RAPTOR MONITORING IN THE MIDDLE RIO GRANDE BOSQUE OF CENTRAL NEW MEXICO 2004-2016

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Management efforts to control invasive species in the riparian forest (bosque) habitat of the Middle Rio Grande can impact avian species community composition, productivity, and abundance. In the early 1980s, Hink and Ohmart conducted a comprehensive biological survey in the Middle Rio Grande bosque in the Albuquerque area of central New Mexico. In an effort to continue and focus on this work, we present results from 13 years of raptor monitoring in the Rio Grande bosque and consider implications for ongoing and future habitat management. Between the years of 2004 and 2016, Hawks Aloft, Inc. monitored bosque lands managed by four different government agencies: Rio Rancho, Corrales, Albuquerque, and the Middle Rio Grande Conservancy District (MRGCD). The area sampled was inclusive of 101 kilometers (70 miles) of bosque; an area of approximately 1,582 ha. We monitored an average of 378 stick nests per year, with an average of 69 becoming active raptor and corvid nests annually from 2004 through the 2016 nesting season. Active nest density was highest in Rio Rancho with 0.06 nests/ha, followed by lands managed by Corrales and MRGCD with 0.05 nests/ha, and Albuquerque with 0.04 nests/ha. Cumulatively, we monitored a total of 899 active nests representing eight different species: Cooper's Hawk (*Accipiter cooperii*), Great Horned Owl (*Bubo virginianus*), Swainson's Hawk (*Buteo Swainsoni*), Common Black-Hawk (*Buteogallus anthracinus*), Common Raven (*Corvus corax*), American Crow (*Corvus brachyrhynchos*), American Kestrel (*Falco sparverius*), and Long-eared Owl (*Asio otus*). Cooper's Hawk was the most abundant nesting raptor, accounting for 72% of all active nests monitored. Although Cooper's Hawks were common in all monitored areas, cumulative active nest density was highest in Corrales (0.57/ha). Productivity was highest in Rio Rancho and Corrales, where 2.82 and 2.43 young (respectively) of all species combined fledged per active nest.

INTRODUCTION

From 2004-2016, Hawks Aloft, Inc. (HAI) was contracted to conduct a study of nesting raptors in the Rio Grande bosque of central New Mexico, between Rio Rancho and Belen. We located and monitored nests for raptors and large corvids in the bosque. We report nest densities and reproductive success for the most common species. The primary objectives of this study were: 1) maintain an active database of current stick nests (the dominant nest type used by these species); 2) identify bosque nesting raptors and corvids; 3) determine the density of nests and productivity associated with landscape and land management entities. The riparian forest (bosque) adjacent to the Rio Grande in central New Mexico provides habitat for a rich assemblage of wildlife. Bosque health is influenced by numerous, and often interrelated, management concerns. In recent years, drought and wildfire suppression have been primary management concerns. Major wildfires, like those that burned several hundred acres of bosque in 2003, fuel reduction efforts, and increasing urban development have reduced the amount of woodland habitat. Further, riparian restoration efforts at several sites throughout the study area, initially begun in 2010, and continuing through 2015, are not yet mature. These areas might have greater wildlife benefits once they are fully mature. Factors like drought, proliferation of exotic plants, fire, and development often have a negative impact on wildlife, and land managers strive to minimize or negate these impacts (Hockin et al. 1992, Theobald et al. 1997). Management efforts to control invasive species in the riparian forest (bosque) habitat of the Middle Rio Grande can impact avian species community composition, productivity, and abundance (Leal et al. 1996). It is important to monitor wildlife to ensure that efforts to maintain the bosque are improving conditions for wildlife, and not exacerbating negative impacts.

As apex species, raptors provide an efficient way to monitor the health of the bosque ecosystem for wildlife. Raptors are relatively easy to observe in sufficient quantities for a robust sample (Sergio et al. 2008). Because raptors prey on a variety of taxa, including mammals and birds, determining raptor abundance and nest productivity can provide an indicator for wildlife population trends in general. Some raptors use the Rio Grande bosque for nesting and cover. Therefore, determining relative raptor abundance and nesting densities can provide an indication of habitat quality. Because some raptors (e.g., Cooper's Hawk [*Accipiter cooperii*]) are tolerant of an urban environment (Rosenfield et al. 1996), whereas many others are sensitive to human-caused disturbance, determining species composition can provide an indicator of urban influence on the bosque.

STUDY AREA

Over all years, our study area for nest monitoring included approximately 101 kilometers (70 miles) of bosque encompassing about 1582 ha. On the west side of the Rio Grande, the bosque survey area extended from Corrales south to I-25 and from the south edge of Isleta Pueblo to the Belen Bridge. On the east side of the river, the survey area extended from the south boundary of Sandia Pueblo south to the Los Lunas bridge, excluding Isleta Pueblo lands. Rio Rancho was added as a study area in 2005. From 2005-2016, the most consistently monitored study areas extended from Rio Rancho south to the I-25 bridge on the west side of the river, and from Sandia Pueblo south to the Los Lunas bridge (excluding Isleta Pueblo lands) on the east side of the river. Maps of all areas surveyed between 2004-2016, including those with intermittent coverage, are presented in order from north to south in Figures 1 – 36.

Habitat types supporting nesting bosque raptors almost always included a mature cottonwood (*Populus fremontii*) overstory with a variety of understory types that consisted of

native plants, such as New Mexico olive (*Forestiera neomexicana*), coyote willow (*Salix exigua*), and silver buffaloberry (*Shepherdia argentea*), as well as exotic plants, such as Russian olive (*Elaeagnus angustifolia*) and salt cedar (*Tamarix* spp.).

Beginning in 2004, widespread mechanical thinning of non-native vegetation occurred in the Albuquerque and Rio Rancho reaches of the survey area for perceived fire prevention and restoration benefits. Rio Rancho constructed a 10' wide crusher fine loop trail throughout the Willow Creek section of their bosque, with additional crusher fine and dirt footpaths intersecting the main loop. In 2015 and 2016, the City of Albuquerque conducted additional thinning of their bosque from Bridge Blvd. north to Montano Road, and installed an 8' wide crusher fine path to increase recreational use in that section of the bosque. Smaller scale thinning operations also occurred on lands managed by the Middle Rio Grande Conservancy District (MRGCD) south of Isleta Pueblo. Such management efforts, at least temporarily, left an open understory. Beginning in 2010, and continuing through 2015, restoration efforts conducted by the US Army Corps of Engineers (USACE) occurred at various sites within the Albuquerque and Corrales bosques. Initially, non-native habitat was largely cleared, river bank edges were lowered and extensive willow swales incorporating other native vegetation were planted. Some non-native vegetation was left intact to provide cover and forage for wildlife until the newly restored areas matured. Newly planted vegetation at these sites was hand watered for a period of two years to ensure increased survival. Additionally, several small (<5 acre) sites were thinned for fuel reduction purposes by contractors for the Village of Corrales. Further, the Middle Rio Grande Conservancy District undertook the removal of all drainside vegetation throughout portions of the Corrales bosque. While portions of the Corrales bosque retain a generally dense understory, the restored and fuelwood reduction sites are generally more open. Since those actions, these

areas have been further impacted by high levels of recreational use, and the creation of multiple dirt footpaths.

Landscape outside the bosque also varied among land management entities. In Corrales, the landscape surrounding the bosque generally consisted of rural homes, many featuring backyard bird feeders, large trees, and/or open horse pastures. Similarly, the landscape adjacent to areas of MRGCD-managed bosque in the southern reaches of the study area (e.g. Los Lunas, Belen) typically consisted of agricultural fields and relatively sparse residential areas. In Albuquerque, landscape adjacent to the bosque was predominantly urban, while in Rio Rancho adjacent landscape predominately consisted of densely populated residential areas.

METHODS

We located and monitored stick nests from 2004-2016, and maintained a cumulative database of nest locations. Because raptors often re-used the same nests in multiple years, we visited all of the historic stick nest locations each year and added any new nests that were found. We also opportunistically monitored cavity nesting species, such as American Kestrel (*Falco sparverius*). In addition to staff, we used the services of trained volunteers to monitor some areas. All volunteers attended an annual training class that included the use of Global Positioning Units, search methods, identification of common bosque nesting raptors and their nest preferences, and aging nestling Cooper's Hawks, the most common nesting raptor in the Middle Rio Grande bosque.

Each year, we made a minimum of three visits to each previously documented stick nest. One visit occurred in each of three survey periods: 15 March-7 April, 8-30 April, and 1-25 May. During each visit, observers walked through the bosque checking all stick nests in the database

from previous years and searched for additional, previously undocumented nests. Although many raptors do not begin nesting during the first survey period, we considered it necessary to begin searching for nests before cottonwoods leafed out and visually obscured nests (typically by mid-April). Using this method, we were able to locate nests that might have been constructed but not found the previous year. Once found, we recorded the location of each nest using Universal Transverse Mercator (UTM) coordinates (North American Datum 1927) from below the nest.

For all nests during each visit, we determined the status and the nesting species. We considered a nest to be active if one of the following was observed:

1. The female was incubating
2. Food was delivered to the nest
3. Young or eggs were observed

Active nests were monitored every 7-14 days, or as often as necessary, to determine nest fate and the number of young fledged.

For the purposes of this report we identify all stick-nesting raptors and corvids, with additional analysis of the most abundant nesting raptor species in the Middle Rio Grande bosque, Cooper's Hawk and Great Horned Owl (*Bubo virginianus*). For the period 2004-2016, we present nest density as the number of active nests per hectare. In some cases, we were unable to locate an active nest where we observed apparently territorial adults. We only included documented active nests in density calculations. For productivity, we present the average number of fledged young observed per active nest. Additionally, we used Tukey-Kramer tests (alpha = 0.05) to compare the mean number of fledged young per year for Cooper's Hawk and Great Horned Owl. All statistical analyses were conducted using JMP 5.0 statistical software (SAS institute 2002). We compared nest densities and productivity among different land management

areas (i.e., Rio Rancho, Corrales, Albuquerque, and MRGCD). Due to varying funding levels and inconsistent monitoring efforts, some of the MRGCD routes, Los Lunas East, Los Lunas West, and Belen West, were not included in data analysis.

RESULTS

Between the years of 2004 and 2016, we monitored 70 miles of bosque habitat, from Rio Rancho on the north, to Belen on the south. During these surveys, we monitored an average of 378 stick nests per year within the primary survey areas. However, three of the four reaches managed by MRGCD were not consistently monitored due to lack of funding and/or available volunteers: Isleta West, Los Lunas East, and Los Lunas West. Thus, among lands managed by MRGCD, only data from the Isleta East route was included in the analysis below.

From 2004-2016, we located and monitored a total of 4915 stick nests in the primary survey areas, with a density of 0.24 stick nests per hectare. Because the database is cumulative (i.e., nests were added each year and subtracted when they were no longer present), one would expect the total to be predictably lowest in 2004 (N=465). However, the known number of stick nests climbed to its highest total in 2005 (N=586) and remained high in 2006 (N=530) and 2007 (N=484). Following that peak, the total number of documented nests began a decline that continued through the 2012 nest monitoring season, which had the lowest number of documented nests (N=189). The number of stick nests increased from 2013-2016 with 261, 370, 317 and 371 documented nests respectively (Table 1).

Cumulatively, over the course of the study, an average of 18.3% of the stick nests in our database became active per year. The percentage of stick nests that became active ranged from

11.5% in 2006 to 32.3% in 2012 (Table 1). The average density of active nests for all species combined was 0.04 nests per hectare per year (Table 2).

Over all years, a total of 1244 nests were located in the 269 ha of the Corrales bosque, resulting in the highest density of stick nests (N=4.62 nests/ha) among bosque land management entities. Bosque managed by the City of Albuquerque had the greatest number of documented nests (N=2809) in 953 ha, but a lower density (N=2.95 stick nests/ha) than Corrales. A total of 647 nests were documented in the 262 ha of MRGCD managed bosque (N=2.5 nests/ha) and Rio Rancho had the lowest density (N=2.19 nests/ha) with a total of 215 documented nests.

A significant factor in the difference of stick nest density among land management entities might be the percent of open habitat within and adjacent to the bosque. Corrales had the highest percentage of mature cottonwood canopy relative to area, while Albuquerque had significant open areas due to fire (e.g. areas near Montano Rd., Bridge Blvd., and in the South Valley) and other habitat (e.g. the Oxbow--marsh habitat located on the west side of the Rio Grande between Montano Rd. and I-40). Similarly, a substantial percentage of the Willow Creek (Rio Rancho) bosque was open habitat due to cottonwood die-off and fire.

We report active nests from all raptor species from 2004-2016, as well as American Crow (*Corvus brachyrhynchos*) and Common Raven (*Corvus corax*) within all primary reaches of the study area, between Rio Rancho on the north, southward to Belen (Table 3). Among all monitored stick nests in the consistently monitored reaches (N = 4915), a total of 899 (18.3%) became active, representing eight different species: Cooper's Hawk, Great Horned Owl, Long-eared Owl *(Asio otu*s), Swainson's Hawk (*Buteo swainson*i), Common Black-Hawk (*Buteogallus anthracinus*), American Kestrel, American Crow and Common Raven. Of the 899 active nests,

718 successfully fledged young, 115 failed, and the outcome was undetermined at 66 nests (Table 4). All active nests were monitored until the young fledged or the nest failed.

Cooper's Hawk was the most common stick-nesting raptor, accounting for 651 (72.41%) active nests. Great Horned Owl was the second most common nesting raptor, with 166 (18.46%) active nests. Other raptor species with active nests in the study area included Swainson's Hawk, N=20 (2.22%), Long-eared Owl, N=2 (0.22%), Common Black-Hawk, N=8 (0.89%), American Crow, N=15 (1.67%) and Common Raven, N=10 (1.11%) (Table 4).

American Kestrel, an obligate cavity nesting species, occurred in low numbers throughout the study. A total of 27 active nest sites were documented over the course of the study, primarily in formerly burned areas with standing snags, or open areas. Due to their secretive nesting habits, nests of this species and the number of fledglings were particularly difficult to detect and were under-documented.

Cooper's Hawk

Of the 651 active Cooper's Hawk nests documented from 2004-2016, 538 (83%) successfully fledged young, 86 (13%) failed, and 27 (4%) had an unknown fate (Table 4). We documented a minimum of 1449 Cooper's Hawk young (i.e., >21 days old) fledging from 538 nests (2.23 young per active nest and 2.7 young per successful nest) (Table 5). There was no significant difference in the number of fledged Cooper's Hawk young per year over the thirteen year study, indicating a stable fledgling population (Tukey-Kramer test). Productivity was highest in the Rio Rancho section of the bosque, with a mean of 2.82 young fledged per active nest. But, this section was considerably smaller than all other areas, with an average of only three active Cooper's Hawk nests per year (Table 5). Productivity was next highest in Corrales (2.43

young per active nest) and Albuquerque (2.26 young per active nest), while MRGCD areas supported the lowest productivity (1.6 young per active nest) (Table 5). The average fledging date was similar among all management areas over the thirteen year study, ranging from July 6 to July 9 (Table 5). The range of Cooper's Hawk fledging dates was June 26 to August 8.

Great Horned Owl

Great Horned Owl, the earliest nesting bosque raptor, typically did not construct its own nest, but chose an existing nest, and refurbished it by adding nest lining material. We monitored 166 active Great Horned Owl nests during the study. Of these, 120 nests were successful, producing 233 fledged young; 22 nests failed, and the outcome was undetermined at 27 nests (Table 6). We found no statistical differences in the mean number of young fledged per year during the course of the study, indicating a stable fledgling population (Tukey-Kramer test). Great Horned Owl fledglings generally left the nest in early May and were exceptionally difficult to detect after initial departure from the nest, a factor that contributed to the relatively high number of nests without a known outcome.

Swainson's Hawk

Swainson's Hawk nested in small numbers in the bosque, with a total of 20 nests over the 13 years of the study. A total of 16 nests (80%) were successful, producing 26 fledged young; two nests failed and the outcome was undetermined at two nests. Swainson's Hawk nested primarily in areas with a mature cottonwood canopy and adjacent open areas for hunting. Because this species nested in the tops of the highest cottonwoods, and were particularly secretive near their nests, they were challenging to locate and monitor.

Common Raven and American Crow

Common Raven and American Crow, both corvid species, also were monitored as part of this study. Although not considered raptors, both built new stick nests and repaired and re-used existing nests initially built by raptors. Thus, the presence of a nesting corvid could create a suitable nesting substrate that might be utilized by a raptor species in future years. Both corvid species nested in small numbers in the bosque throughout the study. We monitored at total of 15 American Crow nests that produced 19 young, and 10 Common Raven nests that produced 13 young.

Common Black-Hawk

Common Black-Hawk, a riparian obligate Parabuteo species, was documented only in recent years (2011-2016). A total of eight active nests were documented, six of which were successful, and produced a total of seven fledged young. All nests were located in the southern reaches of the study area, in densely forested bosque managed by the Middle Rio Grande Conservancy District or the City of Albuquerque.

Long-eared Owl

Long-eared Owl was rare in the bosque and only two active nests were documented over 13 years. In 2005, a Long-eared Owl nest was monitored near the far north end of Corrales in densely vegetated habitat. It successfully fledged four young. In 2007, an active nest that failed was monitored on the west side of the Rio Grande, south of Montano Blvd. Since then, although Long-eared Owls have been occasionally observed during the early nesting season, no nests have been located.

Incidentally Encountered Species

When this study began, we expected that Red-tailed Hawk (*Buteo jamaicensis*) would be among the raptor species utilizing the bosque for nesting. Although Red-tailed Hawks were routinely observed in the bosque during spring, fall, and winter, no bosque nests were documented.

Mississippi Kite (*Ictinia mississippiensis*), although occasionally observed in the bosque as well as in adjacent agricultural lands in Corrales and near MRGCD managed bosque, was not documented nesting in the bosque. On several occasions in 2004, observers noted a Mississippi Kite pair exploring a bosque nest near the Los Lunas Bridge (NM 6) but there was no evidence of incubation and the nest was abandoned shortly thereafter.

Turkey Vulture (*Cathartes aura*) also was regularly observed within, or flying above the bosque, but no nests were documented. During spring and fall migration periods, vultures sometimes congregated in historic roost sites, with as many as 80 individuals roosting in a single tree.

Barn Owls (*Tyto alba*) were occasionally documented during raptor surveys and also during songbird surveys for the Middle Rio Grande Songbird Study, but no nests were located. Barn Owls are secretive, cavity nesting owls, making nests extremely difficult to locate.

DISCUSSION

The Middle Rio Grande bosque provides habitat for a diverse raptor population, and is particularly important for nesting Great Horned Owls and Cooper's Hawks. We currently

manage a database of raptor stick nests that ranges from 350-600 nests annually, of which 18.29% have been active, cumulatively over the course of the study. Such information can be a valuable conservation tool. The government agencies responsible for the bosque habitat in these reaches routinely perform management activities, such as clearing understory vegetation for habitat restoration, fire suppression, or other reasons. Our knowledge of nest distribution, particularly locations of current active nests, can help land managers comply with the Migratory Bird Treaty Act and avoid disturbance to these nests.

Cooper's Hawk was, by far, the most common nesting raptor in the Middle Rio Grande bosque. And, although Albuquerque supported numerous pairs, active nests were more dense in the Corrales reach. Cooper's Hawk productivity in Corrales during the years 2004-2008 matched the upper range of seven studies reviewed by Rosenfield and Bielefeldt (1993). But, lower success in recent years dropped cumulative productivity to 2.23 fledged young per nest, which is within the normal range for this species in the western United States. Unlike Albuquerque, the Corrales bosque is not adjacent to substantial urban development. Cooper's Hawks nesting in the Corrales bosque extended their territories into rural residential lots where prey base was supported by gardens, horse pastures, and numerous bird feeders. Since 2010, the US Army Corps of Engineers has completed restoration efforts in large sections of the Corrales bosque. That work initially increased the amount of open habitat and reduced the density of songbirds, the primary prey item for this species. Further, fuelwood reduction sites, implemented by the Village of Corrales, were largely devoid of understory vegetation that would provide cover and forage for birds and other wildlife, and avian populations have collapsed within the cleared sections of the drains (Hawks Aloft 2012). However, despite these habitat alterations, Cooper's

Hawk nest density and productivity have remained relatively stable in Corrales, perhaps an indicator of their use of adjacent lands for hunting purposes.

Interestingly, Cooper's Hawk reproductive success was greatest in the Rio Rancho bosque, with an average of 2.82 young per nest over 13 years of the study. This relatively small area (98 ha) with smaller patches of mature cottonwoods was largely devoid of dense understory vegetation, potentially making it easier to observe fledged young. The area received substantial recreational use by walkers, bicyclists, and dogs, many of which were off-leash. Free-ranging dogs could certainly impact fledglings on the ground but not yet flighted. However, given the small sample size of this area, it was difficult to draw comparisons among all study areas.

Bosque lands managed by the MRGCD generally contained denser patches of vegetation not subjected to substantial clearing efforts and less developed agricultural landscapes adjacent to the bosque that might provide superior hunting opportunities for Cooper's Hawks. But, Cooper's Hawk reproductive success was lower in MRGCD managed bosque than all other areas with just 1.6 young per active nest. However, this area also supported the greatest number of active Great Horned Owl nests relative to Cooper's Hawk nests (48%). In contrast, Albuquerque and Corrales contained far fewer Great Horned Owl nests relative to Cooper's Hawk nests (24% and 12%, respectively). Great Horned Owl usurps existing nests for its own use, potentially reducing the suitable nest sites available for use by the smaller Cooper's Hawk. Additionally, we noted that nests used by Great Horned Owls were routinely destroyed as their young matured, but prior to fledging, thereby reducing the number of nests in the cumulative database. Finally, among birds taken as prey by Great Horned Owls, Rohner and Doyle (1992) report that nestlings stolen at night include larger birds such as American Crow, Common Raven, and several species of hawks. Thus, direct predation by Great Horned Owls also could have reduce productivity in

Cooper's Hawks that nested in the general proximity. The overall nest density and reproductive success within the bosque, indicated that all reaches within the study area were important sites with favorable conditions for nesting Cooper's Hawks, Great Horned Owls, and the other species that utilize the bosque for nesting. Across all areas combined, mean Cooper's Hawk and Great Horned Owl productivity per year was similar for all years of the study.

The Albuquerque landscape also provided hunting opportunities for Cooper's Hawks (especially pigeons and doves). This urban landscape also might have presented a greater possibility of human-caused disturbance to nesting activities. The mechanical clearing of exotic vegetation throughout most of the Albuquerque bosque by the City and other agencies, primarily between 2004-2006, resulted in a substantial loss of understory vegetation. In a concurrent bosque study we found that songbird densities were significantly lower in areas where the understory had been cleared than in untreated or lightly treated areas (Hawks Aloft 2014). This reduction in songbird density represented a reduction in the potential avian prey base for Cooper's Hawks in the effected areas, and may have influenced Cooper's Hawk territory selection and nest success.

An analysis of the data from the 13 years of this study provides a snapshot of the raptor species that nest in the bosque and their reproductive success. But, it does not adequately measure the educational benefit to the public or the passion of our surveyors for their survey areas and the birds they monitored. With surveyors regularly present throughout the middle Rio Grande bosque during the breeding season, our team has interacted with many human visitors to the riparian woodland, listened to their hawk or owl stories, educated them about our work, and built relationships beneficial to bosque wildlife and vegetation. About twice each season, we encountered illegal clearing during the nesting season that was quickly reported to the

appropriate agency. Sometimes, we also encountered thoughtless humans engaging in activities such as vegetation destruction, littering, use of campfires, smoking, shooting, and letting dogs run uncontrolled. Team members shared a rich culture of stories, and each team member cared passionately about the hawks, falcons and owls that nested within their patches of the woods. It has been an extraordinarily rewarding project with far greater value than the numbers evident in the data reported to date.

RECOMMENDATIONS

We recognize the benefits of controlling exotic plants for fire suppression and habitat restoration. But, with the exception of USACE restoration sites, re-vegetation efforts have largely been nonexistent in areas of exotic species removal. In order to improve habitat for both songbirds and raptors, we recommend the inclusion of re-vegetation components to all future thinning activities. Restoration efforts that include thinning selectively in mosaic patterns, employing thinning methods that maintain native vegetation, re-vegetating thinned areas with native plants, and leaving some areas undisturbed until new vegetation matures have been shown to maintain and enhance avian use (Ellis 1995). In addition, we strongly recommend avoiding thinning treatments and other bosque construction during the avian breeding season.

Future management activities should be conducted outside of the avian breeding season, or after consultation with an appropriate agency that delineates adequate buffers or other necessary provisions.

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Table 1. Annual stick nest presence and active nest totals by bosque land manager, 2004-2016.

Stick Nests by Primary Survey Areas 2004 - 2016														
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**Total All Years**
Rio Rancho	N/A	11	30	32	17	19	13	N/A	17	14	20	21	21	215
Corrales	174	164	160	142	102	76	67	64	55	52	71	54	63	1244
Albuquerque	237	343	340	240	185	227	185	142	76	156	232	201	245	2809
MRGCD	54	68	N/A	70	68	74	60	43	41	39	47	41	42	647
Total Stick Nests	**465**	**586**	**530**	**484**	**372**	**396**	**325**	**249**	**189**	**261**	**370**	**317**	**371**	**4915**
Total Active Nests	75	108	61	83	54	65	52	45	61	59	77	80	79	899
Percentage of nests that became active	16.13%	18.43%	11.51%	17.15%	14.52%	16.41%	16.00%	18.07%	32.28%	22.61%	20.81%	25.24%	21.29%	18.29%

Table 2. Mean and density of active nests per year by bosque land manager, 2004-2016.

Raptor and Corvid Active Nest Density 2004-2016			
Land Manager	Survey Area (ha)	Avg. Active nests/year	Active nests/year/ha
Rio Rancho	98	5.42	0.06
Corrales	269	13.67	0.05
Albuquerque	953	36.83	0.04
MRGCD	262	13.91	0.05
Total	1582	69.83	0.04

Table 3. Active raptor nest totals by species and bosque land manager per year, 2004-2016.

Active Nests 2004-2016 - All Species By Area									
	Great Horned Owl	Long-eared Owl	Cooper's Hawk	Swainson's Hawk	Common Black Hawk	American Kestrel	American Crow	Common Raven	Total Active Nests
2004									
Rio Rancho	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Corrales	1	0	12	0	0	0	0	0	13
Albuquerque	3	0	27	1	0	0	3	0	34
MRGCD	8	0	13	2	0	4	1	0	28
2004 Total Active	**12**	**0**	**52**	**3**	**0**	**4**	**4**	**0**	**75**
2005									
Rio Rancho	2	0	3	0	0	0	0	0	5
Corrales	0	1	14	0	0	0	0	0	15
Albuquerque	10	0	36	1	0	3	1	0	51
MRGCD	7	0	24	2	0	4	0	0	37
2005 Total Active	**19**	**1**	**77**	**3**	**0**	**7**	**1**	**0**	**108**
2006									
Rio Rancho	2	0	3	0	0	0	0	0	5
Corrales	2	0	15	0	0	0	0	1	18
Albuquerque	8	0	27	2	0	0	1	0	38
MRGCD	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2006 Total Active	**12**	**0**	**45**	**2**	**0**	**0**	**1**	**1**	**61**
2007									
Rio Rancho	1	0	3	0	0	0	0	0	4
Corrales	2	0	14	0	0	0	0	1	17
Albuquerque	7	1	24	0	0	1	1	0	34
MRGCD	9	0	15	2	0	2	0	0	28
2007 Total Active	**19**	**1**	**56**	**2**	**0**	**3**	**1**	**1**	**83**
2008									
Rio Rancho	0	0	3	0	0	0	0	0	3
Corrales	1	0	10	0	0	0	0	0	11
Albuquerque	6	0	22	1	0	0	0	1	30
MRGCD	2	0	8	0	0	0	0	0	10
2008 Total Active	**9**	**0**	**43**	**1**	**0**	**0**	**0**	**1**	**54**
2009									
Rio Rancho	0	0	3	0	0	0	0	1	4
Corrales	1	0	12	0	0	0	0	0	13
Albuquerque	6	0	27	0	0	0	2	0	35
MRGCD	3	0	10	0	0	0	0	0	13
2009 Total Active	**10**	**0**	**52**	**0**	**0**	**0**	**2**	**1**	**65**

Table 3 Cont'd. Active raptor nest totals by species and bosque land manager per year, 2004-2016.

Active Nests 2004-2016 - All Species By Area, Cont'd.									
	Great Horned Owl	Long-eared Owl	Cooper's Hawk	Swainson's Hawk	Common Black Hawk	American Kestrel	American Crow	Common Raven	Total Active Nests
2010									
Rio Rancho	1	0	3	0	0	1	0	1	6
Corrales	3	0	12	0	0	0	0	0	15
Albuquerque	5	0	18	0	0	0	0	0	23
MRGCD	2	0	5	0	0	0	1	0	8
2010 Total Active	**11**	**0**	**38**	**0**	**0**	**1**	**1**	**1**	**52**
2011									
Rio Rancho	1	0	3	0	0	1	0	1	6
Corrales	1	0	10	0	0	0	0	0	11
Albuquerque	3	0	19	0	0	0	0	0	22
MRGCD	3	0	1	1	1	0	0	0	6
2011 Total Active	**8**	**0**	**33**	**1**	**1**	**1**	**0**	**1**	**45**
2012									
Rio Rancho	1	0	3	0	0	1	0	1	6
Corrales	1	0	12	0	0	0	0	1	14
Albuquerque	8	0	26	0	0	0	0	0	34
MRGCD	2	0	4	0	1	0	0	0	7
2012 Total Active	**12**	**0**	**45**	**0**	**1**	**1**	**0**	**2**	**61**
2013									
Rio Rancho	0	0	3	0	0	2	0	0	5
Corrales	2	0	10	0	0	0	0	0	12
Albuquerque	7	0	26	0	0	0	1	0	34
MRGCD	0	0	7	0	1	0	0	0	8
2013 Total Active	**9**	**0**	**46**	**0**	**1**	**2**	**1**	**0**	**59**
2014									
Rio Rancho	1	0	4	0	0	2	0	1	8
Corrales	2	0	10	0	0	0	0	0	12
Albuquerque	6	0	35	2	0	0	2	1	46
MRGCD	4	0	7	0	0	0	0	0	11
2014 Total Active	**13**	**0**	**56**	**2**	**0**	**2**	**2**	**2**	**77**
2015									
Rio Rancho	1	0	3	0	0	2	0	0	6
Corrales	2	0	12	0	0	0	0	0	14
Albuquerque	7	0	32	2	2	2	0	0	45
MRGCD	6	0	7	2	0	0	0	0	15
2015 Total Active	**16**	**0**	**54**	**4**	**2**	**4**	**0**	**0**	**80**
2016									
Rio Rancho	1	0	4	0	0	2	0	0	7
Corrales	1	0	11	0	0	0	0	0	12
Albuquerque	10	0	35	1	2	0	2	0	50
MRGCD	4	0	4	1	1	0	0	0	10
2016 Total Active	**16**	**0**	**54**	**2**	**3**	**2**	**2**	**0**	**79**
Total, All Years	**166**	**2**	**651**	**20**	**8**	**27**	**15**	**10**	**899**

Table 4. Nest fate and active nest percentage of total nests by species in the middle Rio Grande bosque, 2004-2016.

Nest Fate and Active Percentage of Total Nests by Species					
Species	Successful	Failed	Outcome Undetermined	Total	# Active Percentage of Total Nests
American Crow	9		6	15	1.67
American Kestrel	22		5	27	3.00
Common Black-Hawk	6	1	1	8	0.89
Cooper's Hawk	538	86	27	651	72.41
Common Raven	6	3	1	10	1.11
Great Horned Owl	120	22	24	166	18.46
Long-eared Owl	1	1		2	0.22
Swainson's Hawk	16	2	2	20	2.22
Total	**718**	**115**	**66**	**899**	

Table 5. Reproductive success and average fledging dates of Cooper's Hawks in the middle Rio Grande bosque, by land manager, 2004-2016.

Cooper's Hawk Reproductive Success 2004 - 2016							
Land Manager/Year	Active Nests	Successful Nests	Failed Nests	Outcome Undetermined	# Fledged	# Young/Active Nest	Avg. Fledge Date
Albuquerque Totals	**354**	**297**	**44**	**13**	**800**	**2.26**	**July 6**
2004	27	21	4	2	63	2.33	4-Jul-04
2005	36	32	4		74	2.06	2-Jul-05
2006	27	21	4	2	52	1.93	6-Jul-06
2007	24	19	5		58	2.42	2-Jul-07
2008	22	21	1		60	2.73	23-Jul-08
2009	27	23	2	2	62	2.30	7-Jul-09
2010	18	15	3		40	2.22	6-Jul-10
2011	19	12	4	3	33	1.74	9-Jul-11
2012	26	20	4	2	56	2.15	3-Jul-12
2013	26	21	4	1	60	2.31	2-Jul-13
2014	35	33	1	1	90	2.57	3-Jul-14
2015	32	28	4		75	2.34	3-Jul-15
2016	35	31	4		77	2.20	3-Jul-16
Corrales Totals	**154**	**133**	**19**	**2**	**374**	**2.43**	**July 8**
2004	12	12			35	2.92	14-Jul-04
2005	14	14			44	3.14	4-Jul-05
2006	15	14	1		39	2.60	11-Jul-06
2007	14	11	3		37	2.64	8-Jul-07
2008	10	8	2		22	2.20	8-Jul-08
2009	12	11	1		33	2.75	10-Jul-09
2010	12	9	3		27	2.25	11-Jul-10
2011	10	10			25	2.50	13-Jul-11
2012	12	8	4		21	1.75	8-Jul-12
2013	10	8	2		18	1.80	4-Jul-13
2014	10	8	1	1	20	2.00	5-Jul-14
2015	12	10	1	1	24	2.00	8-Jul-15
2016	11	10	1		29	2.64	4-Jul-16
MRGCD Totals	**105**	**73**	**22**	**10**	**168**	**1.60**	**July 7**
2004	13	9	3	1	23	1.77	8-Jul-04
2005	24	19	5		44	1.83	4-Jul-05
2007	15	8	5	2	19	1.27	30-Jun-07
2008	8	5	3		11	1.38	14-Jul-08
2009	10	9		1	22	2.20	9-Jul-09
2010	5	3	2		7	1.40	6-Jul-10
2011	1			1	0	0.00	
2012	4	4			8	2.00	26-Jun-12
2013	7	6	1		12	1.71	8-Jul-13
2014	7	4	2	1	7	1.00	15-Jul-14
2015	7	4		3	8	1.14	11-Jul-15
2016	4	2	1	1	7	1.75	
Rio Rancho Totals	**38**	**35**	**1**	**2**	**107**	**2.82**	**July 9**
2005	3	3			5	1.67	3-Jul-05
2006	3	3			10	3.33	9-Jul-06
2007	3	3			9	3.00	16-Jul-07
2008	3	3			8	2.67	4-Jul-08
2009	3	2	1		8	2.67	2-Jul-09
2010	3	3			9	3.00	8-Jul-10
2011	3	1		2	9	3.00	12-Jul-11
2012	3	3			8	2.67	29-Jun-12
2013	3	3			7	2.33	6-Jul-13
2014	4	4			10	2.50	29-Jun-14
2015	3	3			10	3.33	
2016	4	4			14	3.50	
Grand Total	**651**	**538**	**86**	**27**	**1449**	**2.23**	**July 8**

Table 6. Reproductive success of Great Horned Owls in the middle Rio Grande bosque, by land manager, 2004-2016.

Great Horned Owl Reproductive Success 2004 - 2016						
Land Manager/Year	Active Nests	Successful Nests	Failed Nests	Outcome Undetermined	# Fledged	# Young/Active Nest
Albuquerque Totals	**86**	**62**	**17**	**9**	**121**	**1.41**
2004	3	2	1		3	1.00
2005	10	8	2	1	12	1.20
2006	8	4	2	2	10	1.25
2007	7	7			14	2.00
2008	6	3	2	1	7	1.17
2009	6	3	2	1	3	0.50
2010	5	3	2		8	1.60
2011	3	3			6	2.00
2012	8	5	1	2	11	1.38
2013	7	5	2		7	1.00
2014	6	4	1	2	9	1.50
2015	7	6	1		11	1.57
2016	10	9	1		20	2.00
Corrales Totals	**19**	**15**	**2**	**2**	**30**	**1.58**
2004	1		1			0.00
2006	2	1		1	2	1.00
2007	2	2			5	2.50
2008	1	1			2	2.00
2009	1	1			2	2.00
2010	3	2		1	4	1.33
2011	1	1			2	2.00
2012	1	1			1	1.00
2013	2	2			3	1.50
2014	2	1	1		3	1.50
2015	2	2			4	2.00
2016	1	1			2	2.00
MRGCD Totals	**50**	**34**	**2**	**15**	**63**	**1.26**
2004	8	6	1	1	10	1.25
2005	7	4		3	6	0.86
2007	9	7	1	1	15	1.67
2008	2	2			3	1.50
2009	3	1		2	2	0.67
2010	2			2		0.00
2011	3	2		1	3	1.00
2012	2	2			4	2.00
2014	4	2		3	6	1.50
2015	6	5		1	8	1.33
2016	4	3		1	6	1.50
Rio Rancho Totals	**11**	**9**	**1**	**1**	**19**	**1.73**
2005	2	1		1	3	1.50
2006	2	1	1		2	1.00
2007	1	1			2	2.00
2010	1	1			2	2.00
2011	1	1			2	2.00
2012	1	1			1	1.00
2014	1	1			1	1.00
2015	1	1			3	3.00
2016	1	1			3	3.00
Grand Total	**166**	**120**	**22**	**27**	**233**	**1.40**

Figure 1. Legend for all maps showing raptor nesting activity between Rio Rancho and Belen in the Middle Rio Grande bosque, 2004-2016.

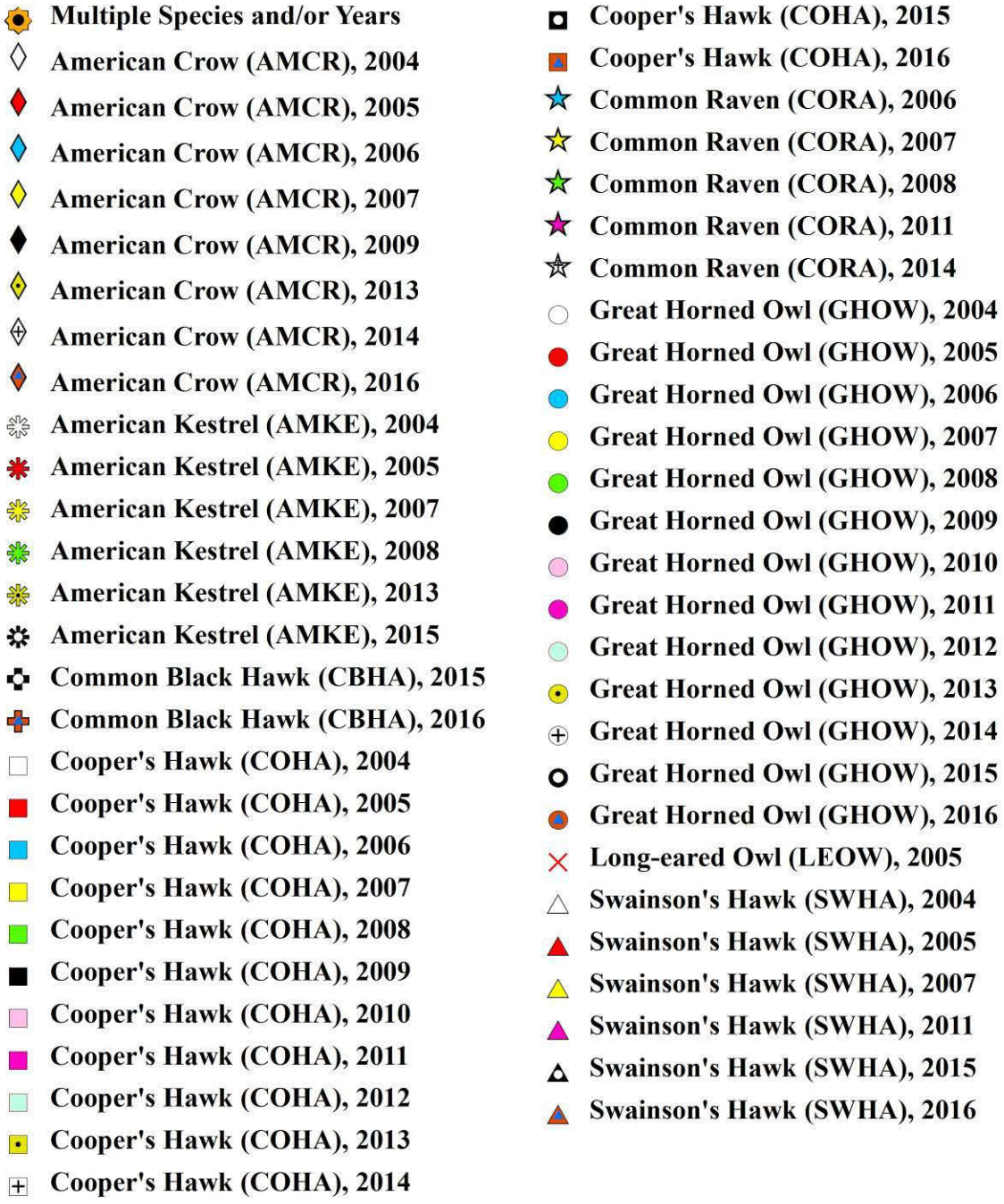

Figure 2. Map of all active raptor nests, 2004-2016, in the Rio Rancho North study area.

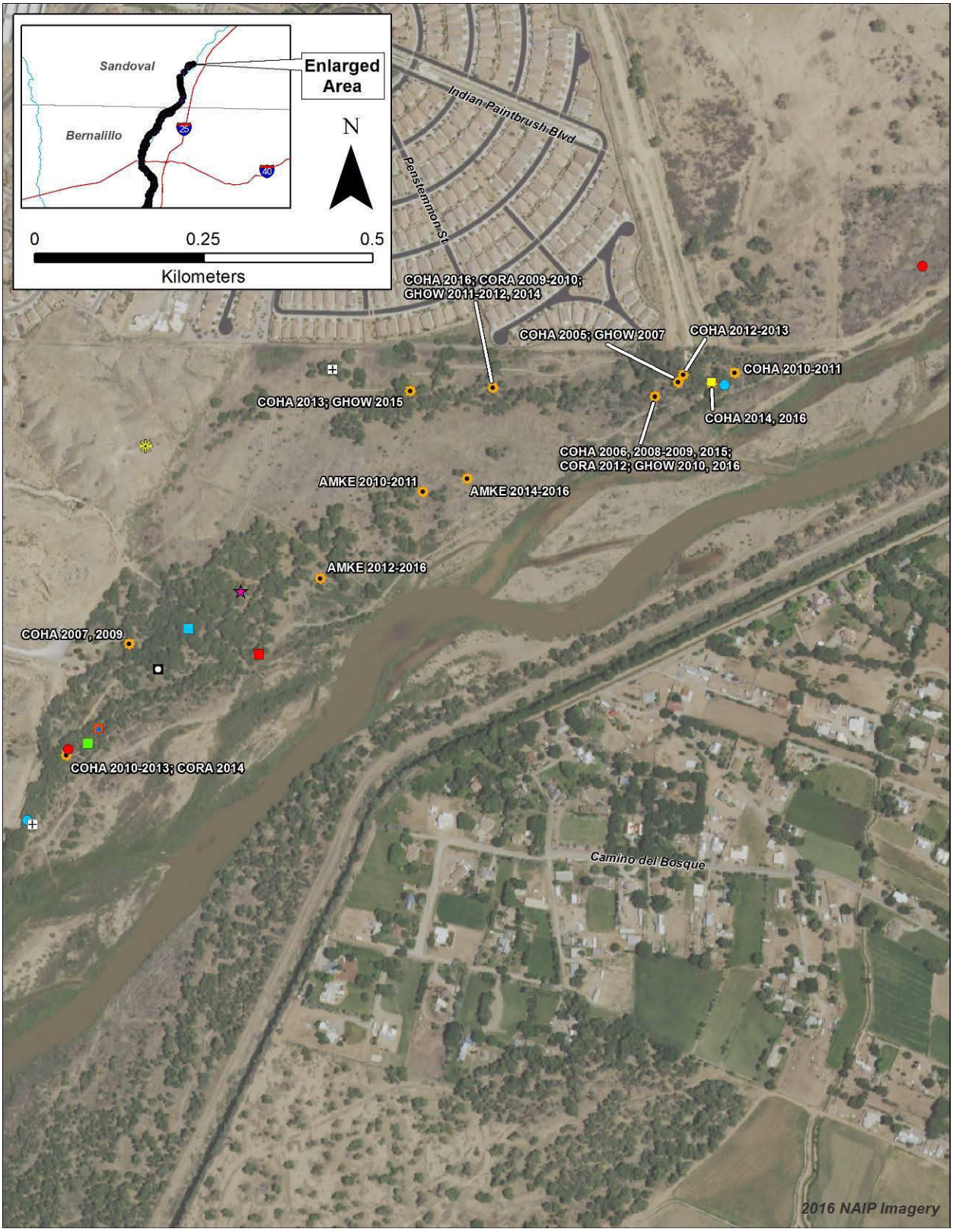

Figure 3. Map of all active raptor nests, 2004-2016, in the Rio Rancho South study area.