor.
- Monitor habitat management plans and/or cooperative agreements with other State, local or nongovernmental entities to determine if positive changes in trend for habitat development and protection are being met in such plans or agreements.
- Where feasible, acquire lands containing habitat for special status species.
- Participate in regional and national working groups to help coordinate agency actions and create opportunities to overcome barriers to special status species and the ecosystems upon which they depend, and to develop species-specific or ecosystem-based conservation strategies.

In 2017, the Taos BLM Field Office requested surveys for breeding Pinyon Jays at the Rio Grande del Norte National Monument (RGNM). In addition to the desire for general information on Pinyon Jays within the monument, there was particular interest in areas targeted for vegetation treatments on North Guadalupe Mountain, Cerro de la Olla, and other cinder cones in the monument. The discovery of active Pinyon Jay nests in 2017 (Johnson et al. 2017c) necessitated a shift in focus from a general survey of several cinder cones to collection of detailed information on Pinyon Jay nest locations, colony boundaries, and suitable nesting habitat at North Guadalupe Mountain. Because 2017 surveys at Cerro de la Olla necessarily occurred after the active nesting season, surveys there focused on general presence/absence surveys for Pinyon Jays and assessment of suitable nesting habitat (Johnson et al. 2017c).

In 2018, our first objective was to conduct surveys for Pinyon Jay nesting colonies at Cerro Chiflo, Cerro Montoso, Cerro de la Olla, North Guadalupe Mountain, South Guadalupe Mountain, and Ute Mountain. We also surveyed at Brushy Mountain, a section of Wild Rivers, and TP 244 and TP 247 (roads W of North and South Guadalupe Mountains, Figure 1). Due to the extensive scope of these surveys, we were limited to establishing the existence of traditional colonies, based on active nests and nests from previous years. Our intention was not to find every active or inactive nest, delineate exact colony boundaries, or monitor nesting success, rather to verify the existence of traditional nesting colonies on the targeted mountains.

Between the extensive nest surveys we conducted at North Guadalupe Mountain in 2017 and the 2018 field season, BLM completed a portion of the planned tree thinning treatment on North Guadalupe Mountain. The treatment extended into the traditional nesting colony site. A second objective of the 2018 research was to assess Pinyon Jay nesting in the treated and untreated parts of the traditional colony site. We also compared tree size, density, and basal area in treated areas, untreated areas, and at nests on North Guadalupe Mountain.

Methods

Study Sites

***Brushy Mountain*.** The Brushy Mountain study area is located on the N aspect of the unnamed peak to the S of Brushy Mountain (Figure 1). The elevation range of this sagebrush and piñon-juniper woodland is approximately 2332 m (7650 ft) to 2393 m (7850 ft).

Cerro Chiflo. The Cerro Chiflo study area encompasses the perimeter of Cerro Chiflo, excluding the area adjacent to the Rio Grande Gorge (Figure 1). The elevation of this sagebrush, sparse piñon-juniper, and piñon-juniper woodland ranges from approximately 2286 m (7500 ft) to 2530 m (8300 ft).

***Cerro de la Olla*.** The Cerro de la Olla study area is located on the SW, S, SE, N, and NE aspects of the mountain (Figure 1), ranging in elevation from 2357 m (7731 ft) to 2743 m (8997 ft). Vegetation ranges from sagebrush and sparse piñon-juniper woodland at the lowest elevations, to persistent piñon-juniper woodland, to Douglas-fir (*Pseudotsuga menziesii*) and ponderosa pine (*Pinus ponderosa*) at the highest elevations.

Cerro Montoso. The Cerro Montoso study area includes the W, NW, N, and E aspects of the mountain (Figure 1), ranging in elevation from approximately 2316 m (7600 ft) to 2438 m (8000 ft). Vegetation ranges from sagebrush and sparse piñon-juniper at lower elevations to persistent piñon-juniper woodland at higher elevations. Much of the surveyed piñon-juniper woodland on Cerro Montoso has been treated (thinned) in the past.

North Guadalupe Mountain. The North Guadalupe Mountain study area, in the NE of RGNM, included the NW, N, and NE aspects of North Guadalupe Mountain (Figure 1), ranging in

elevation from 2316 m (7596 ft) to 2551 m (8367 ft). Vegetation ranges from juniper woodland at the lowest elevations, to persistent piñon-juniper woodland, to Douglas-fir at the highest elevations.

South Guadalupe Mountain. The South Guadalupe Mountain study area includes the W aspect, as well as an interior valley of the mountain (Figure 1), ranging from approximately 2255 m (7400 ft) to 2469 m (8100 ft). Vegetation ranges from sagebrush and juniper woodlands at lower elevations, to persistent piñon-juniper woodland at higher elevations.

Ute Mountain. The Ute Mountain study area is located on the NW, N, NE, and E aspects of the mountain (Figure 1), ranging in elevation from approximately 2316 m (7600 ft) to 2530 m (8300 ft). Vegetation ranges from sagebrush and sparse piñon-juniper at lower elevations, to persistent piñon-juniper woodland and ponderosa pine at higher elevations.

Additional Areas. We surveyed the Wild Rivers area by driving the paved road around a loop along the Rio Grande Gorge, S of South Guadalupe Mountain. The interior of this loop is primarily sagebrush, with piñon-juniper woodland along the canyon rim. TP 244 and TP 247 are roads W of North and South Guadalupe Mountains that loop off of the main paved road; habitat in these areas is a mix of sagebrush flats and sparse and persistent piñon-juniper (Figure 1). None of the above study sites showed significant evidence of fire history or bark beetle infestation.

Treatment Polygons and Trees

On 14, 15, 26, and 27 March 2018, we delineated the treated areas at North Guadalupe Mountain by walking the edges using tracks on a GPS unit. We took photos of treated and untreated areas.

On North Guadalupe Mountain, 30 points were previously established in a grid and designed to sample trees and birds at the same points, with distances between points chosen to avoid overlap in bird detections between points (Natural Heritage New Mexico and Hawks Aloft, Inc. 2011). Because of concern that too few pre-established points fell in treated polygons to allow for a balanced comparison of treated vs. untreated areas, we added 14 new points within areas treated in 2018 (Figure 2) to the six 2010 points that fell within treated areas, for a total of 20 points (80 trees) in treated areas.

On 14 and 15 May, we collected tree data at treated and untreated points at North Guadalupe Mountain. Following a point quarter method, two teams of two people collected tree data on established points in the treated and untreated areas. We measured distance from each point to the nearest tree over 1 m tall in each quadrant. We also measured root crown diameter (RCD) of all four trees at each point. When distance to the nearest tree was >5 m, we collected distance using a range finder. On 7 August, we collected similar data at a sample of 2017 and 2018 nest trees, using the same point quarter method.

Pinyon Jay Nest Surveys

We surveyed for Pinyon Jay nesting colonies during the regular peak nesting season in New Mexico, mid-March to mid-May (Table 1).

Table 1. Sites surveyed for Pinyon Jays and nesting colonies, 2018.

Survey Site	Survey Dates
North Guadalupe Mountain	March 14, 15, 26, 27; April 3, 6, 9, 23; May 14, 15
South Guadalupe Mountain	March 14; April 3, 6, 24
Off TP 244, 247	March 14
Ute Mountain	March 28; April 4, 5, 10; June 22
Wild Rivers	April 3
Cerro Chiflo	April 16, 18, 24; May 3, 4
Brushy Mountain	April 25; May 9
Cerro de la Olla	April 16, 17, 24; May 3, 4, 5
Cerro Montoso	April 22, 23

Whenever we were at any of the study areas, including while delineating treatment polygons, we listened for Pinyon Jays, noted their presence, and collected GPS points if possible. The time spent delineating treatment polygons on 14, 15, 26, and 27 March and collecting tree data on 14 and 15 May therefore also provided Pinyon Jay detections.

From one to four surveyors conducted walking surveys of each survey area, searching trees for Pinyon Jay nests. If we heard jays within the survey area, we shifted our focus to areas of Pinyon Jay activity. In some cases, the jays' activity indicated areas to search for nests; we found a few active nests this way. Most nests were found by searching patches of trees of appropriate size and canopy cover irrespective of Pinyon Jay presence. We recorded GPS coordinates at each nest we found; these were used to delineate the colony boundary. We uploaded GPS coordinates onto a computer and mapped them in ArcGIS 10.4 (Esri 2015).

Analysis

Raw data on tree density and diameter from the previous study (Natural Heritage New Mexico and Hawks Aloft, Inc. 2011) were available at Natural Heritage New Mexico. We computed mean tree density per hectare on point quarter plots (treated, untreated, and at nests) using the formula: $\text{Density} = \frac{10{,}000}{(\text{mean distance to tree})^2}$.

Using these historical data, we assessed changes in tree density, RCD, and basal area (in $m^2\ ha^{-1}$) between 2010 and 2018 with Wilcoxon sign rank tests. We also compared 2018 tree density, RCD, and basal area at nests, untreated points, and treated points with nonparametric Kruskall-Wallis tests for multiple groups using the Kruskall function in the agricolae package (de

Mendiburu 2017). We followed with post-hoc Fisher's least significant difference tests with the Holm correction for multiple comparisons (Holm 1979).

Results

Pinyon Jay Nest Surveys

At all survey sites, we found 22 new 2018 nests (Figure 3). Of these, six were being attended by Pinyon Jays when we found them. We also observed three pairs carrying nesting material, but we did not find those nests. In 2018, we found 12 nest starts, platforms which were either courtship nests, under construction, or started then abandoned. We found 34 old nests which had not been found in the previous year, giving a total of 68 new nests of all types found at all sites in 2018. These nests represent six definite colonies on five different mountains; five colonies were newly detected in 2018. Pinyon Jay activity and one nest suggest that an additional colony exists at Brushy Mountain. Pinyon Jay activity and two old nests suggest presence of a colony at E Ute Mountain. Additional surveys during the peak nesting season will be necessary to confirm the existence of nesting colonies in those two areas.

Brushy Mountain. We found one active nest at Brushy Mountain (Figure 3). On 25 April when we found the nest, one or two Pinyon Jays were calling in the area. On a second visit on 5 May, a flock of 12 – 15 flew over the site. We believe this site is within the home range of a flock, with a nesting colony nearby, but additional surveys will be necessary to locate a nesting colony.

Cerro Chiflo. We found a small colony on the SW side of Cerro Chiflo, including one active nest, three old nests, and one nest start (Figure 3). Females begging in the area suggested the presence of one or two more active nests, but we did not locate them.

Cerro de la Olla. We found two colonies on Cerro de la Olla (Figure 3). A colony on the N side of the mountain was indicated by two active and four old nests. At a colony on the S side of Cerro de la Olla, we found three 2018 nests and four old nests.

Cerro Montoso. We surveyed piñon-juniper habitat on the N edge of Cerro Montoso on 23 and 24 April but did not detect any Pinyon Jays.

North Guadalupe Mountain. In 2018, we found 20 nests at North Guadalupe Mountain, eight that appeared to be new 2018 nests, six old nests we had not found in 2017, and six small platforms we classified as nest starts or courtship nests (Figure 3). None of the nests we found in 2018 was within the recently treated area.

South Guadalupe Mountain. We found a new active colony at South Guadalupe Mountain (Figure 3). During our survey on 24 April, a flock of Pinyon Jays was active within the colony, alarm calling and carrying nesting material. We found five Pinyon Jay nests and one possible Pinyon Jay nest, and we observed one pair carrying nesting material but did not find their nest. We estimate the flock at approximately 20 birds.

Ute Mountain. During surveys on 10 April, we found a new colony on the N side of Ute Mountain (Figure 3). As the survey was somewhat early in the season, the Pinyon Jays were quite active but nesting had just begun. We found two active nests, five stick platforms we called nest starts, and 15 old nests. During our surveys, we estimated the Ute Mountain flock to be 20 – 30 birds. During a separate point count survey in early June, we detected a small crèche of 6-10 Pinyon Jay fledglings, likely from successful nests at the N Ute Mountain colony. We heard Pinyon Jays on the E side of Ute Mountain, and during point count surveys we found two old nests in the area, suggesting the presence of a second Ute Mountain colony. As these nests were not found until after the nesting season, we did not survey the area thoroughly.

Additional Areas. We detected no Pinyon Jays in brief visits to the Wild Rivers area, TP 244, or TP 247.

Figure 1. Sites surveyed for Pinyon Jays and nesting colonies at Rio Grande del Norte National Monument, 2018. Colored outlines indicate areas surveyed.

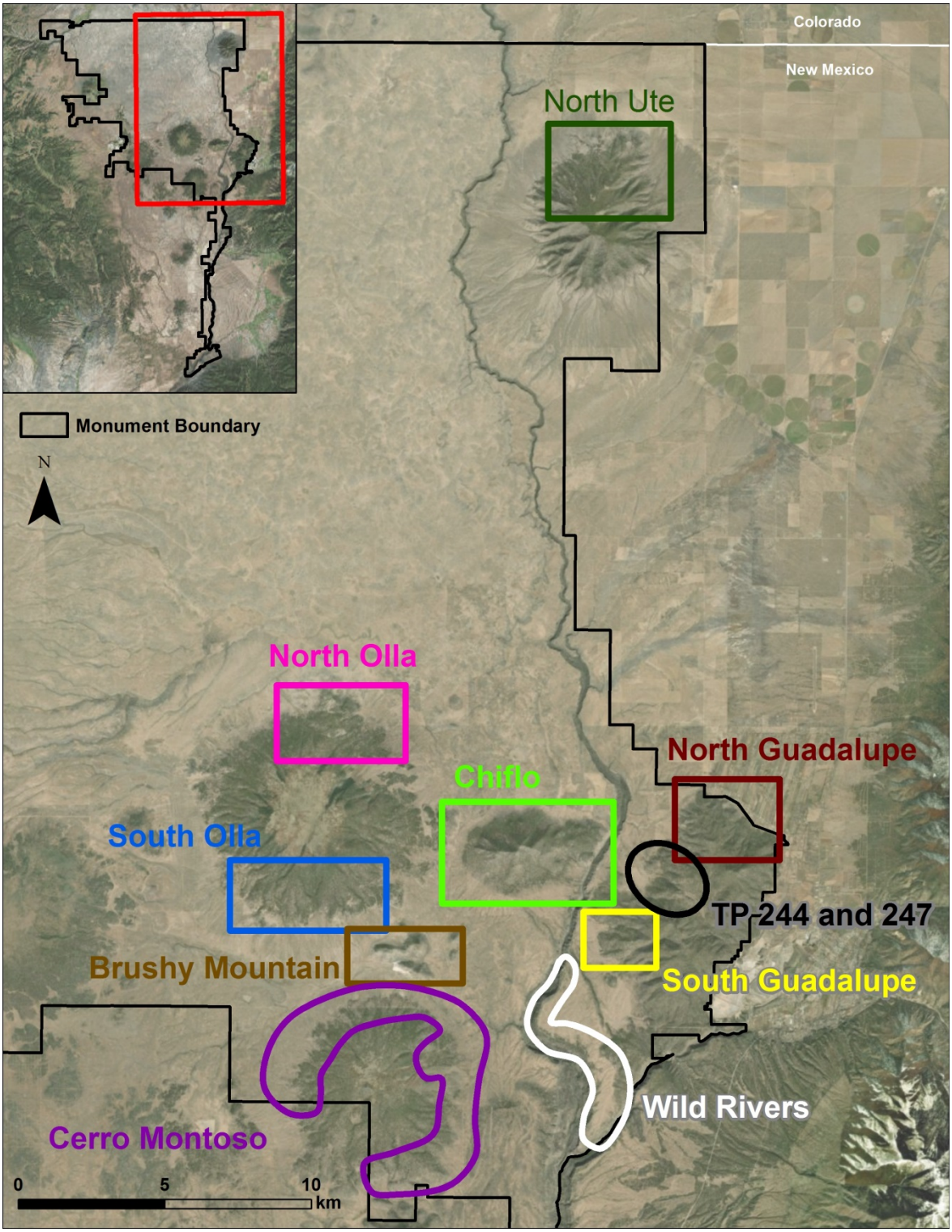
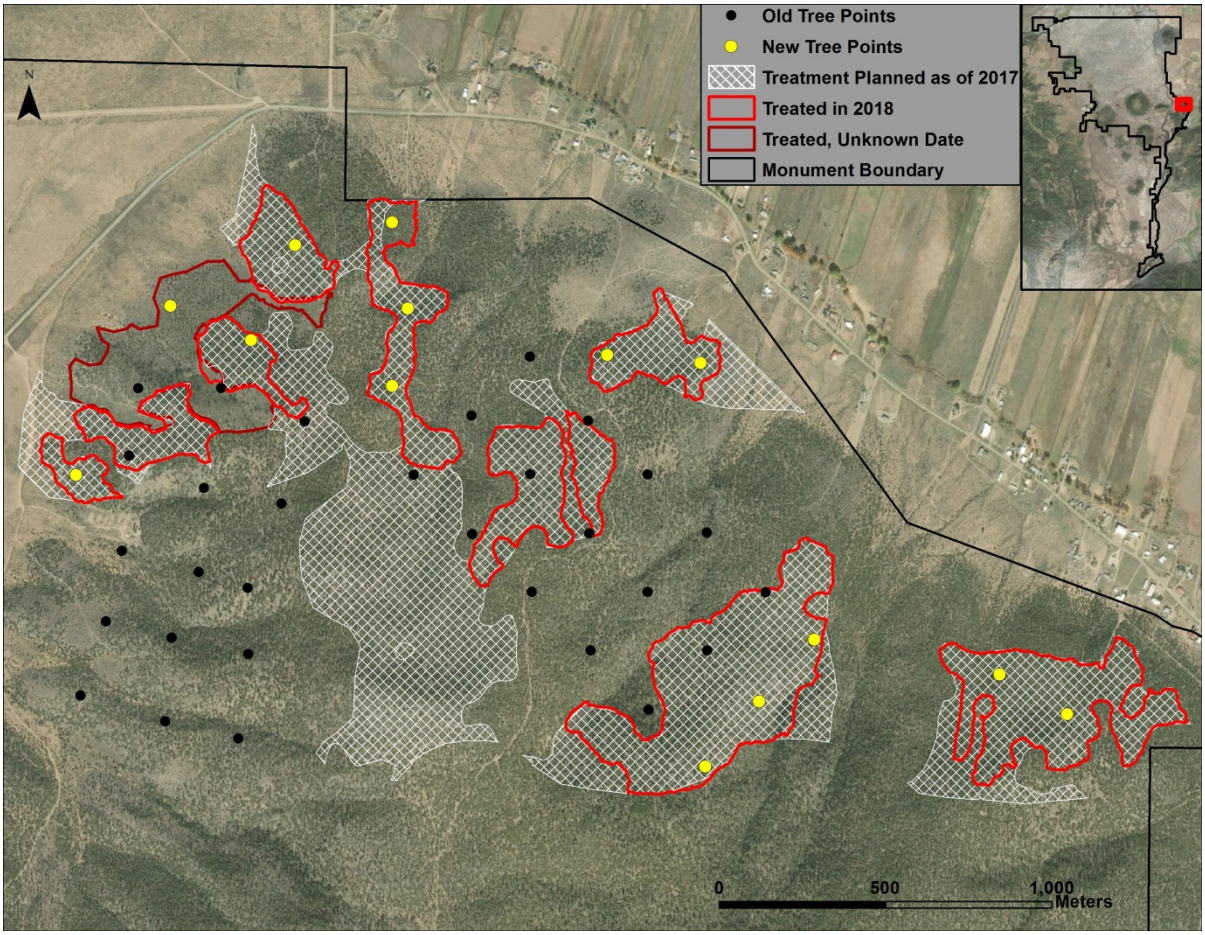


Figure 2. North Guadalupe Mountain, showing proposed treatment areas, treatments completed in 2018, previously treated areas, and locations of tree data points.



Treated vs. Untreated Tree Measures, North Guadalupe Mountain

Of 158.85 ha targeted for treatment, 87.97 ha were treated in 2018 (55.4 %). An additional 16.57 ha had been treated prior to 2018 (Figure 2).

Changes between 2010 and 2018

Tree density at untreated points did not change significantly between 2010 and 2018 (mean increase = 77 trees ha^{-1}, $n = 24$, Wilcoxon sign rank test, $V = 132$, $P = 0.58$, one-tailed test) but was reduced on points in treated areas from a mean 1893 trees ha^{-1} to a mean 248 trees ha^{-1}, an 87% reduction (mean decrease = 1644 trees ha^{-1}, $n = 6$, $V = 0$, $P < 0.02$, one-tailed test).

As expected, RCD increased slightly from 2010 to 2018 (likely due to tree growth) on points in untreated areas (mean increase = 2.0 cm, Wilcoxon sign rank test, $n = 24$, $V = 236$, $P < 0.01$, one-tailed test) but increased more on points in treated areas (mean increase = 11.7 cm, $n = 6$, $V = 21$, $P < 0.02$, one-tailed test), indicating the treatment disproportionately removed smaller trees. This difference was significant (Wilcoxon rank sum test, $W = 138$, $P = 0.0002$).

Basal area (expressed as square meters per hectare) increased slightly from 2010 to 2018 (likely due to tree growth) on points in untreated areas (mean increase = 8.3 m^2 ha^{-1}, Wilcoxon sign rank test, $n = 24$, $V = 241$, $P < 0.01$, one-tailed test) and decreased non-significantly on treated points (mean decrease = 11.9 m^2 ha^{-1} , $n = 6$, $V = 4$, $P = 0.11$, one-tailed test). This slight decrease probably occurred because the remaining trees on this sample of points were larger after treatment, but the increase in tree size was balanced by fewer trees remaining per hectare.

Measurements in 2018

Tree density was significantly higher at nests and untreated areas than in treated areas (Figure 4; Table 2; the first two did not differ significantly.), indicating that Pinyon Jays nest in areas of higher tree density (Overall X^2=44.94, $P < 0.0001$; multiple comparisons in Table 3). RCD was greater on treated than in untreated areas and at nests (Figure 4; Table 2; the latter two did not differ significantly), again indicating that the treatment retained larger trees (Overall X^2=12.84, $P = 0.0016$; multiple comparisons in Table 3). Basal area was significantly higher at nests than in untreated areas, which was higher than in treated areas (Figure 4; Table 2, overall X^2=25.7, $P < 0.0001$; multiple comparisons in Table 3). We did not observe similar differences in basal area on the small sample of points for which we have both 2010 untreated and 2018 treated measurements (See Changes between 2010 and 2018, above). This is probably because the small sample of 2010 points that were subsequently treated provided limited power to detect differences that are apparent in the larger sample of treated and untreated points in the area as a whole.

Table 2. Summary statistics of density, root crown diameter, and basal area at nests, in untreated areas, and in treated areas at North Guadalupe Mountain, 2018.

2018	Nest	Untreated	Treated
Density (trees/ha)			
Mean	3468.65	1349.21	211.99
Range	408.12-21,947.87	305.1-2563.69	57.39-560.20
SD	5349.02	703.38	103.71
RCD (cm)			
Mean	15.85	15.35	22.38
Range	4.95-27.55	3.88-27.25	14.95-35.7
SD	5.93	6.44	6.12
BA (m^2 ha^{-1})			
Mean	54.23	26.16	9.27
Range	5.26-638.71	1.40-77.92	1.79-34.62
SD	104.15	20.92	7.67

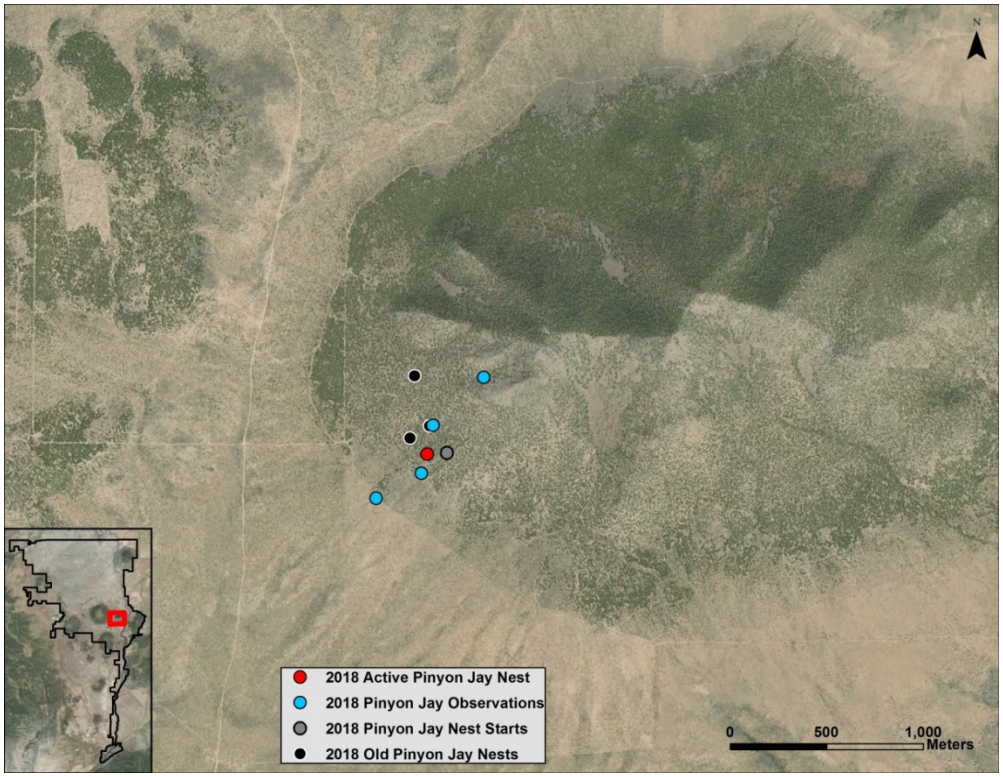
Table 3. Multiple comparisons of root crown diameter, tree density, and tree basal area at nests (2017 and 2018), untreated areas, and treated areas, North Guadalupe Mountain. Shown are differences in the mean rank of values when all points (nest, untreated, and treated) were pooled, P values in parentheses. Trees were measured in 2018.

	Nest vs. Untreated	Nest vs. Treated	Untreated vs. Treated
RCD	1.69 (0.76)	-20.76 (0.0027)	22.45 (<0.0027)
Tree Density	7.19 (0.08)	42.48 (<0.0001)	-35.28 (<0.0001)
Basal Area	12.15 (0.02)	32.86 (<0.0001)	-20.71 (0.002)

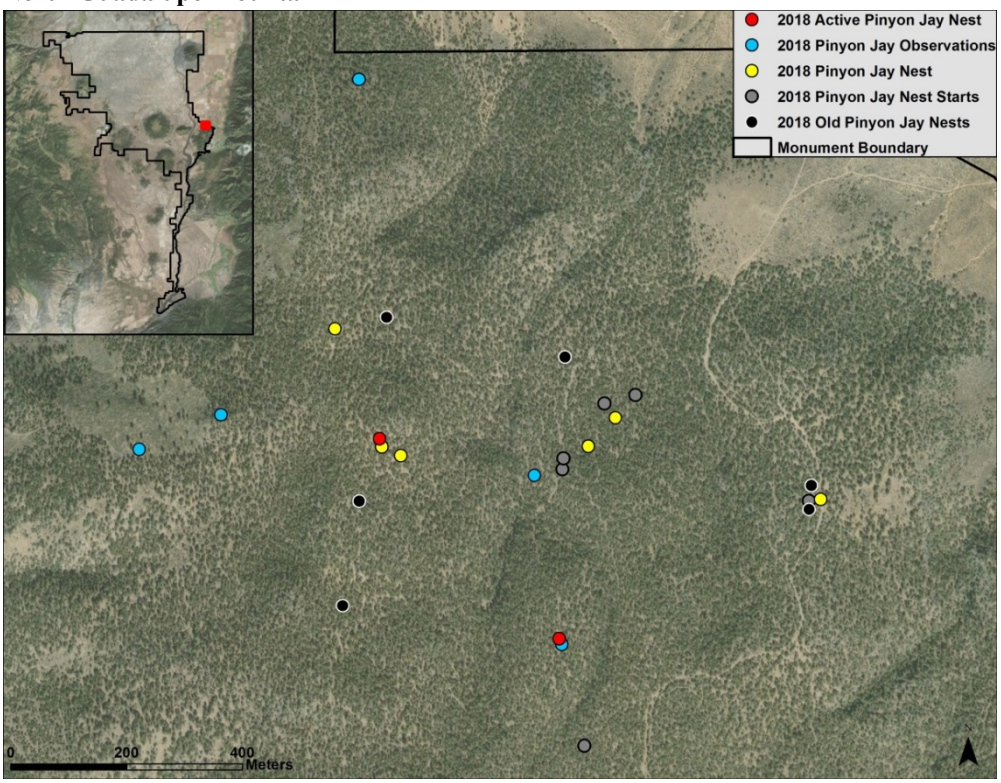
Figure 3. Pinyon Jay nests found at each study site, Rio Grande del Norte National Monument, 2018. Yellow dots indicate nests of the year not attended by Pinyon Jays at the time of detection. Red dots indicate active nests with birds attending. Black dots indicate nests from a previous year.

Brushy Mountain.

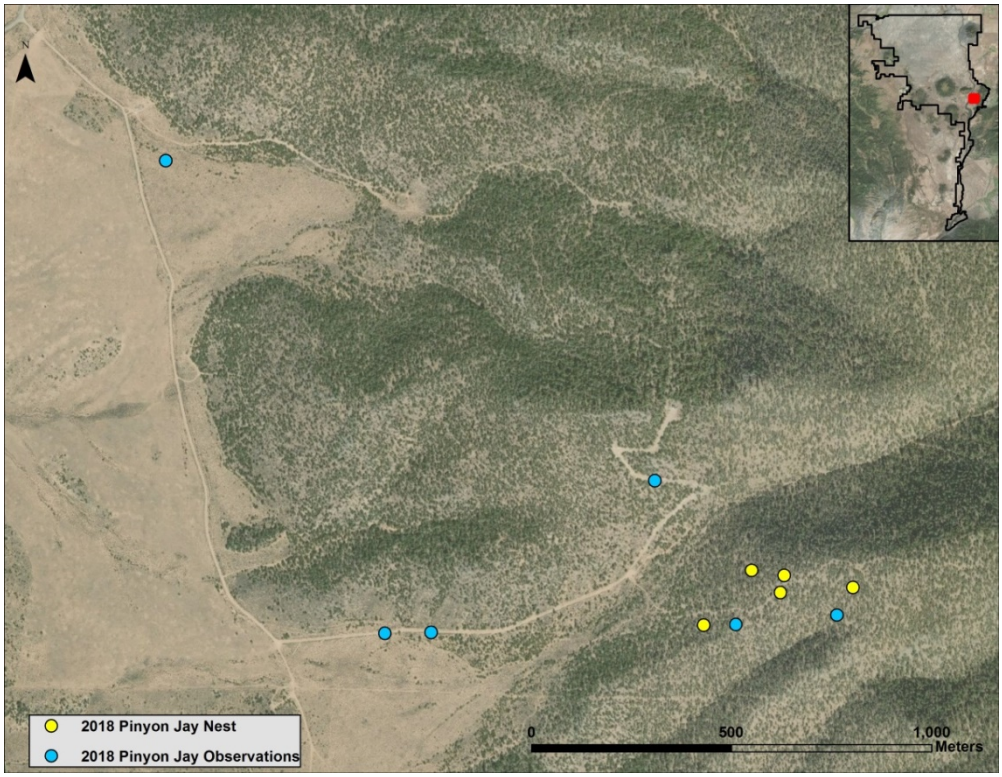
Cerro Chiflo



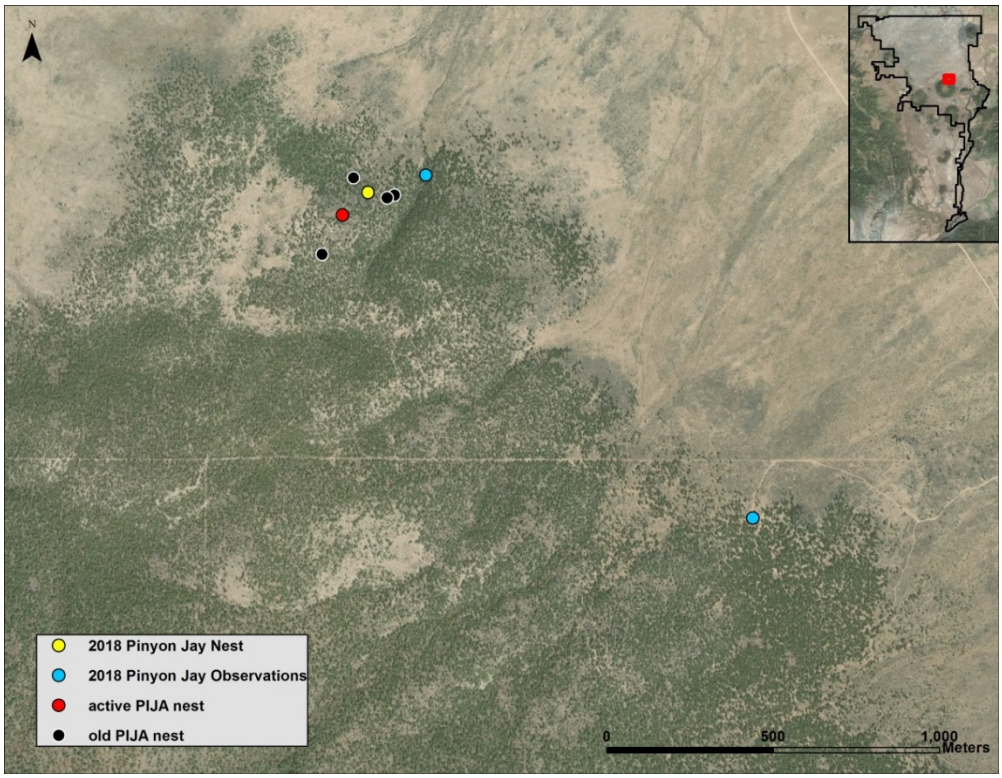
North Guadalupe Mountain



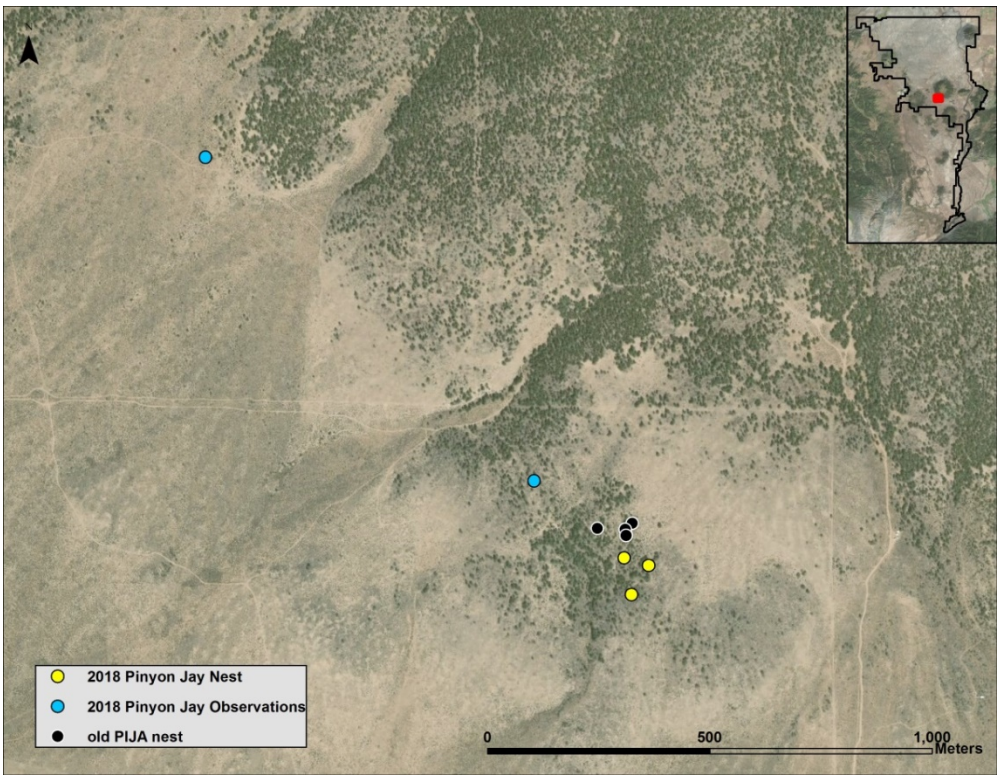
South Guadalupe Mountain



North Cerro de la Olla



South Cerro de la Olla



Ute Mountain

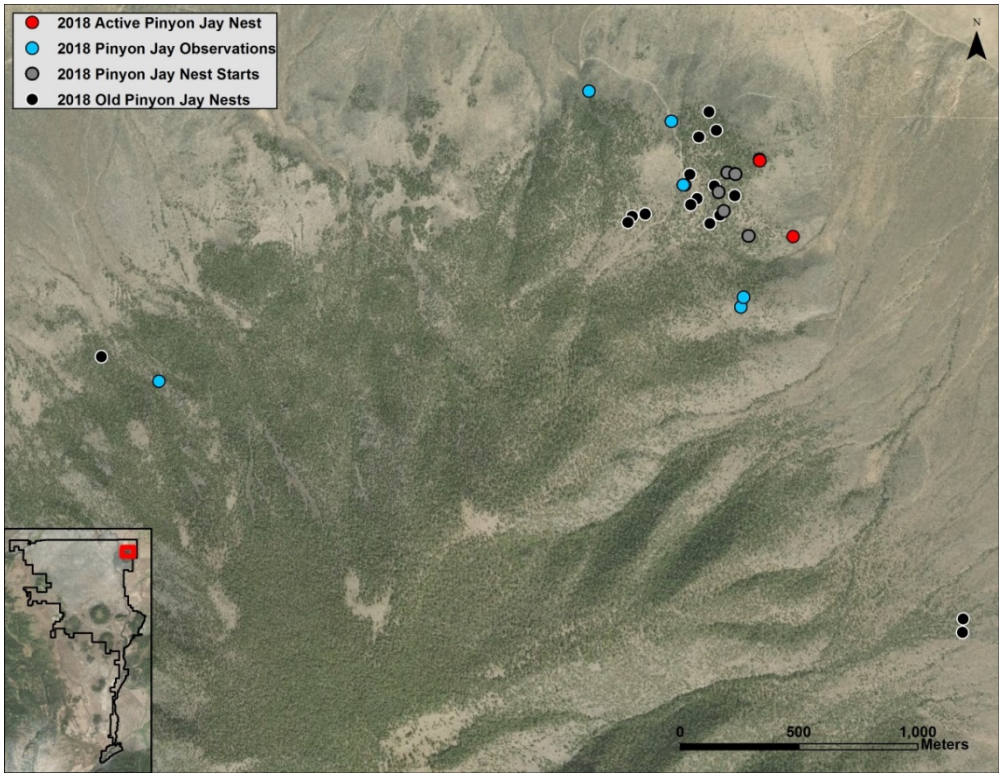


Figure 4. Relative frequency distribution of tree density at treated and untreated points and at 2017 and 2018 Pinyon Jay nest trees. Densities were collected in 2018 using the point quarter method.

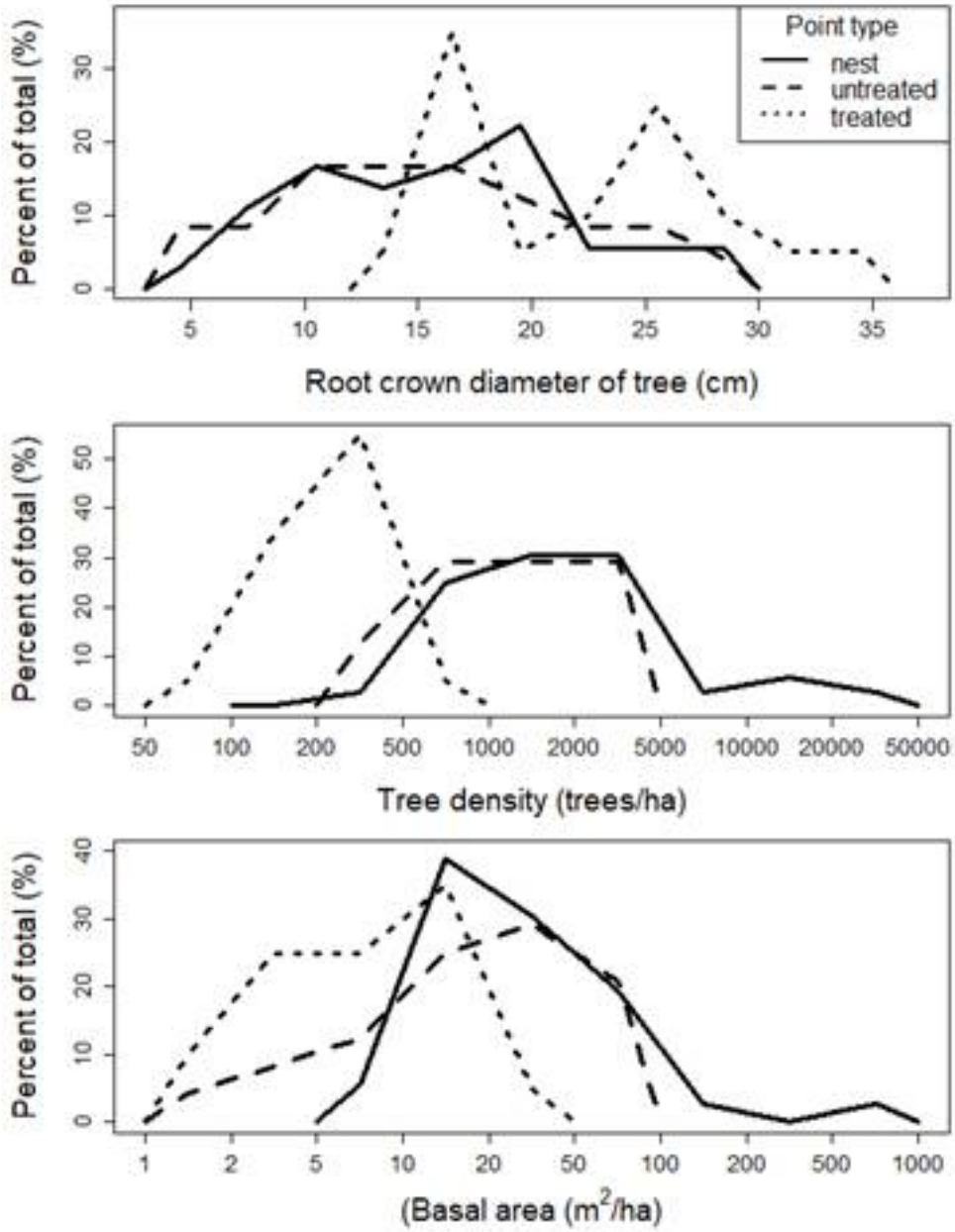
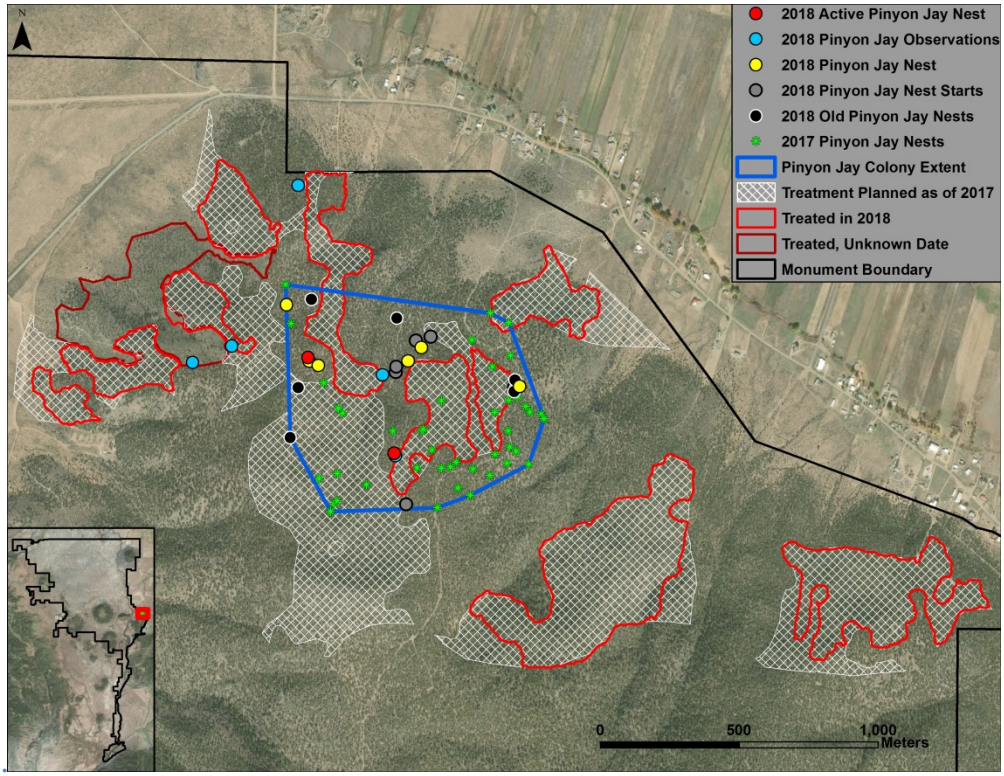


Figure 5. Nests and minimum bounding polygon around 2017 and 2018 nests at North Guadalupe Mountain, showing 2018 and older treated areas, additional areas targeted for treatment.



Pinyon Jay Nesting in Treated vs. Untreated Areas, North Guadalupe Mountain

Part of the 2018 treatment occurred within the boundaries of the nesting colony identified in 2017 (Figure 5)(Johnson et al. 2017c). The traditional nesting colony at North Guadalupe Mountain covered 57.4 ha. The treatment that has occurred thus far has reduced the area of suitable habitat within the original colony by 21%, to 45.4 ha.

Before the treatment, we found 32 nests in untreated areas and 11 nests in areas that were later treated, indicating that the treatment included suitable Pinyon Jay nesting habitat. After the treatment we found 14 nests in untreated areas and 0 nests in treated areas, a significant difference (Fisher's exact test, $P = 0.04$, one-tailed test). The larger area higher on the mountain currently targeted for treatment includes numerous nests which were active in 2017 and 2018 (Figure 5). A few Pinyon Jay pairs nested near treatment polygons but appeared to avoid placing nests within treated areas (Figure 5). The mean distance from new 2018 nests to the nearest edge of a treatment polygon was 50.25 m ($n = 8$, range 15-87 m).

Discussion

Pinyon Jay Surveys

In 2018, we found 68 nests in six colonies; five of these colonies were first detected in 2018. We found evidence of colonies at Brushy Mountain and the E side of Ute Mountain but did not confirm those. Half of the nests found in 2018 were apparently old nests. Old nests are reliable indicators of the location of a traditional nesting colony area. Because our survey time was limited, the nests we found do not provide a complete picture of the temporal or spatial extent of nesting for this year. Our impression was that only a portion of the flocks we detected were nesting in 2018, and nesting apparently commenced later than usual. Pinyon Jays are reported to nest later in spring after a poor piñon crop the previous fall (Balda 2002), and nesting may be light or nonexistent when conditions are especially poor (Ligon 1978).

In addition to piñon seeds, Pinyon Jays take other pine seeds, acorns, juniper berries, arthropods, and small vertebrates (Balda 2002). We attributed the low number of active 2018 nests to low moisture over the winter and spring of 2017-2018, resulting in limited food availability. We did not observe a 2017 piñon mast crop at any of the colony sites or any indication (small green cones) that 2018 would produce a mast crop. Insect activity also appeared to be quite low during our surveys. Pinyon Jays are long-lived and have lasting pair bonds. If conditions are poor for nesting, it may benefit them to postpone nesting until conditions improve. However, we did find 2018 nests at all colony sites, which suggests that at least some Pinyon Jays attempted to nest, even though environmental conditions may have been sub-optimal. Although our surveys probably did not detect all nests at any site, the colonies we found (except for those at North Guadalupe Mountain and Ute Mountain) appeared to be small relative to others we have studied around New Mexico (Johnson et al. 2014, 2015, 2017c). We expect the jays will continue to nest at these sites in the future, and colonies may be larger if food availability in spring is more conducive to successful nesting.

Tree Density, Treated vs. Untreated

Tree size and density did not change significantly between 2011 and 2018 on untreated plots, but the 2018 treatment resulted in an average 87% reduction in tree density (Figures 6, 7). Pinyon Jays typically nest in areas of relatively high tree density (Figure 7). Mean tree density at 0.04-ha plots around nests at nine colony sites in New Mexico in piñon-juniper habitat was 884 trees ha^{-1} (range 75-2725 trees ha^{-1}, N=140 nests; Johnson et al. 2014, 2015, 2017b). The untreated areas at North Guadalupe Mountain therefore contained typical, suitable Pinyon Jay nesting habitat (1349 trees ha^{-1}), roughly six times the mean tree density in the treated areas 212 (trees/ha).

Although trees of suitable size for nesting were still present after treatment, canopy cover, an important covariate of Pinyon Jay nesting habitat (Johnson et al. 2014, 2015), was correspondingly reduced. In undisturbed piñon-juniper woodlands in New Mexico, Pinyon Jays tend to place their nests within clumps of trees having higher canopy cover than the surrounding

woodland (Johnson et al. 2014, 2015). The treatment removed clumps of trees, leaving mainly single, isolated trees. The few scattered clumps left standing were much smaller and contained smaller patches of canopy than is typical in Pinyon Jay nesting colonies (K. Johnson pers. obs.).

Pinyon Jay Nesting in Treated vs. Untreated Areas

In 2017, we found 42 old and current nests within the traditional colony site on North Guadalupe Mountain. Eleven of these were within polygons that were subsequently treated in early 2018. Pinyon Jays did not nest in these or any other treated areas in 2018. The reduction in tree density and Pinyon Jay avoidance of treated areas indicate that treated areas became unsuitable nesting habitat as a result of the treatment.

Pinyon Jays nest colonially at traditional colony sites. They tend to be faithful to colony sites, but they will move colonies several hundred meters (Marzluff and Balda 1992, Johnson et al. 2017a), sometimes in response to declining habitat condition (Johnson et al. 2017a). Although persistent piñon-juniper habitat may appear to be widespread and abundant throughout the Southwest, the specific features of colony sites represent a limited subset of available persistent piñon-juniper woodland (Johnson et al. 2016).

Because of the Pinyon Jay's colonially nesting habit, a colony site must be large enough to accommodate all nesting pairs (Johnson et al. 2014, 2015). By greatly reducing tree density within a traditional colony site, the treatment at North Guadalupe Mountain affected not only the area within the treatment polygons; it also fragmented the remaining suitable nesting habitat at the traditional colony site (Figure 4). One section on the E side is separated from the rest of the colony site by two adjacent treatment polygons, and the remaining habitat on the W side is partially fragmented by a treatment, leaving a U-shaped area where a large contiguous area of habitat formerly existed. In fragmented forests, reduction of habitat patch size and corresponding increase in edge ratio of patches can lead to increased nest predation and decreased nest success (Andren 1994, Huhta et al. 2004, Zuckerberg et al. 2018). Reduced patch size and increased distance between patches contribute to population decline and loss of biological diversity beyond that caused by habitat loss alone (Andren 1994). Reductions in tree density, canopy cover, and patch size (increased fragmentation) in treated areas apparently reduced habitat quality such that Pinyon Jays avoided nesting in treated areas.

Figure 6. Two areas treated in early 2018, North Guadalupe Mountain.

Figure 7. Two untreated areas, North Guadalupe Mountain, 2018.

Management Recommendations

Pinyon Jays are a New Mexico BLM Sensitive Species. BLM policy stipulates that BLM will conserve the habitat of BLM Sensitive Species, minimize or eliminate threats to these species, and achieve no net loss of their habitats (USDI BLM 2012a, b). The treatment at North Guadalupe Mountain appears to have run counter to BLM policy on BLM Sensitive Species. The treatment occurred in part because contracting for the treatment was completed before the Pinyon Jay nesting colony was discovered in 2018. This timing rendered 21% of a traditional Pinyon Jay nesting colony site unsuitable for nesting.

Survey results reported here provide baseline information that could be applied to management of Pinyon Jays and their piñon-juniper wildlife habitats at Rio Grande del Norte National Monument. We recommend the management approaches below. In addition, we are available for consultation on planning woodland management for Pinyon Jay management and other purposes such as wildfire threat.

1. Continue to survey and monitor nesting colonies and foraging habitat for Pinyon Jays in potential habitat at Rio Grande del Norte National Monument. Additional surveys are especially needed to confirm nesting at Brushy Mountain and E Ute Mountain.
2. To identify areas of potential, unoccupied Pinyon Jay nesting habitat for management, consult existing literature on Pinyon Jay habitat requirements (Johnson et al. 2014, 2015, 2017a) and/or expert researchers.
3. Avoid any treatments within and surrounding (See 4. below) known, delineated Pinyon Jay nesting colonies. Treatments within colony boundaries can fragment traditional nesting colony sites and impact suitability of remaining habitat patches.
4. Avoid any treatments for a minimum of 600 m surrounding the center of known, delineated Pinyon Jay nesting colonies. The buffer is recommended because the boundaries of Pinyon Jay nesting colonies are known to shift between years (Johnson et al. 2017a). In one study, colony locations shifted around a 100-ha area over a 14-year period (Marzluff and Balda 1992); a 600-m-radius area would conserve just over 100 ha of habitat for colony movement. The data presented here suggest that Pinyon Jays will continue to use untreated areas near treated sites if sufficient suitable, un-fragmented habitat remains nearby; hence, if a treatment must occur in the vicinity of a Pinyon Jay nesting colony, slightly shifting the locations of areas targeted for treatment away from traditional colony sites could conserve essential nesting habitat while achieving fuels management goals.
5. In areas near Pinyon Jay colonies to be treated for fuels reduction, leave untreated areas of at least 50 ha (Johnson et al. 2014, 2015, 2016) within 1 km, to provide alternative colony sites, in case of fire, insects, disease, or other impacts to nesting habitat at the traditional colony site.
6. If Pinyon Jay nesting colonies must be treated to protect structures, follow prescriptions regarding approaches to thinning that will minimize impact to Pinyon Jays. For example,

consider creating firebreaks around structures in lieu of large-scale thinning of the woodland.

7. Pinyon Jays typically nest near surface water. Wildlife watering stations maintained within 1 km of traditional nesting colonies would likely benefit nesting Pinyon Jays.
8. Reductions in tree density at the scale that occurred at North Guadalupe Mountain are likely to impact many species of piñon-juniper wildlife besides Pinyon Jays. Assessment of impacts of treatments on other key piñon-juniper wildlife species should be standard procedure.
9. Before conducting treatments, consider historical fire regimes within persistent piñon-juniper woodlands (Romme et al. 2009). Historical fire intervals in these woodlands do not imply that thinning is indicated for "restoration" of the woodlands or wildlife habitat management.

Acknowledgments

We thank Valerie Williams, formerly of the Taos BLM Field Office, for her support, including finding funding (under BLM assistance agreement L17AC00151) and providing logistical support for field work. Esteban Muldavin provided access to tree data from his 2011 study. Brian Long and Brittany Zengerly helped with field work. Zoe Davidson, Pam Herrera, and Marikay Ramsey of BLM and Jonathan Hayes of New Mexico Audubon Society provided helpful comments on an earlier draft of this report.

Literature Cited

Andren, H. 1994. Effects of habitat fragmentation on birds and mammals in landscapes with different proportions of suitable habitat: a review. Oikos 71:355-366.

Balda, R. P. 2002. Pinyon Jay (*Gymnorhinus cyanocephalus*), *in* The Birds of North America Online (A. Poole, ed.), no. 605. Cornell Lab Ornithol., Ithaca, NY; http://bna.birds.cornell.edu/bna/species/605.

Boone, J. D., E. Ammon, and K. Johnson. In press. Long-term declines in the Pinyon Jay and management implications for piñon–juniper woodlands. I*n* W. D. Shuford, R. E. Gill Jr., and C. M. Handel, editors. Trends and traditions: Avifaunal change in western North America (Studies of Western Birds 2. Western Field Ornithologists, Camarillo, CA).

Breshears, D. D., N. S. Cobb, P. M. Rich, K. P. Price, C. D. Allen, R. G. Balice, W. H. Romme, J. H. Kastens, M. L. Floyd, J. Belnap, J. J.Anderson, O. B. Myers, and C. W. Meyer. 2005. Regional vegetation die-off in response to global-change-type drought. Proceedings of the Academy of Natural Sciences USA 102:15144.

Breshears, D. D., O. B. Myers, C. W. Meyer, F. J. Barnes, C. B. Zou, C. D. Allen, N. G. McDowell, and W. T. Pockman. 2008. Tree die-off in response to global change-type drought: Mortality insights from a decade of plant water potential measurements. Frontiers in Ecology and Environment 7:185.

Clifford, M.J., Cobb, N.S., Buenemann, M. 2011. Long-term tree cover dynamics in a pinyon-juniper woodland: Climate-change-type drought resets successional clock. Ecosystems 14: 949–962.

Cole, K. L., K. E. Ironside, S. T. Arundel, P. Duffy, and J. Shaw. 2008. Modeling future plant distributions on the Colorado Plateau: An example using *Pinus edulis*. in The Colorado Plateau III. Integrating Research and Resources Management for Effective Conservation. (C. van Riper III, M. K. Sogge, editors).The University of Arizona Press, Tucson, AZ.

de Mendiburu, F. 2017. Agricolae: statistical procedures for agricultural research. R package version 1.2-8.

Esri 2015. ArcGIS Desktop: Release 10. Environmental Systems Research Institute, Redlands, CA.

Fair, J. M., C. Hathcock, and A. W. Bartlow. 2018. Avian communities are decreasing with piñon pine mortality in the southwest. Biological Conservation 226:186-195.

Forcella, F. 1981. Ovate cone production in piñon: Negative exponential relationship with late summer temperature. Ecology 62:488-491.

Holm, S. 1979. A simple sequentially rejective multiple test procedure. Scandinavian Journal of Statistics 6:65-70.

Huhta E., T. Aho, A. Jäntti, P. Suorsa, M. Kuitunen, A. Nikula, and H. Hakkarainen. 2004. Forest fragmentation increases nest predation in the Eurasian treecreeper. Conservation Biology 18:148–155.

IUCN. 2018. The IUCN Red List of Threatened Species. Version 2018-1. http://www.iucnredlist.org. Accessed 29 August 2018.

Johnson, K. and G. Sadoti. Transferability of Pinyon Jay Nesting Habitat Models and Implications for Woodland Management. Ms. in revision.

Johnson, K., L. Wickersham, J. Smith, G. Sadoti, T. Neville, J. Wickersham, and C. Finley. 2014. Habitat use at multiple scales by pinyon-juniper birds on Department of Defense lands III: Landscape, territory/colony, and nest scale. Natural Heritage New Mexico Report 14-GTR-38. Biology Department, University of New Mexico, Albuquerque, NM. https://nhnm.unm.edu/sites/default/files/nonsensitive/publications//Year%203%20Legacy%20FINAL2.pdf

Johnson, K., L. Wickersham, J. Smith, N. Petersen, and J. Wickersham. 2015. Nest-scale Habitat Use by Pinyon Jay and Gray Vireo in the BLM Farmington Resource Area 2013− 2014. Natural Heritage New Mexico Report GTR-15-386. Biology Department, University of New Mexico, Albuquerque, NM. https://nhnm.unm.edu/sites/default/files/nonsensitive/publications//FINAL%202014%20BLM%20P-J%20%20report.pdf

Johnson, K., T. B. Neville, J. W. Smith, and M. W. Horner. 2016. Home range- and colony-scale habitat models for Pinyon Jays in piñon-juniper woodlands of New Mexico, USA. Avian Conservation and Ecology 11(2):6. http://dx.doi.org/10.5751/ACE-00890-110206 Copyright © 2016 by the author(s). Published here under license by the Resilience Alliance.

Johnson, K., G. Sadoti, and J. Smith. 2017a. Weather-induced declines in piñon tree condition and response of a declining bird species. Journal of Arid Environments 146:1-9.

Johnson, K., M. Horner, P. Neville, T. Neville, N. Petersen, J. Smith, and L. Wickersham. 2017b. Landscape-scale habitat map for Pinyon Jay and Gray Vireo at Farmington BLM Resource Area. Natural Heritage New Mexico Report #17-401. Biology Department, University of New Mexico.

Johnson, K., N. Petersen, J. Smith, and V. Williams. 2017c. Surveys for Nesting Pinyon Jays at Rio Grande del Norte National Monument 2017, final report. Natural Heritage New Mexico Report GTR-17-402. Biology Department, University of New Mexico, Albuquerque, NM.

Ligon, J. D. 1978. Reproductive interdependence of Piñon Jays and piñon pines. Ecological Monographs 48:111-126.

Marzluff, J. M., and R. P. Balda. 1992. The Pinyon Jay: behavioral ecology of a colonial and cooperative corvid. T. & A. D. Poyser, London, U.K.

McDowell, N., A. Williams, C. Xu, W. Pockman, L. Dickman, S. Sevanto, R. Pangle, J. Limousin, J. Plaut, and D. Mackay. 2016. Multi-scale predictions of massive conifer mortality due to chronic temperature rise. Nature Climate Change 6:1048.

Natural Heritage New Mexico and Hawks Aloft, Inc. 2011. Pinyon-juniper woodlands of the Wild Rivers Recreation Area, vegetation composition, structure, and bird diversity, monitoring report I. Report submitted in partial fulfillment of BLM assistance agreement L09AC15871. Natural Heritage New Mexico, Museum of Southwestern Biology, University of New Mexico, Albuquerque, NM; and Hawks Aloft, Inc., Albuquerque, NM.

New Mexico Department of Game and Fish. 2017. State Wildlife Action Plan for New Mexico. New Mexico Department of Game and Fish, Santa Fe, New Mexico, USA.

Partners in Flight. 2017. Avian Conservation Assessment Database, version 2017. http://pif.birdconservancy.org/ACAD . Accessed on 29 August 2018.

Redmond, M.D., F. Forcella, and N. Barger. 2012. Declines in pinyon pine cone production associated with regional warming. Ecosphere 3: 1–14.

Romme, W. H., C. D. Allen, J. D. Bailey, W. L. Baker, B. T. Bestelmeyer, P. M. Brown, K. S. Eisenhart, M. L. Floyd, D. W. Huffman, B. F. Jacobs, R. F. Miller, E. H. Muldavin, T. W. Swetnam, R. J. Tausch, and P. J. Weisberg. 2009. Historical and modern disturbance regimes, stand structures, and landscape dynamics in piñon-juniper vegetation of the western United States. Rangeland Ecology and Management 62:203-222.

Sauer, J. R., D. K. Niven, J. E. Hines, D. J. Ziolkowski, Jr., K. L. Pardieck, J. E. Fallon, and W. A. Link. 2017. The North American Breeding Bird Survey, Results and Analysis 1966 - 2015. USGS Patuxant Wildlife Research Center, Laurel, MD.

USDI Bureau of Land Management. 2012a. Special status species management. Revision of Manual 6840, the special status species management manual for the Bureau of Land

Management, Release 6-125, supersedes release 6-121. US Department of the Interior Bureau of Land Management. https://www.blm.gov/sites/blm.gov/files/uploads/mediacenter_blmpolicymanual6840.pdf

USDI Bureau of Land Management. 2012b. Taos resource management plan. BLM/NM/PL-12-09-1610. https://eplanning.blm.gov/epl-front-office/projects/lup/68121/86167/103325/Approved_Taos_RMP_-_5.16.12_(print_version).pdf

US Fish and Wildlife Service. 2008. Birds of Conservation Concern 2008. United States Department of Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Arlington, Virginia. 85 pp. Accessed online at http://www.fws.gov/migratorybirds/NewReportsPublications/SpecialTopics/BCC2008/BCC2008.pdf.

Venkatraman, E. S. 2018. Clinfun: Clinical Trial Design and Data Analysis Functions. R package version 1.0.15.

Zlotin, R. I. and R. R. Parmenter. 2008. Patterns of mast production in pinyon and juniper woodlands along a precipitation gradient in central New Mexico (Sevilleta National Wildlife Refuge). Journal of Arid Enviroments 72: 1562.

Zuckerberg, B., C. Rebec, and L. A. McCauley.2018. Effects of temperature and precitpitation on grassland bird nesting success as mediated by patch size. Conservation Biology. 6 Feb 2018. https://doi.org/10.1111/cobi.13089.

Appendix

Appendix 1. Pinyon Jay survey dates and locations, 2018.

Survey Site	Observer	Date	PIJA Detections	Location	Notes
North Guadalupe	NP	3/14/2018	None	Polys A, B	Treatments delineated
Off TP 244, 247	NP		None		
South Guadalupe	NP		None		Guadalupe Trails
North Guadalupe	NP	3/15/2018	None	Polys C, D	
		3/26/2018	None	Polys E, F, G, H	
		3/27/2018	50 PIJAs	Near poly F	Flying over sagebrush, rattle calls
			Pair PIJAs, several others	Near poly G	Pair with nesting material, others calling
			Pair	Edge of poly H	With nesting material, flying S
			50+ PIJAs	Near South Guadalupe Colony	In sagebrush, rattle calls
Ute Mountain, N side	NP	3/28/2018	None		
South Guadalupe Colony	NP	4/3/2018	None		
Wild Rivers	NP		None		
North	JS		3 PIJA nests		Inc!10m N - incubating

Guadalupe				
			2 old PIJA nests	Old
Ute Mountain, NE	NP, JS	4/4/2018	12 PIJAs	Flew S to W
			2 PIJA	Flew N, then met with flock
			10 PIJA	Flew E, calls to E, SE in sagebrush
Ute Mountain, N	NP, JS		Several old nests	
Ute Mountain, NE	NP, JS	4/5/2018	1 PIJA	Flew out of P-J to sagebrush, E
			Pair PIJA	Building nest
			80 PIJA	Flock flew to colony site
Ute Mountain, NW			4 PIJA	2-3 flew into trees NW
North Guadalupe	NP, JS	4/6/2018	30 PIJAs	Flew over old colony site
North Guadalupe, W	JS		None	
South Guadalupe near colony	NP		None	
North Guadalupe	JS, KJ	4/9/2018	PIJA nests	4/3 nest still active; found 3 old nests
Ute Mountain, N	JS, KJ	4/10/2018	PIJA flock	Colony site, flying, alarm calling
			PIJA nests	5 partial nests (starts), 2 new active, 15 old
Cerro Chiflo, N	NP	4/16/2018	None	
Cerro de la Olla, N	NP		1 PIJA	Flew SW from P-J to NE sagebrush

			1 PIJA	Flew from NW, alarm calls
			3 nests	1 active, 2 old
Cerro de la Olla, N, colony	NP	4/17/2018	Begging, alarm calls	
Cerro Chiflo, SW	NP	4/18/2018	30+ PIJA	In sagebrush, rattle calls
			Active nest	Bird lining nest
			Pairs	Pair begging, other in 2s and 3s
			20 PIJAs	In sagebrush; more activity W of searched area
Cerro Montoso	NP	4/22/2018		
		4/23/2018		
North Guadalupe	JS, KJ	4/23/2018	Colony	PIJAs coming in to colony site
			Nests	2 old, 4 2018, 6 possible nest starts
South Guadalupe	JS, KJ	4/24/2018	PIJA	PIJA activity in new colony site
			Nests	5 nests, potentially active; 1 nest ?
Cerro de la Olla, SW			5 PIJA	Alarm calling, RTHA; 3 continue to fly for 30+ min
Cerro de la Olla, SW	NP	4/24/2018	35 PIJA	Foraging in sagebrush, flew to PIED, returned to sage after 20 min.
Cerro Chiflo, Colony	NP		1 old? nest	Unlined
	NP		30+ PIJA	Flew in from sagebrush and out

Brushy Mountain	NP	4/25/2018	PIJA nest	1 nest
			1-2 PIJA	Calling in sagebrush
			Larger flock	Heard to N
Cerro Chiflo Colony	NP	5/3/2018	Nest start	
			10-20 PIJA	Flew in, begging
Cerro de la Olla North Colony	NP		40 PIJA	Flew from sagebrush to colony at dusk
Cerro de la Olla North Colony	NP	5/4/2018	PIJA nests	1 active, 2 old
Brushy Mountain	NP		12-15 PIJA	Flew over
Cerro Chiflo Colony	NP		PIJA nests	2 old in PIED
Cerro de la Olla South Colony	NP	5/5/2018	Nests	7 nests; 4 old, 3 possibly 2018
North Guadalupe	NP, JS, KJ, BZ	5/14/2018-5/15/2018	Treated and untreated points	Collected tree size and distance data
			Nest 12	Active, female flushed