Pinyon Jay Surveys in the Rio Grande del Norte National Monument 2021

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Executive Summary

The Pinyon Jay (*Gymnorhinus cyanocephalus,* Jay) is an obligate species of western U.S. pinyon-juniper woodlands (*Pinus* spp. and *Juniperus* spp., P-J) in a mutualistic relationship with pinyon pines. Pinyon pines depend on the Pinyon Jay, as they are the primary dispersal agent of pinyon pine seeds, and are specialized in the seeds' harvest, transport, and planting (Johnson and Balda 2020). Pinyon Jays depend on pinyon pine seeds, especially in the fall and winter when they rely on cached stores. However, over the last 50 years, the Pinyon Jay population has declined more than 50%, one of the steepest declines of any landbird species (Sauer et al. 2017, Rosenberg et al. 2019), and is in need of threat identification and priority conservation action for the species and the P-J habitat the species depends upon (Boone et al. 2018).

Within the Rio Grande del Norte National Monument (RGdNNM, Monument) Pinyon Jays are found year-round and a clear need exists for spatially explicit occupancy estimates, and the identification breeding colony locations to inform the pressing conservation needs of the declining species. This study aimed to meet three goals to aid in P-J management for Pinyon Jays with in the RGdNNM.

1. Estimate Pinyon Jay occupancy within the surveyed 2.5 km^2 sample units of appropriate P-J habitat
2. Estimate Pinyon Jay occupancy within proposed fuel reduction treatment areas (areas designated to be thinned in the future).
3. Locate and map Pinyon Jay breeding colony locations

RGdNNM pinyon-juniper habitat was divided into forty-five sample units, thirty-eight of which we successfully surveyed three times each, from March 10 to May 10, following the Pinyon Jay survey protocol (PIJA WG 2021a). Proposed treatment areas were surveyed up to eight times each. Pinyon Jays were easily detected and found in 95% (36 of 38) surveyed sample units on at least one survey visit. Pinyon Jay flocks were regularly observed flying long distances and travelling between sample units.

Four potential treatment areas were surveyed three to eight times each to assess Pinyon Jay occupancy. The South Wind Mountain WUI Thinning area and Wild Rivers Recreation Area WUI thinning areas, each had single Pinyon Jay observations on only one visit and do not appear to contain breeding colonies. Within the Cerro WUI Thinning Area Phase II (found on North Guadalupe Mountain) we found three breeding colonies (two confirmed and one estimated) and four breeding Pinyon Jay colonies (three confirmed and one estimated) were found in the Cerro de la Olla Thinning areas.

In total, 28 active nests were found spread over 15 confirmed breeding colonies; 5 additional estimated Pinyon Jay colonies with suspected breeding were also found within the RGdNNM, though no nesting was confirmed at these locations. Colonies were found on Ute Mountain, Cerro de la Olla, Cerro del Aire, North Guadalupe Mountain, South Guadalupe Mountain, the Wissmath Crater area, and Horsethief Mesa. We suspected additional colonies (estimated colonies) on Cerro de la Olla, North Guadalupe Mountain, South Guadalupe Mountain, and Horsethief Mesa. No colonies were found on Cerro Montoso or in the Wild Rivers Area. Nesting activity was verified in confirmed colonies with visual observations of nest building, nest incubation, and nests with nestlings. Whereas estimated colony designation relied on observations of begging vocalizations and additional breeding behavioral cues, such as jays with nest material, and repeated flights indicating nest attendance (Petersen et al. 2014). Cerro de la Olla, also known as Pot Mountain, appears to contain the highest density of Pinyon Jays and breeding colonies within the RGdNNM. Four colonies were found here, and an additional colony suspected.

Most woodland treatments involve thinning with goals including fuels reduction, reduction of juniper to increase grass and forbs for game and cattle, management for other wildlife species, and watershed restoration (Somershoe et al. 2020). Current P-J woodland treatment management recommendations to minimize impacts to Pinyon Jays (Somershoe et al. 2020) are presented at the conclusion of this report.

Introduction

The Pinyon Jay (*Gymnorhinus cyanocephalus*, jay, PIJA) is a highly social corvid, obligate species of pinyon-juniper woodlands (*Pinus* spp. and *Juniperus* spp., P-J), and has a mutualistic relationship with pinyon pines. Pinyon pines depend on the Pinyon Jay as they are the primary dispersal agent of pinyon pine seeds, and are specialized in the seeds' harvest, transport, storage (planting), and retrieval (Johnson and Balda 2020). Whereas, Pinyon Jays are dependent on the highly nutritious pinyon pine seeds, especially in the fall and winter when they rely on cached stores.

Over the past century the Pinyon Jay has experienced significant population declines and the causes are poorly understood (Johnson and Balda 2020). The Pinyon Jay has risen to the top of various lists of conservation concern and has been listed as "Vulnerable" on the Red List of Threatened Species by the International Union for Conservation of Nature (IUCN 2021), as a Bird of Conservation Concern both continentally and at the Bird Conservation Region scale (U.S. Fish and Wildlife Service 2017), as a Yellow Watch List Species by Partners in Flight (Rosenberg et al. 2016), and is recognized by the NM Department of Game and Fish as a Species of Greatest Conservation Need (SGCN, NMDGF 2016). The Pinyon Jay has suffered range-wide declines of over 3% annually and >50% population loss over the last 50 years (Sauer et al. 2017, Rosenberg et al. 2019); one of steepest declines of any landbird species in western U.S., highlighting the need for threat identification and priority conservation action for the species and the P-J woodlands the species depends upon (Boone et al. 2018). Additionally, P-J habitats support many obligate and semi-obligate avian species in New Mexico, and contribute substantially to landscape-level avian diversity (Paulin 1999).

P-J woodlands (Romme et al. 2009) are the most common forest type in the Southwest and most abundant forest type in New Mexico, with over 8.8 million acres comprising 53% of the forested land in NM (O'Brien 2003). These P-J woodlands vary in structure and vegetation composition across regions, elevational gradients, soil types, and climate conditions, but are commonly classified in to one of three categories: persistent woodlands, wooded shrublands or savannas (Romme et al. 2009, see Table 1). Across the western U.S., P-J habitats have experienced varying levels of expansion, mortality, and changes in tree density and age structure, attributed to interacting processes and impacts including past disturbance, current treatments, fire exclusion, grazing, insect outbreaks, wildfires, and drought (Romme et al. 2009). Concurrent with the Pinyon Jay's dramatic decline, large pinyon pine die-offs related to climate stressors (drought and insect outbreaks) have occurred in the southwest, including throughout New Mexico

(Breshears et al. 2005) and models predict large-scale mortality events into the future that may drastically reduce the availability of these woodlands (Fair et al. 2018, McDowell et al. 2016). Management of P-J woodlands is often directed towards minimizing wildfire impacts through fuel reduction, enhancing the habitat for wildlife, and creating or improving rangeland using various treatments including thinning, prescribed fire, herbicide, and P-J removal (Somershoe et al. 2020). Given these large-scale and fine-scale P-J woodland changes, there exists a clear need to better understanding habitat requirements and preferences for Pinyon Jays and other P-J birds which are poorly understood. While multiple Pinyon Jay studies have been completed in New Mexico (e.g. Johnson et al. 2016), additional information is still needed to develop and refine sound strategies for management and conservation (Somershoe et al. 2020).

Table 1. Three general types of pinyon-juniper woodlands identified by Romme et al. (2009). Persistent pinyon-juniper woodlands, and Wooded shrublands are the primary P-J Woodland types found within the RGdNNM.

Pinyon-Juniper Vegetation Types	Description
Persistent pinyon–juniper woodlands	Ranging from sparse to dense tree stands growing on poor to productive sites with variable cover of shrubs, forbs and grasses. Most commonly found on rugged uplands with shallow, coarse soil, and with sparse herbaceous understory cover and extensive litter or bare ground.
Wooded shrublands	Variable tree component from very sparse to relatively dense. Well-developed shrubs are the dominant understory plants; sagebrush (*Artemisia* spp.) are often the dominant shrub.
Pinyon–juniper savannas	Low to moderate tree density with a well-developed and nearly continuous grass and forb understory on coarse- to fine-textured soils. *Juniperus* spp. are often the dominant tree sp. and *Pinus* spp. may be infrequent or absent.

Within the Rio Grande del Norte National Monument (RGdNNM, Monument), Pinyon Jays are found year-round, and are generally observed in P-J woodlands found on volcanic cones and the adjacent sagebrush plains. They most often synchronously nest in loose breeding colonies, often tens of hectares in size, and show moderately strong site fidelity by returning to breed in the same general area in subsequent years (Johnson and Balda 2020). P-J woodlands within the Monument are subject to multiple resource use as well as management activities including hazardous fuels reduction, improvement of forest health, and providing for public fuelwood harvest. To address wildfire risk, fuel-reduction treatments involving the removal of trees and understory have been implemented within the RGdNNM, and future treatments are planned for

pinyon-juniper habitats (up to 4,000 acres over the next 10 years). In 2017, within the Monument, a fuel-reduction treatment overlapped portions of an occupied Pinyon Jay colony (Johnson et al. 2018). Post thinning, in 2017, Pinyon Jays did not use the treated areas, but were observed in adjacent trees (Johnson et al. 2018). In 2018, nests were not found in the previously treated area, but were located in the surrounding area (mean nest distance from treatment site was 54 m, Johnson et al. 2018). The longer-term impacts within and adjacent to this treatment area are not known. Because the impacts of P-J management activities on Pinyon Jay occupancy and breeding are largely unknown (but see Johnson et al. 2020, Bombaci and Pejchar 2016), it is important to identify the birds' level of tolerance to various management activities, including both short and long-term impacts.

This study aimed to meet three goals to aid in P-J management for the Pinyon Jay with in the RGdNNM.

1. Estimate Pinyon Jay occupancy within the surveyed 2.5 km^2 sample units of appropriate P-J habitat
2. Estimate Pinyon Jay occupancy within proposed fuel reduction treatment areas (areas designated to be thinned in the future).
3. Locate and map Pinyon Jay breeding colony locations

Ultimately, this research can be used to ensure that current management strategies do not contribute to the decline of at-risk avian species, as well as inform the implementation of conservation and management actions to maintain and improve P-J habitats for Pinyon Jay communities; these are high priorities for the U.S. Fish and Wildlife Service (USFWS), Bureau of Land Management (BLM), U.S. Forest Service (USFS), and New Mexico Department of Game and Fish (NMDGF).

Methods

Study Areas. Occupancy surveys and nesting colony searches were conducted within suitable habitat the Rio Grande del Norte National Monument (RGdNNM) located in Taos County in northern New Mexico (Figure 1). The RDdNNM encompasses 50,160 forested acres, primarily pinyon-juniper woodlands mainly found on volcanic cones rising above sagebrush and short grass plains. On north facing slopes and on the highest elevations, ponderosa pine and Douglas fir (*Psuedotsuga menziesii*) can be found, with sparse stands of quaking aspen (*Populus tremuloides*) in deep drainages. The pinyon-juniper habitats include a mix of persistent woodlands and wooded shrublands (Romme et al. 2009).

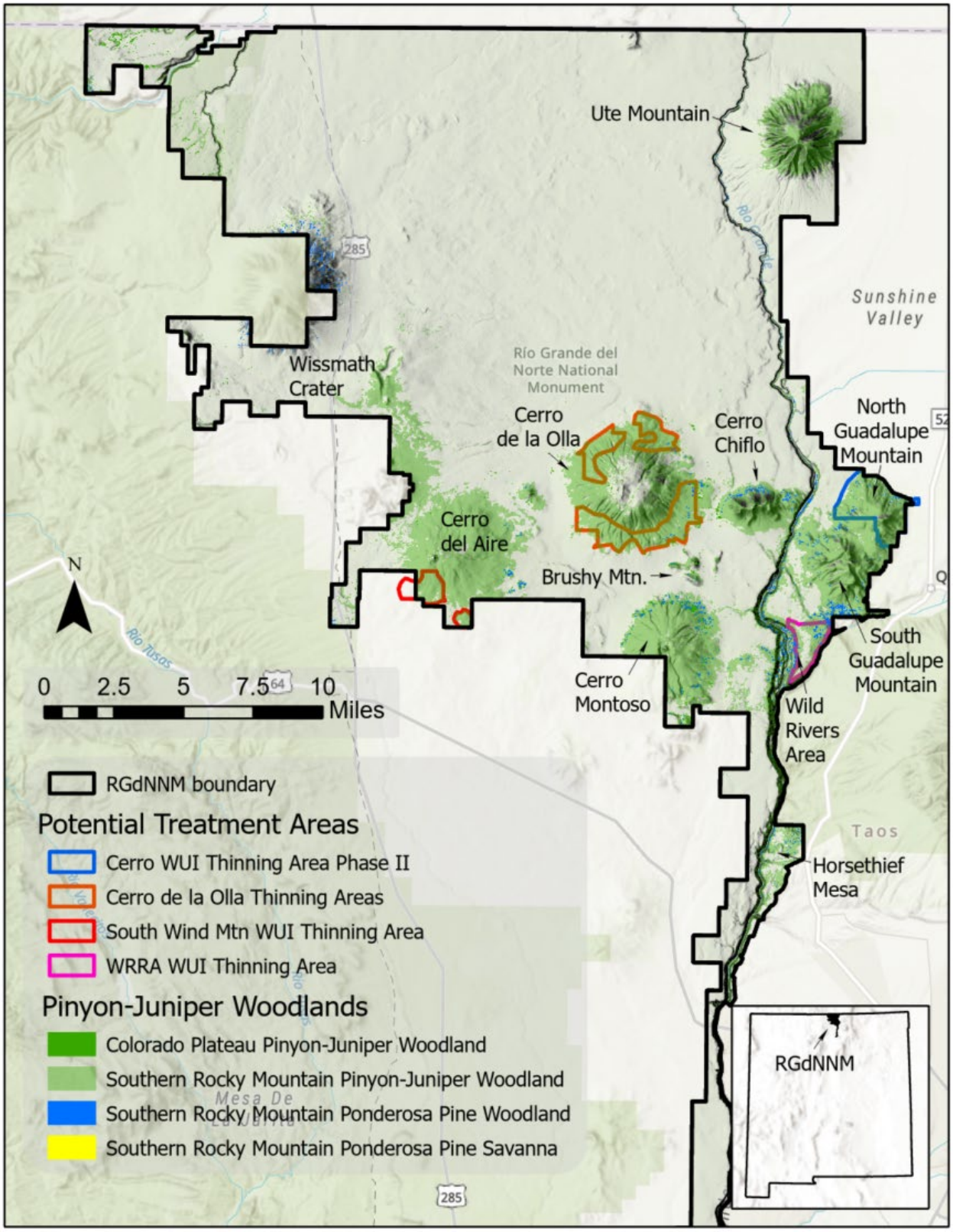

Figure 1. Rio Grande del Norte National Monument study area showing the pinyon-juniper woodlands (modeled by Landfire 2016 data) and potential treatment areas.

Pinon Jay surveys

In developing the survey sampling frame, using ArcPro 2.5 (ArcGIS Pro 2020), we first identified suitable P-J woodland habitat using the following Landfire Existing Vegetation Type layers (Landfire 2016): Colorado Plateau Pinyon-Juniper Woodland, Southern Rocky Mountain Pinyon-Juniper Woodland, Southern Rocky Mountain Ponderosa Pine Woodland, and Southern rocky Mountain Ponderosa Pine Savanna (Figure 1). The majority of the P-J woodland habitat within the RGdNNM was modeled as Southern Rocky Mountain Pinyon-Juniper Woodland (light green in Figure 1). We overlaid a grid comprised of the recommended 2.5 km x 2.5 km grid cell size aligned with the Universal Transverse Mercator (UTM) grid (Pinyon Jay WG 2021b) over the RGdNNM. Sample units not accessible by road, containing less than 10% modeled P-J woodland habitat; and those dominated by privately owned land were excluded from the sampling frame. The remaining sample units (n = 45 sample units) were ranked using a Generalized Random Tesselation Stratified analysis (GRTS) using the SPSurvey Package (Kincaid et al 2019) in R 4.0.1 statistical software (R Core Team 2020).

Because the revised survey protocol (PIJA WG 2021a) was new and mostly untested in 2021, we were uncertain how many sample units our field crew could completely survey. Field staff were directed to survey the 35 highest-ranked sample units three times each from early-March to mid-May. This included all sample units with previously documented breeding colonies (n = 7 sample units, Johnson et al. 2018), and all sample units containing potential treatment polygons (n = 14 sample units). Additionally, field staff were instructed to survey the habitat within the potential treatment polygons (n = 7 treatment polygons, Figure 1) up to 5 times each to attain high confidence of the Pinyon Jay occupancy of these areas. The remaining 14 high-ranked samples units were of unknown occupancy.

Pinon Jay surveys were conducted following the most recent Pinyon Jay Working Group guidelines (PIJA WG 2021a) to locate Pinyon Jays in our sample units. Key elements of the updated survey protocol, designed to collect Pinyon Jay presence (occupancy) data, include:

1. Surveys conducted within discrete sample units
2. 1-3 visits within each sample unit
3. Standardized plot surveys conducted using area searches or point counts

Previously, road-based surveys were the preferred Pinyon Jay survey method, as they allow for increased coverage within an area, but conversely provided limited ability for standardized per plot survey effort comparisons (PIJA WG 2021a). The primary survey protocol objective (PIJA WG 2021a, 2021b) is to determine Pinyon Jay presence within an area of interest by completing

three full area searches during the breeding season, at least 7-10 days apart. We conducted three walking area searches, spaced accordingly, to assess P-J habitat occupancy within sample unit grid cells from early March to early-May. If three areas searches fail to detect Pinyon Jay, it is likely that they are not nesting within the area (PIJA WG 2021a).

Occupancy surveys were conducted when Pinyon Jays were most active, primarily from dawn to noon and surveys were not conducted during poor weather conditions when Pinyon Jay activity and detectability declined (during moderate to heavy rain, snow, or wind). As per the protocol recommendations (PIJA WG 2021a), surveyors aimed to attain complete coverage of the sample unit by walking within 500m of all wooded P-J habitat in the sample unit. Variable and difficult terrain often required alternate coverage strategies, such as walking along ridges to increase Pinyon Jay detectability from high viewpoints, and walking open roads and flatter terrain (e.g. sagebrush flats) adjacent to dense and rugged slopes. Surveyors passively searched and listened for Pinyon Jays. Call broadcast recordings were not used (and are no longer recommended by the survey protocol) as Pinyon Jay vocalizations are often loud and they can be detected from up to a kilometer away (Johnson and Balda 2020). An occupancy survey of a sample unit was completed if the sample unit was adequately covered (see above) or if Pinyon Jays were detected. If Pinyon Jays were detected during a survey, when possible, field staff watched and followed them to identify breeding colony locations. If Pinyon Jays were detected and unable to be followed, surveyors were instructed to initiate a new survey within an adjacent or nearby sample unit if a new survey could be completed before noon.

Breeding Colony Identification

Survey and incidental Pinyon Jay observations were used to narrow our search for Pinyon Jay breeding colonies. Pinyon Jay breeding colony locations identified by Johnson et al. (2018), hereafter referred to as historical colonies, were also visited to assess their current activity status.

When a suspected colony location was identified, field staff watched the area from afar, tracking jay movements and watching and listening for breeding cues, such as courtship chases, pairs moving separately from the flock, birds carrying nest material or food, repeated flights to the same tree or trees, and begging chirr calls (PIJA WG 2021b), to pinpoint potential nest trees.

The key component of identifying a Pinyon Jay breeding colony was locating active jay nests. As recommended (PIJA WG 2021b), to avoid potential impacts to the Pinyon Jays, we aimed to find only one to three active nests per colony as part of our colony mapping objective and did not continue to monitor nests once found. Frequent nest monitoring, and increased searches to find additional nests greatly increases the chances of nest abandonment or human-facilitated nest

predation (PIJA WG 2021b). Field staff were trained how to identify Pinyon Jay nests from similar nests made by other species, such as the Woodhouse's Scrub Jay (*Aphelocoma woodhouseii*), Northern Mockingbird (*Mimus polyglottos*), and American Robin (*Turdus migratorius*), and to identify new Pinyon Jay nests from those made and used in previous years (Table 2). In short, Pinyon Jay nests are typically substantial in size, deep, thickly lined (typically 1-2 cm) often with grass or juniper bark (Petersen et al. 2014). Active nests appear unweathered with a fresh lining. Similar nests, from species listed above, are less substantial in size, flatter in appearance, often with a thinner lining of fine materials, and may contain mud (American Robin). See Petersen et al. (2014) for a good nest comparison for these species. Pinyon Jay nests may persist for greater than one year (Johnson and Balda 2020). Due to the jays' site fidelity tendency, finding old nests is valuable in locating current year colonies. Compared to active, present year nests, old, past year nests are weathered and gray, often flatter, deteriorated lining, and may be falling apart (Petersen et al. 2014). Old nests are not reused, and Pinyon Jays are not known to reuse nesting material from these nests (Johnson and Balda 2020).

Table 2. Pinyon Jay nest terms and definitions used in this report.

Pinyon Jay Nest Type	Description
Active Nest	Current year, Pinyon Jay nests are typically substantial in size, deep, thickly lined, and often incorporate juniper bark. Active nests were used to identify Confirmed Breeding Colonies (Table 3). Identification of active nests included visual observations of Pinyon Jay nests in construction, nests with eggs, nests with chicks, or an incubating adult on nest. Once located, active nests were not monitored to determine nest success.
Old Nest	Pinyon Jay nests may persist for more than one year. Old nests are not reused. Pinyon Jay's exhibit site fidelity, thus the presence of old nests can be used to search for active colonies. Old, past year nests look similar to active nests, but appear weathered and gray, often flatter, and may be falling apart.

We followed safety guidelines recommended by the Pinyon Jay Working Group when searching for nests (PIJA WG 2021b, PIJA WG 2021c). This included minimizing potential Pinyon Jay disturbance whenever possible by making observations from far away using binoculars or spotting scopes, and from a vehicle using the car as a blind where possible. When a potential nest or nest tree was identified from far away, field staff prepared to make a brief visit to locate the nest by marking the potential nest location in the data collection app to aid in navigation, and if needed, quickly sketching a rough drawing of the target tree and nest location within the tree. To minimize potential impact to breeding jays, before hiking into the (suspected) colony area, field

staff waited until any observed jays had departed the area and to avoid increasing predation risk, colonies and nests were not approached when potential nest predators were observed in the area. If a nest was located, following nest searching recommendations (PIJA WG 2021b) field staff spent only a few seconds near the nest to mark or reposition a nest waypoint in the data collection app before moving at least 50m away to finish recording nest data into the data app. Safety and bird well-being was our top priority, and as such nests were located carefully to avoid disturbance, and every effort was made to avoid flushing adult birds off a nest or attracting predators to the area.

Field staff delineated breeding colonies based on field observations of jay locations, observed begging calls, observed breeding behavior, and the location of active nests (Table 3). The chirring begging call is a strong indication of breeding as it is given by the female to the male during courtship, nest-site selection, nest-building, egg-laying, incubation, and brooding (Johnson and Balda 2020); the call is also given by nestlings and fledglings when being fed by their parents (Johnson and Balda 2020). Confirmed colonies contained at least one found active nest, and estimated colonies were delineated where a colony was suspected with begging chirr calls heard, but no nests found. Colony outlines drawn by field staff are not explicit as the true locations of all nests within a colony were unknown.

Table 3. Pinyon Jay Breeding Colony terms and definitions used in this report.

Colony Designation	Definition
Historical Colony	Colonies identified by Johnson et al. (2018). We visited each of these sites to determine if these breeding colonies were still active. These locations are approximately mapped in this report (black stars), but see Johnson et al. (2018) for a detailed description, spatial locations, and nest observations of these colonies.
Confirmed Colony	Confirmed colonies contained at least one found active nest in 2021. Colony delineations are estimates based on found nest locations and jay activity observed by field staff.
Estimated Colony	Estimated colonies were delineated at suspected 2021 colony locations and delineated based on observed jay behavior. No nests were found at these estimated colony locations, but breeding was suspected and begging chirring calls were heard, usually on multiple visits to the area. The Chirring begging call is a strong indication of breeding as it is given by the female to the male during courtship, nest-site selection, nest-building, egg-laying, incubation, and brooding (Johnson and Balda 2020).

Pinyon Jay survey data, incidental detections, nest locations (current year and past year nests), and colony delineations were recorded using the ArcGIS Fieldmap app (ESRI 2021) on Android smartphones using the data structure outline by the Pinyon Jay Working Group (PIJA WG 2021a). Daily, upon returning to the field house with wifi access, the collected data were synced with SSRS's ArcGIS Online (AGOL) account, and then synced again back to every crew member's smartphone. By doing this, all field data was readily available to all field technicians, backed-up, and current on multiple android phones as well as the AGOL account at all times. The data was mapped, tabulated and summarized.

Results

All sample units were surveyed a minimum of three times, with potential treatment areas surveyed up to eight times. Pinyon Jays were easily detected and found in 95% (36 of 38) surveyed sample units on at least one visit (Figure 2, Table 4). Pinyon Jays were not detected during surveys to one of the Wild Rivers Area sample units, although this area contains multiple historical Pinyon Jay eBird records (eBird 2021). They were also not detected within the sample unit containing the west edge of Brushy Mountain. This sample unit had our lowest percentage of modeled P-J Woodland cover (12%), and is dominated by sagebrush plains. However, we detected jays less than 50 meters east and north of this sample unit.

Table 4. Pinyon Jays were found in 36 of 38 sample units in the RGdNNM, 2021.

Sample Unit Type	Sample Units Surveyed	Occupany %[1]
Historical Use	7	100% (n= 7)
Potential Treatment Areas	14	93% (n=13)
Unknown Historical Use	17	94% (n = 16)

[1] Sample units occupancy based on the detection of a single Pinyon Jay within the sample unit.

Pinyon Jay Surveys

For a standardized, comparative assessment, we examined surveyed sample units using Pinyon Jay observations from the first three survey visits. Two surveyors surveyed thirty-eight sample units, three times each, from March 10 to May 10 (Figure 2, Figure 3, Table 5). Sample unit surveys typically required 3-5 hours to complete. When jays were detected during these occupancy surveys, if field staff were able to track and follow the birds, they did so with the intent to locate nests and identify breeding colonies. Alternatively, if the jays could not be followed, which frequently occurred, and if time permitted, surveyors often initiated surveys in a nearby sample unit.

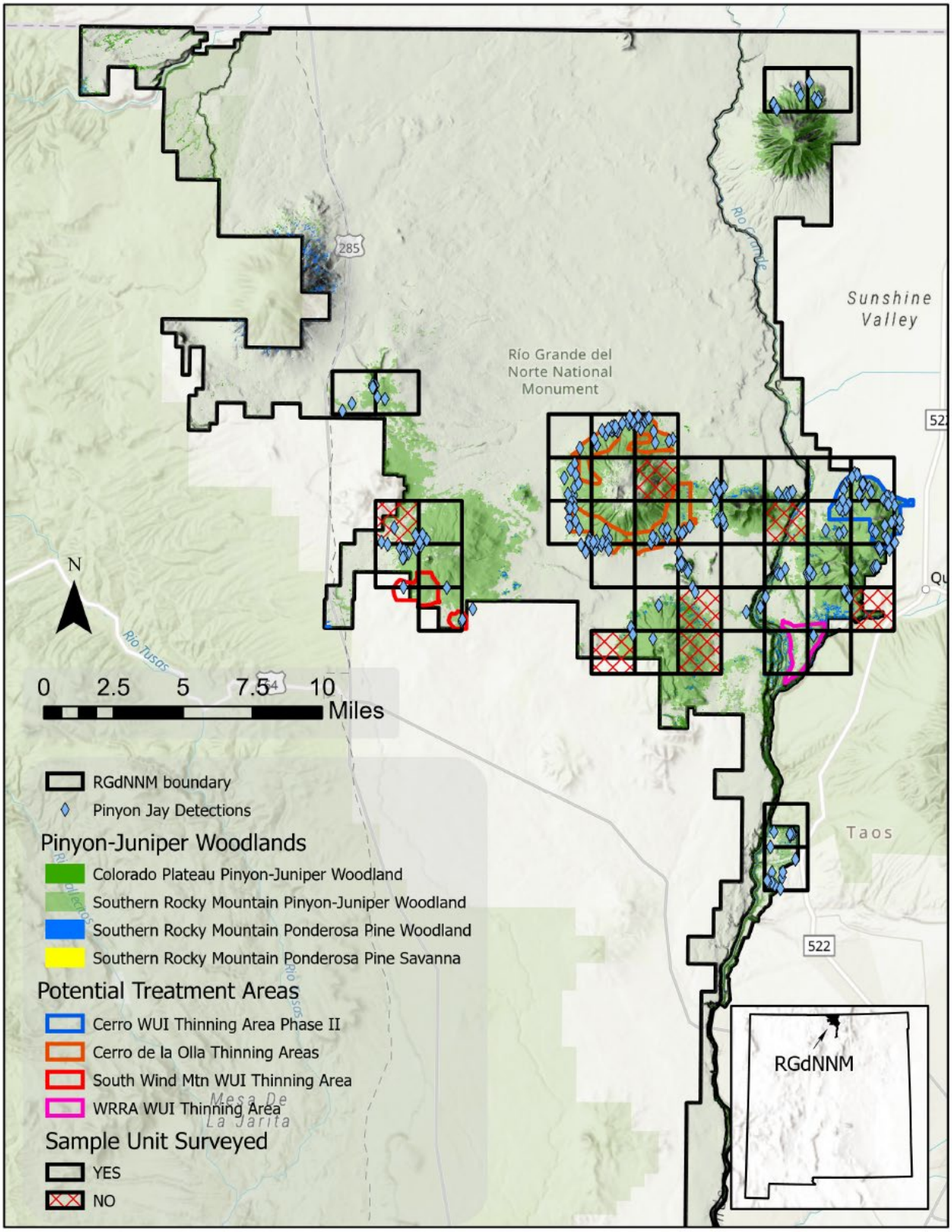

Figure 2. Pinyon Jays detected during protocol surveys within the Rio Grande del Norte National Monument study area. Surveys were conducted from March 10 to May 10.

The largest flocks of Pinyon Jays were detected during the first round of surveys, most of which were conducted in March (Figure 2, Table 5, Appendix A). The largest flock comprised 140 Pinyon Jays and was detected at the two Ute Mountain sample units on the same day. Summary survey information is presented with and without these two observations to enable a comparative assessment without the significant leverage of this one group of birds (Table 5). Aside from this Ute Mountain flock, it is unknown how frequently the same induvial birds were counted on separate sample unit surveys.

With the removal of this outlier, the average number of jays observed per sample unit were similar, between 7 and 10 birds per survey (Table 5). Overall, the number of sample units where jays were detected increased from 53% to 82%, from survey visit 1 to survey visit 3 (Table 5). Survey results (Table 5) summarized by sample units containing a known breeding colony (n=17 sample units, Table 6) and sample units where we did not find a confirmed colony (n = 21 sample units, Table 7) showed that Pinyon Jay detections, flock number, flock size, sample unit occupancy per survey period, and apparent detection rates were all greater at sample units where confirmed breeding colonies were found (Table 6, Table 7, Table 8).

Cerro de la Olla, and Ute Mountain, and North Guadalupe Mountain had the greatest total number of Pinyon Jays detected per survey (Table 9). Ute Mountain surveys had the greatest the average number of jays detected per sample unit (n =28 PIJA, Table 9), but these results are highly influenced by a single 140 bird flock observed in early March. Most areas had an average of 7 to 13 jays observed per sample unit survey and three areas had an average of 1 to 5 jays detected per survey (Table 9).

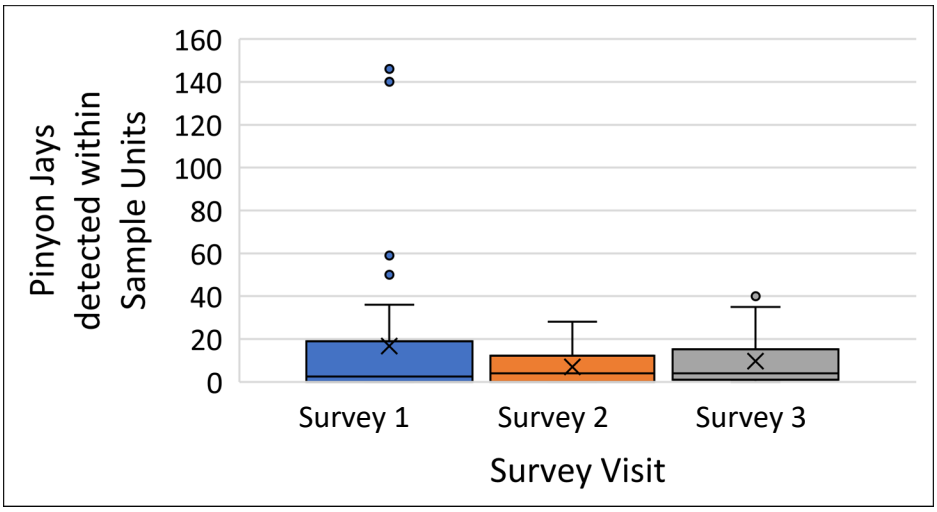

Figure 3. Boxplot of Pinyon Jays detected per sample unit per survey visit.
Mean number of Pinyon Jays detected (x) and medians (solid bar) are shown within the boxplots, and displayed in Table 5.

Table 5. Thirty-eight sample units were surveyed three times each from March 10 to May 10, 2021.

	Survey 1	Survey 1 (two outliers removed)[1]	Survey 2	Survey 3
Survey Dates	March 10 – April 4	March 10 – April 4	March 24 – April 30	April 9 – May 10
Total PIJA flocks detected per survey round	37	35	48	81
Total PIJA detected per survey	634	354	264	368
Average PIJA detected per sample unit survey	16.7	9.3	6.9	9.7
Median PIJA detected per survey	3	1	4	4
Range of PIJA detected per survey	0 - 146	0 - 59	0 - 28	0 - 40
Percent of sample units with PIJA detected	52.6%	50.0%	60.5%	81.6%
Number of sample units with PIJA detected	n=20/38 sample units	n=19/38 sample units	n=23/38 sample units	n=31/38 sample units

[1]The largest flock (a single flock of 140 of Pinyon Jay [PIJA]) was observed at the two Ute Mountain sample units (Figure 3) and removed to present the data without the significant leverage of this one group of birds.

Table 6. Survey results for sample units where confirmed breeding colonies were found, RGdNNM 2021.

	Survey 1	Survey 1 (two outliers removed)[1]	Survey 2	Survey 3
Total PIJA flocks detected per survey	19	17	35	47
Total PIJA detected per survey	436	156	189	241
Average PIJA detected per sample unit survey	25.6	9.2	11.1	14.2
Median PIJA detected per survey	3	3	10	11
Range of PIJA detected per survey	0 - 146	0 - 59	0 - 28	1 - 40
Percent of sample units with PIJA detected	64.7%	58.8%	88.2%	100.0%
Number of sample units with PIJA detected	n=11/17 sample units	n=10/17 sample units	n=15/17 sample units	n=17/17 sample units

[1]The largest flock (a single flock of 140 of Pinyon Jay [PIJA]) was observed at the two Ute Mountain sample units (Figure 3) and removed to present the data without the significant leverage of this one group of birds.

Table 7. Survey results for sample units that did not contain confirmed breeding colonies, RGdNNM 2021.

	Survey 1	Survey 2	Survey 3
Total PIJA flocks detected per survey	18	13	34
Total PIJA detected per survey	198	75	127
Average PIJA detected per sample unit survey	9.4	3.6	6.0
Median PIJA detected per survey	2	6	5
Range of PIJA detected per survey	0 - 50	0 - 20	0 - 35
Percent of sample units with PIJA detected	42.9%	38.1%	66.7%
Number of sample units with PIJA detected	n=9/21 sample units	n=8/21 sample units	n=14/21 sample units

Table 8. Apparent Pinyon Jay detection rates for sample units RGdNNM, 2021.

	PIJA detected on at least 1 of 3 surveys	PIJA detected on 2 out of 3 surveys	PIJA detected on 3 out of 3 surveys
Sample units with a Confirmed Colony	100% (17/17 sample units)	88.2 % (15/17 sample units)	64.7% (11/17 sample units)
Sample units lacking a Confirmed Colony	80.9% (17/21 sample units)	42.8% (9/21 sample units)	23.8% (5/21 sample units)
All Sample Units	89.5% (34/38 sample units)	63.2% (23/38 sample units)	42.1% (16/38 sample units)

Table 9. Average and Total Pinyon Jay survey results per area, RGdNNM 2021.

Area	Sample Units	Survey 1 Total	Survey 2 Total	Survey 3 Total	Survey Average	Average PIJA per Survey per Sample Unit
Brushy Mountain	2	34	3	35	24	12
Cerro Chiflo	3	15	36	10	20	7
Cerro de la Olla	10	163	82	114	120	12
Cerro del Aire	4	3	16	46	22	5
Cerro Montoso	2	0	0	5	2	1
Horsethief Mesa	2	33	18	25	25	13
North Guadalupe	5	35	41	58	45	9
South Guadalupe	2	3	21	43	22	11
Ute Mountain[1]	2	146	13	9	56	28
Wild Rivers Area	4	47	7	1	18	5
Wissmath Crater	2	15	27	22	21	11

[1] Ute Mountain PIJA averages and totals are based on a single observation of the same 140 PIJA flock observed in both Ute Mountain sample units during the first survey.

Pinyon Jay Nests and Colonies

Field staff found twenty-eight Pinyon Jay nests spread over fifteen active colonies (Figure 4, Figures 6-15). Most located nests were actively being built and nest building were observed in March, April and May (Figure 4). Nestlings were observed in three nests with estimated hatching in early to mid-April. Nests were not aged or monitored once found.

Pinyon Jays were detected at all seven historical colony locations (Figure 5, Johnson et al. 2018). We identified active 2021 colonies (confirmed and estimated) at six historical colony locations (Ute Mountain, North Guadalupe Mountain, South Guadalupe Mountain, Cerro Chiflo, at Cerro de la Olla). We did not find enough evidence to indicate nesting at the historical Brushy Mountain colony location which had a single nest in 2018.

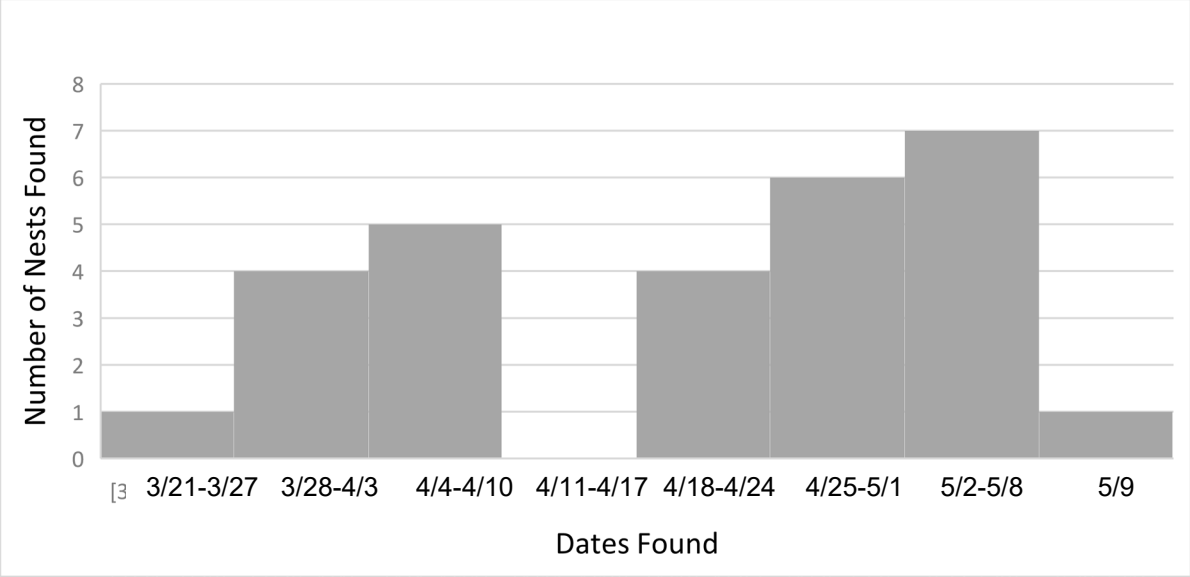

Figure 4. Twenty-eight Pinyon Jay nests were found from March 21, 2021 to May 10, 2021, spread over fifteen active breeding colonies located in RGdNNM.

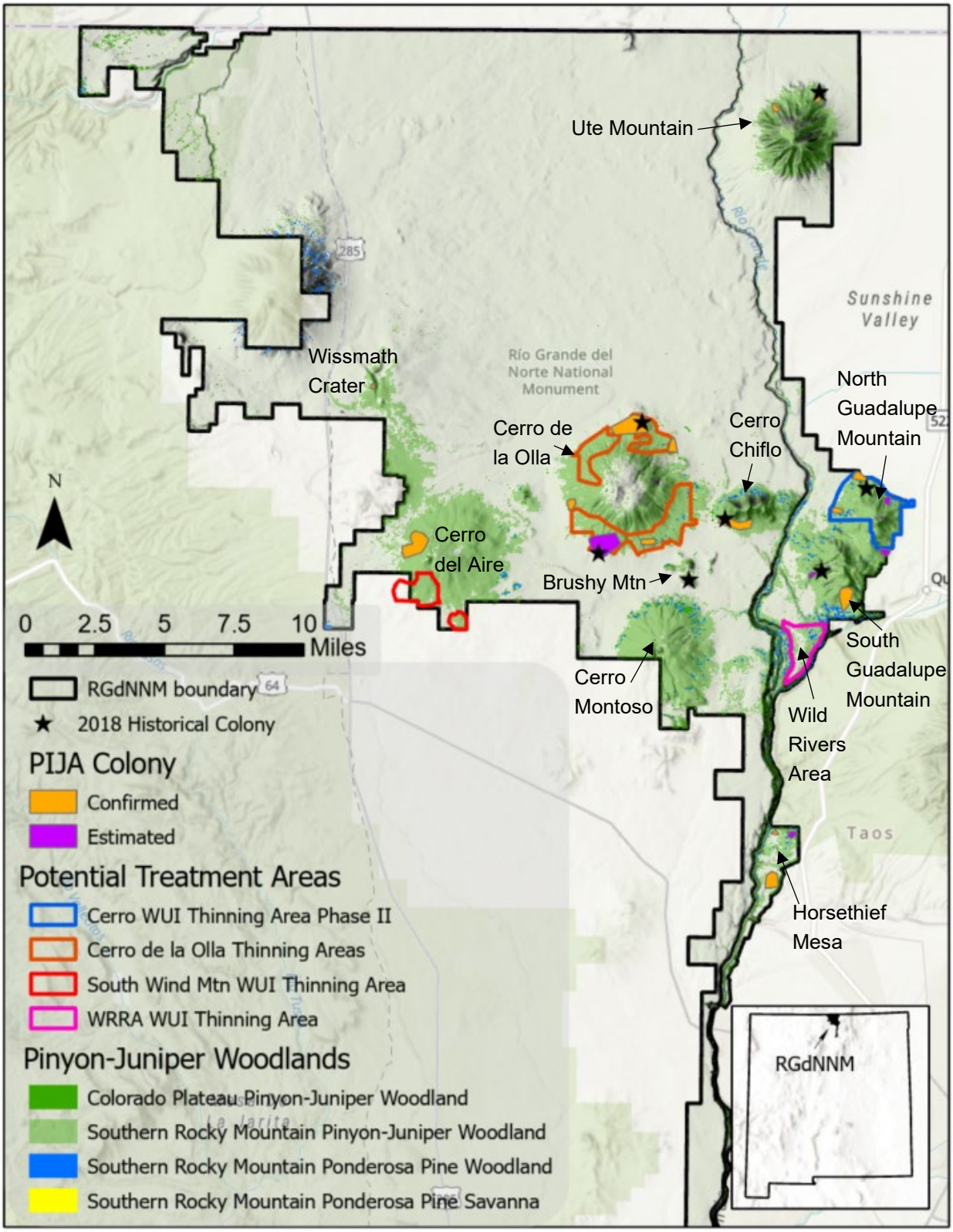

Figure 5. Locations of 15 colonies with confirmed nesting**,** 5 estimated colony locations where nesting was not confirmed, and approximate historical 2018 colony locations (Johnson et al. 2018).

Brushy Mountain

Three survey visits to the Brushy Mountain sample units yielded Pinyon Jay detections on the first two visits, but not the third (Figure 6). Brushy Mountain is actually two small mountains, one north, the other south. The historical colony was a single nest found on the south Brushy Mountain (Johnson et al. 2018). We observed Pinyon Jays on the south mountain only once, on March 12. An active Common Raven nest was found near the 2018 historical nest area. The south Brushy Mountain had no suspected breeding activity in 2021.

On North Brushy Mountain, Pinyon Jays were detected on two of three surveys, and nesting was suspected but not confirmed. On April 23, we observed multiple flocks of 1, 6, and 15 birds, and at least 6 different jays making begging vocalizations. Field staff suspected incubating nests in the area, however subsequent visits to the area yielded no Pinyon Jays.

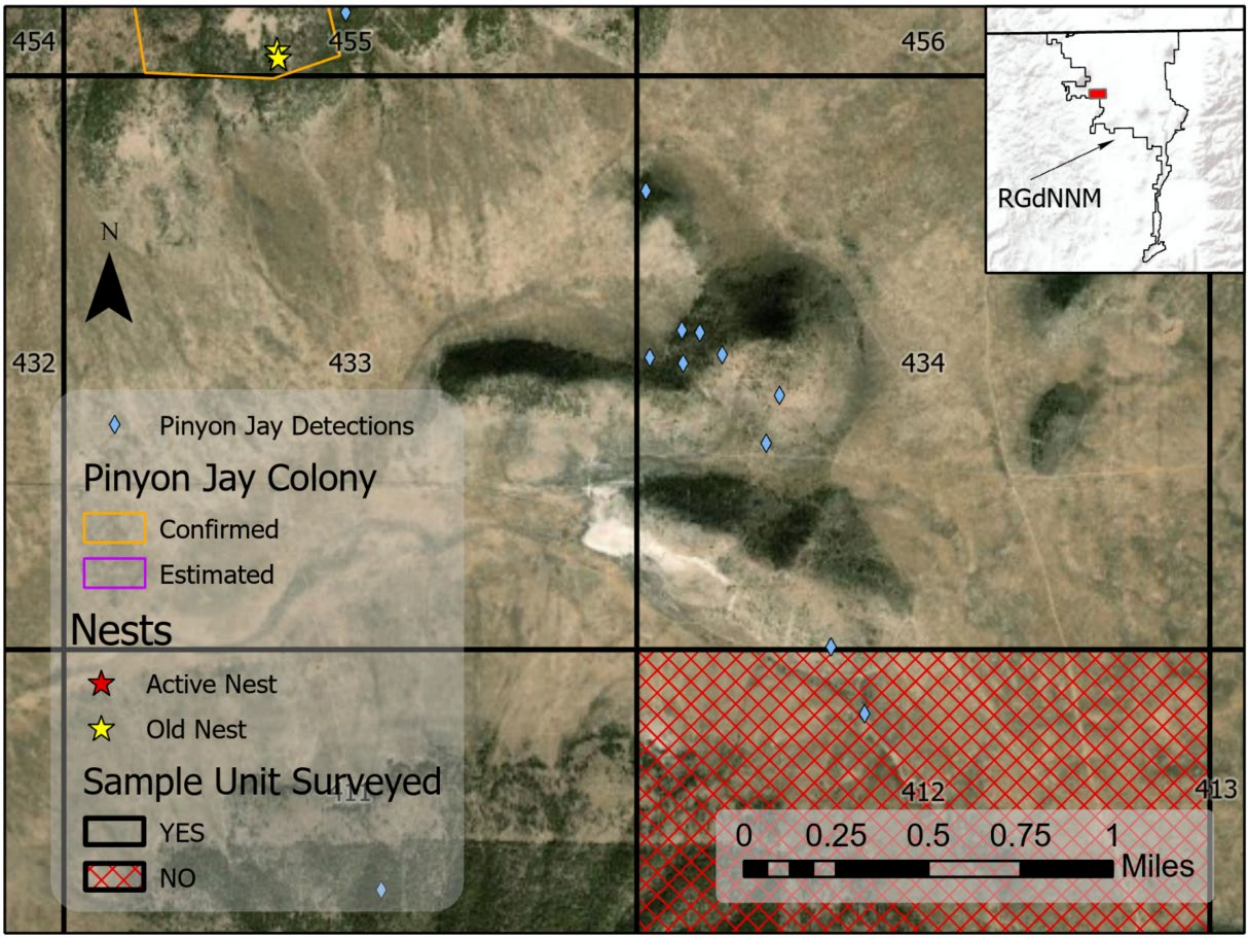

Figure 6. Brush Mountain Pinyon Jay detections, RGdNNM 2021.

Cerro Chiflo

No Pinyon Jays were observed during the first round of surveys (March 25) at Cerro Chiflo (Figure 7). Jays were found around the mountain during the second round of surveys (April 10), and nests were actively being constructed during the third survey visit (May 5). On the south side of Cerro Chiflo, we confirmed one colony with three active nests (Figure 5). One nest was found in the historical colony area, and two others were found approximately 1.5 km east of this historical location. We recorded these three nests as one large colony. Jays observed in the historical colony location were observed foraging in the sagebrush west of Cerro Chiflo.

Two sample units on the North side of Chiflo were also surveyed, but Pinyon Jays in these areas were mostly seen foraging and caching. On the NE slope of Cerro Chiflo, during our second survey, we documented multiple observations of perched jays and begging calls were heard, but on the third survey to this area no jays were observed. These observations may indicate a colony location and possible nest failures. As observed at Brushy Mountain, our breeding evidence was scant and we declined to call this an estimated territory. The eastern slope of Chiflo was not surveyed and would be a good place to surveys for another potential colony.

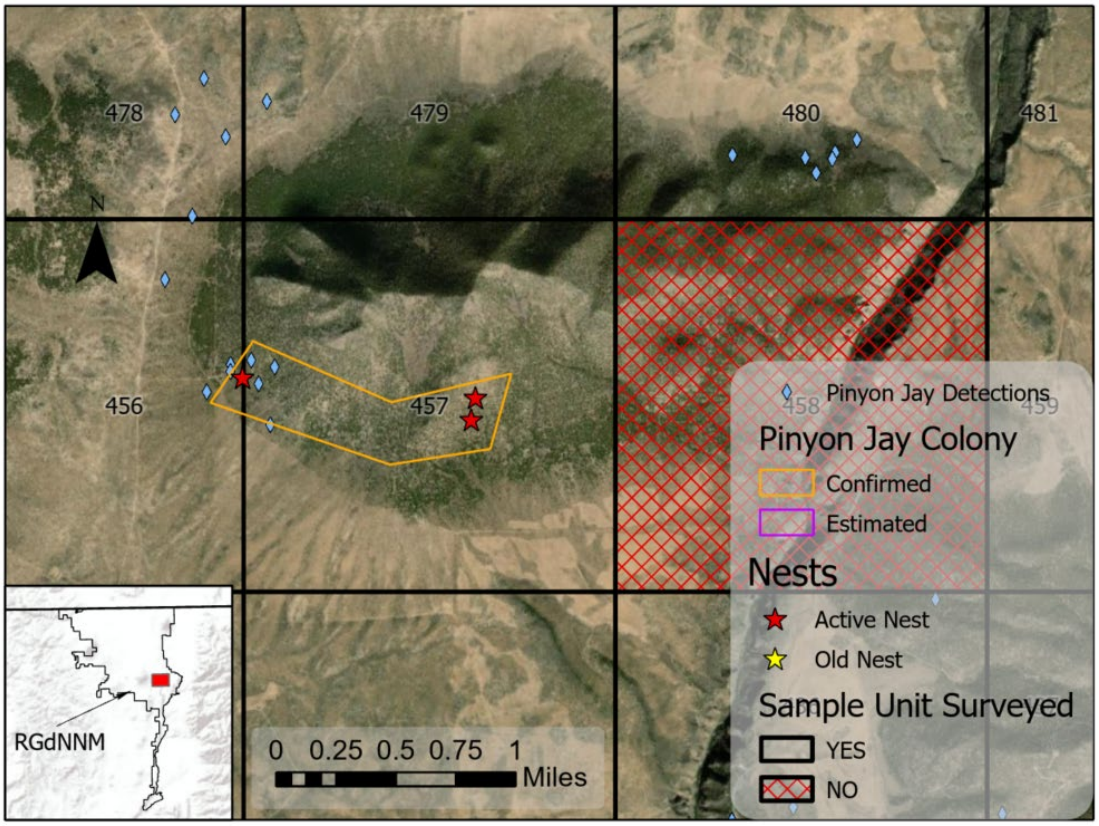

Figure 7. Cerro Chiflo Pinyon Jay detections, nests and colony, RGdNNM 2021.

Cerro de la Olla (Pot Mountain)

Overall, Cerro de la Olla, also known as Pot Mountain, appears to hold the greatest concentration of Pinyon Jays and Pinyon Jay Colonies within the RGdNNM (Figure 8). Across surveys to seven sample units, in total (across all three visits) 83 Pinyon Jay flock observations (range 1 to 52 jays) were made totaling 469 Pinyon Jays. Note, an unknown number Pinyon Jay observations may be of the same individuals detected in different sample units.

Five nesting colonies were found on Pot Mountain (four confirmed, and one estimated), and two additional colonies (not mapped) were suspected based on jay flight observations (one on the western slope of Pot Mountain, and the second on the SE slope opposite the Chiflo Mountain colony). Four of the found colonies are within proposed treatment areas. Two active nests found in the north slope colony were in previously treated (2018 thinned and burned) P-J woodland habitat. One of these nests was in a 100% burned Pinyon Pine just 2 feet off the ground.

At the 2018 historical SW Pot Mountain colony location (Johnson et al. 2018), we found old nests (not mapped), significant Pinyon Jay activity, and begging heard on multiple visits, suggesting active nesting within the historical colony location. Within the outlined estimated colony polygon (Figure 5) we recorded twelve flock observations (1 to 20 birds) during surveys with multiple observations of begging jays.

Field staff noted finding an active nest in the confirmed colony on the south side of Cerro de la Olla (sample unit 455) but did not map the location of this nest.

Pinyon Jays were observed on numerous occasions using the adjacent sagebrush, presumably foraging, and retrieving stored caches, on the north, northeast, southeast, southeast, and west sides of Cerro de la Olla (Figure 8, sample units 498, 499, 478, 456, and 453)

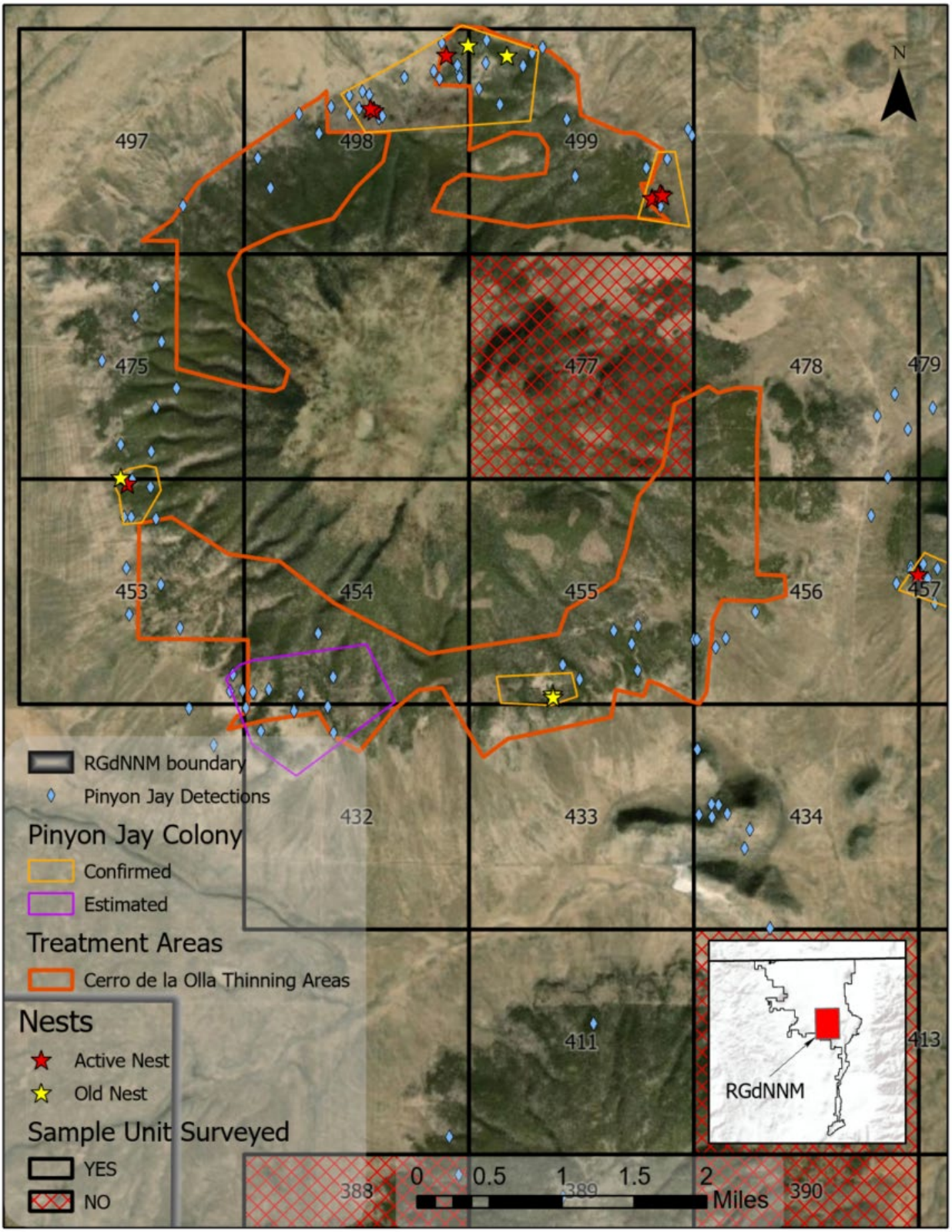

Figure 8. Cerro de la Olla Pinyon Jay colonies, detections, nests, and potential treatment area, RGdNNM 2021.

Cerro del Aire (Wind Mountain)

We surveyed four sample units in the Cerro del Aire area that resulted in abundance of detections in and around a newly confirmed breeding colony (Figure 9). Two nests were found within this colony. The large colony polygon was drawn around the two nests and most of the survey detections in this area. This delineation may overestimate the size of the colony, or alternatively this may be two smaller colonies.

Cerro Montoso

Pinyon Jays were not detected on the first two visits to the two Montoso sample units (Figure 10). Though, on the first visit Pinyon Jays were seen near the drinker located at the NW side of the mountain. On the third survey a single Pinyon Jay was observed passing through one sample unit and a flock of four Pinyon Jay moved through the second sample unit. No breeding activity was indicated at these sample units. Cerro Montoso occupancy surveys required considerable time to complete, due to the lack of Pinyon Jay observations, but also the relative remoteness of the area, and poor local roads. As a result, surveyors did not have time to attempt surveys in the three adjacent, low-ranked sample units (Figure 10).

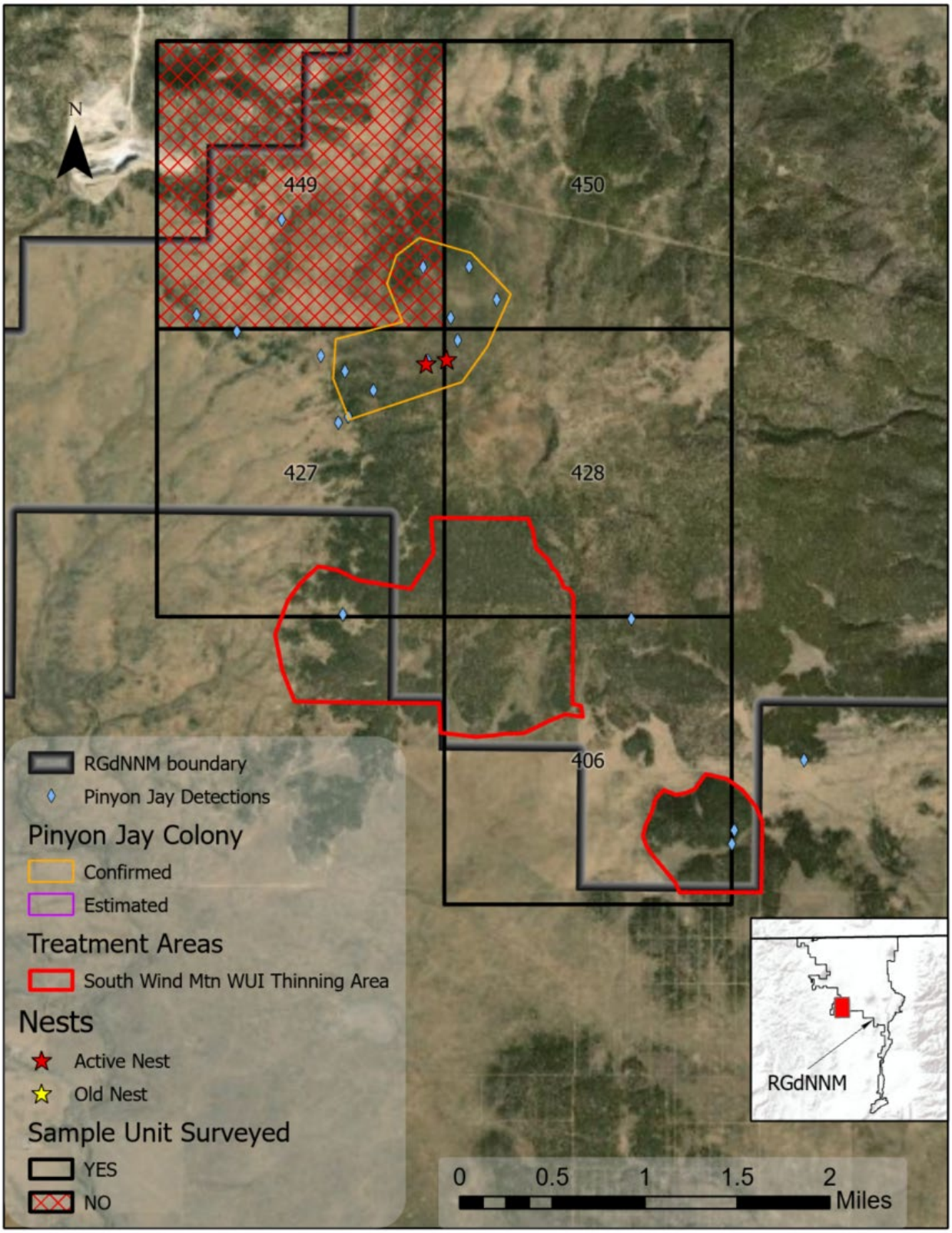

Figure 9. Cerro de Aire (Wind Mountain) Pinyon Jay colony, detections, nests, and potential treatment area, RGdNNM 2021.

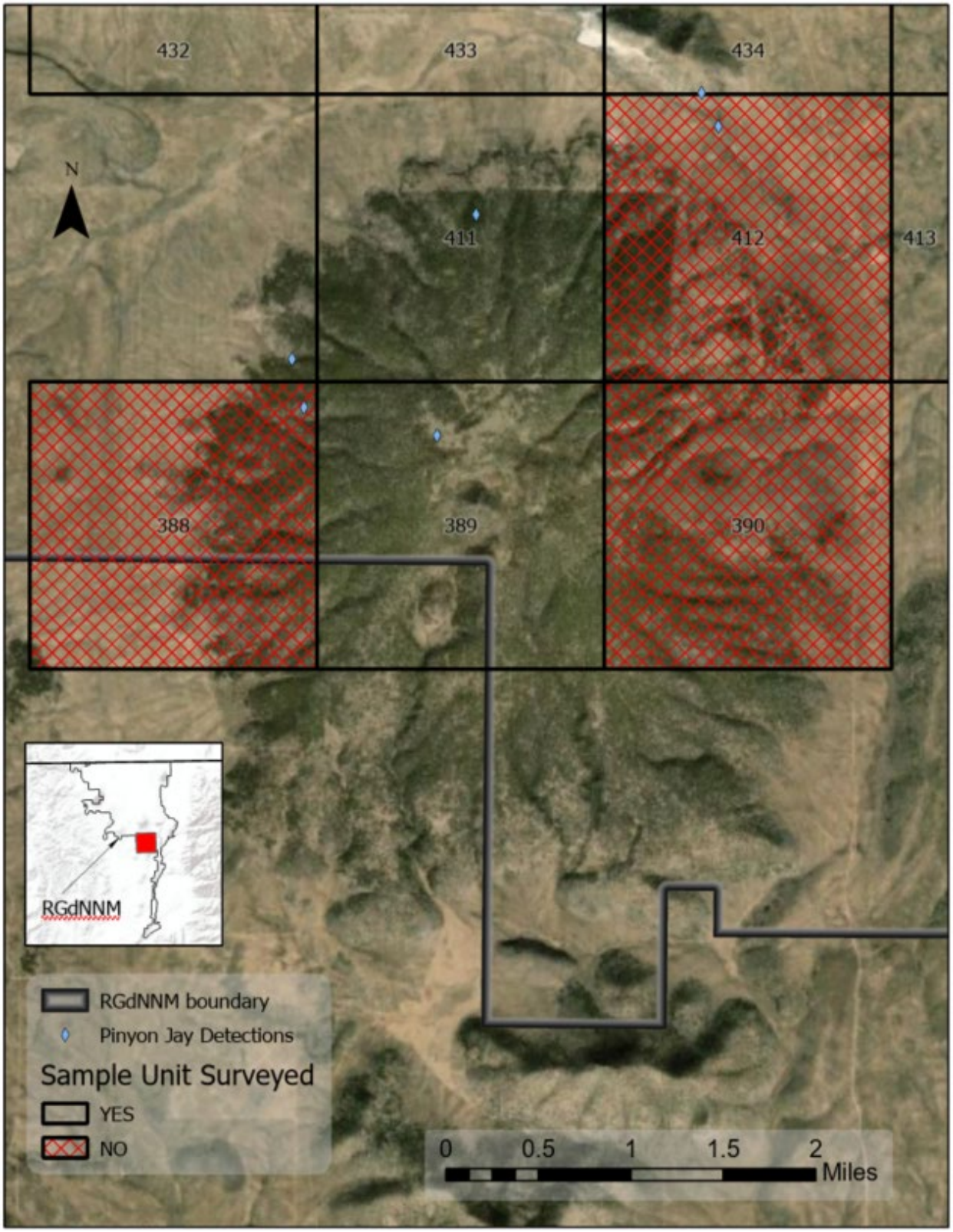

Figure 10. Cerro Montoso Pinyon Jay detections, RGdNNM 2021.

North Guadalupe Mountain

Four colonies were found on North Guadalupe Mountain, two estimated and two confirmed. (Figure 11). The two colonies on the north side of the mountain (one estimated, one confirmed) are 1.5 km apart.

Three active nests were found across the two confirmed colonies. The estimated colony on the north side of the mountain was based off multiple detections in the area over three different visits (April 18, April, 27, and May 8) and begging calls heard. The estimated colony on the south side of North Guadalupe Mountain, was based on repeated detections of begging jays within the area (April 3, 2021 and April 18, 2021).

Though we visited the North slope area eight times, our understanding of Pinyon Jay use of the area remains imperfect. Jays were observed loafing, perching, and traveling through the previously thinned areas, but foraging, caching, and nesting were not observed in the treated areas. Two nests were found in close proximity to the 2017 treatment area. With documented nesting on North Guadalupe Mountain, and an additional estimated colony located near the Cerro town cemetery, the 2017 treatment of the area has not caused the Pinyon Jays to abandon the area. Impacts to the colony size and fecundity are unknown. Supplemental feeding from observed Cerro residence bird feeders (personal observation) likely benefits the Pinyon Jays nesting in this area. Additional Pinyon Jay monitoring within this area is recommended to better understand Pinyon Jay use of the previously thinned P-J woodlands (Johnson et al. 2020).

South Guadalupe Mountain

Two colonies were found on South Guadalupe Mountain (Figure 12). The confirmed colony found appears to be the highest elevation colony found and furthest from adjacent sagebrush plains regularly used by Pinyon Jays to cache pinyon seeds. One of the nests found here was in the P-J woodland / ponderosa pine transition zone, the rest of the colony is down slope in the pinyon pine woodland.

The South Guadalupe historical colony appears to still be active, but has relocated downhill from the previously reported location (Johnson et al. 2018). During the first two visits to this area, we detected no jays around the historical colony. It was not until our third survey visit (April 24) that we detected birds in the area. These jays appeared to be in the early stages or building or laying, as begging, chirring and nest material flights were observed.

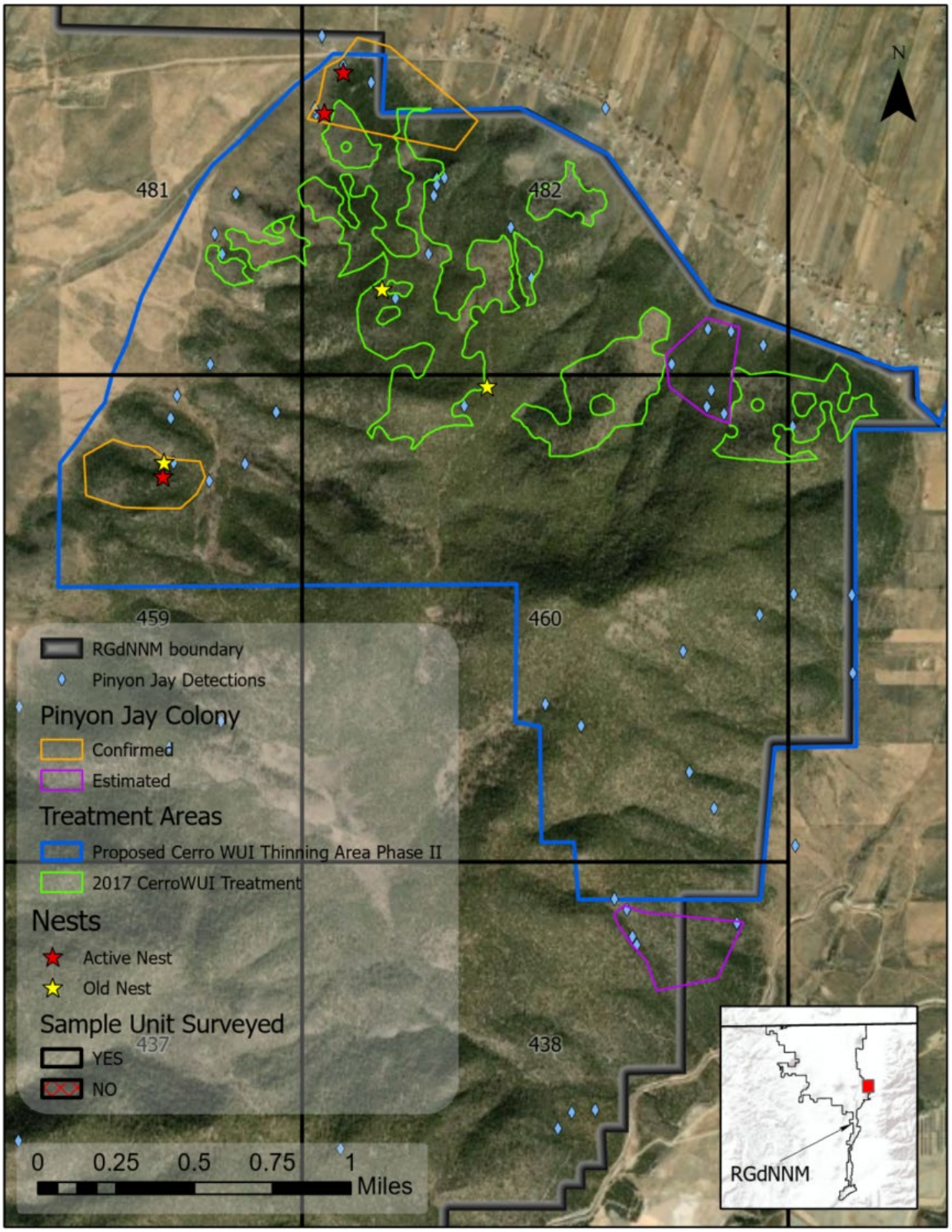

Figure 11. North Guadalupe Mountain treatment areas, and Pinyon Jay colonies, detections, and nests, RGdNNM 2021.

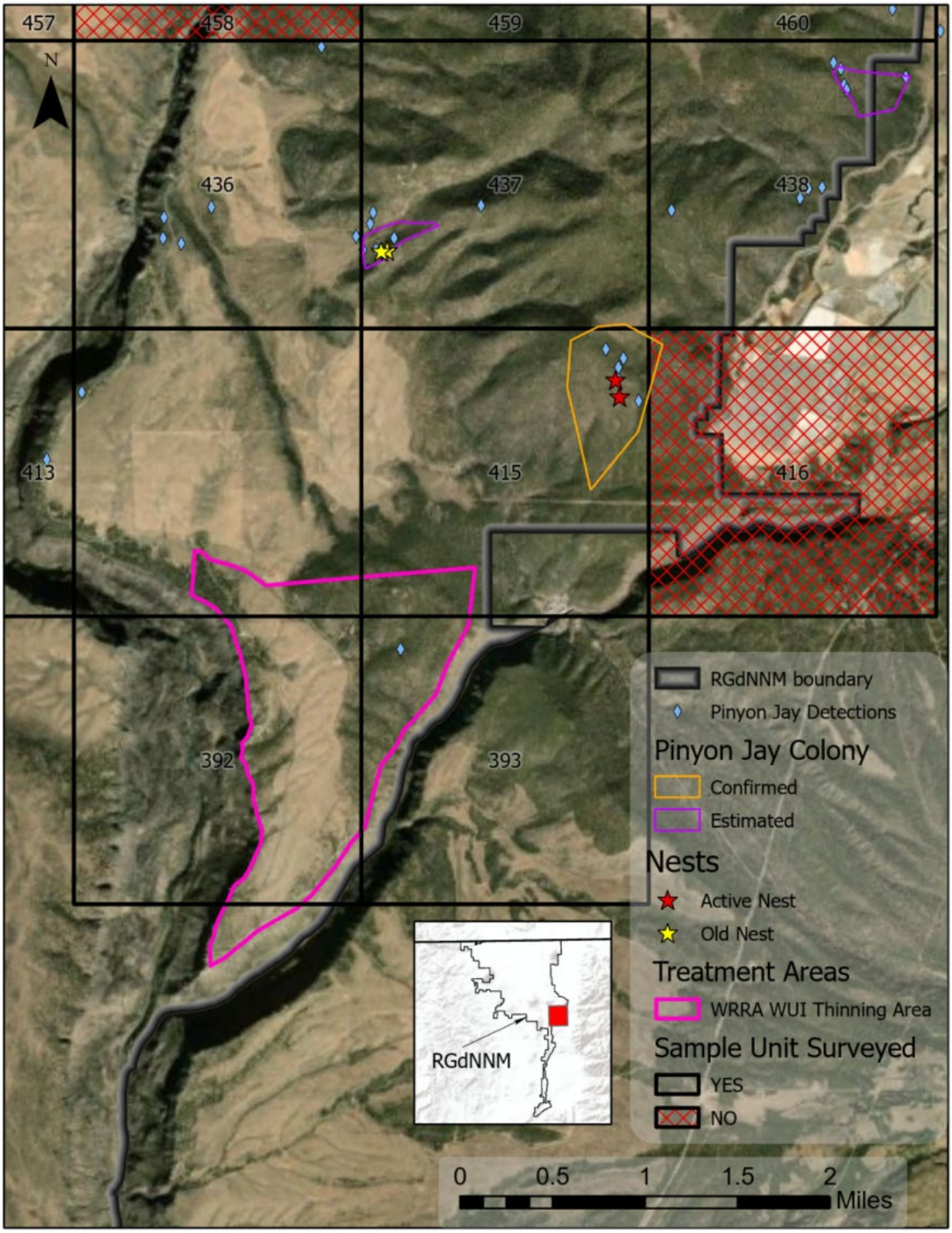

Figure 12. South Guadalupe Mountain and WRRA Pinyon Jay colonies, detections, nests, and potential treatment area, RGdNNM 2021.

Horsethief Mesa

Surveys yielded Pinyon Jays in these two sample units during all three visits and an active nesting colony was confirmed in each sample unit (Figure 13). In the northern sample unit (304), feeding and nest material flights were observed during the second visit. Two nests were located and additional begging calls heard indicate that other nests were present but not found. During the third visit to the sample unit, the colony was quiet, but to the east, a group of jays were found carrying nest material. This new colony, 600 meters east of the original colony, may be a second colony, or it is possible that nesting in the first colony failed, and the birds relocated to this area to renest. No physical nests were found in this estimated colony, but nest material carries were observed by multiple jay pairs. In the southern Horsethief Mesa sample unit (282), during the last survey visit, a colony was confirmed by locating an active nest, and a nest start (a nest partially constructed), and observations of jays making numerous visits to these areas during the visit.

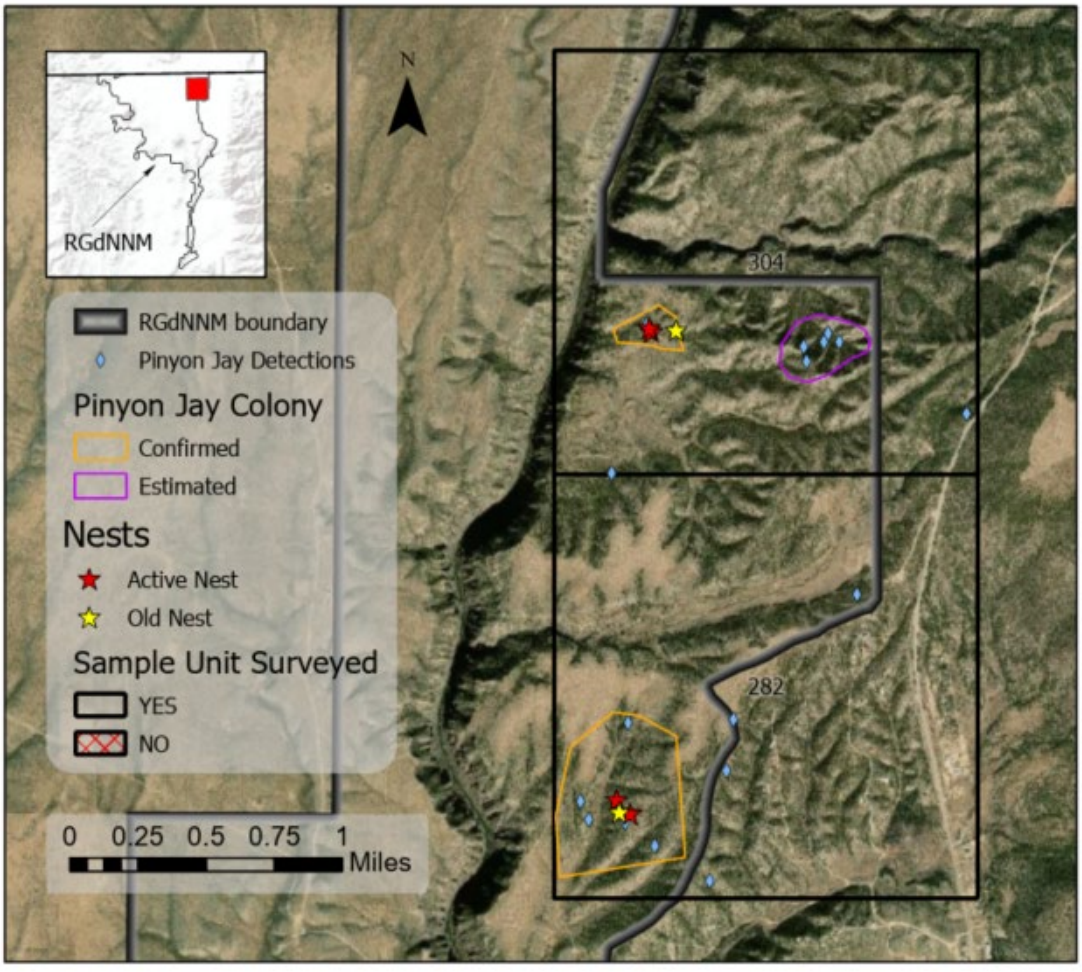

Figure 13. Horsethief Mesa Pinyon Jay detections, nests and colonies, RGdNNM 2021.

Ute Mountain

We surveyed two sample units on the north side of Ute Mountain and found Pinyon Jays were found on all three survey visits, and two active nesting colonies on the mountain, one colony in each sample unit (Figure 14). Most observations were of flocks with fewer than 10 birds, but flocks of 35 and 140 Pinyon Jays were also observed. Flocks were often observed travelling between the two sample units.

The historical 2018 colony on the NE slopes of Ute Mountain was active in 2021, and a second colony was found 2.3 km to the west, on a NW Ute Mountain slope (Figure 14). Field staff observed an abundant pinyon cone crop on the north side of the mountain and suspected that the breeding activity here appeared to be earlier than nesting in other areas within RGdNNM. Three nests were found in these two colonies. One nest was found (April 30th) with nestlings aged at approximately five days old, indicated a nest initiation date around April 5th (5 days as nestlings, 17 days incubation, 3 days to lay).

Common Ravens and Golden Eagles were observed at this site. The east, west and southern areas of Ute Mountain were not included in the sampling frame due to inaccessibility from a lack of roads in the area.

Wild Rivers Recreation Area

Five rounds of surveys to these two sample units (Figure 12) yielded only a single flock observation of two Pinyon Jays during the fifth visit (May 10). These jays quickly departed the area and flew over the gorge to the west (flying over multiple sample units). It appears that this area is seldom used by Pinyon Jays and it is unlikely that there is a nesting colony in this treatment area. Pinyon Jays were detected using adjacent sample units and the canyon rim to the north.

Wissmath Crater Area

We surveyed two sample units in the Wissmath Crater area. During the first visit (March 18) a colony was suspected based on observations of paired birds, nest material carry, allofeeding, begging and chirring calls. Active nests were found in this northern colony on April 8 and April 26. Pinyon Jays were occasionally heard near the drinker in this sample unit. On the last visit to this sample unit a lone nest, far from the colony was found (by Corrie Borgman, USFWS) near the drinker. This nest was found in the building stage, while the northern colony (2.8 km away) had incubating birds. It is unclear whether this represents a satellite colony (renesting birds that moved away to renest from the original colony after a failed nest attempt) or if this is a different

group of birds. The limited amount of habitat in the surrounding area suggests that this southern nest is a satellite colony of the northern nesting colony.

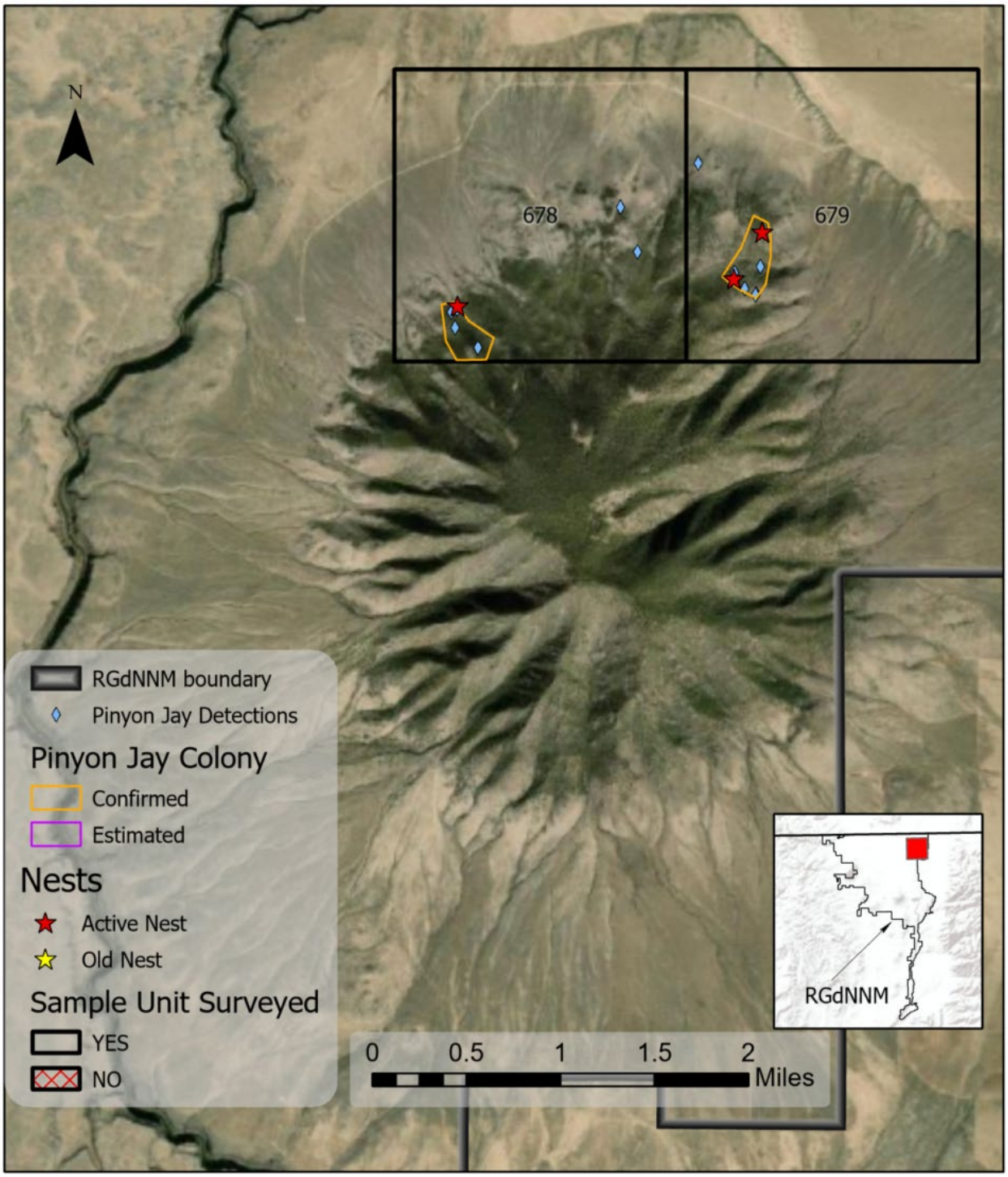

Figure 14. Ute Mountain Pinyon Jay detections, nests and colonies, RGdNNM 2021.

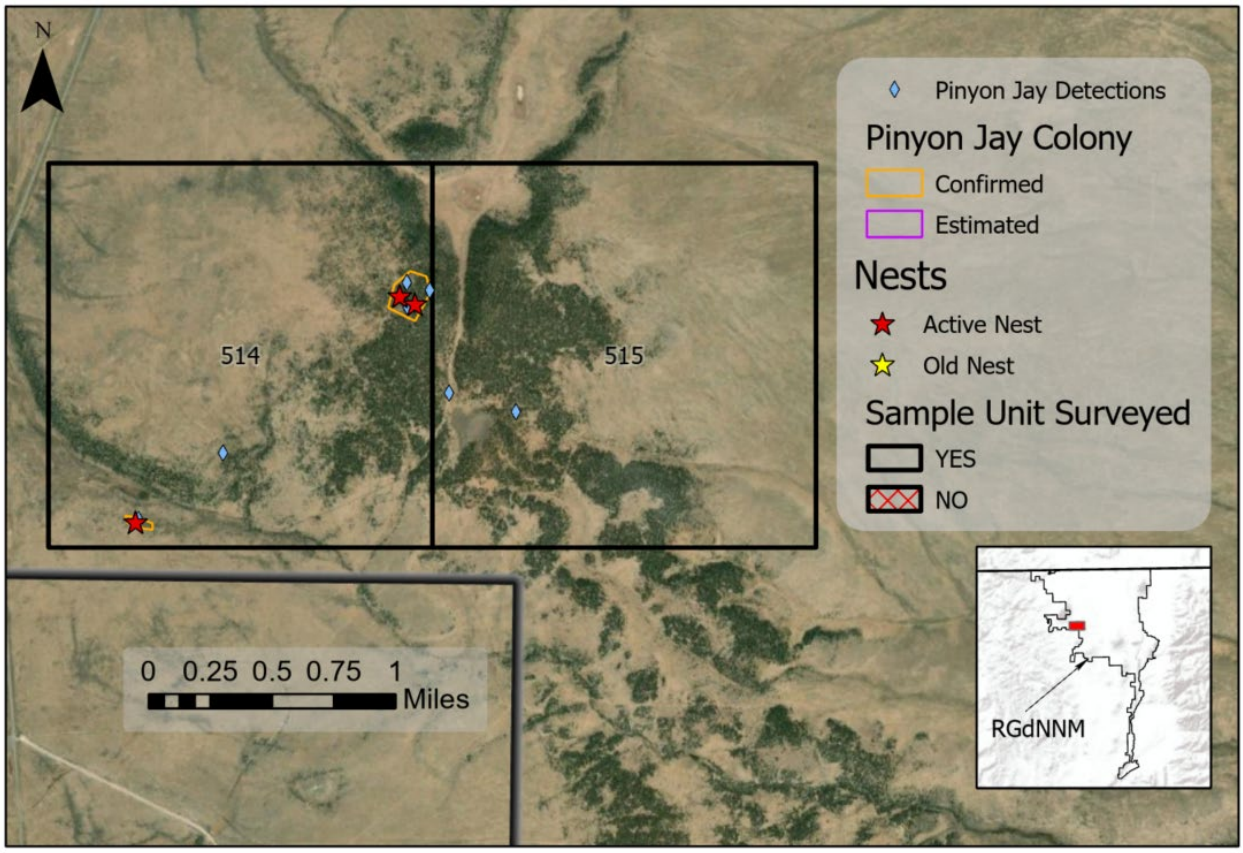

Figure 15. Wissmath Crater area Pinyon Jay detections, nests and colonies, RGdNNM 2021.

Potential Treatment Area Findings

Cerro WUI Thinning Area Phase II

Parts of the Cerro WUI were easily accessible enabling the field staff and volunteers to make eight surveys to the treatment area, plus additional spontaneous visits (2) of roadside observation. We located two confirmed and one estimated colony within the treatment polygon (Figure 11, Table 9). Jays were rarely observed using the 2017 thinned areas lacking trees, but flocks of 1 to 30 were regularly observed during all visits to other areas within the treatment polygon. Three nests were found in the two colonies, and multiple observations of begging birds indicated additional nesting in the area. An estimated colony was suspected just south of the treatment polygon where begging calls were heard on multiple visits.

Table 10. Potential Treatment area Pinyon Jays, nests, and colony observations, RGdNNM 2021.

Potential Treatment Area	Survey Detection Dates	PIJA Survey Detections	Nests Found	Colonies Found
Cerro WUI Thinning Area Phase II	3/13, 4/3, 4/4, 4/16, 4/18, 4/23, 4/24, 4/27, 4/28, 5/8	41 Flock observations, Ave Flock size: 5.3 PIJA	4 Active Nests, 3 Old Nests Found	2 Confirmed Colonies, 1 Estimated Colony
Cerro de la Olla Thinning Area	3/20, 3/31, 4/2, 4/9, 4/16, 4/23, 4/30, 5/1, 5/7. 5/9	38 Flock observations, Ave flock size: 5.2 PIJA	2 Active Nests, 4 Old Nests Found	3 Confirmed Colonies, 1 Estimated Colony
South Wind Mountain WUI Thinning Area	3/28, 4/14, 4/26, 5/6	3 Flock observations, Ave flock size: 3 PIJA	0 Nests	0 Colonies
WRRA WUI Thinning Area	3/15, 3/24, 4/14, 4/15, 4/28, 5/10	1 Flock observation, 2 PIJA	0 Nests	0 Colonies

Cerro de la Olla Thinning Area

Five surveys were conducted within each Cerro de la Olla treatment polygon (Figure 8). Within these polygons we found four breeding colonies, three confirmed and one estimated. An additional confirmed colony, located on the west side of the mountain, was just north of a treatment polygon boundary. In addition to the five colonies found on Cerro de la Olla, field staff suspect there may be at least two more present, one each on the east and west sides of the mountain, based on Pinyon Jay flight observations. The treatment polygons ring the base of the mountain and significantly overlap the areas of jay detections and colony locations, which also ring the base of the mountain. Pinyon Jays were not detected upslope of the treatment polygons. Results from this study indicate that Cerro de la Olla contains the greatest abundance of Pinyon Jays and highest concentration of nesting colonies within the RGdNNM in the areas surveyed.

South Wind Mountain WUI Thinning Area

This area (Figure 9) is comprised of two planned treatment polygons that were difficult to access due to locked gates and long drives. We surveyed the northern treatment polygon five times, and detected a pair of Pinyon Jays during the fourth survey only. No breeding behavior was

observed, and the limited jay observations suggest no colony in this treatment area and the area is used only for foraging.

We surveyed the Southern proposed treatment polygon three times and only had birds passing through on the last survey. We canceled a fourth survey of the area due to wind. Like the northern treatment polygon, no breeding behavior was observed, and the limited jay observations suggest no colony in this treatment area and the area is used only for foraging. A colony was found on the NW side of wind mountain with nests 1.4 km from the northern edge of the northern treatment polygon.

WRRA WUI Thinning Area

Five rounds of surveys to these two sample units yielded only one Pinyon Jay flock of two birds (Figure 12). They briefly perched in a tree and then flew off over the gorge during the fifth visit (May 10). It appears that this area is seldom used by Pinyon Jays and it is unlikely that there is a nesting colony in this treatment area. Pinyon Jays were detected in adjacent sample units and the canyon rim to the north.

Discussion

Pinyon Jay Surveys

Our results show that Pinyon Jays use a significant amount of the pinyon-juniper woodland habitat in the Rio Grande del Norte National Monument. Pinyon Jays were easily detected, found in 95% (36 of 38) of sample units on at least one visit, and were nearby (within 50m) or historically observed (eBird records) in the two sample units where we did not observe them. Scaling sample unit size down from 10^2 km to 2.5^2 km still yields very high occupancy estimates, which are not very informative to land managers. Occupancy may not be an optimal metric in Pinyon Jay monitoring within this study area. Pinyon Jays have large home-ranges, travel widely within them (Johnson et al. 2020), and we regularly watched them fly between sample units, and had surveyors record the same flock on adjacent sample unit surveys. Because of this "open" movement of jays between sample units, in the RGdNNM, measuring presence or absence within a sample unit, is effectively a measure of habitat use rather than occupancy. Additionally, occupancy estimates can remain unchanged despite a substantial increase or decrease in abundance over time (Magee et al. 2019).

On average, the number of jays detected within a sample unit during a survey were similar, with a majority of area sample units averaging between 7-13 jays detected. In areas where breeding was not suspected, such as the Wild Rivers Recreation Area or Cerro Montoso sample units, we

still detected on average 1-5 jays per survey. However, Pinyon Jay observations between sample units with and without located colonies showed sizable differences in relative counts (see Table 6 and Table 7) and comparing relative abundances appears to be more informative than occupancy or use metrics within the RgdNNM.

Ute Mountain, North Guadalupe, and Cerro de la Olla had the greatest number of Pinyon Jay detections and may be the most important Pinyon Jay areas within the Monument. However, the Ute Mountain survey results are significantly impacted by the large 140 jay flock observed during the first survey, and far fewer birds were observed in subsequent surveys. Most of the mountain was not surveyed and it is unknown if these birds dispersed to other areas on Ute Mountain or elsewhere. Continued surveys in these areas is recommended to enable tracking of relative changes over time in jay abundance, and colony activity.

Overall, the updated survey protocol was effective, and enabled a more standardized method to compare survey results between studies. Call broadcasts were not used or needed to detect pinyon jays. The use of unlimited distance sampling point counts (such as the IMBCR 6-minute point count protocol [McLaren et al. 2019]) would be permissible under the current revised protocol framework. The use of this survey method would allow for greater standardization and comparability between studies, and standard multi-species avian monitoring. We recommend the addition of a pinyon pine cone crop metric into the Pinyon Jay protocol, as it could be an easy to collect visual metric to help assess P-J woodland quality for Pinyon Jays.

Nesting and Breeding Colonies

We found 28 active nests within 20 colonies (15 confirmed, 5 estimated). At the five estimated colonies breeding evidence was not observed, and were estimated on breeding behavior observations, including: repeated detection of begging jays, supported by observations of repeated flights by individuals to specific locations (presumed nest attendance, or nest building flights), and flocks remaining within, or returning to the same area. Of the 2018 historical colonies found within the Monument (Johnson et al. 2018), five were active in 2021. Nests were located to identify colony locations. Many of the nests found were still being constructed, and approximately initiated in late-April to early-May, later than expected. Late nesting in the RGdNNM was also observed in 2017 (Johnson et al. 2018) with a potential hypothesis based on a poor pinyon crop the previous fall (Johnson and Balda 2020). In 2021, field staff noted that a large pinyon mast crop was only observed at the Ute Mountain sites within the Monument, which is also the location of our earliest confirmed nest (April 1) and suspected incubating nests. On April 24, 2021 we observed below-freezing temperatures with 4+ inches of snow falling overnight within the Monument. Concurrently, field staff noted a significant increase in new nest

building activity across many sites after this event. This late spring snowfall event may have led to nest failures and renesting observed from late-April to early-May.

Distribution of Pinyon Jays

Recent Pinyon Jay research from the Great Basin (Boone et al. 2021) in Nevada observed that Pinyon Jays used overlapping, but different habitats for seed caching, foraging, and nesting and that all of these behaviors were concentrated within the lower-elevation band of P-J woodland close to the woodland-shrubland ecotone. Within the RGdNNM, P-J woodlands are predominantly found on volcanic cones that rise above the surrounding sagebrush and shortgrass plains. Prior to the start of our 2021 study, an examination of the 2017 Pinyon Jay RGdNNM data in Johnson et al. (2018) showed that Pinyon Jay detections and nests appear to concentrate in low slope P-J woodland areas adjacent to sagebrush plains. For this study, we specifically included higher elevation P-J habitat surveys, away from the lower grassland/sagebrush ecotone, to explore if the low slope Pinyon Jay observations were a result of disproportionate survey effort of these lower-elevation areas because of their close proximity to road access, or if Pinyon Jays use these p-j woodland areas in greater proportion to the overall available habitat. Our survey and colony results indicate that Pinyon Jays in the RGdNNM may prefer to use only a portion of the available P-J woodland as most Pinyon Jay detections and found nests exhibit the Great Basin pattern in that jay activity appears to concentrate in lower elevation P-J woodland areas adjacent to sagebrush plains (Figure 2, Figure 5). In the Great Basin study, Pinyon Jays used low elevation, low tree cover areas for seed caching, slightly higher elevation with moderate, but variable tree cover for foraging, and slightly higher areas with high vegetation cover for nesting (Boone et al. 2021). In the RGdNNM we made similar observations of Pinyon Jay behavior with ground foraging observations at lower elevation, low tree-cover sagebrush P-J ecotone (most often observed around Cerro de la Olla), and arboreal foraging and nesting in slightly higher elevation P-J woodlands, but primarily on the lower slopes of the P-J dominated cones and mountains. This Great Basin model of Pinyon Jay habitat should be examined more closely in the RGdNNM, as it may warrant the consideration of the sagebrush P-J woodland ecotone as a valuable component of the jay's habitat, and prioritizing the importance of lower slope woodlands for Pinyon Jay P-J woodland management.

Management Recommendations

The Pinyon Jay is a NM species of greatest conservation need (NMDGF 2016) and recently petitioned for federal protection under the endangered species act. Within the RGdNNM we recommend additional surveys to more clearly understand Pinyon Jay use at Ute Mountain, and

Cerro Montoso. Both of these sites were under surveyed in this project. We also recommend continued monitoring of Pinyon Jays within the North Guadalupe treatment area.

- Ute Mountain was under surveyed due to logistical constraints in reaching the East, West and Southern Slopes of the mountain. With the high abundance of Pinyon Jays observed on the North slope, priority should be given to fully understanding the population on the rest of the mountain. This area could contain one of the highest densities of Pinyon Jays within the Monument.
- Cerro Montoso was also under surveyed. Few Pinyon Jays were observed at this location and further study should be given to determine if colonies exist around this mountain and to understanding the differences of this area compared to Cerro de la Olla to the north. Pinyon Jay abundance differences between these two closely situated mountains appears to be extreme, and affords a valuable opportunity to learn why the habitat found at Cerro de la Olla appears to be greatly preferred over that found at Cerro Montoso. Between these two areas are significant differences in the P-J woodlands, cone crop, sagebrush ecotone, or water accessibility found?
- We did not monitor Pinyon Jay use of water sources, but Pinyon Jays are known to require access to water (Johnson et al. 2020) and readily use man-made water source (Johnson et al. 2013). In examining maps, Cerro de la Olla, has significantly more water tanks, catchments, and wildlife drinkers compared to Cerro Montoso. This apparent difference is worth exploring, possibly through using remote game cameras, to better understand Pinyon Jay water use and requirement in these two areas.
- It's important to understand how Pinyon Jays respond to woodland thinning. Thinning occurred on North Guadalupe in 2017. In 2021, jays were found on North Guadalupe in high abundance, but not in thinned locations. One Colorado study (Magee et al. 2019) found that mixed woodland thinning impacts Pinyon Jay occupancy where, occupancy was lower at the local scale, but increased at a landscape scale. In the future, will these thinned locations be used for foraging and caching as observed in sagebrush P-J ecotones?

Within the four identified treatment areas, two (the South Wind Mountain WUI, and WRRA WUI) were found to have no significant Pinyon Jay presence, or nesting colonies. Management activities at these sites would not likely negatively impact local Pinyon Jays. The proposed Cerro WUI Thinning Area Phase II and Cerro de la Olla Thinning Area are populated with breeding colonies, and present varying management challenges. The colonies found adjacent to the town of Cerro present a unique opportunity to (relatively) easily monitor Pinyon Jay response to thinning over time given the treatments that have already occurred within the area. Results from

this study suggest the Cerro de la Olla has the largest and therefore most important Pinyon Jay breeding population within the whole RGdNNM. Currently, there is not sufficient information to describe and quantify management actions to actively improve habitat for Pinyon Jays, but specific recommendations have been established to minimize adverse effects of woodland treatments (Somershoe et al. 2020). The following recommendations are taken directly from the Partner's in Flight Conservation Strategy for the Pinyon Jay (Somershoe et al. 2020).

- Coordinate with Pinyon Jay researchers to identify whether particular treatment parameters (e.g., different percentages of retained canopy cover and/or tree density) can meet primary management objectives while remaining within the range of suitable nesting, caching, and foraging habitat.
- Pinyon Jays often use the same general area each year for nesting, with colony site shifts of up to 550 yards (~500 meters) between years (Marzluff and Balda 1992). Thus, if a buffer area of 550 yard (~500 meters) around a known breeding colony remains undisturbed, it allows for colony shifts across years.
- If thinning in persistent piñon-juniper woodlands or wooded shrublands, creating a patchy-clumpy mosaic of suitable nesting habitat within the treated area, as opposed to evenly spaced thinning, allows for shifting colony locations, and better mimics how fire would have impacted the landscape in persistent piñon-juniper woodlands and wooded shrublands (Romme et al. 2009).
- As piñon nut production is critical to Pinyon Jays, mast-producing trees are particularly valuable. Therefore, thinning may be particularly detrimental in known productive piñon woodlands containing old or very old trees, likely of prime piñon nut producing age, and trees of moderate age to support future nut production (Parmenter et al. 2018, Crist et al. 2019). Parmenter et al. (2018) identified age and size of *P. edulis* as an indicator of probable nut productivity.
- Retaining and promoting native grasses, forbs, and shrubs in the understory may increase available invertebrate prey for Pinyon Jays (Bombaci and Pejchar 2016).

Recent research (Boone et al. 2021) indicates Pinyon Jays preferentially select for low elevation P-J woodland habitat and that adjacent sagebrush, and sagebrush-P-J woodland ecotone should be considered a distinct component of Pinyon Jay habitat, and not a separate habitat managed irrespective on Pinyon Jay needs. Woodland treatments often target this same area and should be informed by Pinyon Jay research to aid in the conservation and recovery of the species.

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APPENDIX A – SAMPLE UNIT INFORMATION

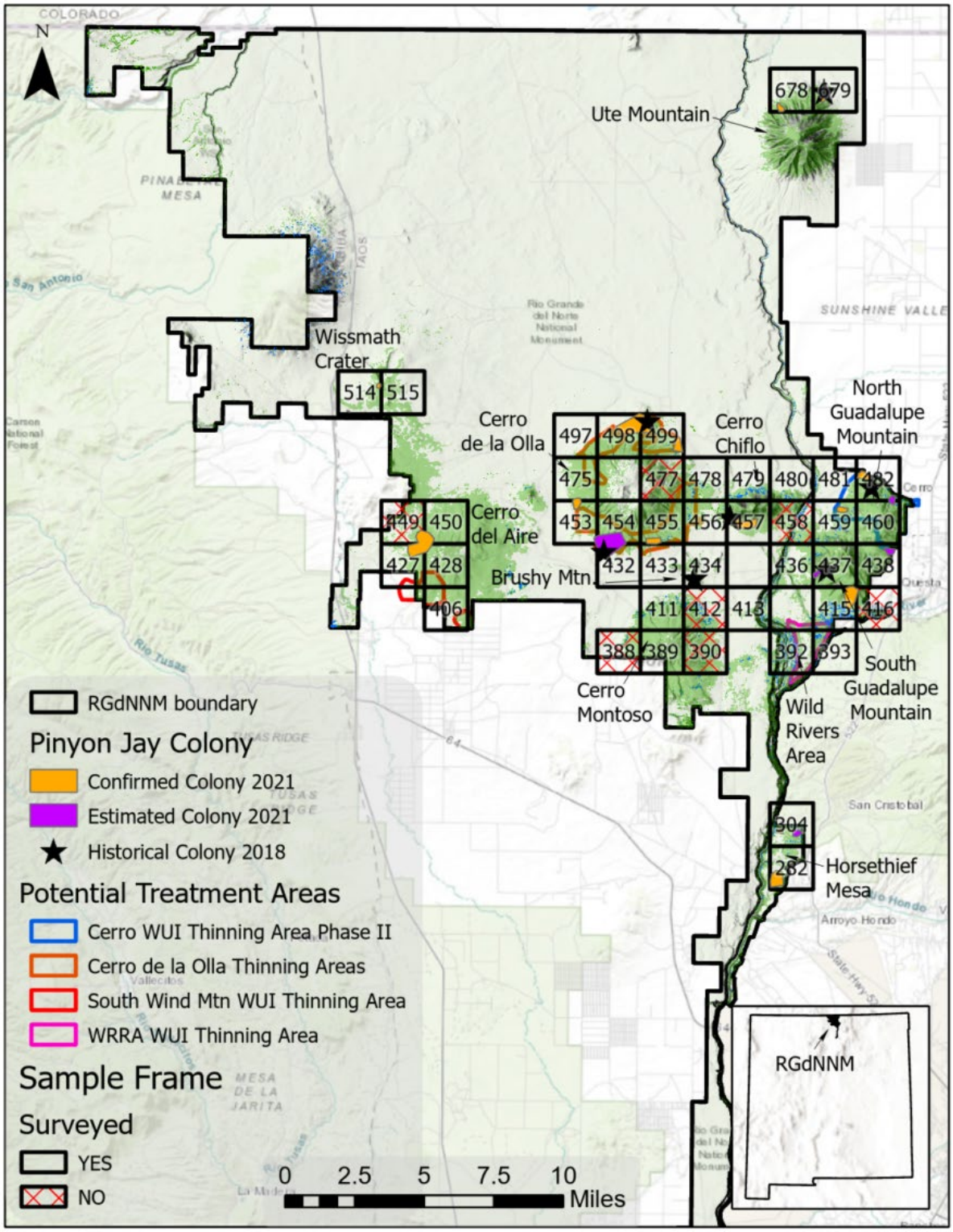

Figure 16. Map showing sample units, colony locations, and potential treatment areas, RGdNNM 2021. Squares lacking numerical labels were not part of the sampling frame. Locations of historical 2018 colonies estimated based on information found in Johnson et al. 2018.

Table 11. Survey dates and results per sample unit, RGdNNM, 2021.

Area	Sample Unit	Survey 1 Date	Survey 1 Flocks Detected	Survey 1 Flock Sizes	Survey 2 Date	Survey 2 Flocks Detected	Survey 2 Flock Sizes	Survey 3 Date	Survey 3 Flocks Detected	Survey 3 Flock Sizes	Survey 4 Date	Survey 4 Flocks Detected	Survey 4 Flock Sizes	Survey 5 Date	Survey 5 Flocks Detected	Survey 5 Flock Sizes
Ute Mountain	679	3/19/2021	3	1, 5, 140	4/1/2021	1	3	4/22/2021	2	2, 2	-	-	-	-	-	-
	678	3/19/2021	1	140	4/1/2021	3	2, 3, 5	4/22/2021	2	2, 3	-	-	-	-	-	-
Wissmath Crater	514	3/18/2021	1	15	4/8/2021	2	5, 25	4/26/2021	3	2, 2, 15	-	-	-	-	-	-
	515	3/18/2021	0	-	4/8/2021	0	-	4/26/2021	2	1, 2	-	-	-	-	-	-
Cerro del Aire	449	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	450	4/4/2021	0	-	4/14/2021	0	-	5/6/2021	3	1,1,1	-	-	-	-	-	-
	427	3/28/2021	1	3	4/4/2021	2	1, 15	4/14/2021	3	2, 3, 35	4/26/2021	1	2	5/6/2021	1	8
	428	3/28/2021	0	-	4/4/2021	0	-	4/14/2021	1	3	4/26/2021	0	-	-	-	-
	406	3/28/2021	0	-	4/14/2021	0	-	4/27/2021	0	-	5/6/2021	3	1, 2, 6	-	-	-
Cerro de la Olla	497	3/20/2021	0	-	4/9/2021	0	-	4/30/2021	1	1	-	-	-	-	-	-
	498	3/20/2021	0	-	4/9/2021	4	2,2,2,5	4/23/2021	5	2,3,3,5,6	4/30/2021	4	1,1,6,20	5/7/2021	5	1,2,2,3,17
	499	3/20/2021	3	1,2,22	4/9/2021	4	1,1,1,4	4/23/2021	2	10, 22	4/30/2021	1	1	5/7/2021	1	4
	475	3/31/2021	1	2	4/9/2021	1	1	4/15/2021	1	4	5/1/2021	6	1,1,1,2,6,6			
	477	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	478	3/12/2021	1	50	4/2/2021	0	-	4/9/2021	1	15	-	-	-	-	-	-
	453	3/21/2021	3	3,4,52	4/15/2021	4	1,3,3,6	5/1/2021	5	2,2,2,5,15	-	-	-	-	-	-
	454	3/31/2021	1	5	4/15/2021	1	2	5/1/2021	4	2,1,1,1	-	-	-	-	-	-
	455	4/2/2021	3	1,1,15	4/16/2021	3	1,2,2	4/30/2021	0	-	5/1/2021	1	1	-	-	-
	456	4/2/2021	0	-	4/16/2021	2	8,15	4/30/2021	1	1	-	-	-	-	-	-
	432	3/31/2021	2	1, 4	4/16/2021	1	20	5/1/2021	2	3, 8	-	-	-	-	-	-
Cerro Chiflo	479	3/25/2021	0	-	4/9/2021	1	15	5/5/2021	0	-	-	-	-	-	-	-
	480	3/25/2021	2	6, 9	4/10/2021	2	8,8	5/5/2021	2	1,6	-	-	-	-	-	-
	457	3/25/2021	0	-	4/10/2021	2	1,4	5/5/2021	1	3	5/9/2021	1	9	-	-	-
	458	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 11 continued

Area	Sample Unit	Survey 1 Date	Survey 1 Flocks Detected	Survey 1 Flock Sizes	Survey 2 Date	Survey 2 Flocks Detected	Survey 2 Flock Sizes	Survey 3 Date	Survey 3 Flocks Detected	Survey 3 Flock Sizes	Survey 4 Date	Survey 4 Flocks Detected	Survey 4 Flock Sizes	Survey 5 Date	Survey 5 Flocks Detected	Survey 5 Flock Sizes
Brushy	433	3/31/2021	0	-	4/30/2021	0	-	5/7/2021	0	-	-	-	-	-	-	-
Mountain	434	3/12/2021	1	34	3/27/2021	1	3	4/23/2021	6	1,1,6,6,6,15	-	-	-	-	-	-
Cerro Montoso	411	3/27/2021	0	-	4/21/2021	0	-	5/9/2021	1	1	-	-	-	-	-	-
	412	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	388	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	389	3/27/2021	0	-	4/21/2021	0	-	5/9/2021	1	4	-	-	-	-	-	-
	390	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
North Guadalupe Mountain	481	3/26/2021	0	-	4/3/2021	0	-	4/16/2021	3	2, 3, 4	4/27/2021	1	2	-	-	-
	482	3/13/2021	1	10	4/3/2021	3	2,6,20	4/18/2021	2	3,8	4/27/2021	4	2,2,5,20	5/8/2021	3	1,4,9
	459	3/26/2021	0	-	4/16/2021	4	1,1,2,2	4/24/2021	4	1, 4, 8, 20	5/8/2021	1	2	-	-	-
	460	3/26/2021	0	-	4/3/2021	0	-	4/18/2021	3	1,1,1	4/27/2021	1	5	5/8/2021	11	1,1,1,1,1,1,2,5
	438	3/17/2021	3	2,3,20	4/3/2021	2	1, 6	4/18/2021	2	1,1	-	-	-	-	-	-
South Guadalupe Mountain	437	3/16/2021	0	-	4/7/2021	0	-	4/28/2021	5	2,2,4,7,15	-	-	-	-	-	-
	415	3/17/2021	2	1,2	4/7/2021	1	21	4/28/2021	2	2,11	-	-	-	-	-	-
	416	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wild Rivers Area	436	3/15/2021	4	1,1,4,30	4/28/2021	2	2,5	5/8/2021	0	-	-	-	-	-	-	-
	413	3/10/2021	1	11	3/24/2021	0	-	4/16/2021	1	1	-	-	-	-	-	-
	392	3/15/2021	0	-	3/24/2021	0	-	4/15/2021	0	-	4/28/2021	0	-	5/10/2021	0	-
	393	3/15/2021	0	-	3/24/2021	0	-	4/15/2021	0	-	4/28/2021	0	-	5/10/2021	1	2
Horsethief Mesa	304	3/21/2021	1	30	4/11/2021	1	6	5/2/2021	5	2,2,2,2,8	-	-	-	-	-	-
	282	3/21/2021	2	1, 2	4/12/2021	1	12	5/2/2021	5	1,1,2,2,3	-	-	-	-	-	-

Dashes indicate no data and is applied where: there is no numeration of flock size when 0 flocks were detected; sample units did not have a 4th or 5th survey; and for sample units that were not selected to be surveyed. Sample units 449, 477, 458, 412, 388, 390, and 416 were not selected to be surveyed.

Table 12. Sample unit table showing inclusion of historical colonies, active colonies, estimated colonies, old nests, active nests, and proposed treatment areas, RGdNNM 2021.

Area	Sample Unit	Historical Colony (2018)[1]	Active 2021 Nests Found	Old Nest Found	Active Colony 2021	Estimated Colony 2021	Proposed Treatment Area
Ute Mountain	679	Yes	2		1		
	678		1		1		
Wissmath Crater	514		3		2		
	515						
Cerro del Aire	449				1		
	450				1		
	427				1		Yes
	428		1		1		Yes
	406						Yes
Cerro de la Olla	497						Yes
	498		3	1	1		Yes
	499	Yes	3	1	2		Yes
	475			1	1		Yes
	477						Yes
	478						Yes
	453		1		1	1	Yes
	454					1	Yes
	455			2		1	Yes
	456		1		1		Yes
	432	Yes				1	Yes
Cerro Chiflo	479						
	480						
	457	Yes	3		1		
	458						
Brushy Mountain	433						Yes
	434	Yes					
Cerro Montoso	411						
	412						
	388						
	389						
	390						

Table 12 continued

Area	Sample Unit	Historical Colony (2018)[1]	Active 2021 Nests Found	Old Nest Found	Active Colony 2021	Estimated Colony 2021	Proposed Treatment Area
North Guadalupe Mountain	481						Yes
	482	Yes	3	1	1	1	Yes
	459		1	1	1		Yes
	460			1		1	Yes
	438					1	Yes
South Guadalupe Mountain	437	Yes		2		1	
	415		2		1		Yes
	416						
Wild Rivers Area	436						
	413						
	392						Yes
	393						Yes
Horsethief Mesa	304		2	1	1	1	
	282		2	1	1		

[1] Locations of historical 2018 colonies estimated based on information found in Johnson et al. 2018.

APPENDIX B - PINYON JAY AND PINYON-JUNIPER DEFINITIONS

Pinyon-Juniper Vegetation Types (from Romme et al. 2009)

Persistent pinyon–juniper woodlands	Ranging from sparse to dense tree stands growing on poor to productive sites with variable cover of shrubs, forbs and grasses. Most commonly found on rugged uplands with shallow, coarse soil, and with sparse herbaceous understory cover and extensive litter or bare ground.
Pinyon–juniper savannas	Low to moderate tree density with a well-developed and nearly continuous grass and forb understory on coarse- to fine-textured soils. *Juniperus* spp. are often the dominant tree sp. and *Pinus* spp. may be infrequent or absent.
Wooded shrublands	Variable tree component from very sparse to relatively dense. Well-developed shrubs are the dominant understory plants; sagebrush (*Artemisia* spp.) are often the dominant shrub.

Pinyon Jay Breeding Colony

Historic Colony	Colonies identified by Johnson et al. (2018). We revisited each of these breeding colonies to determine if these areas were still active.
Confirmed Colony	Confirmed colonies contained at least one found active nest in 2020. Colony delineation was based on found nest locations and jay activity observed by field staff.
Estimated Colony	Estimated colonies were delineated at suspected 2020 breeding locations and delineated based on observed jay behavior. No nests were found at these estimated colony locations, but begging chirring calls were heard, usually on multiple visits to the area. The Chirring begging call is a strong indication of breeding as it is given by the female to the male during courtship, nest-site selection, nest-building, egg-laying, incubation, and brooding (Johnson and Balda 2020); the call is also given by nestlings and fledglings when being fed by their parents (Johnson and Balda 2020).

Pinyon Jay Nest Type

Active Nest	Current year, Pinyon Jay nests are typically substantial in size, deep, thickly lined, and often incorporate juniper bark. Active nests were used to identify Confirmed Breeding Colonies. Identification of active nests included visual observations of Pinyon Jay nests in construction, nests with eggs, nests with chicks, or an incubating adult on nest. Once located, active nests were not monitored to determine nest success
Old Nest	Pinyon Jay nests may persist for more than one year. Old nests are not reused. Pinyon Jay's exhibit site fidelity, so the presence of old nests can be used to search for active colonies. Old, past year nests look similar to active nests, but appear weathered and gray, often flatter, and may be falling apart.