

Pinyon Jay Habitat Use and Management Recommendations in New Mexico Piñon-Juniper Woodlands

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Pinyon Jays and piñon pines have a mutualism whereby the trees provide mast crops of highly nutritional seeds that enhance the jays' population viability (Marzluff and Balda 1992), and the jays cache the seeds, serving as the tree's main long-distance seed disperser (Ligon 1978). Breeding Bird Survey data indicate that Pinyon Jay populations have been declining for 50 years (Sauer et al. 2014), and they are currently the fastest-declining piñon-juniper bird species (Boone et al. in press). Ongoing decline of the piñon tree's main seed disperser will limit the potential of the trees to reestablish in areas of high mortality, colonize higher elevations, or shift distributions northward in response to climate change.

We modeled Pinyon Jay habitat use to inform management and benefit both the bird and tree species. To understand Pinyon Jay habitat needs, we modeled habitat use at the home range, nesting colony, and nest scales at three study sites across New Mexico, USA. At the landscape scale (Ferrari and Ferrarini

2008), the home range of a Pinyon Jay flock can range from 3000–5000 ha. At the ecosystem scale (Ferrari and Ferrarini 2008), a nesting colony can range from 1–50 ha. The nest scale includes the nest tree and its immediate surroundings, an area of about 1 ha. Study areas were the Oscura Mountains, White Sands Missile Range, NM; the Manzanita Mountains, Kirtland Air Force Base, NM; and the Bureau of Land Management Farmington, NM Resource Area.

At the landscape scale, we created habitat maps of the three study areas. For the Oscura Mountains, we used an existing vegetation map (Muldavin et al. 2000) in combination with 1-m natural color aerial photography taken in 2009. For the Manzanita Mountains, we created a vegetation classification based on 6-inch color digital ortho-imagery taken in 2008 (Johnson et al. 2014, 2016). For the Farmington Resource Area, we used National Agriculture Imagery Program 1-m visible and near-infrared digital aerial photography from 2014 and Landsat 8 satellite imagery to create a land

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cover classification (Johnson et al. 2017). Map units were defined based on Pinyon Jay habitat use. Year-round home ranges of two Pinyon Jay flocks in central NM averaged 4,779 ha (Johnson et al. 2014). The summer range of one flock in northwestern NM was 4,034 ha (Johnson et al. 2015). Jays used mainly Juniper Woodland and Savanna, Piñon-Juniper Woodland, and Piñon Woodland habitats (Johnson et al. 2014, 2017). Higher elevation Piñon-Juniper Woodland and Piñon Woodland were used for nesting, while lower elevation Juniper Woodland and Savanna was used more often in the nonbreeding season (Johnson et al. 2016).

We created a predictive habitat model of colony-scale habitat using the landscape-scale habitat model (above) land cover data combined with geospatial data such as slope, aspect, elevation, solar radiation, and NDVI (greenness). We first classified colony sites, then created a supervised classification of the entire study area based on the geospatial measures. For the models, we retained areas conforming to the geospatial and vegetation profiles of known nesting colonies. A comparison of the predictive model to validation colonies at the Oscura Mountains and Manzanita Mountains study sites showed 100 percent and 76 percent overlap of the validation colonies with the predictive model, indicating good predictability of the colony-scale model (Johnson et al. 2016).

Using conditional logistic regression, we modeled nest-scale habitat use at nine nesting colonies, three at each of the three study sites. We collected data on 5-m and 11.3-m radius BBird (Martin et al. 1997) plots at each nest and a paired, random plot 100 m away from the nest plot. Data collected included diameter and height of nest tree and trees on plot, nest height, nest aspect, canopy cover, ground cover, number of trees and shrubs, and so on. Tree density at nests averaged 965 trees/ha at seven colony sites in central NM and 436 trees/ha at two colonies in northwestern NM. Pinyon Jays nested on plots with higher canopy cover, larger trees, and higher litter cover in central NM (Johnson et al. 2014). In northwestern NM, they nested in larger-diameter trees (measured as root crown diameter, RCD) and taller trees, compared to random plots, while avoiding the tallest, most emergent trees (Johnson et al. 2015). Combining nest-scale data from all sites for a case-controlled conditional logistic

regression, we found that nest plots were located on cooler, northeast facing slopes and had higher total canopy cover than random plots. Nest trees were larger diameter, taller, more asymmetrical, and were surrounded by smaller trees, than corresponding trees on random plots.

In New Mexico piñon-juniper woodlands, management for Pinyon Jays should include adequate area for a flock's home range, at least 5,000 ha. Multiple land cover types such as Juniper Woodland and Savanna, Piñon-Juniper Woodland, and Piñon Woodland should be included to account for variation in use across seasons and life history stages. Sagebrush shrubland or grassland components may also be included, especially for wintering habitat. Home ranges should include multiple areas containing 1) many large (>15 cm RCD), mast-producing trees, 2) multiple colony-sized patches (50 ha) of nesting habitat, and 3) water sources, especially near colonies.

Management for Pinyon Jays at the nesting colony-scale should include Piñon-Juniper Woodland and/or Piñon Woodland and have relatively high canopy cover. Colony sites should 1) be at least 50 ha in area, 2) contain large nest trees, 3) include > 20 dense clumps containing potential nest trees, 4) be within 1 km of a water source, 5) have minimal fragmentation by roads, well pads, and so on, and 6) have minimal noise and foot traffic from March—June.

Management for Pinyon Jays at the nest-scale should include: 1) tall piñon or Utah juniper trees, 2) large diameter piñon or Utah juniper trees (mean for this study 35.4 cm, range 7 – 100 cm), 3) high tree density (400–1200+ trees /ha), 4) high canopy cover (in this study, 40% measured from the ground; mean aerial 30%), and 5) healthy trees with dense foliage. We believe these general recommendations are applicable to areas other than these three sites (e.g., nesting in larger trees, higher canopy cover), but specific numerical recommendations (e.g., number of trees/ha, mean tree diameter) will vary depending on the characteristics of each site. In general, retaining large piñon trees and high canopy cover would also benefit mule deer, Juniper Titmouse, Gray Flycatcher, Bewick's Wren, and Black-throated Gray Warbler (Pavlacky and Anderson 2001).

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