

**FALL 2006 RAPTOR MIGRATION STUDIES IN THE
MANZANO MOUNTAINS OF CENTRAL NEW MEXICO**



HawkWatch International, Inc.

Salt Lake City, Utah

January 2007

**FALL 2006 RAPTOR MIGRATION STUDIES IN THE
MANZANO MOUNTAINS OF CENTRAL NEW MEXICO**

Report prepared by:

Jeff P. Smith and Mike C. Neal

Counts conducted by:

Tim Hanks and Greg Levandoski

Trapping and banding conducted by:

Zach Hurst, Kate Heyden, Chris Neri, Nova MacKentley, and Walt Lehman

On-site education by:

Britta Schielke

Project coordinated by:

HawkWatch International, Inc.

Principal Investigator: Dr. Jeff P. Smith

1800 South West Temple, Suite 226, Salt Lake City, UT 84115

(801) 484-6808

January 2007

TABLE OF CONTENTS

List of Tables	iii
List of Figures	iv
Introduction	1
Study Site	1
Methods	1
Standardized Counts	1
Trapping and Banding	2
Results and Discussion	2
Weather	2
Observation Effort	3
Flight Summary	3
Resident Raptors	4
Trapping Effort	5
Trapping and Banding Summary	5
Encounters With Previously Banded Birds	6
Satellite Telemetry	6
Site Visitation	7
Acknowledgments	7
Literature Cited	8
Tables	9
Figures	15
Appendix A. History of official observer participation in the Manzano Mountains Raptor Migration Project: 1985–2006.	23
Appendix B. Common and scientific names, species codes, and regularly applied age, sex, and color-morph classifications for all diurnal raptor species observed during fall migration in the Manzano Mountains, NM.	24
Appendix C. Daily observation effort, visitor disturbance ratings, weather records, and flight summaries for the Manzano Mountains Raptor Migration Project: 2006.	25
Appendix D. Daily observation effort and fall raptor migration counts by species in the Manzano Mountains, NM: 2006.	27
Appendix E. Annual observation effort and fall raptor migration counts by species (unadjusted data) in the Manzano Mountains, NM: 1985–2006.	29
Appendix F. Daily trapping effort and capture totals of migrating raptors by species in the Manzano Mountains, NM: 2006.	31
Appendix G. Annual trapping and banding effort and capture totals of migrating raptors by species in the Manzano Mountains, NM: 1990–2006.	33

LIST OF TABLES

Table 1.	Annual raptor migration counts and adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) annual passage rates by species in the Manzano Mountains, NM: 1985–2005 versus 2006.	9
Table 2.	Annual raptor migration counts by age classes and immature : adult ratios for selected species in the Manzano Mountains, NM: 1990–2005 versus 2006.	10
Table 3.	First and last observed, bulk passage, and median passage dates by species for migrating raptors in the Manzano Mountains, NM in 2006, with comparisons of 2006 and 1985–2005 average median passage dates.	11
Table 4.	Median passage dates by age classes for selected species of migrating raptors in the Manzano Mountains, NM: 1985–2005 versus 2006.	12
Table 5.	Capture totals, rates, and successes for migrating raptors in the Manzano Mountains, NM: 1991–2005 versus 2006.	13
Table 6.	Capture totals by sex and age (HY = hatching year; AHY = after hatching year), female : male capture ratios, and immature : adult capture ratios for selected species of migrating raptors in the Manzano Mountains, NM: 1990–2005 averages versus 2006.	13
Table 7.	Recaptures of previously banded raptors in the Manzano Mountains, NM: 2006.	14
Table 8.	Foreign encounters with raptors originally banded in the Manzano Mountains, NM: 2006.	14

LIST OF FIGURES

Figure 1.	Map of the Manzano Mountains raptor-migration study site in central New Mexico.	15
Figure 2.	Fall raptor-migration flight composition by major species groups in the Manzano Mountains, NM: 1985–2005 versus 2006.	16
Figure 3.	Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) fall-migration passage rates for Turkey Vultures, Ospreys, and Northern Harriers in the Manzano Mountains, NM: 1985–2006. Dashed lines indicate significant ($P \leq 0.10$) regressions.	17
Figure 4.	Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) fall-migration passage rates for Sharp-shinned Hawks, Cooper’s Hawks, and Northern Goshawks in the Manzano Mountains, NM: 1985–2006. Dashed lines indicate significant ($P \leq 0.10$) regressions.	18
Figure 5.	Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) fall-migration passage rates for Broad-winged, Swainson’s, Red-tailed and Ferruginous Hawks in the Manzano Mountains, NM: 1985–2006. Dashed lines indicate significant ($P \leq 0.10$) regressions.	19
Figure 6.	Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) fall-migration passage rates for Golden and Bald Eagles in the Manzano Mountains, NM: 1985–2006. Dashed lines indicate significant ($P \leq 0.10$) regressions.	20
Figure 7.	Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) fall-migration passage rates for American Kestrels, Merlins, Prairie Falcons, and Peregrine Falcons: 1985–2006. Dashed lines indicate significant ($P \leq 0.10$) regressions.	21
Figure 8.	Combined-species, fall-migration passage volume by five-day periods for raptors in the Manzano Mountains, NM: 1985–2005 versus 2006.	22

INTRODUCTION

The Manzano Mountains raptor migration study in central New Mexico is an ongoing effort to monitor long-term trends in populations of raptors using the southern portion of the Rocky Mountain migratory flyway (Hoffman et al. 2002, Hoffman and Smith 2003). HawkWatch International (HWI) initiated standardized counts of the autumn raptor migration through this region in 1985, and began an extensive trapping and banding program at the project site in 1990. To date, HWI observers have recorded 18 species of migratory raptors at the site, with counts typically ranging between 4,000 and 7,000 migrants per season. The 2006 season marked the 22nd consecutive count and the 17th consecutive season of trapping and banding conducted at the site by HWI. This report summarizes the 2006 count and banding results.

STUDY SITE

The project site is located in the Manzano Wilderness Area of the Cibola National Forest (Manzano Ranger District) near Capilla Peak, approximately 56 km south-southeast of Interstate 40 (34°42.25' N, 106°24.67' W; Figure 1). The observation post is located at an elevation of 2,805 m (9,195 ft) on a northwest-southeast facing outcrop of a limestone ridge. It is reached by walking up a 1.2 km trail from the main road leading up to Capilla Peak (FS 522). The predominant vegetation on the slopes of the ridge consists of Gambel oak (*Quercus gambelli*), Douglas-fir (*Pseudotsuga menziesii*), White fir (*Abies concolor*), Ponderosa pine (*Pinus ponderosa*), Pinyon pine (*Pinus edulis*), New Mexico locust (*Robinia neomexicana*), and Bigtooth maple (*Acer grandidentatum*).

During 2006, two traditional banding stations were operated within 0.25–1 km of the observation point (Figure 1). **North** station, operated every year since 1990, was located 100 m east and 50 m north of the observation point at an elevation of 2,790 m. **West** station, operated every year since 1991, was located 0.5 km southwest of the observation point at an elevation of 2,684 m. **South** station, operated part to full-time most years since 1991, was not operated this year.

Many factors make the Manzano Lookout well suited for observing consistent flights of migrating raptors during fall. Several mountain ranges to the north serve as leading lines (*sensu* Geyr von Schweppenburg 1963), funneling raptors into the Manzanos. The Manzano Mountains also are a relatively narrow and well-defined north–south range, which creates beneficial updrafts and serves as a distinct flight path for migrating raptors. The Capilla Peak site provides an excellent source of thermal lift, with two other peaks located 10–15 km north of the observation site also attracting southbound migrants that benefit from strong ridge updrafts. The concentration effect of the Manzano range is further enhanced by the absence of parallel ranges nearby to serve as alternate flight paths.

METHODS

STANDARDIZED COUNTS

Two official or designated observers, relieved or supplemented by other trained volunteers, conducted standardized daily counts of migrating raptors from a single, traditional observation site. Official observer Tim Hanks had three previous seasons of migration counting experience, two at this site (see Appendix A for a complete history of observer participation). This was official observer Greg Levandoski's fourth season of migration counting experience with HWI. Visitors and other crewmembers occasionally assisted with the counts. Weather permitting, observations typically began by 0900 hrs Mountain Standard Time (MST) and ended by 1700 hrs MST.

Data gathering and recording followed standardized protocols used at all HWI migration sites (Hoffman and Smith 2003). The observers routinely recorded the following data:

1. Species, age, sex, and color morph of each migrant raptor, whenever possible and applicable (Appendix A lists common and scientific names for all species, information about the applicability of age, sex, and color morph distinctions, and two-letter codes used to identify species in some tables and figures).
2. Hour of passage for each migrant; e.g., the 1000–1059 hrs MST.
3. Wind speed and direction, air temperature, percent cloud cover, predominant cloud type(s), presence or of precipitation, visibility, and an assessment of thermal-lift conditions, recorded for each hour of observation on the half hour.
4. Predominant direction, altitude, and distance from the lookout of the flight during each hour.
5. Total minutes observed and the mean number of observers present during each hour (included designated observers plus volunteers/visitors who actively contributed to the count [active scanning, pointing out birds, recording data, etc.] for more than 10 minutes in a given hour), recorded on the hour.
6. A subjective visitor-disturbance rating (high, moderate, low, none) for each hour, recorded on the hour.
7. Daily start and end times for each official observer.

Calculation of “adjusted” (to standardize sampling periods and adjust for incompletely identified birds) passage rates (migrants counted per 100 hours of observation) and analysis of trends follows Hoffman and Smith (2003). In comparing 2006 annual statistics against means and 95% confidence intervals for previous seasons, we equate significance with a 2006 value falling outside the bounds of the confidence interval for the associated mean.

TRAPPING AND BANDING

Weather permitting, rotating crews of 2–3 trappers and processors operated each trapping station. The crews generally trapped between 0800–0900 and 1600–1700 hrs MST. Capture devices included mist nets, dho-gaza nets, and remotely triggered bow nets. Trappers lured migrating raptors into the capture stations from camouflaged blinds using live, non-native avian lures attached to lines manipulated from the blinds. Unless already banded, all captured birds were fitted with a uniquely numbered USGS Biological Resources Division aluminum leg band. Data gathering and recording followed standardized protocols used at all HWI migration-banding sites (Hoffman et al. 2002). All birds were released within 45 minutes of capture unless outfitted with a satellite transmitter, which takes longer.

RESULTS AND DISCUSSION

WEATHER

In 2006, inclement weather entirely precluded three full days of potential observation, but no other days were limited to ≤ 4 hours of observation (see Appendix C for daily weather summaries). The number of fully precluded days was well below 1997–2005 average of 6.1 days (range 1–14), and the number of severely hampered days also was well below the previous 9-year average of 2.3 days (range 0–5). Sky conditions followed usual patterns in 2006, with an average proportion of days featuring predominantly fair skies (49% of the active observation days, matching the 1997–2005 average), a near-average proportion of days featuring transitional skies (i.e., changed from fair skies to mostly cloudy or overcast during the day, or vice versa; 29% vs. 1997–2005 average of 34%), and mostly cloudy to overcast skies (21% vs. 1997–2005 average of 18%). Visibility reducing fog and especially haze were considerably more prevalent than usual in 2006, however, occurring on 47% of the active observation days compared

to the 1997–2005 average of 30%. This did not translate, however, to marked reductions in average maximum-visibility ratings to the east (91 km vs. 1997–2005 average of 89.5 km) and west (90 km, matching the long-term average). The frequency of rain/snow showers during active observation periods was below average (13% of active observation days vs. 1997–2005 average of 20%). The proportion of days where the observers rated the thermal lift conditions as good to excellent was near average (41% of active observation days vs. 1997–2005 average of 45%).

Similar to 2005, the proportion of active days where light winds (<12 kph) prevailed was well below average (54% vs. 1997–2005 average of 72%), whereas the proportions of days with predominantly moderate (12–28 kph) and strong winds (>28 kph) were above average (37 and 9% vs. averages of 25 and 3%, respectively).

In terms of wind directions, the range of conditions seen in 2006 was similar to most years since 1997. As usual, SW–W winds was the most common pattern; however, this year SE–SW winds were the second most common pattern, whereas, S–SW winds were much more common during the past four years (prevailing on 20–41% of the active days from 2002–2005 vs. 9% for 2006). The most notable differences in wind direction patterns for 2006 were the complete absence of days where SW–NW conditions predominated (average 9 days) and a low 4 days with winds in the N–SE range (average 8 days).

The temperature during active observation periods averaged 13.1°C (the average of daily values, which in turn were averages of hourly readings), ranging from -0.2–20.7°C. The overall daily average was more than 1.5 degrees below the 1997–2005 average of 14.7°C; the minimum daily-average was the coolest since 1997; and the maximum daily-average was the coolest since 1999. We began recording hourly barometric pressure readings on site in 2001; in 2006, the overall average (30.15 inHg; an average of daily averages, which in turn are averages of hourly readings) and minimum (29.66) and maximum (30.44) daily averages were slightly above average.

In summary, similar to 2005, in 2006 inclement weather had relatively little impact on the observer's ability to conduct daily counts and southwesterly winds predominated. Contrary to the past 4–5 years, however, more frequent cloud cover and fog/haze resulted in cooler than average temperatures, but did not greatly reduce visibility.

OBSERVATION EFFORT

The observers worked on 68 of 71 possible days between 27 August and 5 November. The number of observation days was a significant 6% higher than the 1985–2005 average of $64 \pm 95\%$ CI of 2.3 days. The total hours of observation (566.41) also was a significant 13% above the long-term average of 501.97 ± 25.60 hours. The 2006 average of 2.2 observers per hour (including official and guest observers; value is mean of daily values, which are in turn means of hourly values) matched the 1985–2005 average of $2.2 \pm 95\%$ CI of 0.16 observers/hr.

FLIGHT SUMMARY

The observers counted 8,119 migrant raptors of 16 species during the 2006 season (see Appendix D for daily count records and Appendix E for annual summaries). The flight was composed of 65% buteos, 24% accipiters, 6% falcons, 2% vultures, 1% eagles, 1% harriers, and $\leq 1\%$ each of Ospreys and unidentified raptors. This composition includes a significantly above average proportion of buteos but significantly below average proportions of all other species groups except harriers (Figure 2). The group proportions amounted to record lows for accipiters, falcons, and vultures. In contrast, the high proportion of buteos was due to an unusually high count of Swainson's Hawks. Swainson's Hawks were atypically the most abundant species, followed by Sharp-shinned Hawks, Cooper's Hawks, Red-tailed

Hawks, American Kestrels, and Turkey Vultures (Table 1, Appendix E). No record low or high species-specific counts occurred in 2006.

Adjusted passage rates were significantly above average for three species—Northern Harriers, Broad-winged and Swainsons’ Hawks—and were significantly below average for 11 species—Turkey Vulture, Sharp-shinned Hawk, Cooper’s Hawk, Northern Goshawk, Red-tailed Hawk, Ferruginous Hawk, Rough-legged Hawk, Golden and Bald Eagles, American Kestrel, and Prairie Falcon (Table 1, Figures 3–7). Regression analyses indicated a significant ($P \leq 0.05$) quadratic trend for Turkey Vultures, loosely tracking a strong increasing pattern through 1998, followed by a sharp three-year decline, a slight recovery, and modest or declining numbers for the past four years (Figure 3). A similar pattern and significant quadratic regression applied to Northern Harriers, except that counts had remained low since crashing from a high peak in 1998, then rebounded in 2006 (Figure 3). A significant ($P \leq 0.05$) linear increasing trend was indicated for Ospreys, but more detailed examination shows an accelerating-increase pattern through 1995, followed by a moderate declining pattern since then except for a large spike in 2003 (Figure 3). Among the accipiters, the lowest adjusted passage rate to date in 2006 dampened a highly significant ($P \leq 0.01$) long-term increasing pattern for Cooper’s Hawks (Figure 4). Among the buteos, significant long-term increases were indicated for Broad-winged and Swainson’s Hawks, whereas a highly significant decrease continued for Ferruginous Hawks (Figure 5). However, following a strong slide between 1992 and 2000, the trajectory of Ferruginous Hawk passage rates is now once again showing a slight upward trend. A significant long-term quadratic trend emerged for Bald Eagles, tracking a spike in 1994 and crash in 1996, followed by moderate passage rates thereafter (Figure 6). Among the falcons, significant quadratic trends were indicated for Merlins and Prairie Falcons, tracking increasing patterns through 1998 and then sharp declines, with the Prairie Falcon decline continuing through 2006 but Merlins rebounding sharply in 2005 but dropping again in 2006 (Figure 7). A highly significant linear increasing trend was indicated for Peregrine Falcons, but peregrine passage rates have dropped each year subsequent to peaking in 2002 (Figure 7).

Among 10 species with data suited to comparisons, immature : adult ratios were significantly above average for Broad-winged and Ferruginous Hawks (limited value due to low numbers), and Golden Eagles, but were significantly below average for Cooper’s Hawk and Bald Eagles (Table 2). Young Golden Eagles were 80% as abundant as usual but adult eagles were even less common than usual, again resulting in an inflated ratio. For Cooper’s Hawks, immatures comprised a mere 57% of the long-term mean, significantly reducing the ratio. We also must consider these data tentatively because in most cases significant variation in the proportions of unaged birds confounds the comparisons (Table 2).

The 2006 combined-species median passage date of 25 September nearly matched the 1985–2005 average of 26 September (Table 3), and the overall seasonal distribution of activity followed a typical pattern except for showing a high activity spike in mid-September and other lesser but significant variations from the norm earlier in September and in early October (Figure 8). Species-specific data revealed additional complexity. Median passage dates were significantly later than average for five species (Turkey Vulture, Northern Harrier, Broad-winged Hawk, Golden Eagle, and Peregrine Falcon) and were significantly earlier than average for three species (Sharp-shinned Hawk, Northern Goshawk, and Merlin; Table 3). There were, however, no distinct multi-species patterns of note, and age-specific data revealed no additional noteworthy patterns (Table 4).

RESIDENT RAPTORS

Local birds observed this season included a family of Red-tailed Hawks, including two adults and at least two immatures, which were regularly seen together from 27 August through 10 October. After that, the adults were still regularly seen through the remainder of the season, often flying together. Scattered sightings of local Golden Eagles occurred throughout the season, but only once was a non-adult close enough to be positively identified as an immature. Turkey Vultures were commonly seen from the start

of the season until early October, usually in groups of four or five. At least two immature Peregrine Falcons and one adult were seen regularly from 27 August through 7 October. The only other resident sighting was of two unknowns on 17 Oct. Prairie Falcons were seen sporadically throughout the season, with two confirmed adults seen together on one occasion. Most Prairie Falcon sightings were in Cañon de Jaramillo, just south of the observation site. A brown Merlin took up residence in the area on 19 October and was seen four more times before the end of the season. On three days between 4 and 7 September, an immature Cooper's Hawk with a single leucistic feather on the upperwing was seen. There were no other sightings of local Cooper's Hawks except that an adult was seen on three days during the final week of October. From the start of the season through 15 September, an immature Sharp-shinned Hawk was seen on 13 days and an adult once. No further sightings of local Sharp-shinned Hawks occurred until 20 October, when an adult took up residence in the area and was then seen regularly through the remainder of the season.

This is a typical resident assemblage for the site, except that Sharp-shinned Hawks have been more common in the past. Also of note was a significant presence of unidentified aerial insects (of about nickel to quarter size) which many species of hawks were observed catching on the wing starting 10 September. Most of these were seen from the level of the observation post up to perhaps 1000 feet. Species seen "hawking" such insects included Ospreys, Swainson's Hawks, Red-tailed Hawks, Cooper's Hawks, Peregrine Falcons, Merlins, and American Kestrels.

TRAPPING EFFORT

The crews operated at least one banding station on 48 of 49 possible days between 4 September and 24 October 2006, with effort totaling 94 station days and 677.67 station hours (see Appendix F daily trapping records and Appendix G for annual summaries). The number of trapping days was 5% below the long-term average, and the number of station days and hours were 20 and 23% below average, respectively, due to having only two of three traditional blinds in operation (Appendix G).

TRAPPING AND BANDING SUMMARY

The 2006 capture total of 654 birds included 12 species, 651 newly banded birds, 2 recaptures of birds previously banded in the Manzanos, and 1 recapture of a bird previously banded at HWI's nearby Sandia Mountains spring monitoring site (Table 5, Appendix G). The 2006 effort raises the total number of birds captured since project inception to 16,890, including 34 recaptures of Manzano-banded birds and 23 foreign recaptures (i.e., birds originally banded elsewhere and subsequently recaptured in the Manzanos; Appendix G). Sharp-shinned and Cooper's Hawks accounted for 46% and 43% of the total captures, respectively, with Red-tailed Hawks (5%), Peregrine Falcons (2%), and American Kestrels (2%) the next most abundant species. Each of the remaining species accounted for <1% of the total.

The overall combined-species capture total was 34% below average, largely reflecting a near 50% drop in the number Sharp-shinned and Cooper's Hawk's trapped; however, the 2006 capture totals for Peregrine Falcons and Broad-winged Hawks were above average (Table 5). The overall capture rate of 96.5 birds per 100 station hours also was significantly below average. Overall capture success was near average at 20%, significantly above average for Broad-winged Hawks and Prairie and Peregrine Falcons, but significantly below average for four species (Table 5). Commonly captured species for which the 2006 capture totals, rates, and successes were all significantly below average included Sharp-shinned Hawk, Golden Eagle, American Kestrel, and Merlin. The Broad-winged Hawk and Peregrine Falcon were the only species for which all three metrics were significantly above average in 2006.

Compared to the counts, at this site banding yields unique and substantial sex-age specific data only for Sharp-shinned Hawks, Cooper's Hawks, and American Kestrels. The 2006 immature : adult capture ratios for Sharp-shinned and Cooper's Hawk were near average (Table 6). This is the same pattern as

indicated in the count data (Table 2). For both species, but especially for Sharp-shinned Hawks, the count-based age ratios were lower than the capture-based ratios, suggesting that juvenile birds were more susceptible to capture than adults, which is typical. The female : male capture ratio was near average for Sharp-shinned Hawks, but significantly above average for Cooper's Hawks (Table 6). Capture totals were only 16–18% below average for immature and adult female Cooper's Hawks, but were 30–55% below average for all other sex–age groups of Sharp-shinned and Cooper's Hawks.

Capture totals for were also below average for all sex-age classes of American Kestrels, and both the immature : adult and female : male capture ratios were well below average, as well (Table 6). Females, in particular, were overall twelve times less abundant than the usual among the captured birds. The count data yielded a sex ratio that was near average (0.86), whereas the capture-based sex ratio (0.10) was both much lower than the count-based ratio and significantly below the long-term average of $0.70 \pm 95\%$ CI of 0.20. In combination, the evidence suggests that kestrels were substantially less abundant than usual in 2006, with females proportionately less abundant than males, and adults appeared more susceptible than usual to capture while especially juvenile females were either less susceptible than usual to capture or were proportionately especially scarce in 2006.

ENCOUNTERS WITH PREVIOUSLY BANDED BIRDS

Recaptures.—The 2006 captures included two recaptures of female Cooper's Hawks previously banded in the Manzanos in 2003, one originally banded as a second-year bird and the other as a full after-second-year adult (Table 7). The 2006 recaptures raise the total number of Manzano recaptures since 1990 to 34 birds (Appendix G).

Foreign Recaptures.—One female Cooper's Hawk originally banded as an after-third-year bird at HWI's nearby Sandia Mountains spring migration project site in 1998 was recaptured in the Manzanos in 2006 (Table 7). This capture raises the total number of foreign recaptures at the Manzanos to 23 birds (mostly Sandia-banded birds) and, at 12 years old or older, represents one of the oldest Cooper's Hawks we have ever recaptured.

Foreign Encounters.—Five raptors originally banded in the Manzanos were encountered elsewhere in 2006 (Table 8), which brings the total foreign encounters since 1990 to 106 birds (Appendix G). The 2006 encounters included three male Cooper's Hawks, one banded as a second-year bird in 2005, another as a hatch-year bird in 2003, and the last as an after-hatch-year bird in 2002. The first Cooper's Hawk was found dead of unknown causes during March near Michoacan De Ocampo, Mexico, ~1,414 km south of the project site. The second Cooper's Hawk was captured and released in the Sandias in April, 34 km to the northwest. The third Cooper's Hawk was captured and released near Great Falls, Montana (1,265 km northeast) by a Montana Fish Wildlife and Parks biologist in July, indicating that this bird may have been on its summer range. A Red-tailed Hawk originally banded as a hatch-year bird in 1995 was found dead of unknown causes in mid-March near Piedra River, Colorado, roughly 245 km north of the project site. The last foreign encounter of 2006 involved a female Sharp-shinned Hawk originally banded as a hatch-year bird in 2005 that was found dead of unknown causes in late-April on the Red Rocks Loop Road, Arizona, 593 km west of the project site. These new encounters all fall within the expected range of Rocky Mountain migrants (Hoffman et al. 2002).

SATELLITE TELEMETRY

We succeeded in deploying one new satellite transmitter on a hatch-year male Golden Eagle during the 2006 season. We had hoped to outfit two more eagles this season, but did not succeed in capturing any other suitable candidate birds. After release on 7 October, this bird headed east-southeast across central New Mexico, crossed over into Texas on 11 October, but then returned to back to the west and proceeded to spend the next month wandering around southeast New Mexico between about Carlsbad and the Texas

border. Then in mid-November, he abruptly moved ~120 km farther south-southeast into western Texas, where he remained through mid-January 2007 in an area of extensive oil and gas fields just west of Midland, Texas.

We also continue to track two other Golden Eagles outfitted at the site in 2002 and 2005. Within two days after her release, the 2005 eagle, a hatch-year female at the time, traveled ~300 km northwest up into the northeast corner of Arizona, then continued north another ~150 km into western Colorado. Since then, she has remained in southwest Colorado, mostly in the Dry Creek Basin area ~200 km northwest of Durango. Several times during late fall 2005 and early spring 2006, she made various brief excursions to the west and east. Then in early April 2006, she set out again to the east, then veered north and traveled ~200 km up to near Grand Mesa National Forest and Delta, Colorado. From this area, she made two further, brief excursions of 100–150 km to the southwest and back, but then during the last week of April returned south to the Dry Creek Basin area. Then during mid-May 2006 she set out to the southwest again and moved down to near Sleeping Ute Mountain ~30 km SW of Cortez in the southwest corner of Colorado. She has remained in this general area ever since, with all sensors and a variety of short-distance movements indicating that she is alive and well.

The 2002 eagle, a male outfitted as a hatch-year bird, is our most amazing tracking to date, in that this transmitter has now lasted for 4 years and 3 months, well beyond our expectations! Most recently, he returned for a third winter to the northwest South Dakota and eastern Montana/Wyoming region. Previously, he had wintered two years in similar areas of southeastern New Mexico and far western Texas. His primary summering range has been north-central Canada around the Nunavut–Northwest Territories border area, ranging from the Lac de Gras area ~200 km (125 mi) northeast of Yellowknife in the Northwest Territories to the Peacock Hills area of Nunavut ~100 km (80 mi) farther north. In 2005, however, he summered wandering around the Alberta–Saskatchewan border several hundred kilometers farther south.

Complete tracking summaries and maps for all of HWI's telemetry birds can be found at <http://www.hawkwatch.org>.

SITE VISITATION

In 2006, 335 individuals visited the project site from 14 states. Most originated in New Mexico, but others came from Alaska, Illinois, New York, Louisiana, Washington, Montana, Indiana, Arizona, Utah, Washington DC, Texas, Colorado, Kansas, and Oklahoma. The season's visitors included 11 organized groups: Venturing Beyond Prevention, Albuquerque Home School Coalition, Cub Scouts, East Mountain High School Zoology Class, Mountainair Elementary School, Sangre de Cristo Audubon Society, A New Day, New Mexico Boys Ranch, and Wild Friends.

In 2006, 607 hourly assessments of visitor disturbance resulted in the following ratings: 72% none, 21% low, 3% moderate, and 4% high. These are typical ratings for the site.

ACKNOWLEDGMENTS

Financial support for this project was provided by the USDA Forest Service, Cibola National Forest and Region 3; U.S. Fish and Wildlife Service, Region 2 and the Neotropical Migratory Bird Conservation Act Grant Program; Albuquerque Community Foundation; Public Service Company of New Mexico; Intel Corporation; Central New Mexico Audubon Society; and HWI private donors and members. HWI and the field crew also thank Wild Oats and Whole Foods Market of Albuquerque for their generous contributions of food to support the field crew during the season. The field crew would also like to thank Tillie's Inn & RV Park for providing discounted showers. Lastly, we extend our heartfelt thanks to the following individuals for their generous volunteer service and support during the season: Roger Grimshaw, Art Arenholz, Ken Babcock and Melanie Keithley, Jessie Jewell and John DeLong, Jenny

Good, Walt & Jennifer Lehman, Cole Shaw, Penny Thompson, John Acklen, Shirley Kendall, Peter Neils and Sue Chavez, and Jim Place.

LITERATURE CITED

Geyr von Schweppenburg, H. F. 1963. Zur Terminologie und Theorie der Leitlinie. *Journal für Ornithologie* 104:191–204.

Hoffman, S. W., and J. P. Smith. 2003. Population trends of migratory raptors in western North America, 1977–2001. *Condor* 105:397–419.

Hoffman, S. W., J. P. Smith, and T. D. Meehan. 2002. Breeding grounds, winter ranges, and migratory routes of raptors in the Mountain West. *Journal of Raptor Research* 36:97–110.

Table 1. Annual raptor migration counts and adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) annual passage rates by species in the Manzano Mountains, NM: 1985–2005 versus 2006.

SPECIES	COUNTS			RAPTORS / 100 HRS ¹		
	1985–2005 ²	2006	% CHANGE	1985–2005 ²	2006	% CHANGE
Turkey Vulture	396 ± 104.6	150	-62	117.8 ± 29.76	42.1	-64
Osprey	30 ± 7.5	30	1	8.3 ± 1.89	7.6	-9
Northern Harrier	58 ± 11.2	90	55	11.9 ± 2.10	17.1	44
Sharp-shinned Hawk	1489 ± 193.1	958	-36	368.8 ± 42.43	216.7	-41
Cooper's Hawk	1029 ± 159.1	865	-16	295.9 ± 37.38	232.8	-21
Northern Goshawk	16 ± 4.0	10	-36	3.6 ± 1.05	1.8	-49
Unknown small accipiter ³	155 ± 42.1	119	-23	–	–	–
Unknown large accipiter ³	3 ± 1.8	2	-41	–	–	–
Unidentified accipiter	86 ± 27.8	6	-93	–	–	–
TOTAL ACCIPITERS	2657 ± 335.3	1960	-26	–	–	–
Broad-winged Hawk	7 ± 1.8	9	35	2.4 ± 0.60	3.0	26
Swainson's Hawk	553 ± 671.9	4695	749	210.8 ± 255.36	1701.6	707
Red-tailed Hawk	657 ± 77.0	534	-19	144.1 ± 14.55	100.8	-30
Ferruginous Hawk	13 ± 2.3	9	-31	2.8 ± 0.51	1.8	-35
Rough-legged Hawk	0.2 ± 0.2	0	-100	0.1 ± 0.04	0.0	-100
Zone-tailed Hawk	1 ± 0.4	0	-100	–	–	–
Unidentified buteo	24 ± 10.3	23	-4	–	–	–
TOTAL BUTEOS	1254 ± 675.1	5270	320	–	–	–
Golden Eagle	118 ± 14.1	87	-26	25.5 ± 3.22	15.3	-40
Bald Eagle	3 ± 1.1	3	-11	1.1 ± 0.37	0.6	-47
Unidentified Eagle	1 ± 0.6	1	50	–	–	–
TOTAL EAGLES	122 ± 14.1	91	-25	–	–	–
American Kestrel	562 ± 64.3	412	-27	156.7 ± 17.49	107.1	-32
Merlin	25 ± 6.2	23	-8	6.3 ± 1.45	5.2	-18
Prairie Falcon	21 ± 5.0	13	-37	4.5 ± 0.98	2.7	-41
Peregrine Falcon	49 ± 15.9	43	-12	11.9 ± 3.84	10.5	-12
Unknown small falcon ³	2 ± 1.3	1	-44	–	–	–
Unknown large falcon ³	5 ± 5.3	3	-38	–	–	–
Unidentified falcon	3 ± 1.2	1	-60	–	–	–
TOTAL FALCONS	661 ± 73.3	496	-25	–	–	–
Unidentified raptor	47 ± 17.6	32	-32	–	–	–
GRAND TOTAL	5225 ± 890.4	8119	55	–	–	–

¹ Based on data truncated to standardized, species-specific sampling periods and adjusted for incompletely identified birds.

² Mean ± 95% CI.

³ Designations used for the first time in 2001.

Table 2. Annual raptor migration counts by age classes and immature : adult ratios for selected species in the Manzano Mountains, NM: 1990–2005 versus 2006.

	TOTAL AND AGE-CLASSIFIED COUNTS						IMMATURE : ADULT			
	1990–2005 AVERAGE			2006			% UNKNOWN AGE		RATIO	
	TOTAL	IMM.	ADULT	TOTAL	IMM.	ADULT	1990–2005 ¹	2006	1990–2005 ¹	2006
Northern Harrier	61	32	15	90	43	25	27 ± 7.0	24	2.2 ± 0.54	1.7
Sharp-shinned Hawk	1624	642	707	958	344	361	17 ± 3.9	26	0.9 ± 0.15	1.0
Cooper's Hawk	1174	423	515	865	245	371	20 ± 4.9	29	0.8 ± 0.13	0.7
Northern Goshawk	16	7	6	10	5	5	14 ± 6.8	0	1.7 ± 0.92	1.0
Broad-winged Hawk	8	1	4	9	4	4	42 ± 17.3	11	0.5 ± 0.41	1.0
Red-tailed Hawk	736	243	387	534	186	273	14 ± 3.9	14	0.7 ± 0.13	0.7
Ferruginous Hawk	11	3	3	9	3	1	49 ± 7.6	56	1.8 ± 0.82	3.0
Golden Eagle	118	62	32	87	50	12	17 ± 4.4	29	2.2 ± 0.48	4.2
Bald Eagle	4	2	1	3	1	2	12 ± 16.3	0	2.2 ± 1.23	0.5
Peregrine Falcon	67	19	29	43	12	19	23 ± 11.0	28	0.8 ± 0.44	0.6

¹ Mean ± 95% CI. For age ratios, note that the long-term mean immature : adult ratio is an average of annual ratios and may differ from the value obtained by dividing average numbers of immatures and adults. Discrepancies in the two values reflect high annual variability in the observed age ratio.

Table 3. First and last observed, bulk passage, and median passage dates by species for migrating raptors in the Manzano Mountains, NM in 2006, with comparisons of 2006 and 1985–2005 average median passage dates.

SPECIES	2006				1985–2005
	FIRST OBSERVED	LAST OBSERVED	BULK PASSAGE DATES ¹	MEDIAN PASSAGE DATE ²	MEDIAN PASSAGE DATE ^{2,3}
Turkey Vulture	30-Aug	16-Oct	19-Sep – 7-Oct	26-Sep	16-Sep ± 3.0
Osprey	28-Aug	19-Oct	4-Sep – 11-Oct	17-Sep	17-Sep ± 1.5
Northern Harrier	27-Aug	2-Nov	16-Sep – 23-Oct	10-Oct	2-Oct ± 1.9
Sharp-shinned Hawk	28-Aug	5-Nov	11-Sep – 18-Oct	27-Sep	27-Sep ± 1.1
Cooper's Hawk	27-Aug	2-Nov	10-Sep – 7-Oct	24-Sep	25-Sep ± 1.1
Northern Goshawk	27-Aug	1-Nov	27-Aug – 1-Nov	15-Oct	4-Oct ± 4.4
Broad-winged Hawk	23-Sep	5-Oct	23-Sep – 5-Oct	28-Sep	26-Sep ± 2.7
Swainson's Hawk	29-Aug	7-Oct	16-Sep – 4-Oct	25-Sep	20-Sep ± 3.2
Red-tailed Hawk	27-Aug	5-Nov	12-Sep – 25-Oct	2-Oct	3-Oct ± 2.0
Ferruginous Hawk	13-Sep	21-Oct	13-Sep – 21-Oct	7-Oct	1-Oct ± 4.1
Golden Eagle	28-Aug	5-Nov	26-Sep – 4-Nov	21-Oct	13-Oct ± 1.6
Bald Eagle	23-Sep	5-Nov	–	–	20-Oct ± 5.5
American Kestrel	27-Aug	30-Oct	9-Sep – 3-Oct	18-Sep	21-Sep ± 1.6
Merlin	16-Sep	5-Nov	19-Sep – 22-Oct	11-Oct	6-Oct ± 2.9
Prairie Falcon	14-Sep	21-Oct	16-Sep – 20-Oct	7-Oct	24-Sep ± 3.1
Peregrine Falcon	9-Sep	30-Oct	11-Sep – 10-Oct	19-Sep	22-Sep ± 1.4
All species	27-Aug	5-Nov	14-Sep – 6-Oct	25-Sep	26-Sep ± 0.8

¹ Dates between which the central 80% of the flight passed; calculated only for species with counts ≥5 birds.

² Date by which 50% of the flight had passed; calculated only for species with counts ≥5 birds.

³ Mean of annual values ± 95% CI in days; calculated using only data for years with counts ≥5 birds.

Table 4. Median passage dates by age classes for selected species of migrating raptors in the Manzano Mountains, NM: 1985–2005 versus 2006.

SPECIES	ADULT		IMMATURE / SUBADULT	
	1985–2005 ¹	2006	1985–2005 ¹	2006
Northern Harrier	7-Oct ± 3.9	19-Oct	1-Oct ± 2.5	2-Oct
Sharp-shinned Hawk	5-Oct ± 1.5	4-Oct	19-Sep ± 1.4	16-Sep
Cooper's Hawk	29-Sep ± 2.0	25-Sep	21-Sep ± 1.8	16-Sep
Northern Goshawk	5-Oct ± 4.1	21-Oct	1-Oct ± 6.6	15-Oct
Red-tailed Hawk	8-Oct ± 2.2	7-Oct	25-Sep ± 1.9	24-Sep
Golden Eagle	15-Oct ± 2.1	29-Oct	13-Oct ± 1.4	19-Oct
Peregrine Falcon	24-Sep ± 2.1	25-Sep	17-Sep ± 2.9	14-Sep

Note: Median passage dates are dates by which 50% of the flight had passed the lookout; values were calculated based only on counts of ≥5 birds per year.

¹ Mean ± 95% confidence interval in days; unless otherwise indicated, values were calculated only for species with ≥3 years of counts ≥5 birds per year.

Table 5. Capture totals, rates, and successes for migrating raptors in the Manzano Mountains, NM: 1991–2005 versus 2006.

SPECIES	CAPTURE TOTAL		CAPTURE RATE ¹		CAPTURE SUCCESS (%) ²	
	1991–2005 ³	2006	1991–2005 ³	2006	1991–2005 ³	2006
Northern Harrier	4 ± 2.0	6	0.4 ± 0.16	0.9	7 ± 3.1	7
Sharp-shinned Hawk	541 ± 89.4	299	59.5 ± 6.91	44.1	32 ± 2.9	29
Cooper's Hawk	400 ± 65.8	280	44.6 ± 6.27	41.3	33 ± 3.3	30
Northern Goshawk	5 ± 2.0	3	0.6 ± 0.25	0.4	32 ± 10.6	30
Broad-winged Hawk	0.3 ± 0.23	1	0.03 ± 0.028	0.1	3 ± 2.6	11
Swainson's Hawk	0.3 ± 0.40	1	0.03 ± 0.042	0.1	0.1 ± 0.3	0
Red-tailed Hawk	55 ± 11.4	35	6.0 ± 1.03	5.2	7 ± 1.4	7
Zone-tailed Hawk	0.1 ± 0.13	0	0.00 ± 0.010	0.0	6 ± 10.9	0
Golden Eagle	4 ± 0.9	1	0.5 ± 0.13	0.1	3 ± 0.5	1
American Kestrel	41 ± 11.2	10	4.5 ± 1.08	1.5	7 ± 1.3	2
Merlin	5 ± 2.0	2	0.5 ± 0.22	0.3	16 ± 7.5	9
Prairie Falcon	4 ± 1.5	4	0.5 ± 0.13	0.6	17 ± 3.1	29
Peregrine Falcon	6 ± 2.1	12	0.7 ± 0.24	1.8	9 ± 2.1	27
All Species	1066 ± 170.5	654	117.9 ± 13.71	96.5	23 ± 2.1	20

¹ Captures / 100 station hours.

² Number of birds captured / number of birds observed. The combined-species value was calculated excluding Ospreys, Turkey Vultures, Swainson's Hawks, Rough-legged Hawks, Ferruginous Hawks, and unknown raptors from the count totals. Species-specific values were calculated after birds identified only to genus were allocated across possible species in proportion to the relative abundance of birds identified to those species.

³ Mean of annual values ± 95% confidence interval.

Table 6. Capture totals by sex and age (HY = hatching year; AHY = after hatching year), female : male capture ratios, and immature : adult capture ratios for selected species of migrating raptors in the Manzano Mountains, NM: 1990–2005 averages versus 2006.

SPECIES	YEAR	FEMALE		MALE		FEMALE : MALE	IMMATURE : ADULT
		HY	AHY	HY	AHY	RATIO ¹	RATIO ¹
Sharp-shinned Hawk	1990-2005	160	124	152	79	1.3 ± 0.10	1.6 ± 0.25
	2006	110	56	87	46	1.2	1.9
Cooper's Hawk	1990-2005	90	106	96	89	1.1 ± 0.09	0.9 ± 0.17
	2006	73	89	58	60	1.4	0.9
American Kestrel	1990-2005	10	2	17	7	0.7 ± 0.20	4.2 ± 1.13
	2006	0	1	5	4	0.1	1.0

¹ Long-term value – mean ± 95% CI.

Table 7. Recaptures of previously banded raptors in the Manzano Mountains, NM: 2006.

BAND #	SPECIES	SEX	BANDING SITE	BANDING DATE	BANDING AGE ¹	RECAPTURE DATE	RECAPTURE AGE ¹
1005 – 18269	Cooper's Hawk	F	Manzano Mts., NM	10-Oct-03	SY	22-Sep-06	≥4 th yr
0804 – 18248	Cooper's Hawk	F	Manzano Mts., NM	26-Sep-03	ASY	10-Oct-06	≥5 th yr
0745 – 96131	Cooper's Hawk	F	Sandia Mts., NM	10-Apr-98	ATY	24-Sep-06	≥12 th yr

¹ HY = hatch year; SY = second year; TY = third year; AHY = after hatch year; ASY = after second year; ATY = after third year.

Table 8. Foreign encounters with raptors originally banded in the Manzano Mountains, NM: 2006.

BAND #	SPECIES	SEX	BANDING AGE ¹	BANDING DATE	ENCOUNTER DATE	ENCOUNTER AGE ¹	ENCOUNTER LOCATION	DISTANCE (KM)	STATUS
1005 – 23261	CH	M	SY	26-Sep-05	09-Mar-06	TY	Michoacan, MEX	1,414	found dead
0614 – 16410	CH	M	HY	15-Sep-03	14-Apr-06	ATY	Sandia Mountains, NM	34	captured/released
0804 – 15377	CH	M	AHY	22-Sep-02	01-Jul-06	≥5 th yr	Great Falls, MT	1,265	captured/released
1387 – 43171	RT	U	HY	19-Sep-95	14-Mar-06	≥11 th yr	Piedra River, CO	245	found dead
2003 – 23999	SS	F	HY	14-Sep-05	28-Apr-06	SY	Red Rock Loop Road, AZ	593	found dead

¹ HY = hatch year; SY = second year; TY = third year; AHY = after hatch year; ASY = after second year; ATY = after third year.

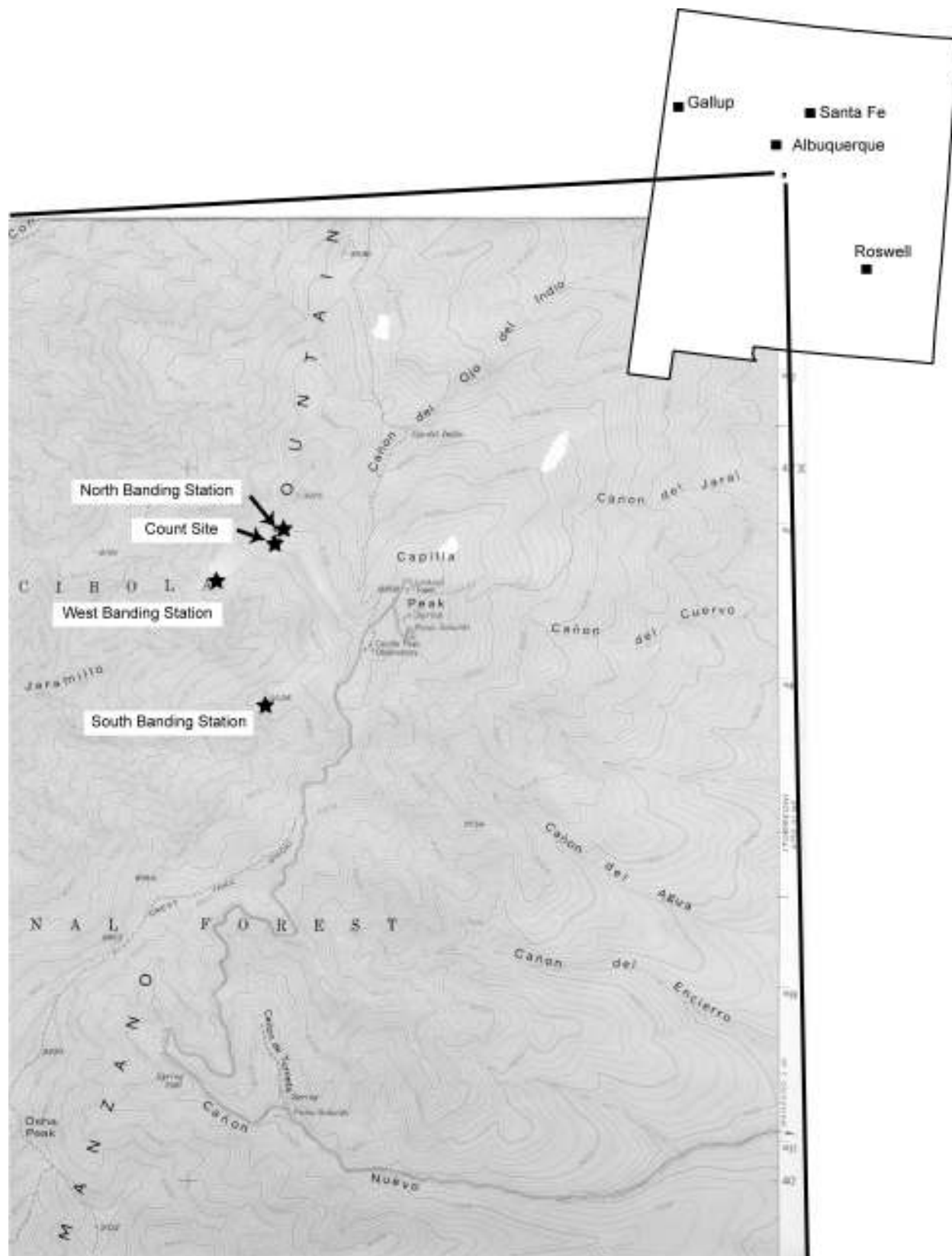


Figure 1. Map of the Manzano Mountains raptor-migration study site in central New Mexico.

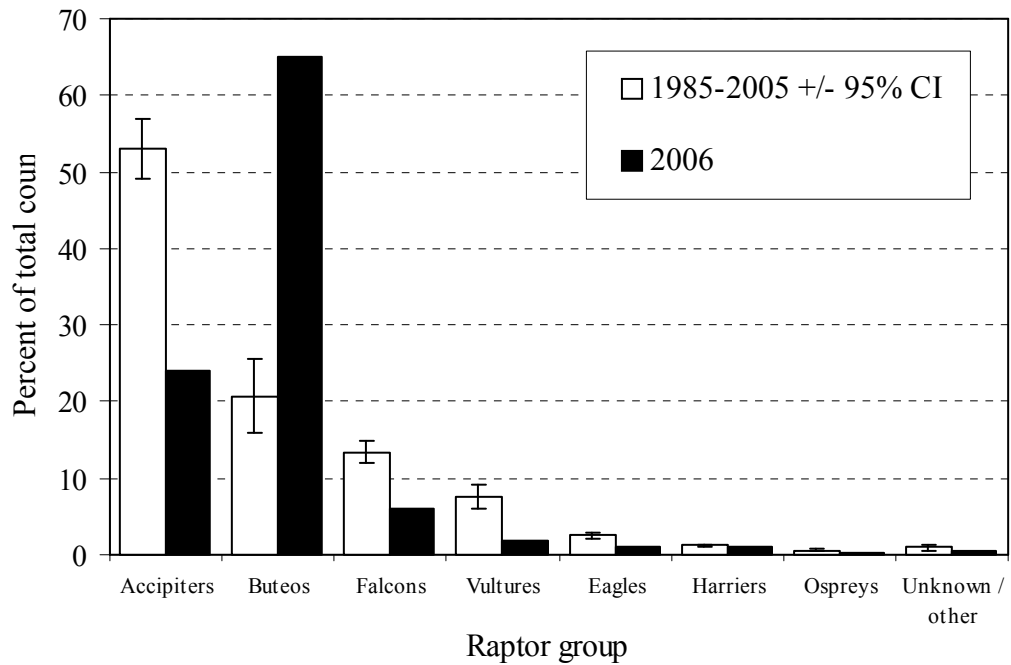


Figure 2. Fall raptor-migration flight composition by major species groups in the Manzano Mountains, NM: 1985–2005 versus 2006.

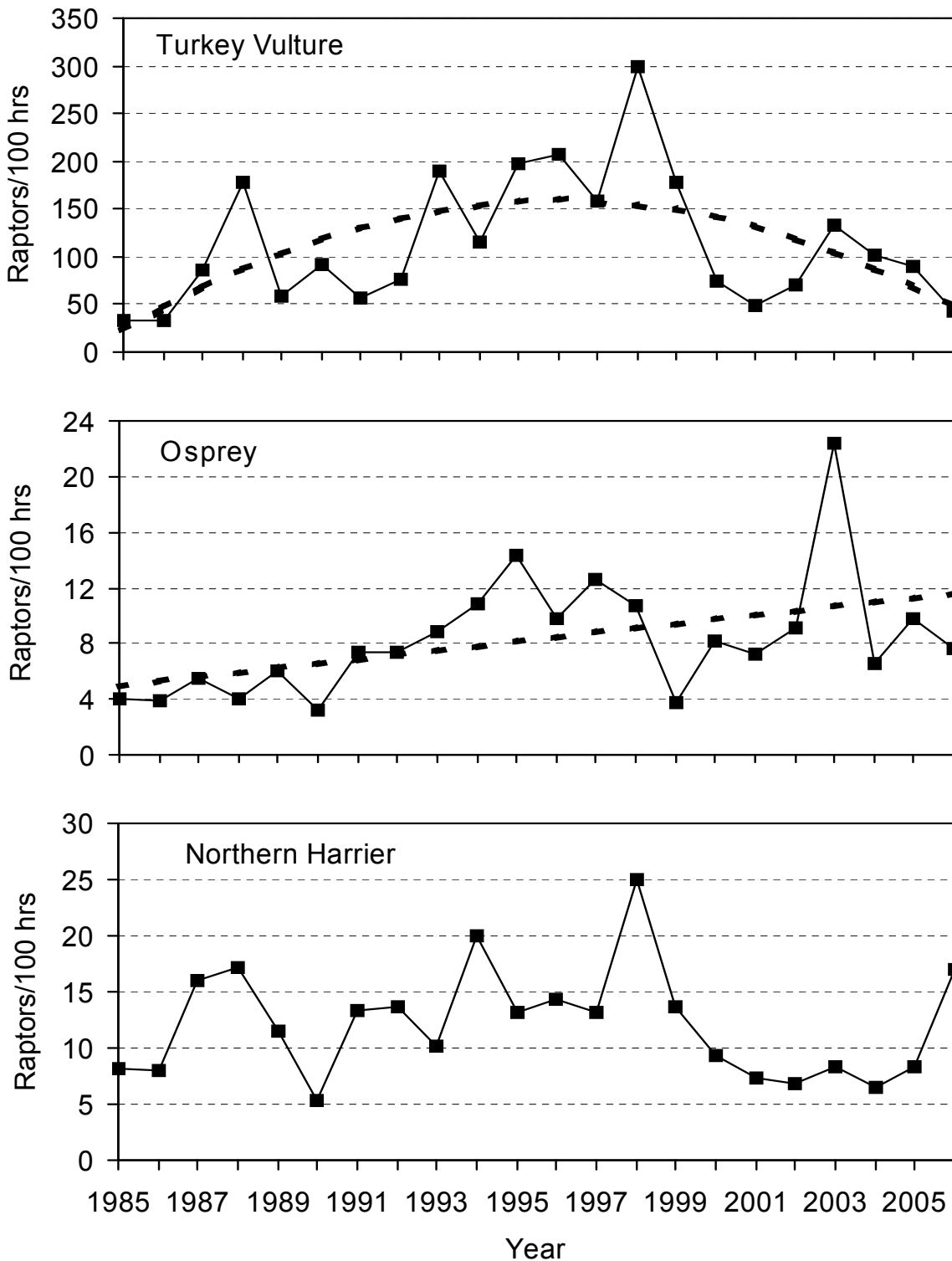


Figure 3. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) fall-migration passage rates for Turkey Vultures, Ospreys, and Northern Harriers in the Manzano Mountains, NM: 1985–2006. Dashed lines indicate significant ($P \leq 0.10$) regressions.

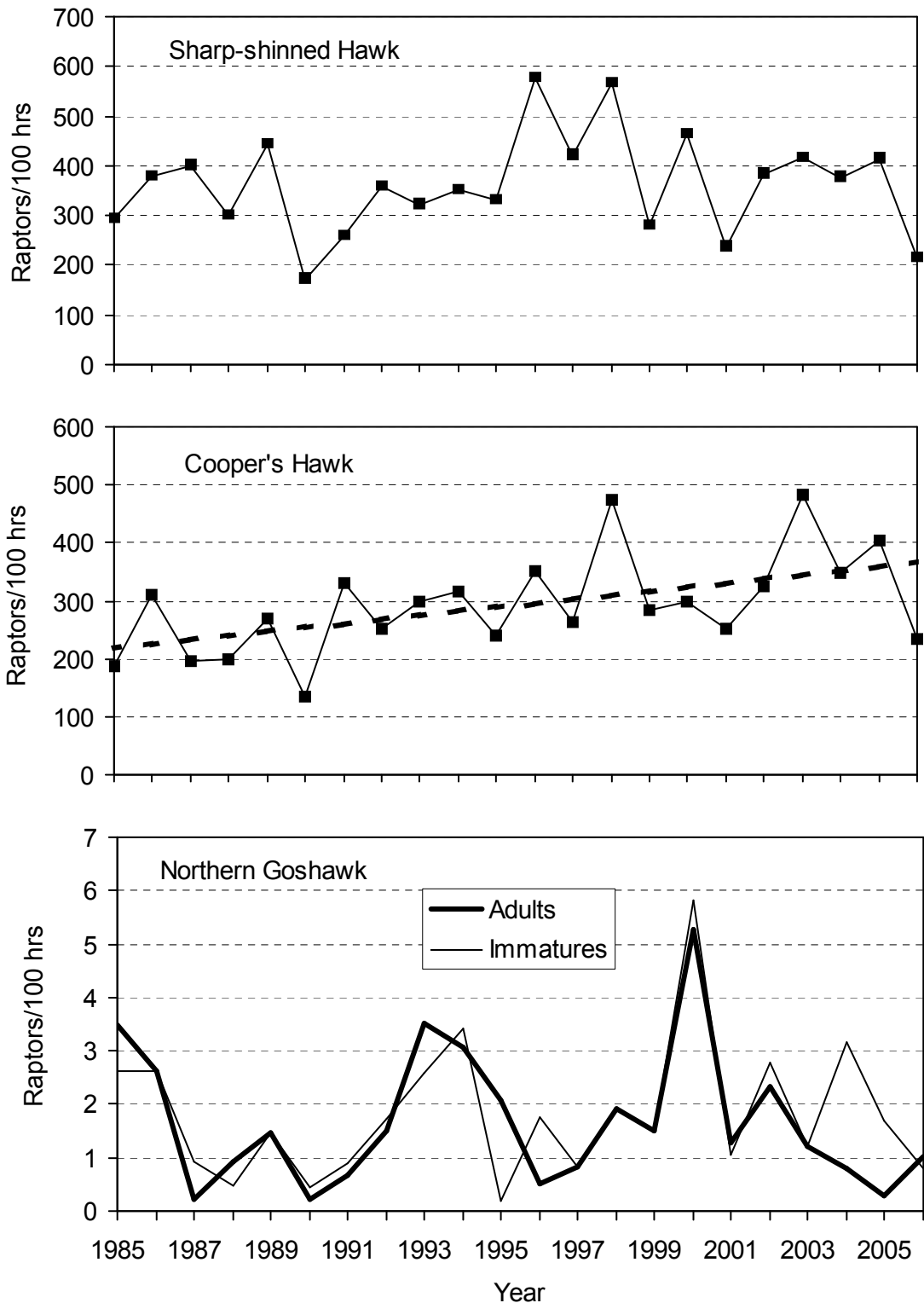


Figure 4. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) fall-migration passage rates for Sharp-shinned Hawks, Cooper's Hawks, and Northern Goshawks in the Manzano Mountains, NM: 1985–2006. Dashed lines indicate significant ($P \leq 0.10$) regressions.

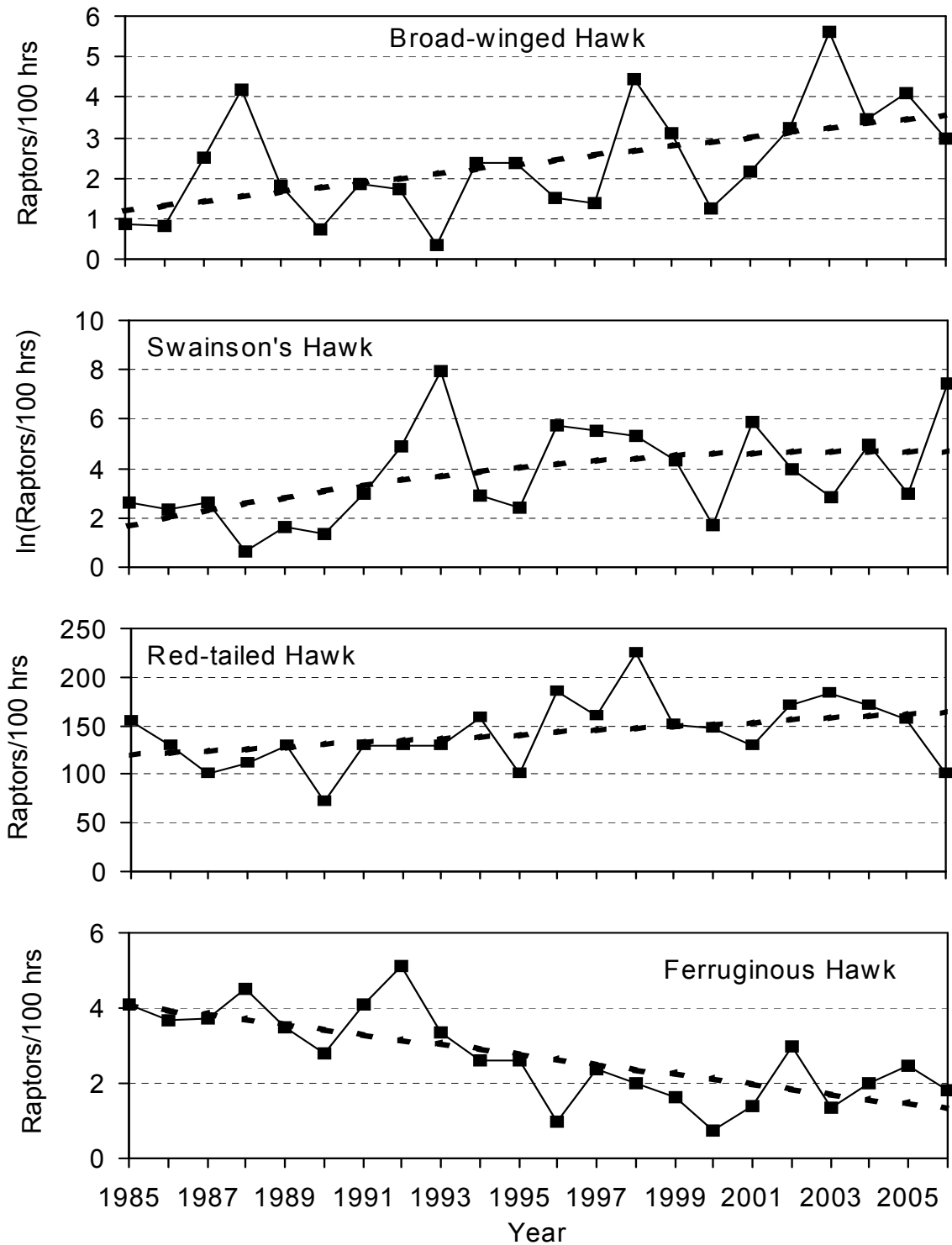


Figure 5. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) fall-migration passage rates for Broad-winged, Swainson's, Red-tailed and Ferruginous Hawks in the Manzano Mountains, NM: 1985–2006. Dashed lines indicate significant ($P \leq 0.10$) regressions.

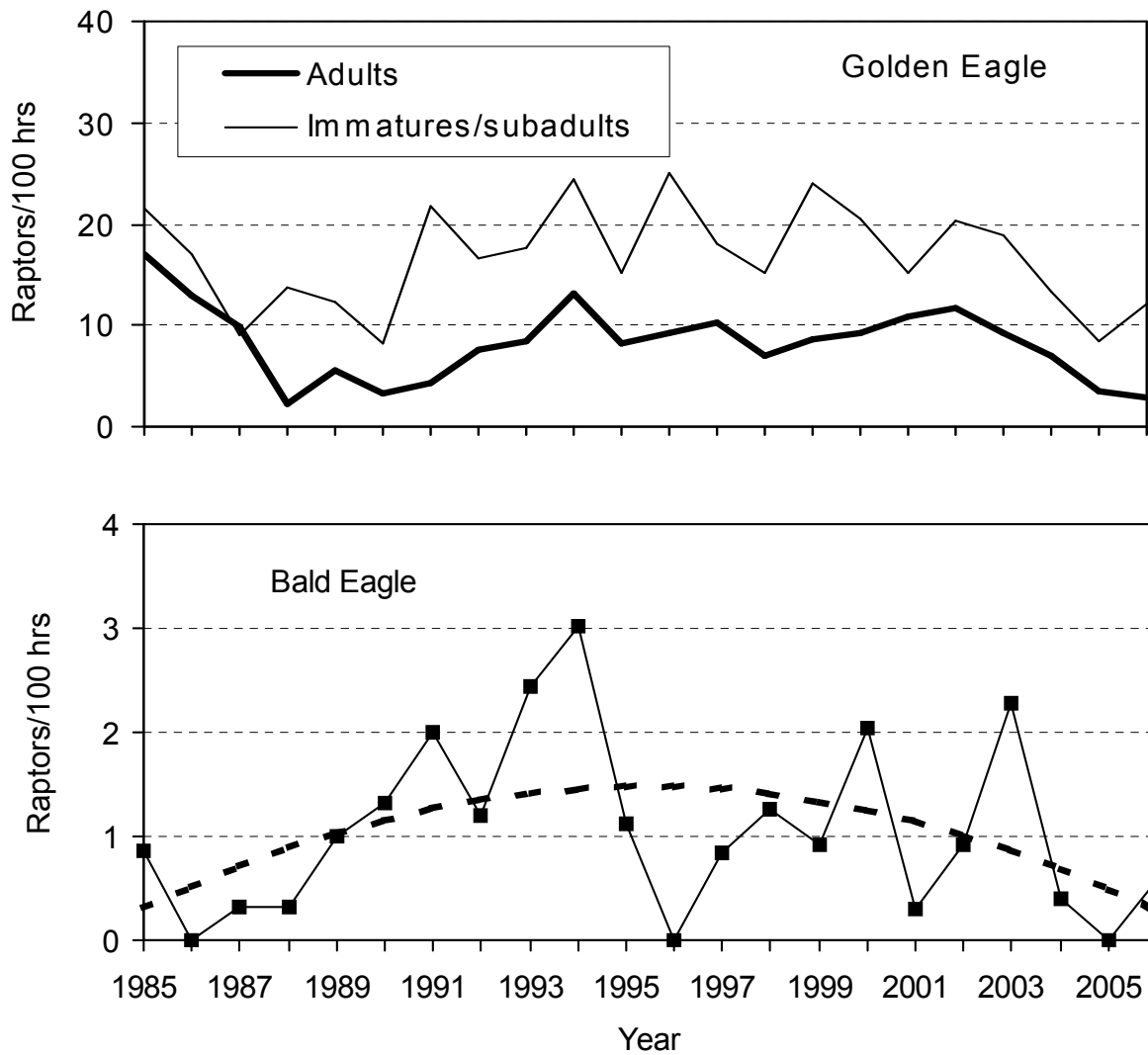


Figure 6. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) fall-migration passage rates for Golden and Bald Eagles in the Manzano Mountains, NM: 1985–2006. Dashed lines indicate significant ($P \leq 0.10$) regressions.

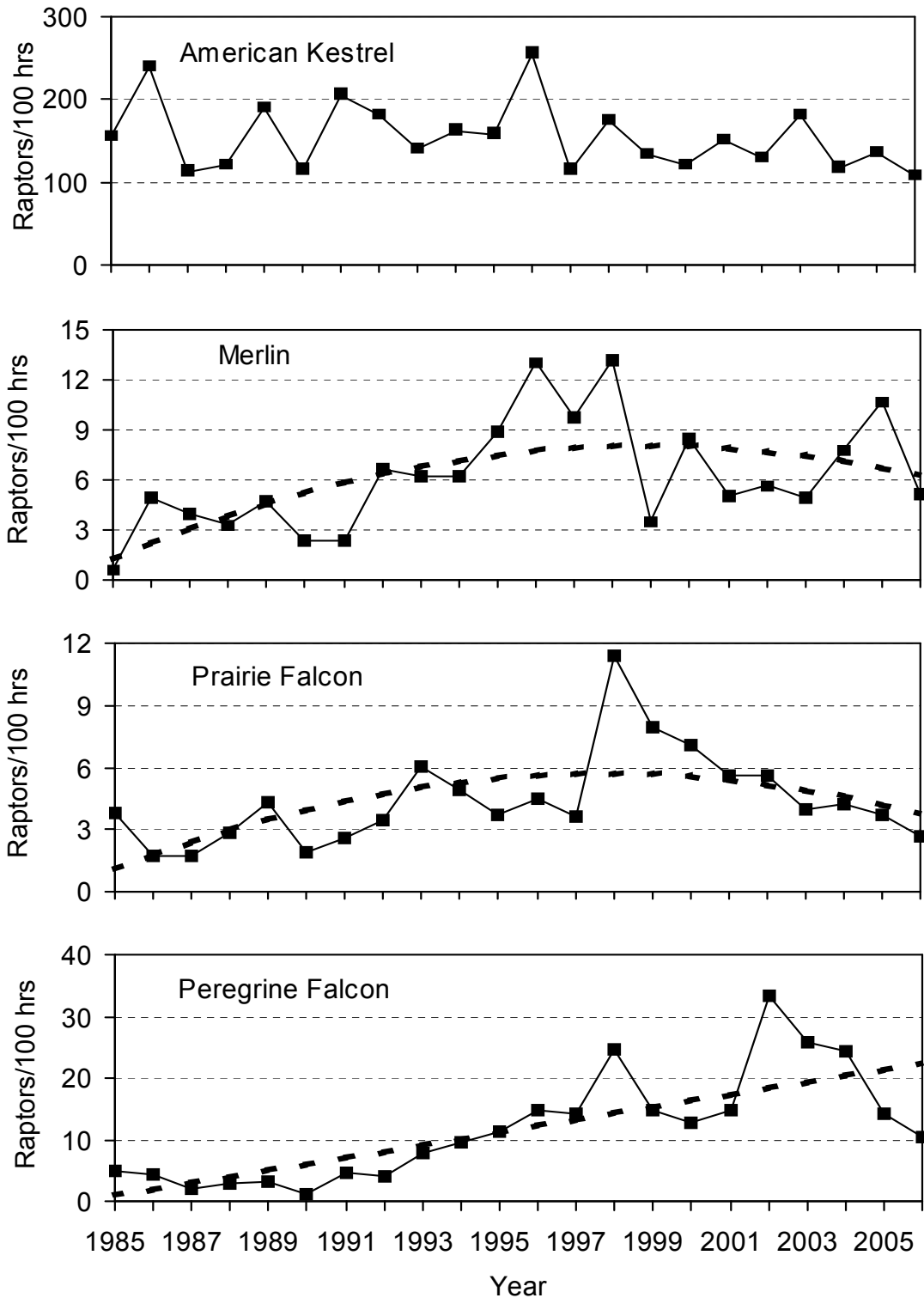


Figure 7. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) fall-migration passage rates for American Kestrels, Merlins, Prairie Falcons, and Peregrine Falcons: 1985–2006. Dashed lines indicate significant ($P \leq 0.10$) regressions.

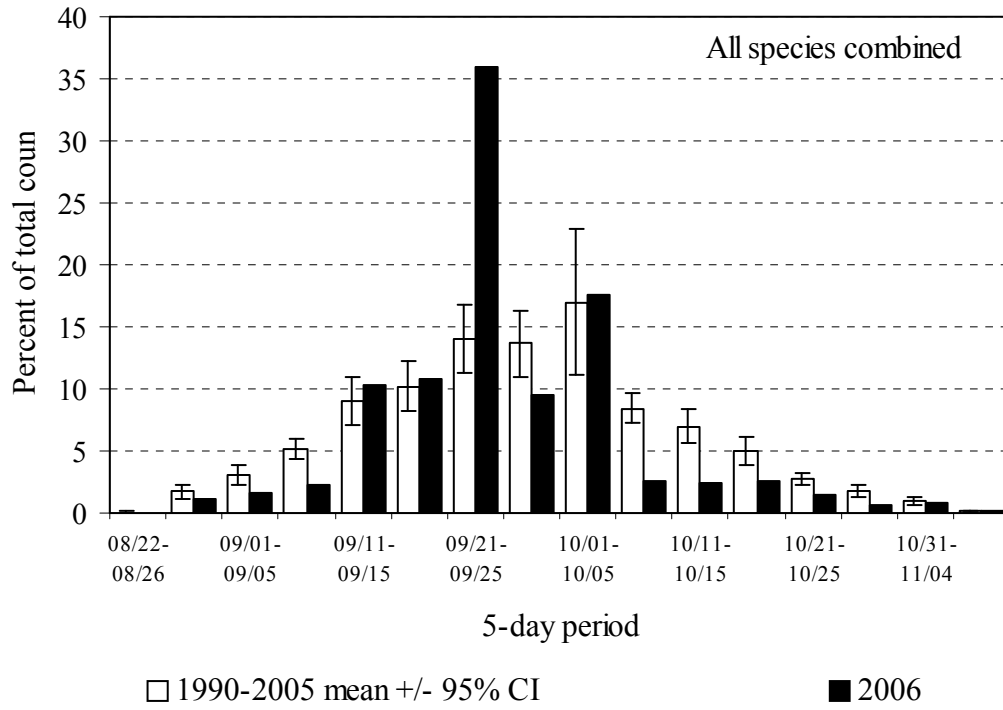


Figure 8. Combined-species, fall-migration passage volume by five-day periods for raptors in the Manzano Mountains, NM: 1985–2005 versus 2006.

Appendix A. History of official observer participation in the Manzano Mountains Raptor Migration Project: 1985–2006.

- 1985** Single observer throughout, shared duty: Gary Cress (0)¹, Jim Daly (1), Allen Hale (1)
- 1986** Single observer throughout: Jim Daly (2)
- 1987** Single observer throughout: Jim Daly (3)
- 1988** Single observer throughout: Gordon Vickrey (1)
- 1989** Two observers during peak 3/4 of the season, one observer otherwise: Brett Ewald (2), Tim Menard (0)
- 1990** Two observers during peak 3/4 of the season, one observer otherwise: David Curson (0), Gary Cress (1)
- 1991** Two observers throughout: Eric Meyer (1), Tylan Dean (0)
- 1992** Two observers throughout: Eric Meyer (3), Jessie Jewell (0)
- 1993** Two observers throughout: Jessie Jewell (2), John Haskell (0)
- 1994** Two observers throughout: Jessie Jewell (4), Jeff Ogburn (1)
- 1995** Two observers throughout: Jessie Jewell (6), Jeff Ogburn (2)
- 1996** Two observers throughout: Jessie Jewell (8), Sean O'Connor (3)
- 1997** Two observers throughout: Jeff Ogburn (4), Sean O'Connor (4)
- 1998** Two observers throughout: Dan Rossman (1), Lawry Sager (0)
- 1999** Two observers throughout: Jason Beason (4), Lawry Sager (1)
- 2000** Two observers throughout: Jorge Canaca (1), Laura Lutz (1)
- 2001** Two observers throughout: Tim Meehan (1), Carrie Hisaoka (0)
- 2002** Two observers throughout: Carrie Hisaoka (1), Richard Sim (0)
- 2003** Two observers throughout: Carrie Hisaoka (2), Tim Hanks (1)
- 2004** Two observers throughout: Paula Shannon (3), Frank Mayer (2)
- 2005** Two observers throughout: Tim Hanks (2), Geoff Gould (0)
- 2006** Two observers throughout: Tim Hanks (3), Greg Levandoski (3)

¹ Numbers in parentheses indicate previous full seasons of observation experience.

Appendix B. Common and scientific names, species codes, and regularly applied age, sex, and color-morph classifications for all diurnal raptor species observed during fall migration in the Manzano Mountains, NM.

COMMON NAME	SCIENTIFIC NAME	SPECIES CODE	AGE ¹	SEX ²	COLOR MORPH ³
Turkey Vulture	<i>Cathartes aura</i>	TV	U	U	NA
Osprey	<i>Pandion haliaetus</i>	OS	U	U	NA
Northern Harrier	<i>Circus cyaneus</i>	NH	A I Br U	M F U	NA
Sharp-shinned Hawk	<i>Accipiter striatus</i>	SS	A I U	U	NA
Cooper's Hawk	<i>Accipiter cooperii</i>	CH	A I U	U	NA
Northern Goshawk	<i>Accipiter gentilis</i>	NG	A I U	U	NA
Unknown small accipiter	<i>A. striatus</i> or <i>cooperii</i>	SA	U	U	NA
Unknown large accipiter	<i>A. cooperii</i> or <i>gentilis</i>	LA	U	U	NA
Unknown accipiter	<i>Accipiter</i> spp.	UA	U	U	NA
Broad-winged Hawk	<i>Buteo platypterus</i>	BW	A I U	U	D L U
Swanson's Hawk	<i>Buteo swainsoni</i>	SW	U	U	D L U
Red-tailed Hawk	<i>Buteo jamaicensis</i>	RT	A I U	U	D L U
Ferruginous Hawk	<i>Buteo regalis</i>	FH	A I U	U	D L U
Rough-legged Hawk	<i>Buteo lagopus</i>	RL	U	U	D L U
Zone-tailed Hawk	<i>Buteo albonotus</i>	ZT	A I U	U	NA
Unknown buteo	<i>Buteo</i> spp.	UB	U	U	D L U
Golden Eagle	<i>Aquila chrysaetos</i>	GE	I, S, NA, A, U ⁴	U	NA
Bald Eagle	<i>Haliaeetus leucocephalus</i>	BE	I, S1, S2, NA, A, U ⁵	U	NA
Unknown eagle	<i>Aquila</i> or <i>Haliaeetus</i> spp.	UE	U	U	NA
American Kestrel	<i>Falco sparverius</i>	AK	U	M F U	NA
Merlin	<i>Falco columbarius</i>	ML	AM Br	AM U	NA
Prairie Falcon	<i>Falco mexicanus</i>	PR	U	U	NA
Peregrine Falcon	<i>Falco peregrinus</i>	PG	A I U	U	NA
Unknown small falcon	<i>F. sparverius</i> or <i>columbarius</i>	SF	U	U	NA
Unknown large falcon	<i>F. mexicanus</i> or <i>peregrinus</i>	LF	U	U	NA
Unknown falcon	<i>Falco</i> spp.	UF	U	U	NA
Unknown raptor	Falconiformes	UU	U	U	NA

¹ Age codes: A = adult, I = immature (HY), Br = brown (adult female or immature), U = unknown age.

² Sex codes: M = male, F = female, U = unknown.

³ Color morph codes: D = dark or rufous, L = light, U – unknown, NA = not applicable.

⁴ Golden Eagle age codes: I = Immature: juvenile or first-year bird, bold white wing patch visible below, bold white in tail, no molt; S = Subadult: white wing patch variable or absent, obvious white in tail and molt or tawny bar visible on upper wing; NA = Not adult: unknown age immature/subadult; A = Adult: no white in wings or tail; U = Unknown.

⁵ Bald Eagle age codes: I = Immature: juvenile or first-year bird, dark breast and tawny belly; S1 = young Subadult: Basic I and II plumages, light belly, upside-down triangle on back; S2 = older Subadult: Basic III plumage, head mostly white with osprey-like dark eye line and dark band on tail; NA = Not adult: unknown age immature/subadult; A = Adult: includes near adult with dark flecks in head and dark tail tip, and adult with white head and tail; U = Unknown.

Appendix C. Daily observation effort, visitor disturbance ratings, weather records, and flight summaries for the Manzano Mountains Raptor Migration Project: 2006.

DATE	OBS. HOURS	OBSVR / HOUR ¹	MEDIAN	PREDOMINANT WEATHER ³	WIND	WIND DIRECTION	TEMP (°C) ¹	BAROM.	MEDIAN	VISIB.	VISIB.	MEDIAN	BIRDS / HOUR
			VISITOR		SPEED (KPH) ¹			PRESS. (IN HG) ¹	THERMAL LIFT ⁴	WEST (KM) ¹	EAST (KM) ¹	FLIGHT DISTANCE ⁵	
27-Aug	8.25	2.0	0	clr, am haze	8.0	w	20.7	30.26	2	100	100	1	2.3
28-Aug	8.00	2.7	0	pc, haze	6.5	var	20.4	30.34	2	68	68	2	2.0
29-Aug	8.00	2.0	0	pc-mc, haze	8.1	sw	19.9	30.35	2	86	75	1.5	2.0
30-Aug	8.25	1.0	0	clr-mc, haze	7.6	sw	20.0	30.26	2	100	90	2	2.1
31-Aug	5.00	1.7	0	pc-mc, haze/scat ts	2.9	var	19.3	30.27	2	64	78	3.5	5.0
1-Sep	8.25	1.9	0	mc-ovc	3.3	calm, ne, s	18.6	30.30	3	94	90	2	1.2
2-Sep	0.00			weather day									
3-Sep	0.00			weather day									
4-Sep	8.33	2.6	0	mc-ovc, AM fog	3.7	ene, ese	15.4	30.35	3	70	86	1	4.2
5-Sep	9.00	2.8	0	clr-pc, AM haze	4.7	calm, sw	17.9	30.44	1	100	100	1.5	10.1
6-Sep	8.50	1.8	0	clr-ovc, scat rain	12.2	sw	17.9	30.34	3	98	97	1	3.4
7-Sep	8.33	1.9	0	ovc, haze/scat rain	10.4	sw	17.0	30.19	3	100	64	2	2.5
8-Sep	6.00	1.6	0	ovc, fog	13.3	ssw	15.0	30.10	4	7	24	1	1.3
9-Sep	7.00	3.4	0	pc-ovc, scat fog/rain	7.6	wsw	16.5	30.18	3	98	67	1	4.3
10-Sep	9.00	3.1	1	clr	7.4	sw	17.9	30.21	2	97	100	1	10.0
11-Sep	9.00	2.0	0	pc-ovc, haze	2.8	calm, s, sw	18.2	30.30	2	62	76	1.5	9.3
12-Sep	8.25	1.8	0	pc-ovc, AM fog/haze	4.3	sw	19.3	30.34	2	87	94	1	9.8
13-Sep	10.00	2.0	0	mc-ovc, fog/haze	9.1	s, sw	19.2	30.23	3	81	74	1	13.5
14-Sep	9.75	2.5	0	pc-ovc, PM rain	21.8	s, sw	15.1	30.02	3	91	81	1	19.8
15-Sep	10.25	3.0	0	pc-ovc	20.3	s, sw	16.4	30.01	3	100	96	1	33.6
16-Sep	9.75	2.6	1	clr	22.8	sw	16.0	30.03	3	100	100	2	37.9
17-Sep	9.50	2.7	0	clr	10.5	sw	12.5	30.07	3	100	100	1	7.1
18-Sep	9.25	2.8	0	clr	6.6	sw	12.5	30.17	2	100	100	1.5	2.9
19-Sep	9.75	2.6	1	clr	14.1	sw	16.9	30.26	3	100	100	1	22.5
20-Sep	8.00	2.4	0	pc-ovc	28.0	s, sw	12.5	30.00	4	85	91	1	24.6
21-Sep	9.25	3.0	0	clr-pc	34.1	sw, w	8.6	29.76	4	100	100	2	13.3
22-Sep	9.00	2.7	0	pc-ovc, haze	28.2	sw	10.8	29.74	4	71	63	1	3.8
23-Sep	8.75	1.9	1	ovc	5.8	sw, w	9.7	30.09	4	100	100	1	2.5
24-Sep	9.75	2.5	1	clr-pc	2.7	w	12.6	30.32	2	94	100	2	125.0
25-Sep	10.00	3.8	0	clr-pc, AM haze	5.5	s, sw, w	13.9	30.36	2	100	95	1	152.5
26-Sep	9.00	2.3	0	clr-mc, AM haze	11.0	ssw, sw	15.3	30.36	3	100	100	1	34.9
27-Sep	9.25	3.0	1.5	clr-mc	8.9	w, nw	17.2	30.33	2	100	100	1	10.1
28-Sep	9.75	2.5	1.5	clr, haze	8.7	sw, w	14.3	30.33	2	93	100	1	15.2
29-Sep	9.75	2.2	0	pc	14.2	w	15.3	30.24	3	100	100	1	10.7
30-Sep	9.75	3.3	3	clr-pc	11.5	sw, w	17.5	30.26	2	100	100	1	11.8
1-Oct	9.50	2.9	3	pc-mc, haze	8.5	sw	18.4	30.28	2	100	100	1.5	17.3
2-Oct	9.00	1.7	1	pc-mc, haze	11.7	ssw, sw	20.3	30.33	2	100	94	1	10.1
3-Oct	9.50	1.9	0	pc-ovc, pm haze	13.5	sw	17.7	30.34	3	100	96	1	30.5
4-Oct	8.50	2.0	0	clr-pc	14.7	e, se	16.4	30.43	3	100	96	2	50.5
5-Oct	9.50	1.9	1.5	mc-ovc, AM haze	6.8	se, s	18.1	30.40	2	83	80	2	47.2
6-Oct	9.25	2.0	1	mc-ovc, haze	9.2	s	16.6	30.32	4	92	92	1.5	12.4
7-Oct	8.00	2.6	3	mc-ovc, pm rain/scat ts	15.2	s, sw	13.3	30.23	4	91	91	1	8.6
8-Oct	7.50	2.8	1	ovc, fog	1.7	var	14.2	30.20	4	8	17	1	1.1
9-Oct	0.00			weather day									
10-Oct	8.67	2.3	0	pc-mc, scat fog	17.1	sw, w	6.6	30.06	4	75	100	1	2.8
11-Oct	9.00	1.6	1.5	clr-pc	28.4	wnw	8.5	30.06	4	100	100	1	4.7
12-Oct	9.25	2.3	0	clr, haze	17.1	w	9.0	30.06	3	100	100	1	6.2
13-Oct	9.25	2.0	1	clr-pc	12.5	w	12.4	30.09	2	100	100	1	5.4
14-Oct	8.75	2.4	0	ovc, pm fog/rain	13.0	sse, ssw	12.0	30.00	4	56	70	1.5	1.7
15-Oct	7.50	2.1	0	pc-ovc, rain/snow/scat ts	8.3	var	8.3	29.76	4	48	47	1.5	3.7
16-Oct	5.00	2.4	0	clr-pc, am fog	28.7	w	9.7	29.66	4	100	100	1	9.0
17-Oct	9.25	2.3	0	clr-ovc	34.3	sw	9.7	29.73	4	100	100	1	6.8
18-Oct	8.50	1.7	0	pc-ovc, PM snow	8.9	sw, w	5.3	29.93	4	93	94	1	3.9

Appendix C. continued

DATE	OBS. HOURS	MEDIAN		PREDOMINANT WEATHER ³	WIND		TEMP (°C) ¹	BAROM. PRESS. (IN HG) ¹	MEDIAN THERMAL LIFT ⁴	VISIB. WEST (KM) ¹	VISIB. EAST (KM) ¹	MEDIAN FLIGHT DISTANCE ⁵ / HOUR	BIRDS / HOUR
		OBSRVR / HOUR ¹	VISITOR DISTURB ²		SPEED (KPH) ¹	WIND DIRECTION							
19-Oct	8.50	1.9	0	clr, haze	16.8	w	3.8	30.03	4	100	100	1	4.8
20-Oct	9.00	2.2	0	clr	20.6	w	7.3	29.88	3	100	100	1	3.6
21-Oct	9.00	2.5	1	clr	11.6	wnw	6.5	30.05	2	100	100	1	6.3
22-Oct	8.25	2.9	1	clr	13.3	sw	7.3	30.19	2	100	100	1	3.6
23-Oct	8.25	1.9	0	clr-pc	10.3	sw	11.1	30.25	2	100	100	1	1.7
24-Oct	8.33	1.9	0	ovc, PM rain	8.8	s, sw	10.3	30.07	4	98	90	1	0.5
25-Oct	4.50	1.3	0	mc	31.2	sw	10.4	29.91	4	100	98	2	3.8
26-Oct	7.00	2.0	0	pc-ovc, AM dust	32.1	nw	-0.2	29.92	4	100	100	2	2.0
27-Oct	7.50	2.0	0	clr	4.6	nw	8.0	30.35	2	100	100	1	0.5
28-Oct	6.00	1.0	0	clr	5.0	sw	10.6	30.35	2	100	100	3	0.3
29-Oct	6.50	1.0	0	ovc	19.3	sw	11.7	30.02	3	100	100	1.5	1.2
30-Oct	7.00	1.8	0	clr-pc, haze	25.8	w	7.5	29.90	4	100	100	1	3.1
31-Oct	7.50	1.9	0	pc, haze	23.9	sw	8.1	29.96	4	98	89	1	3.1
1-Nov	7.75	1.9	0	clr-pc, haze	8.9	w	6.6	30.13	2	100	85	2	2.6
2-Nov	7.00	1.9	0	pc, haze	8.4	ssw, w	7.8	30.23	2	100	95	1	1.0
3-Nov	7.50	1.9	0	pc	18.9	sw, w	10.4	30.15	3	100	100	1	1.5
4-Nov	7.00	2.3	0	clr-pc	15.3	sw	11.1	30.11	3	100	100	1	1.1
5-Nov	4.25	2.0	0	pc	11.2	w	8.0	30.13	2	100	100	1	3.1

¹ Average of hourly records.

² Median hourly visitor-disturbance rating (subjective assessment by observers): 0 = none, 1 = low, 2 = moderate, 3 = high.

³ Predominant sky condition during day: clr = clear (0–15% cloud cover); pc = partly cloudy (16–50% cover); mc = mostly cloudy (51–75% cover); ovc = overcast (76–100% cover); ts = thunderstorms.

⁴ Median hourly rating concerning prevalence of lift-generating thermals, based on subjective assessments of solar intensity, wind speeds, and migrant behavior: 1 = excellent, 2 = good, 3 = fair, 4 = poor.

⁵ Median hourly rating concerning line-of-sight distance of flight from observation site: 1 = close, detection and identification possible with naked eye; 2 = moderate, detection possible with naked eye, but binoculars needed for identification; 3 = far, binoculars needed for both detection and identification; 4 = distant, birds detected and identified only with excellent binoculars or spotting scope and by experienced observers.

Appendix D. Daily observation effort and fall raptor migration counts by species in the Manzano Mountains, NM: 2006.

DATE	HOURS	SPECIES ¹																								BIRDS				
		TV	OS	NH	SS	CH	NG	SA	LA	UA	BW	SW	RT	FH	RL	ZT	UB	GE	BE	UE	AK	ML	PR	PG	SF	LF	UF	UU	TOTAL	/HOUR
27-Aug	8.25	0	0	1	0	2	1	0	0	0	0	0	6	0	0	0	1	0	0	0	8	0	0	0	0	0	0	0	19	2.3
28-Aug	8.00	0	1	0	5	4	0	2	0	1	0	0	1	0	0	0	0	1	0	0	1	0	0	0	0	0	0	16	2.0	
29-Aug	8.00	0	0	1	1	2	0	0	0	0	0	11	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	16	2.0	
30-Aug	8.25	1	0	0	0	4	0	1	0	0	0	1	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	2.1	
31-Aug	5.00	0	0	0	1	0	0	0	0	0	0	19	4	0	0	0	0	0	0	0	1	0	0	0	0	0	0	25	5.0	
1-Sep	8.25	3	1	0	1	3	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	1.2	
2-Sep	0.00																													
3-Sep	0.00																													
4-Sep	8.33	2	3	0	10	10	0	0	0	0	0	4	3	0	0	0	1	0	0	0	2	0	0	0	0	0	0	35	4.2	
5-Sep	9.00	2	0	3	17	30	0	3	0	0	0	20	3	0	0	0	1	0	0	0	8	0	0	0	0	0	4	91	10.1	
6-Sep	8.50	0	0	0	6	8	0	0	0	0	0	1	3	0	0	0	0	0	0	0	11	0	0	0	0	0	0	29	3.4	
7-Sep	8.33	1	0	0	9	7	0	0	0	0	0	0	3	0	0	0	0	0	0	0	1	0	0	0	0	0	0	21	2.5	
8-Sep	6.00	0	0	0	5	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	8	1.3	
9-Sep	7.00	0	1	2	3	3	0	1	0	0	0	8	2	0	0	0	0	0	0	0	9	0	0	1	0	0	0	30	4.3	
10-Sep	9.00	1	0	0	17	18	0	1	0	0	0	27	8	0	0	0	1	2	0	0	12	0	0	2	0	0	1	90	10.0	
11-Sep	9.00	1	3	0	37	17	0	7	0	0	0	1	9	0	0	0	0	0	0	2	0	0	3	0	2	0	2	84	9.3	
12-Sep	8.25	0	0	0	34	22	0	3	0	0	0	7	9	0	0	0	0	0	0	5	0	0	1	0	0	0	0	81	9.8	
13-Sep	10.00	0	2	0	17	14	0	0	1	0	0	78	3	1	0	0	1	0	0	0	16	0	0	1	0	0	1	135	13.5	
14-Sep	9.75	2	1	0	28	35	0	6	0	0	0	89	7	0	0	0	1	0	0	0	20	0	1	2	0	0	1	193	19.8	
15-Sep	10.25	0	1	0	60	63	0	5	0	0	0	150	18	0	0	0	4	1	0	0	39	0	0	3	0	0	0	344	33.6	
16-Sep	9.75	1	1	3	44	51	1	9	0	0	0	174	15	0	0	0	0	0	0	62	1	2	4	0	0	0	2	370	37.9	
17-Sep	9.50	0	1	2	22	15	0	3	0	0	0	7	6	0	0	0	1	0	0	0	6	1	0	1	0	0	0	2	67	7.1
18-Sep	9.25	0	0	1	2	9	0	1	0	0	0	8	4	0	0	0	0	0	0	2	0	0	0	0	0	0	0	27	2.9	
19-Sep	9.75	3	0	2	27	32	0	3	0	0	0	125	14	0	0	0	2	1	0	0	4	1	0	4	0	0	0	1	219	22.5
20-Sep	8.00	0	3	1	14	25	0	1	0	0	0	135	8	0	0	0	0	0	0	9	0	1	0	0	0	0	0	197	24.6	
21-Sep	9.25	11	1	1	24	30	0	12	0	0	0	11	6	0	0	0	0	1	0	0	18	1	0	4	0	0	1	2	123	13.3
22-Sep	9.00	0	0	0	9	16	0	1	0	1	0	6	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	34	3.8	
23-Sep	8.75	1	0	1	2	3	0	0	0	0	1	12	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	22	2.5	
24-Sep	9.75	6	2	4	39	103	0	7	0	4	1	1023	21	0	0	0	2	0	0	1	1	1	0	1	0	0	3	1219	125.0	
25-Sep	10.00	24	0	3	12	19	0	1	0	0	1	1439	17	0	0	0	0	0	0	2	2	0	3	0	1	0	1	1525	152.5	
26-Sep	9.00	27	1	3	17	20	0	2	0	0	0	212	18	0	0	0	0	3	0	0	9	0	0	2	0	0	0	314	34.9	
27-Sep	9.25	16	1	0	29	18	0	5	0	0	0	0	6	0	0	0	0	1	0	0	16	0	0	1	0	0	0	93	10.1	
28-Sep	9.75	8	0	1	27	25	0	1	0	0	2	40	14	0	0	0	0	0	0	27	0	1	1	0	0	0	1	148	15.2	
29-Sep	9.75	2	0	1	22	21	0	7	0	0	1	0	10	0	0	0	0	0	0	38	0	1	0	0	0	0	1	104	10.7	
30-Sep	9.75	1	0	2	33	20	0	6	0	0	0	0	18	1	0	0	1	3	0	0	26	1	0	2	0	0	1	115	11.8	
1-Oct	9.50	3	0	1	21	19	0	3	0	0	1	96	12	0	0	0	0	3	0	0	3	1	0	1	0	0	0	164	17.3	
2-Oct	9.00	2	0	4	24	20	0	2	0	0	0	19	14	1	0	0	1	1	0	0	3	0	0	0	0	0	0	91	10.1	
3-Oct	9.50	4	0	1	18	13	0	0	0	0	0	225	17	0	0	0	0	1	0	0	10	1	0	0	0	0	0	290	30.5	

Appendix D. continued

DATE	HOURS	SPECIES ¹																									BIRDS			
		TV	OS	NH	SS	CH	NG	SA	LA	UA	BW	SW	RT	FH	RL	ZT	UB	GE	BE	UE	AK	ML	PR	PG	SF	LF	UF	UU	TOTAL	/HOUR
4-Oct	8.50	1	0	1	30	23	0	6	0	0	0	355	9	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	429	50.5
5-Oct	9.50	1	0	4	56	37	0	3	0	0	2	325	14	0	0	0	0	0	0	4	0	0	1	0	0	0	1	448	47.2	
6-Oct	9.25	3	3	0	20	13	1	4	0	0	0	65	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	115	12.4	
7-Oct	8.00	18	0	1	22	14	0	0	1	0	0	1	5	3	0	0	0	1	0	0	2	0	1	0	0	0	0	69	8.6	
8-Oct	7.50	0	0	0	4	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	3	0	0	0	0	0	0	8	1.1	
9-Oct	0.00																													
10-Oct	8.67	0	0	4	5	5	0	1	0	0	0	0	5	0	0	0	0	0	0	2	0	0	1	0	0	0	1	24	2.8	
11-Oct	9.00	0	1	1	8	10	0	0	0	0	0	0	10	0	0	0	0	0	0	9	2	0	0	0	0	0	1	42	4.7	
12-Oct	9.25	4	1	4	14	13	1	1	0	0	0	0	6	0	0	0	2	2	0	0	5	1	1	1	0	0	0	1	57	6.2
13-Oct	9.25	0	1	5	18	3	0	2	0	0	0	0	11	0	0	0	0	3	0	0	5	1	1	0	0	0	0	50	5.4	
14-Oct	8.75	0	0	0	4	1	0	0	0	0	0	0	5	0	0	0	1	2	0	0	1	0	0	0	0	0	1	15	1.7	
15-Oct	7.50	0	0	0	8	10	1	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28	3.7	
16-Oct	5.00	1	0	3	7	7	0	3	0	0	0	0	17	0	0	0	0	3	0	0	3	1	0	0	0	0	0	45	9.0	
17-Oct	9.25	0	0	1	22	10	0	2	0	0	0	0	23	0	0	0	0	0	0	1	1	1	0	1	0	0	1	63	6.8	
18-Oct	8.50	0	0	5	14	2	0	0	0	0	0	0	7	0	0	0	0	3	0	0	0	0	1	1	0	0	0	33	3.9	
19-Oct	8.50	0	1	5	15	1	0	0	0	0	0	0	14	0	0	0	0	4	0	0	0	1	0	0	0	0	0	41	4.8	
20-Oct	9.00	0	0	1	14	2	0	0	0	0	0	0	11	0	0	0	0	2	0	0	1	0	1	0	0	0	0	32	3.6	
21-Oct	9.00	0	0	4	17	4	1	0	0	0	0	0	20	2	0	0	0	7	0	0	0	1	1	0	0	0	0	57	6.3	
22-Oct	8.25	0	0	3	9	1	0	0	0	0	0	0	4	0	0	0	0	7	0	0	2	3	0	1	0	0	0	30	3.6	
23-Oct	8.25	0	0	3	6	1	1	0	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	14	1.7	
24-Oct	8.33	0	0	1	1	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0.5	
25-Oct	4.50	0	0	0	3	1	0	1	0	0	0	0	10	0	0	0	0	2	0	0	0	0	0	0	0	0	0	17	3.8	
26-Oct	7.00	0	0	0	0	1	0	0	0	0	0	0	9	0	0	0	0	2	0	0	0	0	0	0	0	0	2	14	2.0	
27-Oct	7.50	0	0	0	2	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	4	0.5	
28-Oct	6.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	0.3	
29-Oct	6.50	0	0	0	2	0	0	0	0	0	0	0	3	0	0	0	0	3	0	0	0	0	0	0	0	0	0	8	1.2	
30-Oct	7.00	0	0	2	4	2	0	1	0	0	0	0	11	0	0	0	0	0	0	0	1	0	0	1	0	0	0	22	3.1	
31-Oct	7.50	0	0	2	7	0	1	0	0	0	0	0	7	0	0	0	0	6	0	0	0	0	0	0	0	0	0	23	3.1	
1-Nov	7.75	0	0	1	4	0	2	1	0	0	0	0	9	0	0	0	0	3	0	0	0	0	0	0	0	0	0	20	2.6	
2-Nov	7.00	0	0	1	1	1	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	7	1.0	
3-Nov	7.50	0	0	0	3	0	0	0	0	0	0	0	5	0	0	0	1	1	0	0	0	1	0	0	0	0	0	11	1.5	
4-Nov	7.00	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	3	0	0	0	0	0	0	0	0	0	8	1.1	
5-Nov	4.25	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	8	2	0	0	1	0	0	0	0	0	13	3.1	
Total	566.41	150	30	90	958	865	10	119	2	6	9	4695	534	9	0	0	23	87	3	1	412	23	13	43	1	3	1	32	8119	14.3

¹ See Appendix B for explanation of species codes.

Appendix E. Annual observation effort and fall raptor migration counts by species (unadjusted data) in the Manzano Mountains, NM: 1985–2006.

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Start date	6-Sep	23-Aug	25-Aug	30-Aug	28-Aug	27-Aug	27-Aug	25-Aug	25-Aug	25-Aug	27-Aug	27-Aug
End date	2-Nov	31-Oct	4-Nov	31-Oct	31-Oct	31-Oct	5-Nov	5-Nov	5-Nov	2-Nov	8-Nov	5-Nov
Days of observation	50	63	65	60	63	62	67	70	68	66	70	59
Hours of observation	343.33	464.50	517.92	453.08	489.75	510.75	524.58	537.25	489.67	508.75	560.00	461.67
Raptors / 100 hours	843.2	863.9	758.6	772.3	955.4	494.6	825.6	946.3	2429.2	966.5	832.9	1545.9
SPECIES	RAPTOR COUNTS											
Turkey Vulture	74	118	283	466	178	295	176	268	601	430	636	640
Osprey	10	14	19	13	22	12	24	26	31	38	53	33
Northern Harrier	28	36	78	78	59	27	66	69	48	97	72	64
Sharp-shinned Hawk	956	1300	1622	1118	1834	688	1080	1540	1193	1415	1519	2174
Cooper's Hawk	531	881	679	604	929	471	1105	961	944	1054	907	1205
Northern Goshawk	21	20	7	6	14	3	8	16	27	30	11	9
Unknown small accipiter ¹	-	-	-	-	-	-	-	-	-	-	-	-
Unknown large accipiter ¹	-	-	-	-	-	-	-	-	-	-	-	-
Unknown accipiter	78	104	119	111	121	120	156	117	266	118	44	147
TOTAL ACCIPITERS	1586	2305	2427	1839	2898	1282	2349	2634	2430	2617	2481	3535
Broad-winged Hawk	2	2	7	10	5	2	5	5	1	7	7	4
Swainson's Hawk	27	33	44	3	16	9	58	344	7301	67	32	867
Red-tailed Hawk	513	527	457	486	604	329	577	667	566	707	519	771
Ferruginous Hawk	14	15	17	20	16	13	19	25	17	13	13	4
Rough-legged Hawk	0	0	0	1	1	0	0	0	0	0	0	0
Zone-tailed Hawk	0	0	0	0	0	0	0	2	0	1	1	0
Unknown buteo	21	12	11	16	4	19	30	11	31	22	9	11
TOTAL BUTEOS	577	589	536	536	646	372	689	1054	7916	817	581	1657
Golden Eagle	133	123	86	67	85	52	124	119	120	172	136	151
Bald Eagle	2	0	1	1	3	4	7	4	7	9	4	0
Unknown Eagle	0	0	0	4	0	4	0	0	0	0	0	0
TOTAL EAGLES	135	123	87	72	88	60	131	123	127	181	140	151
American Kestrel	421	755	426	385	677	409	728	704	520	582	584	905
Merlin	2	16	17	12	18	9	10	28	24	24	42	48
Prairie Falcon	13	7	8	12	19	9	14	17	27	22	18	19
Peregrine Falcon	14	15	7	10	15	5	21	18	31	37	49	60
Unknown small falcon ¹	-	-	-	-	-	-	-	-	-	-	-	-
Unknown large falcon ¹	-	-	-	-	-	-	-	-	-	-	-	-
Unknown falcon	4	0	1	0	3	5	3	1	0	1	0	1
TOTAL FALCONS	454	793	459	419	732	437	776	768	602	666	693	1033
Unknown raptor	31	35	40	76	56	41	120	142	140	71	8	24
TOTAL	2895	4013	3929	3499	4679	2526	4331	5084	11895	4917	4664	7137

¹ New designations used for the first time in 2001.

Appendix E. continued

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Mean
Start date	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug	28-Aug	27- Aug	27- Aug	26-Aug
End date	5-Nov	5-Nov	5-Nov	2-Nov	4-Nov	3-Nov	5-Nov	30-Oct	5-Nov	5- Nov	2-Nov
Days of observation	68	65	70	57	68	65	69	57	69	68	64
Hours of observation	565.08	559.58	553.77	434.33	545.47	518.50	577.25	424.08	599.58	566.41	501.97
Raptors / 100 hours	1044.8	1594.2	873.1	991.6	855.8	972.0	1126.4	1039.9	937.8		
SPECIES	RAPTOR COUNTS										
Turkey Vulture	563	1116	637	241	164	239	468	289	363	150	396
Osprey	47	44	14	25	26	32	86	20	35	30	30
Northern Harrier	69	133	69	38	37	33	50	27	46	90	58
Sharp-shinned Hawk	1872	2585	1212	1698	1032	1524	1861	1268	1842	958	1489
Cooper's Hawk	1018	2025	1069	984	913	1149	1758	964	1486	865	1029
Northern Goshawk	9	19	14	42	13	23	12	15	10	10	16
Unknown small accipiter ¹	-	-	-	-	86	188	205	169	129	119	155
Unknown large accipiter ¹	-	-	-	-	0	3	5	4	5	2	3
Unknown accipiter	76	107	51	29	0	11	5	28	1	6	86
TOTAL ACCIPITERS	2975	4736	2346	2753	2044	2898	3846	2448	3473	1960	2657
Broad-winged Hawk	5	14	12	3	6	9	16	6	13	9	7
Swainson's Hawk	679	572	194	19	815	139	53	291	52	4695	553
Red-tailed Hawk	803	1151	733	591	632	778	924	636	823	534	657
Ferruginous Hawk	13	10	8	3	10	14	7	8	13	9	13
Rough-legged Hawk	0	1	1	0	1	0	0	0	0	0	0.2
Zone-tailed Hawk	1	2	0	3	1	1	0	0	1	0	1
Unknown buteo	3	28	5	2	106	32	30	69	33	23	24
TOTAL BUTEOS	1504	1778	953	621	1571	973	1030	1010	935	5270	1254
Golden Eagle	145	115	159	115	128	149	146	79	71	87	118
Bald Eagle	3	4	3	5	1	3	8	1	1	3	3
Unknown Eagle	0	0	0	1	0	0	1	0	4	1	1
TOTAL EAGLES	148	119	162	121	129	152	155	80	76	91	122
American Kestrel	455	742	525	397	560	470	686	362	520	412	562
Merlin	42	56	14	27	21	22	22	26	48	23	25
Prairie Falcon	19	58	38	30	28	24	20	18	16	13	21
Peregrine Falcon	67	116	64	49	63	127	112	82	61	43	49
Unknown small falcon ¹	-	-	-	-	0	4	2	1	2	1	2
Unknown large falcon ¹	-	-	-	-	0	15	3	1	5	3	5
Unknown falcon	0	12	2	1	5	2	1	5	6	1	3
TOTAL FALCONS	583	984	643	504	677	664	846	495	658	496	661
Unknown raptor	15	11	11	4	20	49	21	41	37	32	47
TOTAL	5904	8921	4835	4307	4668	5040	6502	4410	5623	8119	5225

¹ New designations used for the first time in 2001.

Appendix F. Daily trapping effort and capture totals of migrating raptors by species in the Manzano Mountains, NM: 2006.

DATE	STN.	SPECIES ¹													CAPTURES	
	HOURS	NH	SS	CH	NG	BW	SW	RT	ZT	GE	AK	ML	PR	PG	TOTAL	/STN HR
4-Sep	4.25	0	5	4	0	0	0	0	0	0	0	0	0	0	9	2.1
5-Sep	13.17	0	8	3	0	0	0	1	0	0	1	0	0	1	14	1.1
6-Sep	13.92	0	1	6	0	0	0	0	0	0	0	0	0	2	9	0.6
7-Sep	15.00	0	4	7	0	0	0	0	0	0	0	0	0	0	11	0.7
8-Sep	6.00	0	1	0	0	0	0	0	0	0	0	0	0	1	2	0.3
9-Sep	11.67	0	4	0	0	0	0	1	0	0	0	0	0	0	5	0.4
10-Sep	15.75	0	6	8	0	0	0	1	0	0	1	0	0	2	18	1.1
11-Sep	14.75	0	22	8	0	0	0	2	0	0	0	0	0	3	35	2.4
12-Sep	12.75	0	17	8	0	0	0	3	0	0	0	0	0	0	28	2.2
13-Sep	14.50	0	10	3	0	0	0	0	0	0	1	0	0	0	14	1.0
14-Sep	15.75	0	11	14	0	0	0	0	0	0	1	0	0	0	26	1.7
15-Sep	15.75	0	22	25	0	0	0	1	0	0	2	0	0	0	50	3.2
16-Sep	15.50	1	13	9	0	0	0	2	0	0	0	0	0	0	25	1.6
17-Sep	15.50	0	9	4	0	0	0	0	0	0	0	0	0	0	13	0.8
18-Sep	15.75	0	6	3	0	0	1	1	0	0	0	0	0	0	11	0.7
19-Sep	15.75	0	15	16	0	0	0	1	0	0	0	0	0	1	33	2.1
20-Sep	13.50	0	4	13	0	0	0	0	0	0	0	0	1	0	18	1.3
21-Sep	14.25	0	2	5	0	0	0	1	0	0	0	0	0	0	8	0.6
22-Sep	15.00	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0.1
23-Sep	14.50	0	1	2	0	0	0	0	0	0	0	0	0	0	3	0.2
24-Sep	15.75	1	8	33	0	0	0	1	0	0	0	0	0	0	43	2.7
25-Sep	16.00	1	6	6	0	0	0	3	0	0	0	0	0	1	17	1.1
26-Sep	16.00	1	4	13	0	0	0	2	0	0	0	0	0	0	20	1.3
27-Sep	16.25	0	7	7	0	0	0	2	0	0	1	0	0	0	17	1.0
28-Sep	16.25	0	8	10	0	0	0	0	0	0	0	0	2	0	20	1.2
29-Sep	16.00	0	4	11	0	0	0	0	0	0	0	0	1	0	16	1.0
30-Sep	16.00	0	10	5	0	0	0	0	0	0	1	0	0	0	16	1.0
1-Oct	15.83	0	8	6	0	0	0	2	0	0	0	1	0	0	17	1.1
2-Oct	16.00	0	10	9	0	0	0	1	0	0	0	0	0	0	20	1.3
3-Oct	15.75	0	6	5	0	0	0	1	0	0	2	0	0	1	15	1.0
4-Oct	16.00	0	1	2	0	0	0	0	0	0	0	0	0	0	3	0.2

Appendix F. continued

DATE	STN.	SPECIES ¹													CAPTURES	
	HOURS	NH	SS	CH	NG	BW	SW	RT	ZT	GE	AK	ML	PR	PG	TOTAL	/STN HR
5-Oct	15.50	0	11	9	0	1	0	0	0	0	0	0	0	0	21	1.4
6-Oct	15.50	0	4	5	0	0	0	0	0	0	0	0	0	0	9	0.6
7-Oct	12.75	0	5	2	0	0	0	0	0	1	0	0	0	0	8	0.6
8-Oct	0.00															
9-Oct	0.00															
10-Oct	14.25	1	3	2	0	0	0	1	0	0	0	0	0	0	7	0.5
11-Oct	15.00	0	2	0	0	0	0	0	0	0	0	0	0	0	2	0.1
12-Oct	15.25	0	4	5	1	0	0	1	0	0	0	0	0	0	11	0.7
13-Oct	15.50	1	3	0	0	0	0	1	0	0	0	1	0	0	6	0.4
14-Oct	8.00	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0.1
15-Oct	3.50	0	2	1	1	0	0	0	0	0	0	0	0	0	4	1.1
16-Oct	6.00	0	1	4	0	0	0	2	0	0	0	0	0	0	7	1.2
17-Oct	14.50	0	3	2	0	0	0	0	0	0	0	0	0	0	5	0.3
18-Oct	9.75	0	4	0	0	0	0	1	0	0	0	0	0	0	5	0.5
19-Oct	15.25	0	7	0	0	0	0	1	0	0	0	0	0	0	8	0.5
20-Oct	14.75	0	3	0	0	0	0	0	0	0	0	0	0	0	3	0.2
21-Oct	15.25	0	4	2	0	0	0	2	0	0	0	0	0	0	8	0.5
22-Oct	15.08	0	6	0	0	0	0	0	0	0	0	0	0	0	6	0.4
23-Oct	13.50	0	3	1	1	0	0	0	0	0	0	0	0	0	5	0.4
24-Oct	9.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Total	677.67	6	299	280	3	1	1	35	0	1	10	2	4	12	654	1.0

¹ See Appendix B for explanation of species codes.

Appendix G. Annual trapping and banding effort and capture totals of migrating raptors by species in the Manzano Mountains, NM: 1990–2006.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	TOTAL	MEAN
Start date	28-Aug	5-Sep	31-Aug	3-Sep	1-Sep	4-Sep	2-Sep	31-Aug	29-Aug	31-Aug	2-Sep	1-Sep	3-Sep	7-Sep	5-Sep	4-Sep	4-Sep		1-Sep
End date	27-Oct	29-Oct	30-Oct	24-Oct	25-Oct	31-Oct	19-Oct	28-Oct	29-Oct	16-Oct	27-Oct	25-Oct	25-Oct	24-Oct	28-Oct	28-Oct	24-Oct		25-Oct
Blinds in operation	1	3	3	3	3	4	4	4	3	3	3	3	3	2	2	2	2		3.0
Trapping days	47	54	57	50	48	53	45	54	58	46	50	55	51	45	45	51	48		50.7
Station days	47	95	131	120	121	136	132	151	165	94	119	145	131	84	84	99	94		117.2
Station hours	511	693	967	889	926	1041	1030	1211	1352	664	791	1037	957	633	756.15	707.77	677.67		885.4
Captures / 100 stn hrs	47.7	72.4	108.2	100.8	110.7	85.7	137.0	95.0	148.2	115.7	121.7	85.9	135.3	152.7	136.0	163.0	96.5		112.5
RAPTOR COUNTS																			
Northern Harrier	1	2	2	3	9	2	1	8	14	0	5	7	6	3	0	3	6	72	4.2
Sharp-shinned Hawk	124	262	589	430	502	493	778	612	987	321	495	426	635	458	566	562	299	8539	502.3
Cooper's Hawk	95	195	335	374	353	310	460	427	772	323	330	337	510	400	378	495	280	6374	374.9
Northern Goshawk	1	7	6	6	7	1	5	3	6	6	16	1	10	1	2	3	3	84	4.9
Broad-winged Hawk	0	0	0	0	0	0	0	0	1	0	0	0	1	1	1	0	1	5	0.3
Swainson's Hawk	0	0	0	0	0	0	0	0	0	0	0	1	3	0	0	0	1	5	0.3
Red-tailed Hawk	8	18	61	55	83	50	50	46	112	56	76	39	56	38	43	35	35	861	50.6
Zone-tailed Hawk	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0.1
Golden Eagle	1	3	4	4	4	4	6	4	5	2	4	5	7	8	2	2	1	66	3.9
American Kestrel	10	13	42	14	59	28	92	32	75	44	25	56	37	43	18	37	10	635	37.4
Merlin	1	0	2	4	1	1	11	6	7	2	8	2	12	3	10	3	2	75	4.4
Prairie Falcon	1	1	3	5	3	1	3	5	13	6	3	7	5	4	3	4	4	71	4.2
Peregrine Falcon	2	1	2	1	4	2	5	7	12	8	1	10	13	7	5	10	12	102	6.0
All Species	244	502	1046	896	1025	892	1411	1150	2006	768	963	891	1295	966	1028	1154	654	16890	993.5
Recaptures ¹	0	0	1	1	2	2	1	2	4	4	3	2	3	2	2	3	2	34	2.0
Foreign recaptures ²	2	1	1	1	2	0	5	1	2	2	0	0	3	2	0	0	1	23	1.4
Foreign encounters ³	0	2	2	3	6	6	7	8	13	12	6	7	10	7	5	3	4	106	6.2

¹ Recaptures in the Manzanos of birds originally banded in the Manzanos.

² Recaptures in the Manzanos of birds originally banded elsewhere.

³ Birds originally banded in the Manzanos and subsequently encountered elsewhere.