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

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EXECUTIVE SUMMARY

In the early 1980s, a comprehensive biological survey was conducted in the Middle Rio Grande bosque in the Albuquerque area of central New Mexico. Determining raptor abundance through a set of transect surveys was one objective of that study. We conducted similar raptor surveys from 2002-2004 to inventory raptors using the bosque, identify changes over a 20-year period, and evaluate alternative survey methods. We also expanded on the previous study by conducting tape playback surveys for nocturnal owls from 2002-2004 and monitoring raptor stick nests from 2004-2007.

We observed 16 species of raptors during surveys, with American Kestrel (*Falco sparverius*) most frequent during the summer and Red-tailed Hawk (*Buteo jamaicensis*) most frequent during the winter. Detection rates for most species were similar to the rates reported in the 1980s, with a few exceptions. In summer, we detected more Swainson's Hawks (*Buteo swainsoni*) and considerably fewer American Kestrels in the current study, and in winter, we detected more Bald Eagles (*Haliaeetus leucocephalus*) and Red-tailed Hawks than was reported in the 1980s. We found that adding standardized point count stops to the transect surveys increased detection rates for species not easily observed from inside of a vehicle, and we recommend using this approach for achieving a more thorough inventory. Tape playback also improves detection rates, but because response is variable among species, we recommend reserving the use of tapes for documenting nocturnal species or the presence of select species of conservation interest.

Western Screech-Owl (*Otus kennicottii*) was the most frequently detected owl in the Middle Rio Grande bosque (N=220 detections), followed by Great Horned Owl (*Bubo virginianus*, N=114), Barn Owl (*Tyto alba*, N=19), and Long-eared Owl (*Asio*

otus, N=8). We recorded the highest detection rate at Bosque del Apache National Wildlife Refuge, but the rate for rural sites was similar to the rate for urban sites. The low detection rate at Sevilleta National Wildlife Refuge indicates that monotypic salt cedar, characteristic of the transect at that site, provides inferior habitat for owls.

We monitored an average of 676 stick nests per year in the Middle Rio Grande bosque from 2004-2007 and found that Cooper's Hawk (*Accipiter cooperii*) was by far the most common stick-nesting raptor, accounting for 75% of the active stick nests monitored. Although Cooper's Hawks were common in all monitored portions of the bosque, density of nests was highest in Corrales (2.85 per 40 ha). Internest distance in Corrales (799 m) matched another suburban site once believed to have one of the highest, if not the highest, density of nesting Cooper's Hawks. Productivity was also highest in Corrales, where 2.8 young fledged per active nest. Landscape and/or management factors probably contribute to the high nest density and productivity of Cooper's Hawks in Corrales. The less developed landscape in Corrales adjacent to the bosque, with residential plantings, pastures, and bird feeders might provide superior hunting opportunities for Cooper's Hawks nesting in the bosque. In the Albuquerque portion of the bosque, widespread understory clearing for fire suppression or habitat restoration might affect songbird numbers, thereby limiting prey base for Cooper's Hawks south of Corrales. We recognize the benefits of controlling exotic plants for fire suppression and habitat restoration, but we strongly recommend a better commitment to avian conservation among land managers, particularly avoiding thinning treatments during the avian breeding season, avoiding methods that destroy native plants in the process, and replacing cleared vegetation with native shrubs.

INTRODUCTION

The riparian forest (bosque) lining the Rio Grande in central New Mexico provides habitat for a rich assemblage of wildlife, and bosque health is influenced by numerous, and often interrelated, management concerns. In recent years, drought and encroachment of exotic vegetation have been prime concerns. Major wildfires, like those that burned several hundred acres of bosque in 2003, and urban development have reduced the amount of woodland habitat. Factors like drought, proliferation of exotics, fire, and development often have a negative impact on wildlife, and land managers strive to minimize or negate these impacts. It is important to monitor wildlife to ensure that efforts to maintain the bosque are improving conditions for wildlife, and not exacerbating negative impacts.

Studying raptors (i.e., hawks, eagles, falcons, and owls) can be an efficient way to monitor the health of this ecosystem for wildlife. Raptors are relatively easy to observe in quantities sufficient for a robust sample. Because they prey on a variety of taxa, including mammals and birds, determining raptor abundance and nest productivity can provide an indicator for wildlife populations in general. Some raptors use the Rio Grande bosque for nesting and cover, therefore determining raptor abundance and nesting densities can provide an indicator for vegetation 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.

From 2002-2007, Hawks Aloft was contracted to conduct a study of raptors in the Rio Grande bosque, between Corrales and Bosque del Apache National Wildlife Refuge

in central New Mexico, by one or more of the following agencies each year: the Middle Rio Grande Bosque Initiative Group, through the U.S. Fish and Wildlife Service, the U.S. Army Corps of Engineers, and the U.S. Bureau of Reclamation. We were not the first to consider a raptor study for this area. In 1981 and 1982, Hink and Ohmart (1984) conducted a comprehensive biological survey of the Middle Rio Grande, including raptor counts. Although raptor counts were just one component of their vast study and provide only a brief index of abundance, our raptor study offers an opportunity to identify general population changes that might have occurred in the last 20+ years. In addition to raptor abundance and species composition, we address other aspects of raptor biology that were not included in the Hink and Ohmart (1984) survey. We conducted tape playback surveys to inventory nocturnal owls in the bosque, and we report species composition and site-specific detection rates. We also located and monitored nests for raptors in the bosque, and we report nest densities and reproductive success for the most common species. Below, we summarize objectives for three main tasks of our raptor study.

OBJECTIVES

Task A: Raptor Surveys
1. Inventory raptors using the bosque
2. Identify changes over a 20-year period
3. Evaluate alternative survey methods
Task B: Nocturnal Owl Surveys
1. Inventory owls using the bosque
2. Determine site-specific owl detection rates
Task C: Raptor Nest Monitoring
1. Maintain database of current stick nests
2. Identify important bosque nesters
3. Determine density of nests associated with landscape and land management
4. Determine productivity associated with landscape and land management

STUDY AREA

Raptor Surveys

We conducted surveys on seven transects along levees at the landward edge of the bosque (Fig. 1). These transects covered 56.3 miles on at least one side of the river from the Alameda bridge south to the Bosque bridge. Our coverage was not complete over this span; we did not survey the portion of the bosque on the Isleta Pueblo. On the stretch between Los Lunas and Belen, we surveyed on both sides of the river.

In the early 1980s, Hink and Ohmart (1984) also surveyed seven transects, but only five of our transects were consistent with those used in the earlier study. We did not gain access to portions of the bosque on tribal land on the Isleta Pueblo and in the village of Corrales, two areas surveyed by Hink and Ohmart (1984). We replaced these with two new routes, including a 4.8-mile section of the bosque between the Central and Rio Bravo bridges on the east side of the river and a 5.5-mile section of the bosque between the Rio Bravo and Interstate 25 bridges on the west side of the river.

Bosque habitat usually consisted of a mature cottonwood (*Populus fremontii*) overstory with a variety of understory types. Understory consisted of native plants, such as New Mexico olive (*Forestiera neomexicana*), coyote willow (*Salix exigua*), and silver buffaloberry (*Shepherdia argentea*), and exotic plants, such as Russian olive (*Elaeagnus angustifolia*) and salt cedar (*Tamarix* spp.).

Nocturnal Owl Surveys

We conducted nocturnal owl surveys on eight two-mile transects covering a total of 16 miles along levees between the Montano bridge in Albuquerque and Bosque del

Apache National Wildlife Refuge (Fig. 2). Transects were generally categorized by landscape (urban or rural) and vegetation type (a mixture of native and exotic plants or monotypic salt cedar). We considered the transects near Montano Road, the Rio Grande Nature Center, and the north side of Belen to be in an urban landscape. The remaining five transects to the south, including Casa Colorado, Bernardo, La Joya, and the Sevilleta and Bosque del Apache National Wildlife Refuges, were in a rural landscape. Sevilleta contained mainly monotypic salt cedar. The remaining seven transects, including Bosque del Apache, contained a mix of native and exotic vegetation.

Raptor Nest Monitoring

We located and monitored raptor nests in most accessible portions of the bosque from Corrales south to Belen on the west side of the river, and from Sandia Pueblo south to Los Lunas on the east side of the river (Fig. 3). Our study area for nest monitoring included approximately 115 kilometers (70 miles) of bosque and about 2,070 ha. Habitat included a canopy of mostly cottonwoods with the same variety of understory types present along the raptor survey transects. Beginning in 2004, widespread mechanical understory clearing was conducted, particularly in the Albuquerque bosque (i.e., Alameda bridge to the I-25 bridge), for perceived fire prevention and restoration benefits. Such management efforts, at least temporarily, left an open understory that was in stark contrast to untreated portions of the bosque, particularly in Corrales, north of Albuquerque along the west side of the river. Corrales maintained a locally dense understory of New Mexico olive and other plants throughout the study. Corrales also differed from Albuquerque in the landscape surrounding the bosque. Rural homes, many

featuring backyard bird feeders, large trees, and/or open horse pastures, bordered the Corrales bosque, whereas the Albuquerque landscape was predominantly urban. South of Albuquerque, which we collectively call Los Lunas, the bosque was mostly surrounded by agricultural fields.

METHODS

Raptor Surveys

We conducted both transect and point count surveys during three summers (2002-2004) and two winters (2002/2003 and 2003/2004). We employed transect surveys to allow a comparison with results reported in the early 1980s by Hink and Ohmart (1984), who also surveyed using transects. We added point counts at the same sites to evaluate an alternative method to inventory raptors, one which we believed would provide a more robust sample. We conducted both a transect and a point count survey six times per summer (three visits per month in May and June) and nine times per winter (three visits per month in December, January, and February). Transects and point counts were completed on the same day; the transect surveys were always done first (between 8:00 AM and 12:00 PM), followed by point count surveys on a return pass through the site.

Transect surveys were conducted by two observers (the driver and a recorder) from inside a vehicle driven 10-15 miles per hour along the levee. Observers watched for raptors along both sides of the levee for the entire length of the transect (range of 5.0 miles at Isleta East to 12.4 miles at Los Lunas West). Because of safety concerns associated with high recreational use of the Alameda East levee, we conducted transect surveys there on bicycles.

Point counts were conducted at survey points established at 0.5-mile intervals along the same levees as the transects. The seven sites contained a total of 106 survey points (range of 9 at Central East to 24 at Los Lunas West). Two observers stopped at each survey point, stepped out of the vehicle, and recorded all raptor species encountered by sight or sound within five minutes. During summer point count surveys, we used tape playback to solicit response vocalizations and improve our ability to detect raptors. This tape contained calls from four different species: Cooper's Hawk, Red-tailed Hawk (*Buteo jamaicensis*), American Kestrel (*Falco sparverius*), and Mississippi Kite (*Ictinia mississippiensis*). The use of selective tape playback limits our ability to compare detection rates for different survey methods, species, and seasons. However, we employed tape playback to improve detectability, especially for species like Cooper's Hawk, which can be easily overlooked during surveys.

We present summer and winter inventories of raptors in the Middle Rio Grande bosque, and the number of observations for each species. We include Turkey Vulture (*Cathartes aura*) observations, because of their superficial resemblance to raptors. We also report Greater Roadrunner (*Geococcyx californianus*) observations, because their prey base is similar to the prey base for some raptor species. For transects, we present the number of raptors detected per 10 miles, similar to Hink and Ohmart (1984). We compare results reported by Hink and Ohmart (1984) with our transect results. For point counts, we again present the number of raptors per 10 miles (including only observations at survey stops), but additionally provide the number of raptors detected per point. We also present transect and point count detection rates for each site by season.

Nocturnal Owl Surveys

We conducted three nocturnal owl surveys at each of the eight sites per year (one in March, April, and May) in 2003 and 2004; this task was preceded by a pilot season of owl surveys in 2002, which we do not include here in the analyses. We established 11 survey stops per site at 0.2-mile intervals along the levee, and we used tape playback to solicit response vocalizations from owls. The tape recording included calls for Western Screech-Owl (*Otus kennicottii*), Great Horned Owl (*Bubo virginianus*), Barn Owl (*Tyto alba*), and Long-eared Owl (*Asio otus*). Observers, usually two per survey, played the tape for six minutes (90 seconds for each of the four species on the tape) and recorded all owls detected. When we detected an owl, we immediately curtailed playback of that species' call and commenced playback of the next section of the tape. Each survey evening began 15-20 minutes after sunset and continued until we completed all survey stops at the site (approximately two hours).

For each species, we present the total number of owls detected by species and site-specific detection rates for all owls combined. We calculate point detection rates for each survey point by adding the number of owl detections at that point and dividing by the number of surveys (a total of six in 2003 and 2004). We calculate a detection rate for each site by adding the point detection rates and dividing by the number of points at the site (11). We compared detection rates among sites, and between urban and rural sites, using 95% confidence intervals.

Raptor Nest Monitoring

We located and monitored raptor nests from 2002-2007. Beginning in 2002, we

kept a cumulative database of nest locations. Because the same stick nests are often used by raptors in multiple years, we visited all of the locations in the database each year and added any new nests that were found. Searches during the first two years were mostly opportunistic; starting in 2004, nest searching and monitoring efforts were systematic and covered nearly the entire portion of the bosque in our survey area. We present the average number of stick nests monitored per year (with a range) from 2004-2007.

Each year, we made a minimum of three visits to each section of the bosque. We made one visit 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 searching trees for additional stick 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 obscured nests (typically in mid-April). For new nests, we recorded Universal Transverse Mercator (UTM) coordinates (North American Datum 1927) from under the nest and added these to the database. For all nests during each visit, we determined the status and the nesting species. We considered a nest to be active if we observed a bird on the nest in an incubating posture, a bird delivering material or food to the nest, or young in the nest. Active nests were subsequently monitored twice per month, or as often as necessary, to determine nest success and the number of young fledged.

We identify the most numerous stick-nesting raptor in the Middle Rio Grande bosque, and determine density and productivity for that species. Because our study focused on species using stick nests, we were unable to evaluate nesting parameters for cavity nesters, such as American Kestrel. For the period 2004-2007, we present annual

nest density as the number of active nests per hectare. Because riparian habitat at our site is linear, and we know that the home ranges for many raptors extend beyond the bosque, we also find it useful to present density as an average distance (in meters) between active nests. In some cases, we were unable to find an active nest where we observed apparently territorial adults. We only include active nests in density calculations. For productivity, we present the average number of fledged young observed per active nest. Using 95% confidence intervals, we compare nest densities and productivity among different regions (i.e., Corrales, Albuquerque, and Los Lunas), and evaluate potential effects associated with their different landscape and management characteristics.

RESULTS

Raptor Surveys

We observed 16 species of raptors during transect and point count surveys in the Middle Rio Grande bosque from 2002-2004 (Table 1, next page). During summer surveys, we recorded American Kestrels most frequently; during winter surveys, we recorded Red-tailed Hawks most frequently. We found that American Kestrels, Cooper's Hawks, and Mississippi Kites responded well to tape playback used during summer point counts; totals for these species might reflect actual abundance differently.

Compared to transect results reported by Hink and Ohmart (1984) from this area in 1981-1982, we calculated a lower summer detection rate and higher winter detection rate for our surveys approximately twenty years later (Table 2, page 13). In summer, our detection rates were considerably lower for American Kestrel but higher for Swainson's Hawk (*Buteo swainsoni*); summer detection rates between studies were similar for all

other species. If we remove kestrels from the comparison, our summer transect detection rate would exceed the rate reported by Hink and Ohmart (1984). In winter, our detection rates were higher for Bald Eagles (*Haliaeetus leucocephalus*) and Red-tailed Hawks, and relatively similar for all other species. Detection rates for Greater Roadrunner in the early 1980s were higher than the rates we recorded for both seasons.

Table 1. Inventory of raptors detected during summer and winter transect and point count surveys in the Middle Rio Grande bosque from 2002-2004. We provide the number of birds detected for each species during transects and point counts combined.

Summer Raptors	Number	Winter Raptors	Number
American Kestrel	625	Red-tailed Hawk	1367
Cooper's Hawk	222	American Kestrel	530
Swainson's Hawk	122	Bald Eagle	257
Mississippi Kite	52	Northern Harrier	77
Red-tailed Hawk	17	Cooper's Hawk	63
Great Horned Owl	12	Ferruginous Hawk	17
Peregrine Falcon	4	Prairie Falcon	7
Prairie Falcon	4	Peregrine Falcon	7
Osprey	3	Northern Goshawk	5
Sharp-shinned Hawk	2	Sharp-shinned Hawk	4
Bald Eagle	1	Golden Eagle	3
Northern Harrier	1	Merlin	3
Unknown Raptors	19	Unknown Raptors	197
Total Summer Raptors	1084	Total Winter Raptors	2537

Summer Non-Raptors	Number	Winter Non-Raptors	Number
Turkey Vulture	231	Greater Roadrunner	247
Greater Roadrunner	288		

We calculated a point count detection rate of 0.63 birds per point for summer surveys and 0.84 birds per point for winter surveys. As expected, we sampled a greater number of raptors using the point count method (Table 3, page 14). We observed a greater number of raptors per 10 miles during point count surveys at all sites, in both

summer and winter, indicating that the tape playback used in the summer is not the sole mechanism for increasing the sample.

In both summer and winter, our greatest detection rates occurred at sites south of Albuquerque. Raptors appeared particularly numerous in the bosque along the east side of the river in Los Lunas (Table 3). Central East, near downtown Albuquerque, had the lowest detection rate, followed by two other urban sites, Alameda East and Rio Bravo West (Table 3).

Table 2. Comparison of raptor detection rates (number per 10 miles) reported by Hink and Ohmart (1984) from 1981-1982 transect surveys, and by Hawks Aloft from 2002-2004 transect surveys, in the Middle Rio Grande bosque, New Mexico.

	Summer		Winter	
Raptors	1981-1982*	2002-2004	1981-1982*	2002-2004
American Kestrel	9.6	4.7	2.4	2.2
Bald Eagle	-	-	-	0.9
Cooper's Hawk	0.2	0.3	0.2	0.3
Ferruginous Hawk	-	-	0.1	0.1
Golden Eagle	-	-	-	-
Great Horned Owl	0.1	0.1	-	-
Merlin	-	-	-	<0.05
Mississippi Kite	0.3	0.3	-	-
Northern Goshawk	-	-	-	<0.05
Northern Harrier	-	<0.05	0.3	0.2
Osprey	-	<0.05	-	-
Peregrine Falcon	-	<0.05	-	<0.05
Prairie Falcon	-	-	-	<0.05
Red-tailed Hawk	0.1	0.1	3.2	6.7
Sharp-shinned Hawk	-	-	0.2	<0.05
Swainson's Hawk	0.1	0.6	-	-
Unknown Raptor	-	0.1	-	0.3
Total Raptors	10.4	6.2	6.4	10.7
Non-raptors				
Turkey Vulture	0.2	1.0	-	-
Greater Roadrunner	5.6	2.5	2.5	1.6

* Transect data from 1981 and 1982 reported by Hink and Ohmart (1984)

Table 3. Raptor detection rates for seven sites surveyed by Hawks Aloft with transects and point counts from 2002-2004 in the Middle Rio Grande bosque.

	Summer			Winter		
	Transect	Point Counts		Transect	Point Counts	
Site	#/10 mi.	#/10 mi.	#/pt	#/10 mi.	#/10 mi.	#/pt
Alameda East	2.8	8.0	0.3	2.9	5.8	0.3
Belen West	6.5	10.4	0.5	17.1	20.0	1.0
Central East	0.1	4.7	0.3	1.5	4.2	0.2
Isleta East	8.9	11.2	0.6	12.0	12.6	0.6
Los Lunas East	23.5	24.8	1.4	23.8	34.8	1.9
Los Lunas West	10.9	12.0	0.6	14.2	17.7	0.9
Rio Bravo West	2.1	5.4	0.3	4.6	5.9	0.3

Nocturnal Owl Surveys

We detected 361 owls, including four species, during nocturnal tape playback surveys in 2003 and 2004. Western Screech-Owl (N=220) was the most frequently detected owl species, followed by Great Horned Owl (N=114). We observed a small number of Barn Owls (N=19) and Long-eared Owls (N=8). We observed Western Screech-Owl and Great Horned Owl at all sites. Neither Barn Owl nor Long-eared Owl were observed at Montano and the Rio Grande Nature Center in Albuquerque, but we observed one or more of these species at most of the other sites.

We recorded the highest detection rate at Bosque del Apache (1.18 owls/point ± 0.38), and the lowest detection rate at Sevilleta (0.24 ± 0.21), the one site dominated by monotypic salt cedar (Fig. 4, page 29). Detection rates for the remaining sites were within that range, with widely overlapping confidence intervals (Fig. 4). The average detection rate for the five rural sites (0.71 ± 0.18) was similar to the average detection rate for the three urban sites (0.64 ± 0.14).

Raptor Nest Monitoring

We monitored an average of 676 nests per year in the Rio Grande Bosque from 2004-2007. Our database of stick nests was greatest in 2005 (N=838) and 2007 (N=811). Because the database is cumulative (i.e., nests are added each year and subtracted when they are no longer present), our total was predictably lowest in 2004 (N=490). Our total of 567 in 2006 was limited by our lack of funding for monitoring south of Albuquerque. On average, 11.8% of the stick nests in our database each year became active (range 10.2% in 2006 to 14.3% in 2004).

Cooper's Hawk was the most common stick-nesting raptor in the bosque, accounting for 232 of the 311 (75%) active stick nests monitored from 2004-2007. We monitored 57 Great Horned Owl nests (18% of the active stick nests). Other raptor species (Swainson's Hawk, N=8, and Long-eared Owl, N=2) accounted for 10 (3%) of the active stick nests. The remaining 12 active stick nests were used by non-raptors, including American Crow (*Corvus brachyrhynchos*, N=7), Common Raven (*Corvus corax*, N=2), Black-crowned Night-Heron (*Nycticorax nycticorax*, N=2), and Wood Duck (*Aix sponsa*, N=1). Although not using stick nests, apparent nesting American Kestrels were encountered at 20 tree cavities in the bosque.

Average density of Cooper's Hawk nests in the Middle Rio Grande bosque from 2004-2007 was 1.27 active nests per 40 ha (range 1.03 in 2004 to 1.61 in 2006). Cooper's Hawk nest density varied by section of the bosque. The average density was highest in the 193-ha Corrales section (Fig. 3), at 2.85 nests per 40 ha. Further south, average nest density in the 883-ha Albuquerque section (Alameda bridge to the I-25 bridge) was 1.30

nests per 40 ha. The average nest density in monitored portions of the bosque south of Albuquerque (i.e., Los Lunas) was 0.74 nests per 40 ha.

We calculated an average internest distance of 1,578 m (± 204, 95% confidence interval) for Cooper's Hawks in the Middle Rio Grande bosque; like our density results, average internest distances varied by section of the bosque. Cooper's Hawk nests were substantially closer together in Corrales (799 m ± 155) than in Albuquerque (1,525 m ± 241) or Los Lunas (2,577 ± 604).

Of the 232 active Cooper's Hawk nests from 2004-2007, 189 (81%) successfully fledged young, 34 (15%) failed, and 8 (3%) had an unknown fate. We documented a minimum of 510 Cooper's Hawk young (i.e., >21 days old) fledging from nests (2.2 young per active nest and 2.7 young per successful nest). Productivity was highest in the Corrales section of the bosque, where 2.8 young fledged per active nest. Productivity was close to the average for all areas in Albuquerque (2.2 young per active nest) and below the average in Los Lunas (1.6 young per active nest).

DISCUSSION

Raptor Surveys

The Middle Rio Grande bosque provides habitat for a diverse raptor population, and is particularly important for American Kestrels and Cooper's Hawks in the summer and Red-tailed Hawks in the winter. We detected nearly all raptors regularly occurring in central New Mexico during summer and winter surveys in the Middle Rio Grande bosque from 2002-2004. Rough-legged Hawk (*Buteo lagopus*), a species wintering in open areas of northern New Mexico, was not observed using the bosque during our surveys.

For most species, raptor detection rates for our transect surveys were similar to detection rates reported by Hink and Ohmart (1984) for transect surveys more than 20 years previous. American Kestrel, Red-tailed Hawk, and Bald Eagle were notable exceptions. Our American Kestrel detection rate during 2002-2004 summer transect surveys was about half the rate recorded during 1981-1982 summer transect surveys. The Red-tailed Hawk detection rate for winter transect surveys was twice as high during the 2002-2004 period. Because these species are conspicuous, with easily distinguishable vocal and plumage characteristics, we suggest that our results reflect an actual difference in numbers between periods, rather than sampling variation or differences in observer performance. Bald Eagles were scarce during the early 1980s when Hink and Ohmart (1984) conducted their surveys, but the population has since recovered following the increased regulation of pesticides, particularly DDT, in the late 20th century (Buehler 2000). The increase in Bald Eagle detections for 2002-2004 winter transect surveys, though modest, probably reflects an actual population increase in the last 20 years. Currently, Bald Eagles are regular winter residents in the Middle Rio Grande bosque.

Perhaps surprising is the lack of change for Mississippi Kite detection rates since the Hink and Ohmart (1984) surveys in the early 1980s. Mississippi Kite populations in New Mexico were nonexistent or unknown before the mid-20th century, but regional range expansion has occurred since the early 1970s, particularly in riparian and urban areas (Parker 1999). Parker (1996) described Mississippi Kite as perhaps the most abundant urban raptor in North America. Based on documented range expansion and increases in urban populations (Parker 1996), it seemed reasonable to expect increased numbers of Mississippi Kites in the Albuquerque area. However, our transect and nest

monitoring results indicate that Mississippi Kites are still uncommon in the Middle Rio Grande bosque and generally do not nest in the bosque.

In addition to transect surveys, we experimented with the use of point counts, augmented with tape playback in the summer. When designing raptor survey studies, we recommend incorporating standardized point count stops along transects to allow more time outside of a vehicle, thereby increasing opportunities for observing species that are often detected by voice or perched in heavily wooded areas, such as Cooper's Hawk. The combination of point count and transect methodology, with observations for each method separated on the data form, offers the benefit of achieving greater power for detecting statistical differences while allowing greater flexibility in comparisons with other studies. Because the level of response to tape playback is variable among species, we do not recommend using tapes for determining species composition and relative abundance. Tape playback can be useful for documenting presence/absence for select individual species, or for studying species not otherwise easily detected, such as owls.

Nocturnal Owl Surveys

Although infrequently seen, Western Screech-Owls were frequently detected during nocturnal owl surveys and are likely the most common owl species in the Middle Rio Grande bosque. Because we played calls for only four species, and detected all four (though few Barn and Long-eared Owls), we do not consider our surveys to provide a complete inventory of owls in the bosque. Other New Mexico species (e.g., migrants or species preferring higher elevation coniferous woodland) might also occasionally visit the bosque. Our surveys, though, appear to accurately reflect the abundance of Western

Screech-Owls and Great Horned Owls in the Middle Rio Grande bosque. Cannings and Angell (2001) indicate that Western Screech-Owl densities are highest in low-elevation riparian woodland, and that this species is tolerant of humans and a suburban environment. This apparent tolerance of an urban landscape by Western Screech-Owls probably explains the similarity of owl detection rates between urban and rural transects.

The low detection rate at the Sevilleta transect indicates that the monotypic salt cedar found there provides inferior habitat for owls. Riparian areas dominated by exotic vegetation, such as salt cedar, often support fewer bird species than native riparian areas (Anderson et al. 1977, Cohan et al. 1978, Ellis 1995). Salt cedar provides little suitable forage for wildlife (Hoddenbach 1987), and owl prey base along the Sevilleta transect is probably lower than that of native habitats along our other transects, such as Bosque del Apache. However, the dense cover provided by monotypic salt cedar at Sevilleta offers some benefit to roosting owls, rendering this stand better owl habitat than a non-wooded alternative. Riparian restoration projects that include salt cedar removal should also include a commitment to planting or restoring native trees and shrubs.

Raptor Nest Monitoring

We currently manage a database of raptor stick nests in excess of 800 nests, and such information can be a valuable conservation tool. The City of Albuquerque and other agencies routinely perform management activities in the Middle Rio Grande, 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. Continued monitoring of such an extensive collection of nests, however, would require considerable additional funding, and the future status of this project is unknown.

Cooper's Hawk was by far the most common nesting raptor (using stick nests) in the Middle Rio Grande bosque, and although Albuquerque supported numerous pairs, active nests were especially dense in the Corrales section. Average internest distance for Cooper's Hawks in Corrales was about 0.8 km, matching the distance reported by Rosenfield et al. (1996) for a central Wisconsin suburb. The density of nests reported by Rosenfield et al. (1996) was, to their knowledge, the highest known for the species at the time. Our density calculations are perhaps less comparable to other studies than internest distances, because we could not measure portions of home ranges that extended beyond the bosque into private land. Nevertheless, low internest distance and high productivity (2.8 young per active nest, matching the upper range of seven studies reviewed by Rosenfield and Bielefeldt 1993) in the Corrales bosque, indicates that this is an important site with favorable conditions for nesting Cooper's Hawks.

Several landscape and/or management factors could explain the exceptional nest density, internest distance, and productivity we observed for Cooper's Hawks in Corrales. Compared to Albuquerque, the Corrales bosque is not adjacent to substantial urban development. Cooper's Hawks nesting in the Corrales bosque extend their territories into rural residential lots, where prey base is supported by gardens, horse pastures, and numerous bird feeders. Although the Albuquerque landscape also provides hunting opportunities for Cooper's Hawks (especially pigeons and sparrows), this urban landscape presents a greater possibility of human-caused disturbance to nesting activities. The mechanical clearing of understory vegetation in most of the Albuquerque bosque by

the city and other agencies (aimed at exotics, but destroying many native plants in the process), along with the lack of such treatments in Corrales, might contribute to our observed differences in Cooper's Hawk nesting. We believe that as many as four active Cooper's Hawk nests in the Albuquerque bosque failed as a direct result of vegetation clearing in the summer of 2005. By clearing vegetation around these nests while they were active, the City of Albuquerque demonstrated a lack of commitment to, or awareness of, avian conservation and protective measures outlined by the Migratory Bird Treaty Act. 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. Clearing treatments might also have indirectly affected nesting by altering avian prey base, thereby influencing Cooper's Hawk territory selection. In a concurrent study in the bosque, we found that songbird densities were lower in areas where the understory had been thinned than in untreated areas (Hawks Aloft 2007). Songbird densities were among the highest in the untreated Corrales bosque, perhaps attracting a greater density of nesting Cooper's Hawks. We recognize the benefits of controlling exotic plants for fire suppression and habitat restoration, but we have witnessed little effort to replant native shrubs in treated portions of the Albuquerque bosque or effectively control the conditions that favor the regrowth of exotics. Without appropriate follow-up, we are concerned that future bosque management in the Middle Rio Grande, particularly in Albuquerque, might consist of a continuous cycle of clearing with possible long-term negative impacts on songbird and raptor populations.

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Figure 1. Locations of seven transects where we conducted summer and winter raptor surveys in the Middle Rio Grande bosque, New Mexico from 2002-2004. We conducted raptor point count surveys along these same transects.

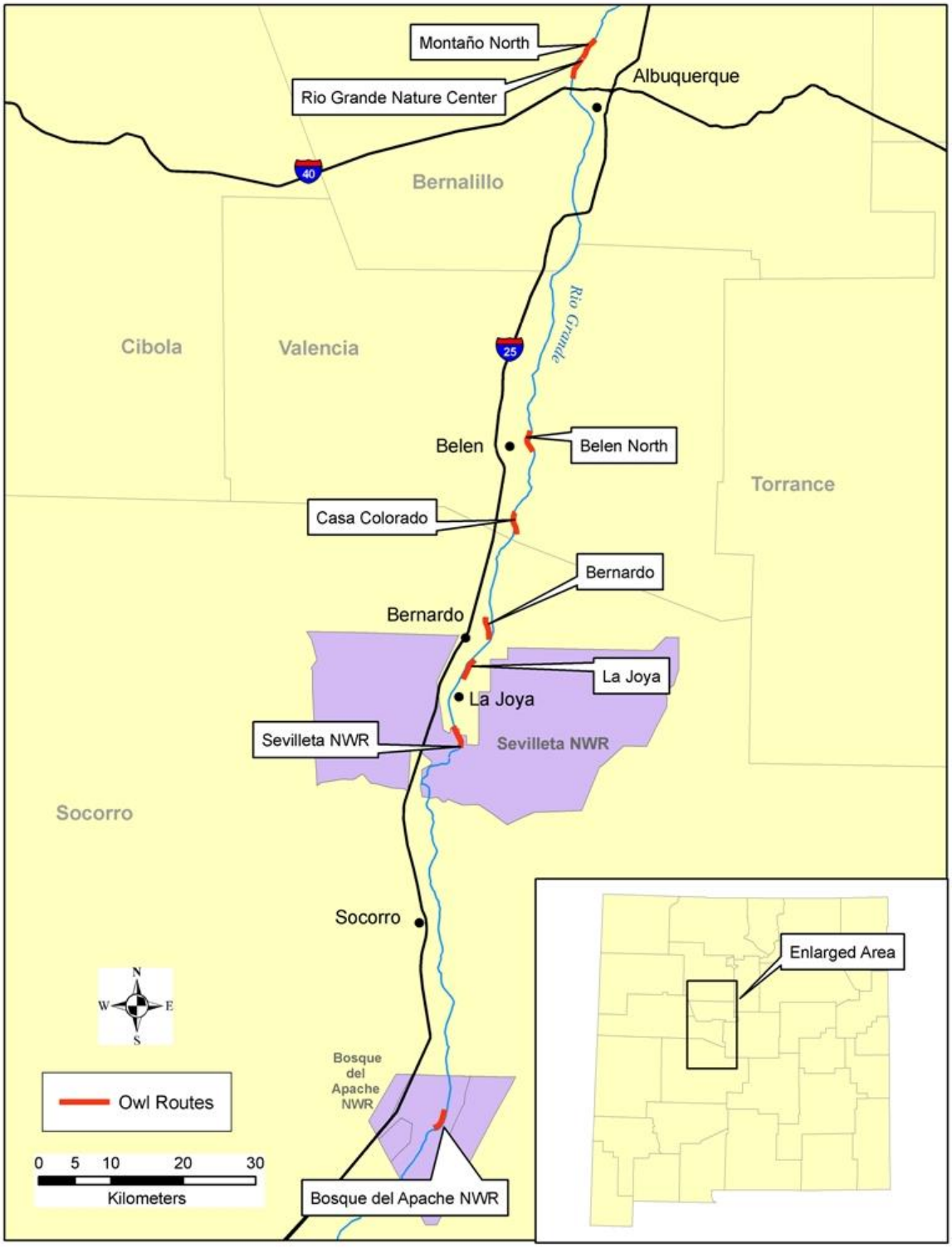

Figure 2. Locations of eight two-mile transects where we conducted nocturnal owl surveys in the Middle Rio Grande bosque, New Mexico from 2002-2004.

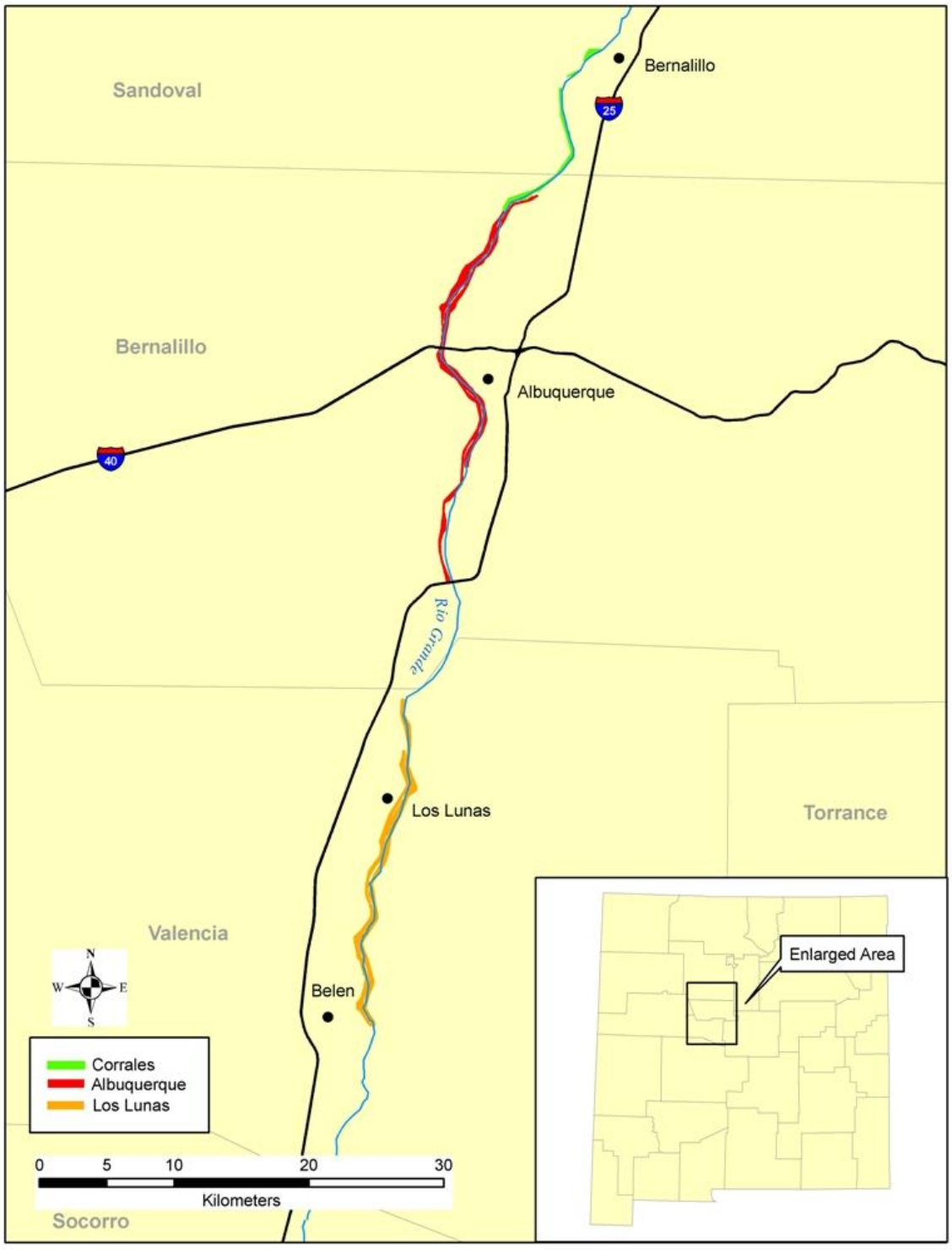

Figure 3. Locations of the Corrales, Albuquerque, and Los Lunas sections of the Middle Rio Grande bosque, where we searched for and monitored raptor nests from 2004-2007.

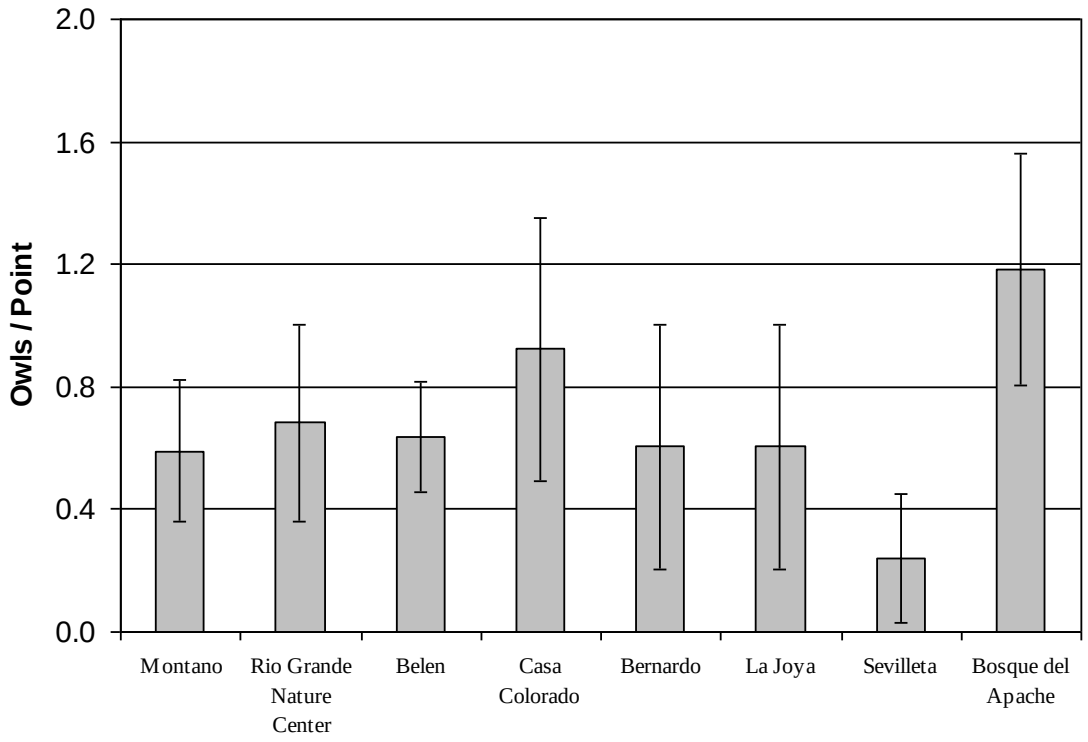

Figure 4. Point count detection rates (owls/point with 95% confidence intervals) at eight nocturnal owl survey sites in the Middle Rio Grande bosque in 2003 and 2004. We list sites from north to south appearing left to right. We considered Montano, Rio Grande Nature Center, and Belen to be urban sites and the remaining five to be rural sites.