

**FALL 2010 RAPTOR MIGRATION STUDIES IN THE  
MANZANO MOUNTAINS OF CENTRAL NEW MEXICO**



**HawkWatch International, Inc.  
Salt Lake City, Utah**

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## INTRODUCTION

The Manzano Mountains Raptor Migration Project 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, Smith et al. 2008a). 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 2010 season marked the 26<sup>th</sup> consecutive count and the 21<sup>st</sup> consecutive season of trapping and banding conducted at the site by HWI. This report summarizes the 2010 count and banding results.

The Manzanos project was 1 of 10 long-term, annual migration counts and 1 of 4 migration-banding studies conducted or co-sponsored by HWI in North America during 2010. The primary objective of these efforts is to track long-term population trends of diurnal raptors in western North America and around the Gulf Coast region (Hoffman and Smith 2003; Smith et al. 2001, 2008 a, b). Raptors serve as important biological indicators of ecosystem health (Bildstein 2001) and long-term migration counts are one of the most cost effective and efficient methods for monitoring the regional status and trends of multiple raptor species (Zalles and Bildstein 2000).

The intensive counting and banding operations, along with related research activities such as satellite tracking of migrants, also provide valuable information about species' ranges, migratory routes and behaviors, and population demographics (e.g., Hoffman et al. 2002, Lott and Smith 2006, Goodrich and Smith 2008), as well as affording rich opportunities for a variety of other biological assessments and studies (e.g., DeLong and Hoffman 2004, McBride et al. 2004). This information helps us understand the life histories, ecology, status, and conservation needs of raptor populations in North America. In addition, these migration studies offer unique opportunities for the public to learn about raptors and the natural environment, and providing such opportunities is another important component of all HWI migration projects.

## 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 2010, 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 between 1991 and 2002, 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 (Bildstein 2006), 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. Lead Observer, Tim Hanks is a veteran of the Manzano project with seven previous seasons of migration counting experience, whereas Russell Seeley was a novice Observer in 2010 (see Appendix A for a complete history of observer participation). Volunteers and other crewmembers occasionally assisted with the counts, particularly seasoned volunteer Roger Grimshaw. Weather permitting, observations typically began by 0900 H Mountain Standard Time (MST) and ended by 1700 H 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 H 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.

Smith et al. (2008) present trend analyses of data collected through 2005 for most of the long-term, ongoing, autumn migration studies in western North America, including the Manzanos (hereafter, called the raptor Population Index or “RPI” analyses; see <http://www.repi-project.org>). 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 updated through 2010 are based on recent methods described in Farmer et al. (2007), as well as those described in Hoffman and Smith (2003), used herein to present analyses updated through 2010. In comparing 2010 annual statistics against means and 95% confidence intervals for previous seasons, we equate significance with a 2010 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 H 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 30 minutes of capture.

## RESULTS AND DISCUSSION

### WEATHER

In 2010, inclement weather entirely precluded one full day of potential observations and did not severely hamper ( $\leq 4$  hours observation) observations on any other day (see Appendix C for daily weather summaries). The number of days fully precluded by weather was significantly below the 1997–2009 average of 5.2 days (range 1–14) and the absence of otherwise severely hampered days was also significantly below the average of 1.8 days (range 0–5). Sky conditions during active observation periods were fairer than the 1997–2009 averages for the site: 63% of the active observation days featured predominantly fair skies (average 50%), 13% transitional skies (i.e., changed from fair skies to mostly cloudy or overcast during the day, or vice versa; average 17%), 24% mostly cloudy to overcast skies (average 33%); the prevalence of scattered rain/snow showers during active observation periods was also well below average in 2010 (29% of active days vs. average of 36%), as was the prevalence of visibility reducing fog and especially haze (24% vs. average of 40%). These factors translated to record high ratings in average maximum-visibility ratings to the east (96 km vs. average of 90 km) and west (95 km vs. average of 90 km), whereas the proportion of days where the observers rated the thermal lift conditions as good to excellent was significantly below average (26% of the active days vs. average of 43%).

In contrast to last year, wind speeds at the observation point matched long-term means, with the proportion of active observation days where light winds ( $<12$  kph) prevailed was (69%), the proportion of days with predominantly moderate winds (12–28 kph) was (27%), strong winds ( $>28$  kph) prevailing on (4%) of the active observation days in 2010.

In terms of wind directions, the range of conditions experienced in 2010 differed from the long-term average pattern in a few ways, but less so than in recent years. As usual, SW–W winds were most common, but below average in 2010 (34% of the active days vs. 1997–2009 average of 40%). In contrast, the prevalence of both the second most common pattern, more variable S–W winds, and the fourth most common pattern, calm/variable winds, were significantly higher in 2010 (14% of the active days vs. average of 3%, and 11% vs. average of 1%, respectively), whereas the pattern that averages third-most common, S–SW winds, matched the long-term mean at 13%. Variable and E–S winds were the fifth and sixth most common wind directions and were both significantly more prevalent than average in 2010 (7% of the active days vs. average of 4%, and 7% vs. average of 0%, respectively)

The temperature during active observation periods averaged 13.7°C (the average of daily values, which in turn were averages of hourly readings), ranging from 0.8–21.1°C. The overall daily average was slightly below the 1997–2009 average of 14.3°C. The minimum and maximum daily-average fell well within the ranges of values recorded since 1997. We began recording hourly barometric pressure readings on site in 2001. In 2010, the overall average (30.14 in Hg; the average of daily values, which in turn were averages of hourly readings) and minimum (29.68) and maximum (30.31) daily averages were slightly above average.

In summary, inclement weather had little impact on the observer's ability to conduct daily counts. Cloud cover conditions were clearer than averages for the previous 12 years and the prevalence of mostly cloudy to overcast skies, scattered rain/snow showers, and fog/haze remained well below average. Wind speeds exactly matched those of the long-term mean in 2010. While SW–W winds dominated, they were less common than usual; whereas more variable (S–W, calm/variable, variable, and E–S) wind patterns were



much more prevalent than usual, while the S–SW pattern matched the average. The subjective nature of rating thermal-lift conditions speaks more to an apparent reduction in favorable thermal-lift conditions, than localized weather variables indicate.

### **OBSERVATION EFFORT**

The observers worked on 70 of 71 possible days between 27 August and 5 November. The number of observation days was a significant 8% higher than the 1985–2009 average of  $65 \pm 95\%$  CI of 2.0 days. The total hours of observation (578.00) also was a significant 12% above the long-term average of  $514.94 \pm 24.12$  hours. The 2010 average of 2.4 observers per hour (including official and guest observers; value is mean of daily values, which are in turn means of hourly values) was a significant 9% above the 1985–2009 average of  $2.2 \pm 95\%$  CI of 0.14 observers/hr. This difference is due to two related factors: 1) the presence of an on-site interpreter as part of the seasonal field crew and simultaneous closure of the access road to visitors; and 2) the regular presence of Citizen Science volunteers, namely Roger Grimshaw.

### **FLIGHT SUMMARY**

The observers counted 7,674 migrant raptors of 17 species during the 2010 season (see Appendix D for daily count records and Appendix E for annual summaries). The flight was composed of 45% buteos, 44% accipiters, 6% falcons, 2% vultures, 2% eagles, 2% harriers, and  $\leq 1\%$  each of Ospreys and unidentified raptors. This composition includes significantly above-average proportions of accipiters and harriers and significantly below-average proportions of falcons, vultures, and Osprey (Figure 2). The group proportion for vultures, harriers, and Osprey amounted to record (tied low) levels in 2010. The Swainson's Hawks was the most abundant species seen in 2010, followed by Sharp-shinned Hawk, Cooper's Hawks, Red-tailed Hawks, American Kestrels, and Turkey Vultures (Table 1, Appendix E). No record high or low species counts occurred in 2010.

### **Passage Rates and Long-term Trends**

Adjusted passage rates were significantly above average for the Sharp-shinned Hawk, Broad-winged Hawk, Swainson's Hawk, and Merlin, but were significantly below average for Turkey Vulture, Osprey, Northern Harrier, Red-tailed hawk, Ferruginous Hawk, and Rough-legged Hawk (Table 1, Figures 3–7). Updated regression analyses (after Hoffman and Smith 2003) 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 but then mostly moderate counts and no real trend since 2001 (Figure 3). A roughly similar pattern applied to Northern Harrier (Figure 3). A significant ( $P \leq 0.05$ ) linear increasing trend was indicated for Ospreys, but more detailed examination shows a strong increasing pattern through 1995, a sharp drop in 1999, a return to a gradual increasing pattern since then with a high spike in 2003, and another sharp drop in the last two years (Figure 3). Among the accipiters, low adjusted passage rates for three of the last five years eliminated a previously significant increasing trend for Sharp-shinned Hawks. Lower passage rates during the past five seasons dampened what had been a highly significant ( $P \leq 0.01$ ) long-term increase for Cooper's Hawks (Figure 4). Among the buteos, continued significant long-term increases were indicated for Broad-winged and Swainson's Hawks (Figure 5). In contrast, a highly significant long-term decrease continues to be indicated for Ferruginous Hawks; however, following a strong slide between 1992 and 2000, passage rates of this species have remained relatively stable for the past ten years (Figure 5). Previously, a long-term increasing pattern had been evident for Red-tailed Hawks; however, after rising to high peak in 1998, passage rates of this species have fluctuated some but have been on a downward trend, with flights in the past five years among the lowest to date and a highly significant third-order regression now tracking the ups-and-downs of this species (Figure 5). No significant long-term trends are currently shown for Golden or Bald Eagles at the species level; however, a significant third-order trend was indicated for adult Golden Eagles, tracking a sharp decline in the late 1980s, a gradual rebound through the late 1990s, and then another recent decline (Figure 6). That said, after having dropped sharply between 2003 and 2006 to near-record lows, passage rates of Golden Eagles rose again in the past 3–4 years, with the flight of non-adult birds, in particular, actually reaching a near-

record high in 2008, plummeting again in 2009, and back up in 2010. Overall, the recent ups-and-downs of this species mimic the pattern seen in the late 1980s and early 1990s – roughly tracking the Palmer Drought Severity Index (PDSI) (Figure 6). Among the falcons, a significant long-term decrease was newly indicated for American Kestrels; previously no significant long-term trend was indicated, but passage rates generally have been average to below average since the late 1990s and addition of three record-low passage rates in a row from 2006 to 2009 has now tipped the trend to a significant long-term decline, even though the passage rate was up slightly in 2010 (Figure 7). A significant quadratic trend was indicated for Merlins, tracking a strong increasing pattern through about 1996, but a relatively stable increasing pattern since then (Figure 7). Highly significant third-order regressions were indicated for Prairie and Peregrine Falcons, in both cases tracking relatively stable patterns in the late 1980s, then strong increasing patterns through at least the late 1990s, but then very sharp declines for the past 8–11 years (Figure 7). Despite a sharp decline since reaching a high peak in 2002, the 2010 passage rate for Peregrine Falcons was a near-significant 27% below average and still higher than during the late 1980s, whereas the 2010 passage rate for Prairie Falcons was a significant 21% below average, but significantly higher than the record low passage observed in 2009.

### **Age Ratios**

Among 10 species with data suited to comparisons, immature : adult ratios were not significantly above average for any species, but were significantly below average for Sharp-shinned Hawks and Golden Eagles (Table 2). Both immature and adult Golden Eagles were more abundant than usual, but immatures were proportionally less common than usual, suggesting that adult survival was good, but productivity may have been slightly lower in 2010. A similar pattern applied to Bald Eagles; however, a low total count limits the utility of this comparison.

For Sharp-shinned Hawks, adult birds clearly were more abundant than usual, whereas immatures were proportionately less common than usual, suggesting that the low age ratios for these species resulted from low productivity, but high over-winter survival for adults. Age ratios differed (high or low) for the remaining species, but hovered closer to long-term means.

### **Seasonal Timing**

The 2010 combined-species median passage date of 26 September matched the 1985–2009 average (Table 3). The overall seasonal distribution of activity differed from the average pattern, in showing significantly below-average proportional activity levels during the first half of the season (27 August – 20 September), followed by a huge spike in seasonal passage (21–25 September), and then tapering to near average passage rates for the remainder of the count (Figure 8). The spike in passage was driven by a significant flight of 2411 Swainson's Hawks on 25 September. At the species level, all species, except Red-tailed Hawk (significantly early), showed significantly late timing (Table 3). Age- and sex-specific data further confirmed late passage timing; the only exception was that unknown-age Red-tailed Hawks were significantly early (Table 4).

### **TRAPPING EFFORT**

The crews operated at least one banding station on 52 of 56 possible days between 2 September and 27 October 2010, with effort totaling 61 station days and 408.67 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, whereas the number of station days and hours were 39 and 52% below average, respectively, primarily due to low funding levels and minimal crew size (Appendix G).

### **TRAPPING AND BANDING SUMMARY**

The 2010 capture total of 382 birds included 10 species, 2 recaptures of birds previously banded at the site (Table 5, Appendix G). The 2010 effort raises the total number of birds captured since project inception to 18,785, including 38 recaptures of Manzano-banded birds and 24 foreign recaptures (i.e.,

birds originally banded elsewhere and subsequently recaptured in the Manzanos; Appendix G). Sharp-shinned and Cooper's Hawks accounted for 48% and 42% of the total captures, respectively, with Red-tailed Hawks (6%), American Kestrels (1%), and all other species each comprising less than 1% of the total.

The overall combined-species capture total was 60% below average, the overall capture rate of 93.5 birds per 100 station hours was a significant 19% below average, and the overall capture success of 8.4% was 61% below average (Table 5), again largely reflecting reduced crew size and experience levels. With a capture total of three birds, the Prairie Falcon was the only species for which any (capture rate and success) metrics were above average in 2010. All three capture metrics were low or significantly low for all other species.

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 2010 immature : adult capture ratio for Sharp-shinned Hawks of 1.6 matched the average (Table 6), whereas the count-based age ratio of 0.6 was a significant 33% below average (Table 2). This suggests that immature birds were much more susceptible to capture than usual compared to adults in 2010. The 2010 capture age ratio for Cooper's Hawks of 1.6 was a significant 61% above average, while the count age ratio of 0.71 was a non-significant 13% below average. Once again, it suggests that immature Cooper's Hawks were much more susceptible to capture than usual compared to adults. The banding data also uniquely suggested that the female : male ratio for captured Cooper's Hawks was significantly below average, whereas the sex ratio of captured Sharp-shinned Hawks matched the long-term average (Table 6).

Only five hatch-year (two female and three male) American Kestrels were captured in 2010, which is only 17% of the average total, but the 2010 female : male capture ratio of 0.7 was a non-significant 14% above average (Table 6). Similarly, the count-based sex ratio for kestrels of 1.04 was a significant 24% above the long-term average of  $0.82 \pm 95\%$  CI of 1.00. This suggests that female kestrels were proportionately more abundant and more susceptible to capture than usual in 2010 compared to males. A dearth of adult kestrels in 2010 suggests that adult birds were either relatively scarce or much less susceptible to capture than usual in 2010.

## **ENCOUNTERS WITH PREVIOUSLY BANDED BIRDS**

**Recaptures.**—The recapture of two Accipiters at the Manzano site occurred during the 2010 season, which brings the total number of recaptures to 38 since the inception of banding at this site (Appendix G). The first bird was an adult (ASY) female Cooper's Hawk originally trapped and banded at the Sandia Mountain spring migration site on 05 April 2007. It was subsequently recaptured on 13 September, 2010, at the Manzano fall site. On 06 October 2010, an already banded second-year (SY) female Sharp-shinned Hawk was captured. The original encounter happened during the previous fall migration season on 21 September 2009 at the same location.

**Foreign Recaptures.**— No recaptures of birds that were originally banded at another location occurred during the 2010 season.

**Foreign Encounters.**—In 2010, two raptors originally banded at the Manzanos were encountered elsewhere (Table 7), which brings the total of foreign encounters to 125 birds since 1990 (Appendix G). In both cases, the birds were Cooper's Hawks and were reported dead of unknown causes (Table 7). The recoveries of the two birds happened the subsequent spring after banding, in the state of New Mexico as part of the Rocky Mountain Flyway (see Hoffman et al. 2002). One of them was found only 43 km, the other approximately 126 km from the Manzano banding station (Table 7). These records are important to understand which flyways raptors are using, and help us to gain an insight into the longevity and survivorship of migratory raptors.

## **SATELLITE TELEMETRY**

No new raptor species were outfitted with telemetry units during the 2010 season. At present, data are being analyzed and it is anticipated that the results will be published in a scientific journal within the next year. However, tracking summaries and maps for all of HWI's telemetry birds can be found at <http://www.hawkwatch.org>.

## **RESIDENT RAPTORS**

A pair of light morph Red-tailed Hawks was observed in the area all season with at least one light morph juvenile (possibly two). Almost all sightings of the adults were with just one immature bird, but there were a few sightings of two juveniles with one or two adults. These sightings may have been the residents escorting an immature through the area. The resident Red-tailed Hawks were seen multiple times almost daily hunting in all directions; though they were seen most often at lower elevation to the west (Comanche Canyon), beyond North Point, and over the towers to the south. An interesting observation was made towards the end of the field season where the resident Red-tailed Hawks seemed to spend an increased amount of time feeding on insects during the last two weeks of October, more than the occasional attempts earlier that year. Individual Swainson's Hawks were seen in the area during the first week of the count. By the second and third week of September, multiple individuals spent time throughout most days hawking insects in all directions, although most typically to the northwest and north and far to the east on east wind days. The last resident Swainson's Hawk was seen on 28 September 2010.

Resident Turkey Vultures were seen daily from the start of the count through the first week of October, often in groups of three to six with the largest resident group containing 10-12 individuals.

A pair of adult Sharp-shinned Hawks and two juveniles were seen frequently through late October. The immature birds appeared more often than adults in September, and the opposite was true throughout October. This could mean that immature birds observed later in the season were not the same as the ones seen in September. These residents, particularly the juveniles, were often seen harassing migrants. One immature and one adult Cooper's Hawk were confirmed residents as well. Although we can assume the presence of an adult pair they were never noticed together. Both the Sharp-shinned and Cooper's Hawks were seen most often hunting low to the west, south on the point behind observation and around North Point. One immature Northern Goshawk was seen multiple times from 04-05 October. It was observed hunting behind the observation deck, lower to the west, and around the north trapping blind and North Point. No adult Northern Goshawks were seen acting as residents from observation, but one was noted along the road near the original location of south blind by one of the observers when driving down the mountain.

One female American Kestrel was seen hawking insects low to the west, near the west blind on 02 November. It ended up flying in front of the observers and out past north point, heading northeast. This was the only day a seemingly non-migrant kestrel was noted. A brown Taiga Merlin (most likely a hatch year male) was seen multiple times hunting around the area during the afternoon on 01 October. On 17, 19, and 21 of October a brown Taiga Merlin (most likely a female) was seen acting in a non-migratory fashion. We believe this individual stayed in the area over this period of time. It was noticed hunting the ridge behind the observation point, around north point and swooping down on the observation owl decoy. On 01 November, an adult male Taiga Merlin was observed passing from behind the observation deck and flying to the north on two different occasions. Two adult and two juvenile peregrine falcons were seen frequently in the area through late September. They were all noticed chasing migrants, mainly other large falcons, and hunting. For the second year in a row, no prairie falcon residents were observed.

Two adult and two hatch year Golden Eagles were observed on the first days of the count out to the west. This was the only day all four birds were seen together, but individual hatch year and adults were noticed throughout the season, at regular but not frequent intervals. The adults were noticed escorting migrating

eagles multiple times in October. The resident eagles were most often noticed far to the west and occasionally far to the east moving from south to north, although sometimes they came very close to the observation point. There were also multiple sub-adults seen throughout the season (more in October and November) moving in a non-migratory direction.

On 20 October a brown Northern Harrier was seen going northeast in the early morning and on 04 November an immature Northern Harrier appeared three times in the area, once hunting low to the west and twice moving in a non-migratory direction. It was last seen flying to the northwest.

This field season produced a typical resident assemblage for the site, except for the apparent lack of resident Prairie Falcons, whose territory may have been usurped by Peregrine Falcons during the past three years.

## **SITE VISITATION**

In 2010, the access road (FR 245) was again closed above New Canyon Campground, due to hazardous conditions caused by an extensive wildfire that burned the area during the spring of 2008. Thus, access to the project site was restricted to USFS, HWI personnel, and Citizen Science volunteers during the 2010 season. However, hikers and other public land users were able to access the site on foot throughout parts of the fall season.

We kept track of 621 hourly assessments of visitor disturbance, which resulted in the following disturbance ratings: 84% none, 11% low, 5% moderate, and < 1% high. These values reflect higher visitor-disturbance ratings than usual for the site, given the lack of visitors from the general public. It may reflect a slight increase in visitation by local hawk watching volunteers and the press in light of the 25<sup>th</sup> anniversary celebration for the Manzano migration monitoring site.

## **ACKNOWLEDGMENTS**

Financial support for this project in 2010 was provided by the USDA Forest Service – Cibola National Forest, U.S. Forest Service - Region 3, New Mexico Department of Game and Fish – Share with Wildlife Program, and HWI private donors and members. We especially thank Karen Lessard, Zach Parsons, Tyler Hunning, and Beverly DeGruyter of the Forest Service for their continued logistical support. HWI and the field crew also thank Peter Neils, Sue Chavez, and Art Arenholz of Albuquerque for their generous contributions of food to support the field crew during the season. We extend our heartfelt thanks to the following individuals for their generous Citizen Science volunteer service and general support during the season: Roger Grimshaw, Walt and Jennifer Lehman, Steve de la Pena, Ken Babcock, Jon Stravers, and everyone else that joined us in celebrating the Manzanos 25<sup>th</sup> Anniversary! Lastly, we would like to thank Wes Anderson and Steve and Nancy Cox for their continued support of our banding operation through the provision of lure birds.

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**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: 1985–2009 versus 2010.**

SPECIES	COUNTS			RAPTORS / 100 HRS <sup>1</sup>		
	1985–2009 <sup>2</sup>	2010	% CHANGE	1985–2009 <sup>2</sup>	2010	% CHANGE
Turkey Vulture	374 ± 93.4	189	-50	110.5 ± 26.73	47.0	-57
Osprey	31 ± 6.8	17	-44	7.9 ± 1.59	3.7	-53
Northern Harrier	61 ± 10.1	41	-33	12.3 ± 1.84	7.5	-39
Sharp-shinned Hawk	1456 ± 173.2	2067	42	357.1 ± 38.60	455.6	28
Cooper's Hawk	1004 ± 137.7	1162	16	287.4 ± 32.90	299.3	4
Northern Goshawk	16 ± 3.6	23	41	3.7 ± 0.92	4.5	21
Unknown small accipiter <sup>3</sup>	125 ± 34.3	102	-18	–	–	–
Unknown large accipiter <sup>3</sup>	5 ± 2.5	9	69	–	–	–
Unidentified accipiter	74 ± 25.7	3	-96	–	–	–
TOTAL ACCIPITERS	2597 ± 295.6	3366	30	–	–	–
Broad-winged Hawk	7 ± 1.8	13	79	2.2 ± 0.49	3.5	56
Swainson's Hawk	815 ± 672.9	2906	257	315.1 ± 259.25	1144.2	263
Red-tailed Hawk	634 ± 68.8	491	-23	137.2 ± 13.77	95.9	-30
Ferruginous Hawk	12 ± 2.0	9	-27	2.6 ± 0.46	1.7	-33
Rough-legged Hawk	0.2 ± 0.2	0	-100	0.1 ± 0.04	0.0	-100
Zone-tailed Hawk	1 ± 0.3	1	92	–	–	–
Unidentified buteo	25 ± 9.1	22	-11	–	–	–
TOTAL BUTEOS	1494 ± 670.2	3441	130	–	–	–
Golden Eagle	116 ± 13.3	130	12	24.8 ± 2.98	25.1	1
Bald Eagle	4 ± 1.0	4	14	0.9 ± 0.28	1.0	4
Unidentified Eagle	1 ± 0.9	4	233	–	–	–
TOTAL EAGLES	121 ± 13.4	138	14	–	–	–
American Kestrel	523 ± 65.6	359	-31	142.5 ± 18.04	85.5	-40
Merlin	26 ± 5.5	54	105	6.6 ± 1.29	12.2	84
Prairie Falcon	19 ± 4.5	13	-31	4.1 ± 0.86	3.0	-27
Peregrine Falcon	48 ± 13.3	40	-17	11.5 ± 3.13	9.0	-21
Unknown small falcon <sup>3</sup>	2 ± 1.0	2	20	–	–	–
Unknown large falcon <sup>3</sup>	4 ± 2.9	5	32	–	–	–
Unidentified falcon	2 ± 1.1	0	-100	–	–	–
TOTAL FALCONS	621 ± 72.3	473	-24	–	–	–
Unidentified raptor	43 ± 15.4	8	-81	–	–	–
GRAND TOTAL	5341 ± 821.6	7674	44	–	–	–

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

<sup>2</sup> Mean ± 95% CI.

<sup>3</sup> 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: 1990–2009 versus 2010.**

	TOTAL AND AGE-CLASSIFIED COUNTS						IMMATURE : ADULT			
	1990–2009 AVERAGE			2010			% UNKNOWN AGE		RATIO	
	TOTAL	IMM.	ADULT	TOTAL	IMM.	ADULT	1990–2009 <sup>1</sup>	2010	1990–2009 <sup>1</sup>	2010
Northern Harrier	64	32	16	41	24	10	27 ± 5.6	17	2.1 ± 0.43	2.40
Sharp-shinned Hawk	1548	590	673	2067	522	876	19 ± 3.4	32	0.9 ± 0.12	0.60
Cooper's Hawk	1107	389	480	1162	296	418	22 ± 4.1	39	0.8 ± 0.11	0.71
Northern Goshawk	16	8	7	23	13	8	13 ± 5.6	9	1.7 ± 0.78	1.63
Broad-winged Hawk	8	1	4	13	1	9	40 ± 13.8	23	0.5 ± 0.32	0.11
Red-tailed Hawk	686	219	361	491	161	236	16 ± 3.5	19	0.6 ± 0.11	0.68
Ferruginous Hawk	11	3	3	9	1	4	48 ± 7.4	44	1.7 ± 0.68	2.00
Golden Eagle	116	63	31	130	70	42	17 ± 3.7	14	2.3 ± 0.45	1.67
Bald Eagle	4	2	1	4	1	3	9 ± 12.6	0	2.0 ± 0.95	1.00
Peregrine Falcon	62	17	28	40	11	21	23 ± 8.5	20	0.7 ± 0.35	0.52

<sup>1</sup> 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 2010, with comparisons of 2010 and 1985–2009 average median passage dates.**

SPECIES	2010				1985–2009
	FIRST OBSERVED	LAST OBSERVED	BULK PASSAGE DATES <sup>1</sup>	MEDIAN PASSAGE DATE <sup>2</sup>	MEDIAN PASSAGE DATE <sup>2,3</sup>
Turkey Vulture	31-Aug	12-Oct	8-Sep – 5-Oct	3-Oct	18-Sep ± 2.9
Osprey	7-Sep	26-Oct	14-Sep – 8-Oct	26-Sep	17-Sep ± 1.3
Northern Harrier	5-Sep	4-Nov	26-Sep – 25-Oct	13-Oct	2-Oct ± 1.8
Sharp-shinned Hawk	27-Aug	3-Nov	16-Sep – 16-Oct	5-Oct	28-Sep ± 1.0
Cooper's Hawk	27-Aug	2-Nov	16-Sep – 11-Oct	1-Oct	25-Sep ± 1.0
Northern Goshawk	8-Sep	4-Nov	8-Sep – 31-Oct	11-Oct	6-Oct ± 4.4
Broad-winged Hawk	1-Sep	10-Oct	1-Sep – 8-Oct	28-Sep	26-Sep ± 2.6
Swainson's Hawk	6-Sep	10-Oct	25-Sep – 27-Sep	26-Sep	21-Sep ± 2.8
Red-tailed Hawk	27-Aug	4-Nov	19-Sep – 26-Oct	26-Sep	3-Oct ± 1.9
Ferruginous Hawk	3-Sep	30-Oct	15-Sep – 27-Oct	17-Oct	3-Oct – 4.1
Rough-legged Hawk	0-Jan	0-Jan	–		0-Jan ± 0.0
Golden Eagle	27-Aug	4-Nov	26-Sep – 30-Oct	16-Oct	14-Oct ± 1.8
Bald Eagle	16-Oct	30-Oct	–		23-Oct ± 5.1
American Kestrel	27-Aug	30-Oct	8-Sep – 8-Oct	28-Sep	20-Sep ± 1.4
Merlin	12-Sep	2-Nov	26-Sep – 27-Oct	13-Oct	8-Oct ± 2.9
Prairie Falcon	9-Sep	29-Oct	9-Sep – 17-Oct	5-Oct	26-Sep ± 3.0
Peregrine Falcon	31-Aug	31-Oct	12-Sep – 22-Oct	26-Sep	22-Sep ± 1.4
All species	27-Aug	4-Nov	20-Sep – 12-Oct	26-Sep	26-Sep ± 0.8

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

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

<sup>3</sup> 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: 1985–2009 versus 2010.**

SPECIES	ADULT		IMMATURE / SUBADULT	
	1985–2009 <sup>1</sup>	2010	1985–2009 <sup>1</sup>	2010
Northern Harrier	9-Oct ± 3.5	17-Oct	1-Oct ± 2.1	13-Oct
Sharp-shinned Hawk	5-Oct ± 1.3	7-Oct	19-Sep ± 1.3	26-Sep
Cooper's Hawk	29-Sep ± 1.8	5-Oct	21-Sep ± 1.7	26-Sep
Northern Goshawk	8-Oct ± 4.7	23-Oct	4-Oct ± 6.1	16-Oct
Broad-winged Hawk	22-Sep ± 5.8	27-Sep	±	
Red-tailed Hawk	8-Oct ± 1.9	12-Oct	26-Sep ± 1.7	5-Oct
Ferruginous Hawk	7-Oct ± 7.9		25-Sep ± 5.0	
Golden Eagle	16-Oct ± 2.4	17-Oct	14-Oct ± 1.6	16-Oct
Bald Eagle	±		21-Oct ± 10.9	
Peregrine Falcon	25-Sep ± 2.0	4-Oct	17-Sep ± 2.4	26-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.

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

<sup>2</sup> Data for 2003 only.

**Table 5. Capture totals, rates, and successes for migrating raptors in the Manzano Mountains, NM: 1991–2009 versus 2010.**

SPECIES	CAPTURE TOTAL		CAPTURE RATE <sup>1</sup>		CAPTURE SUCCESS (%) <sup>2</sup>	
	1991–2009 <sup>3</sup>	2010	1991–2009 <sup>3</sup>	2010	1991–2009 <sup>3</sup>	2010
Northern Harrier	4 ± 1.6	2	0.5 ± 0.14	0.5	7 ± 2.5	5
Sharp-shinned Hawk	483 ± 87.7	184	57.9 ± 5.92	45.0	30 ± 3.4	9
Cooper's Hawk	362 ± 62.9	160	44.0 ± 5.17	39.2	31 ± 3.4	13
Northern Goshawk	5 ± 1.7	2	0.7 ± 0.25	0.5	30 ± 8.8	9
Broad-winged Hawk	0.3 ± 0.21	0	0.04 ± 0.032	0.0	3 ± 2.4	0
Swainson's Hawk	0.3 ± 0.33	0	0.03 ± 0.036	0.0	0 ± 0.2	0
Red-tailed Hawk	48 ± 10.8	22	5.8 ± 1.00	5.4	7 ± 1.3	4
Zone-tailed Hawk	0.1 ± 0.10	0	0.004 ± 0.008	0.0	6 ± 10.9	0
Golden Eagle	4 ± 1.0	1	0.5 ± 0.16	0.2	3 ± 0.6	1
American Kestrel	34 ± 10.6	5	4.0 ± 1.00	1.2	6 ± 1.3	1
Merlin	5 ± 1.6	2	0.6 ± 0.20	0.5	15 ± 6.0	4
Prairie Falcon	4 ± 1.3	3	0.5 ± 0.11	0.7	17 ± 2.9	21
Peregrine Falcon	6 ± 1.8	1	0.7 ± 0.23	0.2	9 ± 2.6	2
All Species	956 ± 167.7	382	115.1 ± 11.71	93.5	22 ± 2.3	8

<sup>1</sup> Captures / 100 station hours.

<sup>2</sup> Number of birds captured / number of birds observed. The combined-species value was calculated excluding Ospreys, Turkey Vultures, 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.

<sup>3</sup> 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: 1990–2009 averages versus 2010.**

SPECIES	YEAR	FEMALE		MALE		FEMALE : MALE	IMMATURE : ADULT
		HY	AHY	HY	AHY	RATIO <sup>1</sup>	RATIO <sup>1</sup>
Sharp-shinned Hawk	1990-2009	144	112	137	72	1.2±0.08	1.6 ± 0.23
	2010	58	42	55	29	1.2	1.6
Cooper's Hawk	1990-2009	84	97	87	80	1.1±0.08	1.0 ± 0.15
	2010	40	29	58	33	0.8	1.6
American Kestrel	1990-2009	8	1	14	6	0.6±0.18	3.4 ± 0.94
	2010	2	0	3	0	0.7	-

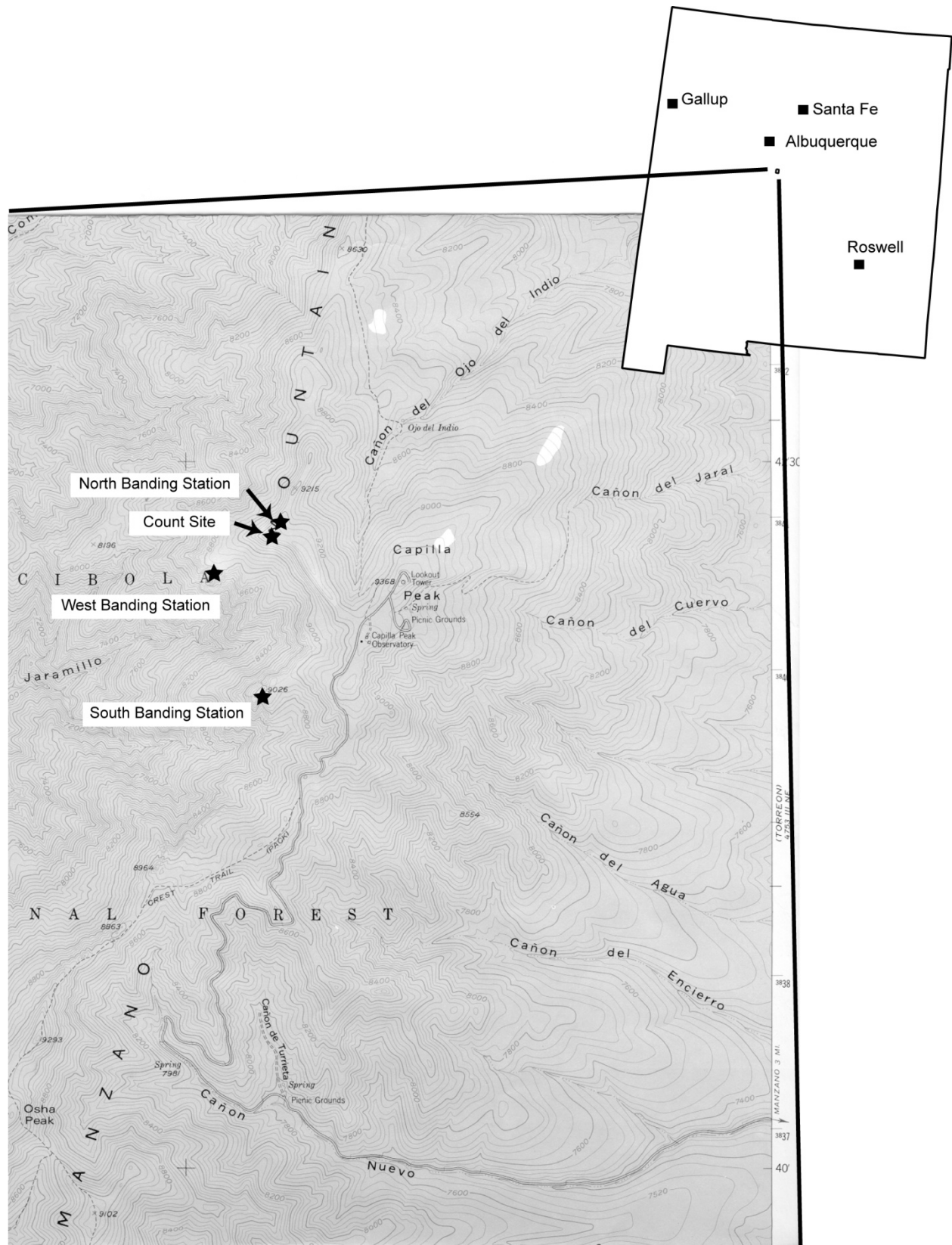
<sup>1</sup> Long-term value: mean ± 95% confidence interval.

**Table 7. Foreign encounters of raptors banded at the Manzano Mountain Raptor Migration Project from records obtained in 2010.**

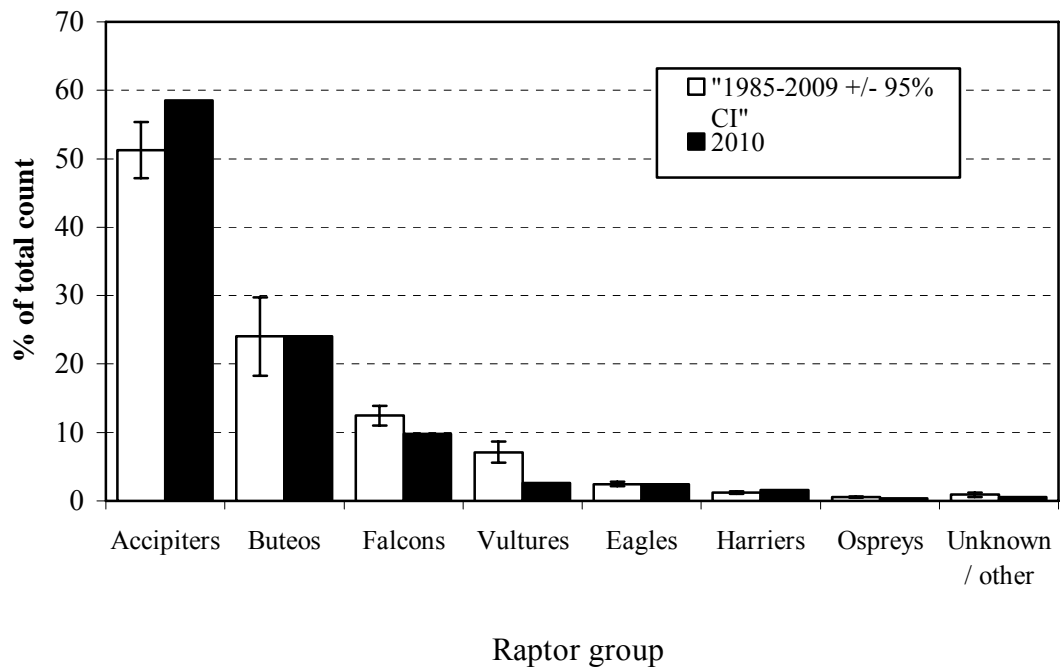
BAND #	SPECIES <sup>1</sup>	SEX	BANDING AGE <sup>1</sup>	BANDING DATE	ENCOUNTER DATE	ENCOUNTER AGE <sup>2</sup>	ENCOUNTER LOCATION	DISTANCE (KM)	STATUS
0874 – 01951	CH	M	ASY	08-Oct-09	23-May-10	3 <sup>rd</sup> yr	Albuquerque, NM	43	found dead
1075 – 02306	CH	F	HY	07-Sep-09	20-Apr-10	HY	San Fidel, NM	126	found dead

<sup>1</sup> See Appendix B for explanation of species codes.

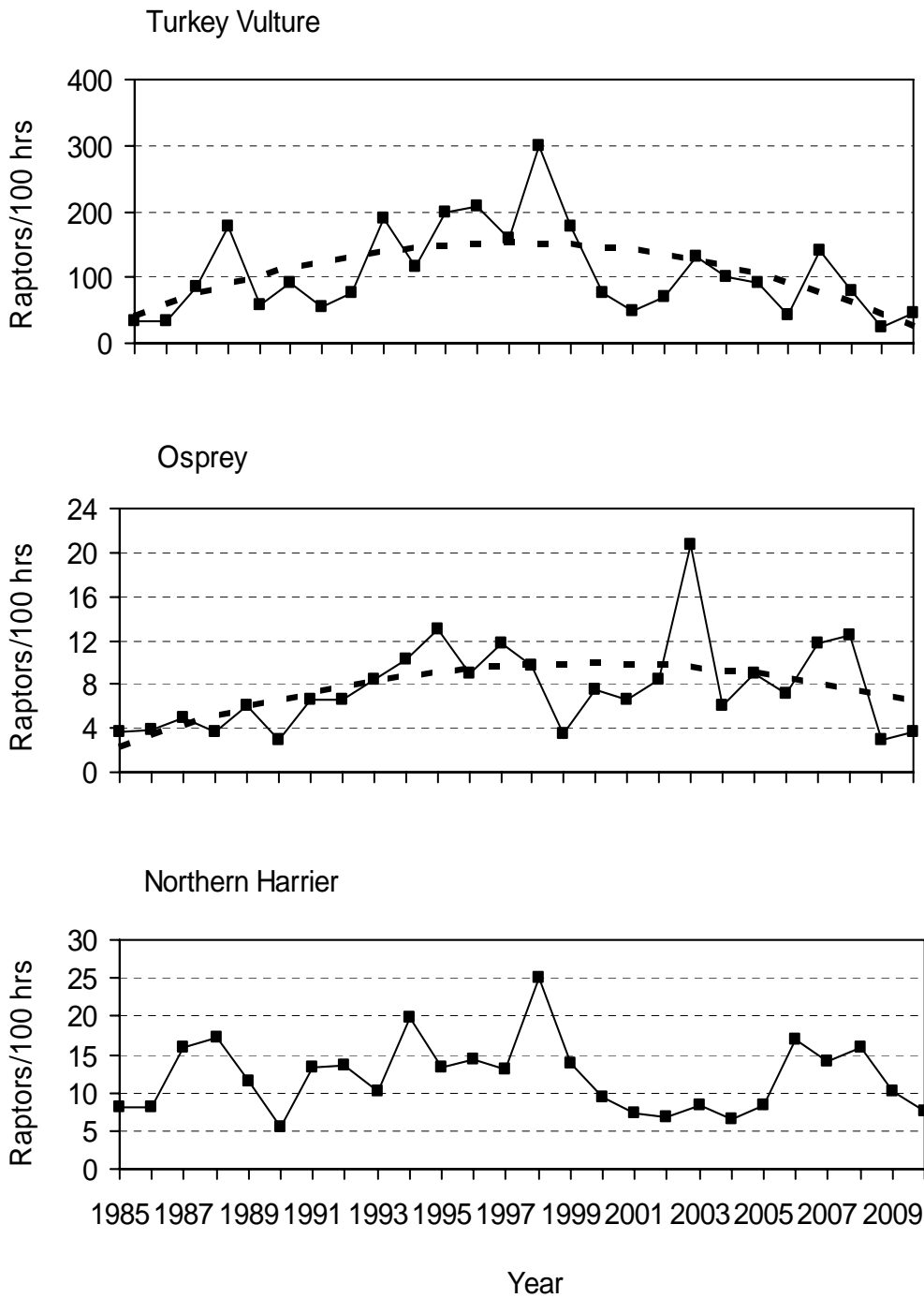
<sup>2</sup> HY = hatch year; SY = second year; TY = third year; AHY = after hatch year; ASY = after second year; ATY = after third year.



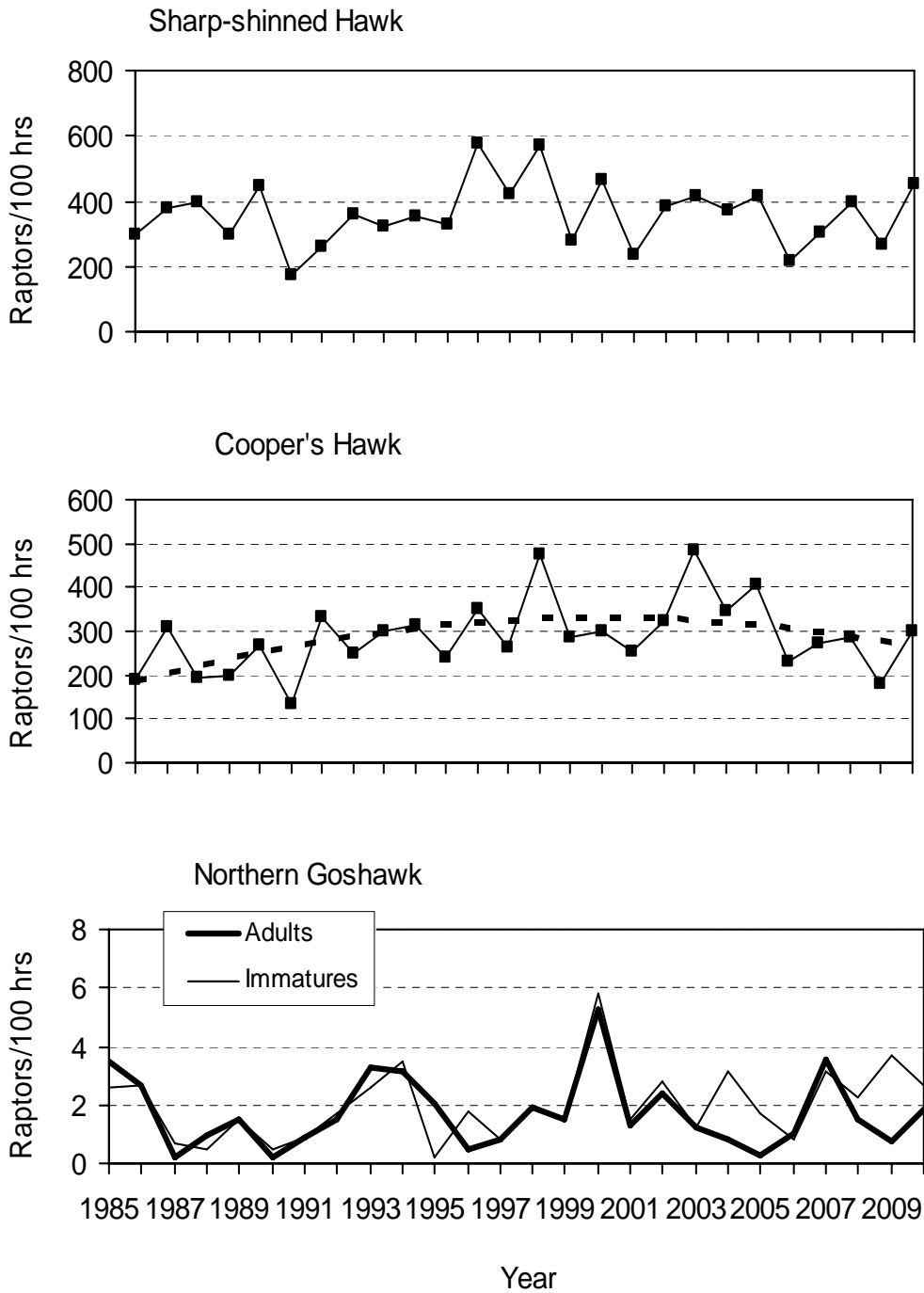
**Figure 1. Map of the Manzano Mountains raptor-migration study site in central New Mexico.**



**Figure 2. Fall raptor-migration flight composition by major species groups in the Manzano Mountains, NM: 1985–2009 versus 2010.**

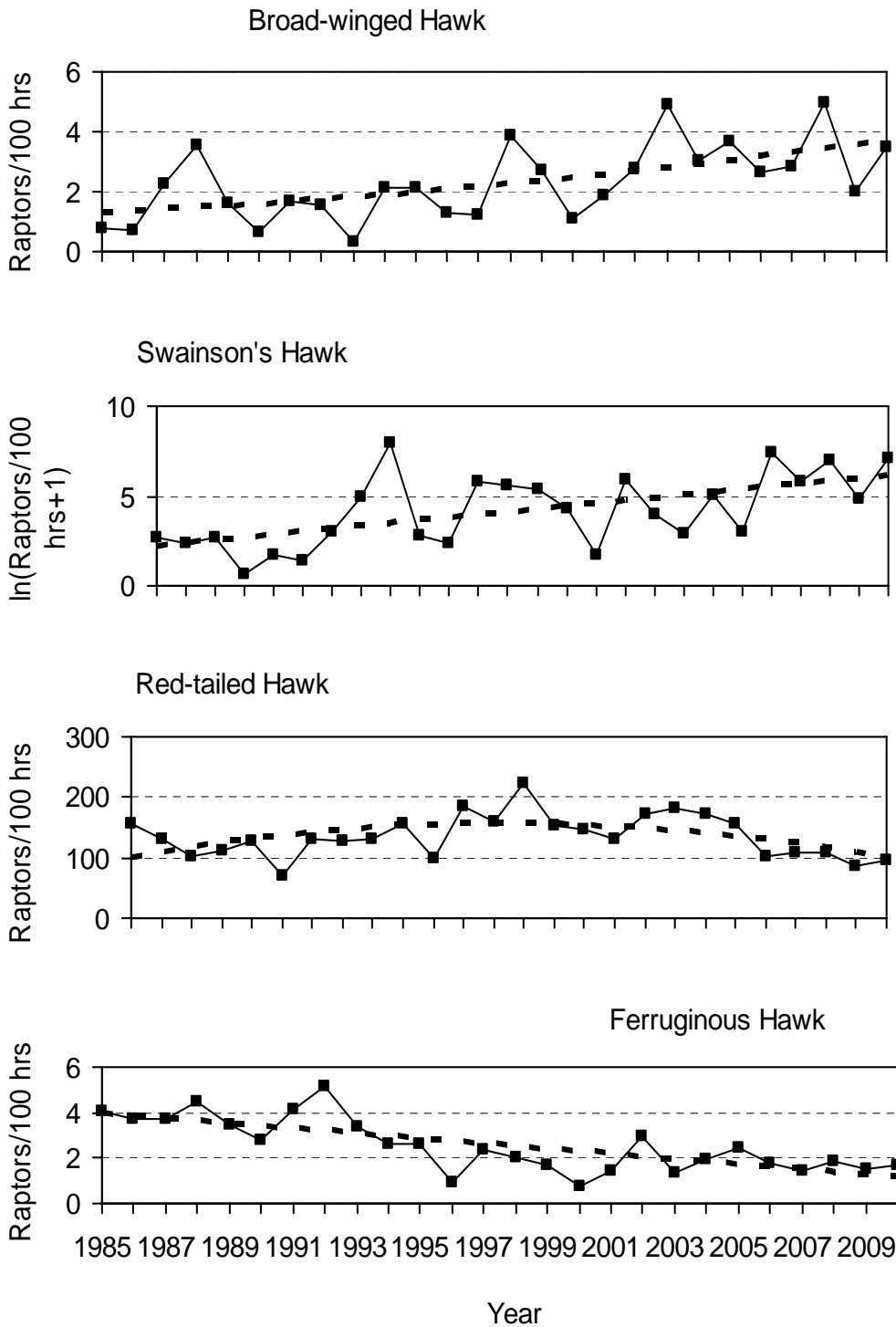


**Figure 3. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) fall-migration passage rates for Turkey Vultures, Ospreys, and Northern Harriers in the Manzano Mountains, NM: 1985–2010. Dashed lines indicate significant ( $P \leq 0.10$ ) regressions.**

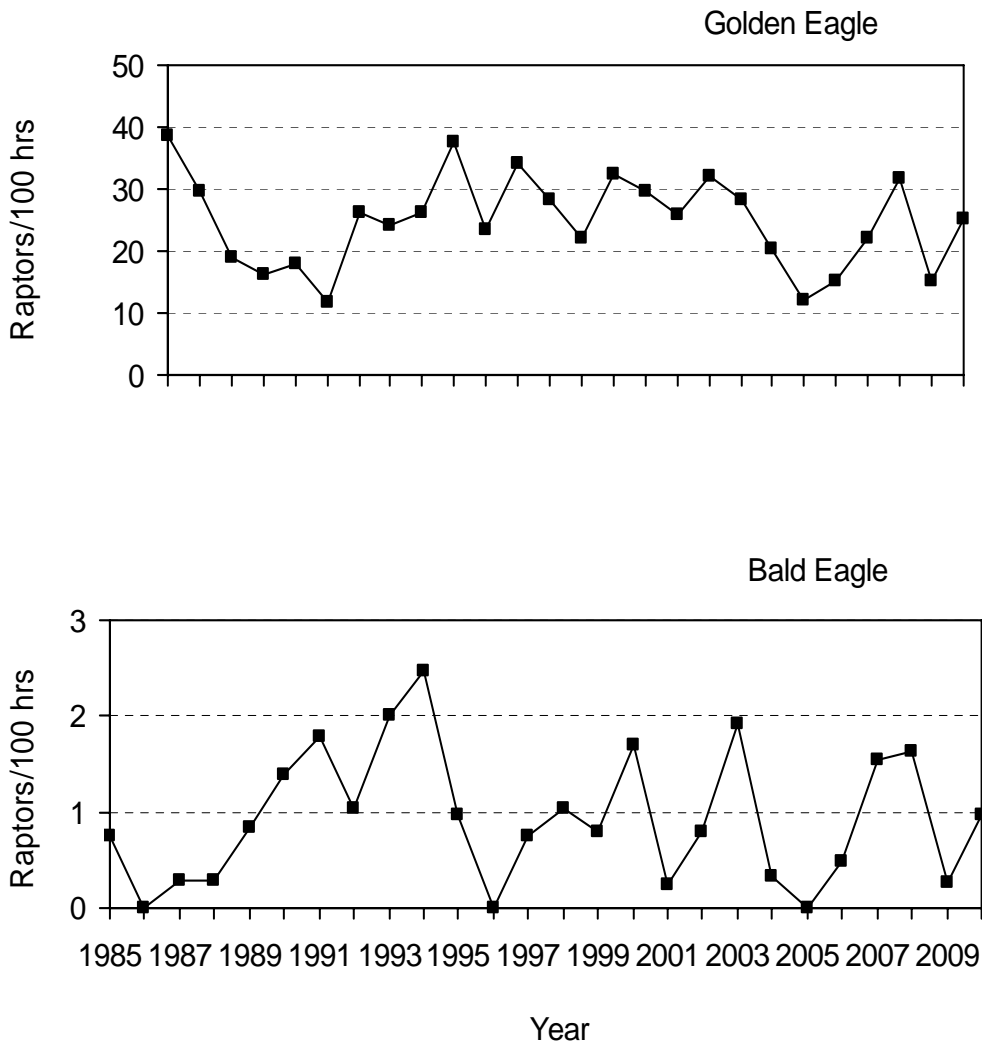


**Figure 4. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) fall-migration passage rates for Sharp-shinned Hawks, Cooper's Hawks, and Northern Goshawks in the Manzano Mountains, NM: 1985–2010. Dashed lines indicate significant ( $P \leq 0.10$ ) regressions.**

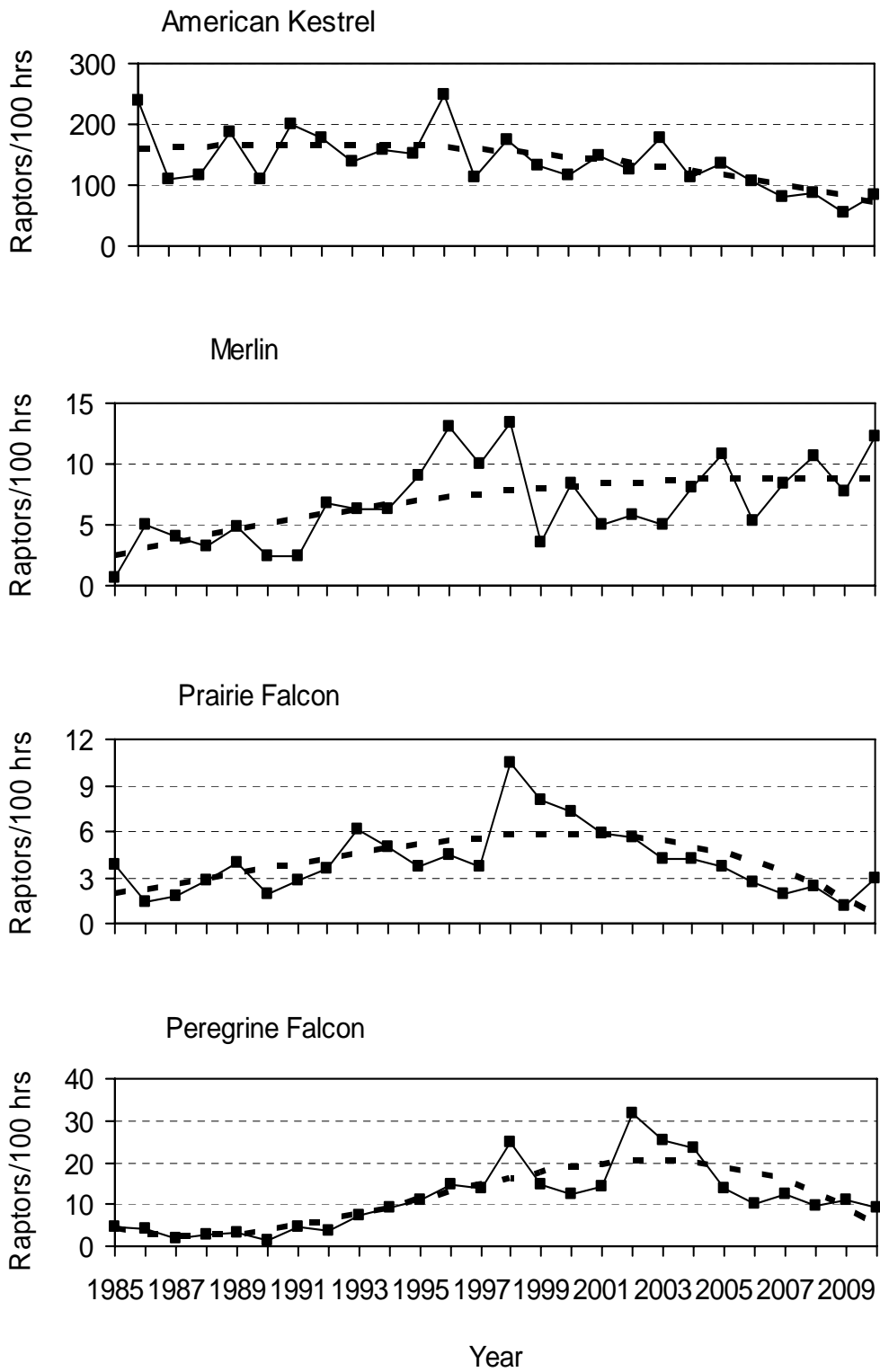




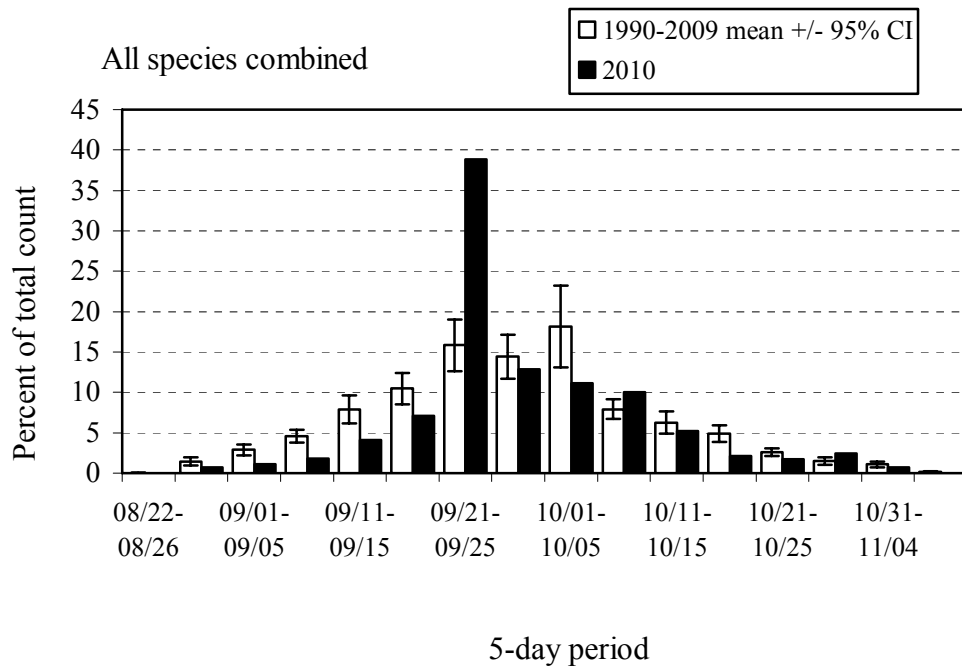
**Figure 5. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) fall-migration passage rates for Broad-winged, Swainson's, Red-tailed and Ferruginous Hawks in the Manzano Mountains, NM: 1985–2010. Dashed lines indicate significant ( $P \leq 0.10$ ) 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: 1985–2010. Dashed lines indicate significant ( $P \leq 0.10$ ) regressions.**



**Figure 7. Adjusted (truncated to standardized annual sampling periods and adjusted for incomplete identification) migration passage rates for American Kestrels, Merlins, Prairie Falcons, and Peregrine Falcons: 1985–2010. 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: 1985–2009 versus 2010.**

**Appendix A. History of official observer participation in the Manzano Mountains Raptor Migration Project: 1985–2010.**

- 1985** Single observer throughout, shared duty: Gary Cress (0)<sup>1</sup>, 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)
- 2007** Two observers throughout: Tim Hanks (4), Aldo Raul Coutreras Reyes (4)
- 2008** Two observers throughout: Tim Hanks (5), Aldo Raul Coutreras Reyes (5), Roger Grimshaw (1)
- 2009** Two observers throughout: Kimberly Cullen (1), Amber Wingert (1), Roger Grimshaw (2)
- 2010** Two observers throughout: Tim Hanks (6+), Russell Seeley (0), Roger Grimshaw (3+)

<sup>1</sup> 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 <sup>1</sup>	SEX <sup>2</sup>	COLOR MORPH <sup>3</sup>
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 <sup>4</sup>	U	NA
Bald Eagle	<i>Haliaeetus leucocephalus</i>	BE	I, S1, S2, NA, A, U <sup>5</sup>	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

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

<sup>2</sup> Sex codes: M = male, F = female, U = unknown.

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

<sup>4</sup> 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.

<sup>5</sup> 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: 2010.**

DATE	OBS. HOURS	OBSVR / HOUR <sup>1</sup>	MEDIAN		PREDOMINANT WEATHER <sup>3</sup>	WIND		TEMP (°C) <sup>1</sup>	BAROM. PRESS. (IN HG) <sup>1</sup>	MEDIAN THERMAL LIFT <sup>4</sup>	VISIB. WEST (KM) <sup>1</sup>	VISIB. EAST (KM) <sup>1</sup>	MEDIAN FLIGHT DISTANCE <sup>5</sup> / HOUR	BIRDS / HOUR
			VISITOR DISTURB <sup>2</sup>	VISITOR		SPEED (KPH) <sup>1</sup>	WIND DIRECTION							
27-Aug	7.50	3.9	1.5		pc, mc	9.0	sw	17.7	30.16	3	92	92	1	0.9
28-Aug	6.00	2.5	0		ovc, t-storm	9.6	ws	16.0	30.05	4	90	74	1	1.0
29-Aug	7.50	2.0	1.5		clr, pc, mc	11.3	ssw-sw	17.3	30.08	3	100	97	1	1.7
30-Aug	7.50	1.6	0		pc, mc	19.7	ssw-sw	16.9	30.12	3	98	98	1.5	0.9
31-Aug	7.75	1.0	0		pc	12.7	sw-w	17.0	30.19	3	100	96	2	2.5
1-Sep	8.00	2.4	0		clr	10.6	ws	19.0	30.16	3	100	100	1	1.6
2-Sep	8.25	1.8	0		clr	7.4	ws	19.1	30.20	2	100	100	1	1.2
3-Sep	8.00	2.6	0		clr, haze	8.7	ese	18.0	30.30	2	92	84	0	2.4
4-Sep	8.33	2.3	0		clr, pc	9.9	ws	19.0	30.23	3	100	100	1	2.0
5-Sep	8.67	2.6	0		clr, pc, mc, haze	13.8	ssw-w	20.0	30.11	3	100	96	1	2.8
6-Sep	8.67	2.7	0		clr	14.7	ws	18.4	30.08	4	100	99	1	5.1
7-Sep	8.00	2.0	0		pc, haze	7.6	e-se	18.7	30.16	2	88	88	0	1.4
8-Sep	6.25	2.4	0		mc, ovc, haze, t-storm	9.4	sw-w	18.0	30.12	4	90	76	1	2.7
9-Sep	8.75	2.5	0		pc, mc	22.0	sw	16.3	30.04	4	90	90	1	3.9
10-Sep	9.25	1.8	0		clr, haze	23.4	sw-w	12.8	30.07	4	99	100	1	3.8
11-Sep	9.17	2.7	0		clr, pc	7.4	ene	16.0	30.22	2	100	100	1	8.8
12-Sep	9.50	1.9	0		pc	7.7	ssw-w	17.5	30.26	2	100	100	1.5	7.9
13-Sep	8.25	2.0	0		mc, ovc	8.6	sw-w	19.0	30.23	4	100	99	2	4.2
14-Sep	9.00	1.8	0		clr, pc, mc, ovc, t-storm	7.0	sw-w	18.9	30.20	2	100	100	1.5	5.2
15-Sep	9.75	2.6	0		clr, pc	8.4	ws	18.8	30.19	3	100	100	1	7.9
16-Sep	9.50	3.4	0		pc	6.5	ese	21.1	30.19	2	100	100	1	15.9
17-Sep	8.25	2.6	0		clr, pc, mc	3.2	s-w	20.1	30.19	2	99	99	2	6.1
18-Sep	9.83	2.8	0		clr, pc	4.8	sw-w	18.6	30.21	2	100	100	2.5	12.4
19-Sep	9.75	2.5	2		clr, pc, haze	2.3	nne	19.4	30.22	2	100	100	2	18.7
20-Sep	8.00	2.6	0		pc, mc, ovc	12.9	sw	17.6	30.09	3	83	85	1	4.8
21-Sep	9.00	3.0	0		pc, haze	7.7	ssw	18.5	30.06	2	100	97	1.5	14.8
22-Sep	4.25	2.9	0		ovc, rain	5.5	s-sw	15.2	30.02	4	75	62	1	2.6
23-Sep	6.08	2.5	0		clr, pc	16.0	sw-w	13.7	30.09	4	100	100	1	13.6
24-Sep	9.50	2.9	0		clr, pc	4.6	se	15.2	30.25	2	100	100	1.5	17.9
25-Sep	10.00	4.0	2		clr	5.9	ese	15.6	30.26	2	100	100	3	258.5
26-Sep	9.67	2.8	0		clr, pc	3.8	sse	15.0	30.25	2	94	90	1	19.6
27-Sep	9.25	2.9	0		clr, pc	5.0	ne	18.5	30.21	2	100	100	2	47.5
28-Sep	10.00	2.2	0		clr	6.0	ws	17.9	30.21	2	100	100	1.5	12.7
29-Sep	9.17	2.0	0		clr	8.7	ws	18.3	30.13	3	100	100	2	9.2
30-Sep	9.75	1.7	0		clr, pc	7.9	ese	16.5	30.22	2	89	87	2	15.3
1-Oct	9.50	2.5	0		clr, pc	10.5	ssw-w	16.8	30.26	3	100	99	2	11.9
2-Oct	8.92	2.8	2		pc, mc, ovc, t-storm	7.7	ese	17.2	30.25	3	100	98	2	32.4
3-Oct	8.50	3.4	2		mc, ovc, t-storm	9.5	ssw	14.3	30.21	4	100	97	1	20.9
4-Oct	8.25	4.4	1.5		pc, t-storm	15.1	ssw	13.7	30.17	3	100	98	1	18.4
5-Oct	8.50	2.1	0		pc, mc, ovc, rain	8.8	se	10.8	30.20	4	95	100	2	14.7
6-Oct	9.00	2.7	1		pc, mc	6.6	se	14.1	30.27	2.5	99	89	2	39.1
7-Oct	9.75	2.0	0		pc, mc, haze	8.4	sse	14.1	30.25	3	95	92	2	13.2
8-Oct	9.25	2.7	0		clr, pc, haze	17.3	ssw	12.6	30.15	4	100	100	1	17.7
9-Oct	9.25	3.0	1		clr	10.7	sw	10.6	30.15	3	100	100	2	7.2
10-Oct	9.00	4.7	0		clr	7.0	sw	9.3	30.05	2.5	100	100	1	6.7
11-Oct	8.75	2.9	0		clr, pc	7.2	sw	10.6	30.06	3	100	100	2	8.6
12-Oct	9.00	1.9	0		clr, pc	4.9	ne	11.5	30.20	3	100	100	2	16.2
13-Oct	8.75	1.9	0		pc, fog, haze	5.2	sse	11.3	30.30	3	62	88	1	12.0
14-Oct	9.00	1.8	0		clr, haze	10.2	ssw	12.2	30.30	3	94	93	1	4.3
15-Oct	9.00	1.6	0		clr, pc, haze	7.5	sw	12.5	30.19	4	100	99	2	4.0
16-Oct	8.67	2.9	1		clr, pc	6.7	sw	12.1	30.16	3	100	100	1	5.9
17-Oct	8.75	2.6	0		clr, pc, mc, haze	8.6	s	12.6	30.12	4	99	99	2	4.0
18-Oct	8.50	1.8	0		mc, ovc	5.7	sw	12.7	30.06	3	99	97	1	4.9
19-Oct	8.50	2.8	0		clr, pc, haze	5.3	ssw	11.5	30.09	3	95	98	1	3.3
20-Oct	4.50	2.0	0		pc, ovc, haze	11.3	ese	12.7	30.12	4	93	97	1	1.1

Appendix C. continued

DATE	OBS. HOURS	OBSRVR / HOUR <sup>1</sup>	MEDIAN		PREDOMINANT WEATHER <sup>3</sup>	WIND		TEMP (°C) <sup>1</sup>	BAROM. PRESS. (IN HG) <sup>1</sup>	MEDIAN THERMAL LIFT <sup>4</sup>	VISIB. WEST (KM) <sup>1</sup>	VISIB. EAST (KM) <sup>1</sup>	MEDIAN FLIGHT DISTANCE <sup>5</sup> / HOUR	BIRDS / HOUR
			VISITOR	DISTURB <sup>2</sup>		SPEED (KPH) <sup>1</sup>	WIND DIRECTION							
21-Oct	8.50	1.8	0		pc, ovc, fog, t-storm	4.9	se-s	9.4	29.96	4	76	73	1	4.5
22-Oct	5.25	2.0	0		ovc, fog	18.0	ssw-wsw	2.9	29.87	4	71	66	1	2.9
23-Oct	6.00	1.5	0		ovc	25.1	sw-w	3.0	29.91	4	97	100	1	5.3
24-Oct	6.00	1.6	0		pc, ovc	21.4	sw-w	6.1	29.95	4	99	99	1	5.3
25-Oct	7.33	1.5	0		ovc	43.6	sw-w	5.3	29.68	4	98	95	1	2.6
26-Oct	8.00	2.8	0		clr	27.5	sw-w	1.8	29.76	4	100	100	1	7.1
27-Oct	8.25	2.4	0		clr, pc	15.7	wsw-w	0.8	30.03	4	100	100	1	4.2
28-Oct	8.25	1.9	0		clr	4.6	s-wsw	7.0	30.31	3	100	100	2	3.8
29-Oct	7.50	2.0	0		clr, pc	22.6	ssw-sw	9.9	30.21	4	100	100	1	2.7
30-Oct	7.50	2.0	0		clr, pc, haze	28.9	ssw-sw	12.5	30.10	4	89	88	1	5.9
31-Oct	7.50	1.7	0		clr, pc	15.9	sw-w	5.8	30.04	4	100	100	1	2.7
1-Nov	7.75	1.8	0		clr	14.2	w-nw	4.1	30.14	4	100	100	1	2.8
2-Nov	7.25	2.2	0		clr	4.5	se, nw-n	6.1	30.26	2.5	100	100	0	0.8
3-Nov	6.50	2.7	0		clr, pc	10.0	ne-ene	9.0	30.31	4	100	100	0	0.6
4-Nov	7.00	2.2	0		clr, pc, mc	11.3	ssw-sw	6.6	30.22	3	100	100	0.5	0.6
5-Nov	0.00				Weather Day									0.0

<sup>1</sup> Average of hourly records.

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

<sup>3</sup> 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.

<sup>4</sup> 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.

<sup>5</sup> 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: 2010.**

DATE	HOURS	SPECIES <sup>1</sup>																								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	7.50	0	0	0	1	2	0	0	0	0	0	0	1	0	0	0	0	2	0	0	1	0	0	0	0	0	0	0	5	0.7
28-Aug	6.00	0	0	0	3	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0.8
29-Aug	7.50	0	0	0	3	4	0	0	0	0	0	0	0	0	0	0	1	0	0	5	0	0	0	0	0	0	1	33	3.8	
30-Aug	7.50	0	0	0	4	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	21	2.7	
31-Aug	7.75	8	0	0	0	3	0	0	0	0	0	5	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0	5	0.6	
1-Sep	8.00	6	0	0	4	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	1.2	
2-Sep	8.25	0	0	0	0	5	0	1	0	0	0	0	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	12	1.5	
3-Sep	8.00	0	0	0	4	3	0	1	0	0	0	0	3	1	0	0	0	1	0	0	6	0	0	0	0	0	0	30	4.1	
4-Sep	8.33	2	0	0	4	4	0	0	0	0	0	0	3	0	0	0	0	1	0	0	3	0	0	0	0	0	0	6	1.1	
5-Sep	8.67	0	0	1	9	4	0	0	0	0	0	0	5	0	0	0	0	0	0	4	0	0	1	0	0	0	0	12	2.1	
6-Sep	8.67	1	0	0	8	7	0	1	0	0	0	1	1	0	0	0	0	0	0	25	0	0	0	0	0	0	1	31	3.8	
7-Sep	8.00	0	1	0	4	4	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	22	2.6	
8-Sep	6.25	1	0	0	10	4	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	15	2.2	
9-Sep	8.75	1	0	0	8	5	0	0	0	0	0	1	6	0	0	0	0	2	0	0	9	0	2	0	0	0	0	9	1.1	
10-Sep	9.25	0	0	0	9	6	0	0	0	0	0	1	3	0	0	0	0	1	0	0	13	0	0	1	0	0	0	55	6.9	
11-Sep	9.17	0	0	0	37	31	0	6	0	0	0	1	3	0	0	0	1	0	0	1	0	0	1	0	0	0	0	55	7.3	
12-Sep	9.50	0	0	0	23	10	0	1	0	0	0	14	4	0	0	0	1	0	0	17	1	0	4	0	0	0	0	10	1.2	
13-Sep	8.25	2	1	0	11	9	0	1	0	0	0	1	7	0	0	0	0	1	0	0	2	0	0	0	0	0	0	108	13.2	
14-Sep	9.00	0	2	0	23	9	0	0	0	0	0	1	1	0	0	0	0	1	0	0	9	1	0	0	0	0	2	50	5.6	
15-Sep	9.75	0	0	2	24	17	2	1	0	0	1	0	9	1	0	0	1	3	0	0	15	1	0	0	0	0	0	56	6.7	
16-Sep	9.50	0	1	0	76	49	0	7	0	0	0	1	3	0	0	0	0	1	0	0	11	0	0	1	0	0	0	11	1.6	
17-Sep	8.25	0	2	0	22	14	0	3	0	0	1	0	2	0	0	0	0	0	0	6	0	0	0	0						
18-Sep	9.83	0	0	0	25	25	1	2	1	0	1	53	3	1	0	0	1	0	0	6	0	0	1	1						
19-Sep	9.75	0	0	1	77	53	0	11	0	0	0	16	10	1	0	0	1	0	0	10	0	1	1	0	0	0	0	22	2.6	
20-Sep	8.00	0	0	2	18	13	0	0	0	0	0	0	2	0	0	0	0	0	0	2	0	0	1	0	0	1	0	59	8.3	
21-Sep	9.00	41	0	0	31	15	0	2	0	1	0	27	4	0	0	0	1	2	0	0	9	0	0	0	0	0	0	73	8.4	
22-Sep	4.25	0	0	0	6	4	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	93	11.3	
23-Sep	6.08	1	1	0	23	14	0	1	0	0	0	0	6	0	0	0	0	0	0	33	0	0	3	0	0	0	1	53	6.3	
24-Sep	9.50	2	1	0	73	59	1	8	2	0	0	0	14	0	0	1	1	0	0	5	2	0	0	0	0	0	0	61	7.6	
25-Sep	10.00	0	1	0	73	63	2	8	1	2	0	2411	8	0	0	0	2	0	0	8	1	0	5	0	0	0	0	34	4.2	
26-Sep	9.67	24	1	1	58	40	0	1	1	0	1	30	8	0	0	0	0	3	0	0	18	2	0	1	0	0	0	84	10.1	
27-Sep	9.25	5	0	1	115	65	0	9	0	0	2	212	8	0	0	0	1	3	0	0	17	0	1	0	0	1	0	70	8.1	
28-Sep	10.00	3	0	2	33	19	0	0	0	0	0	50	4	0	0	0	0	0	0	13	1	0	1	0	0	0	0	143	17.3	
29-Sep	9.17	24	1	0	28	17	0	0	0	0	0	0	6	0	0	0	1	2	0	0	4	0	1	0	0	0	0	92	10.4	
30-Sep	9.75	0	0	0	74	52	1	3	0	0	1	0	12	0	0	0	0	2	0	0	1	0	0	2	0	0	1	91	13.6	
1-Oct	9.50	0	0	2	24	16	0	1	0	0	0	50	6	0	0	0	0	4	0	0	5	4	0	1	0	0	0	45	5.0	
2-Oct	8.92	19	1	1	115	92	0	11	0	0	2	11	27	0	0	0	3	1	0	0	2	1	0	1	1	0	0	39	4.9	
3-Oct	8.50	0	0	0	69	43	0	2	0	0	0	19	13	0	0	0	2	2	0	0	23	3	1	1	0	0	0	40	4.8	
4-Oct	8.25	21	0	2	67	23	0	2	1	0	0	4	13	0	0	0	0	2	0	0	14	2	1	0	0	0	1	0	43	5.2
5-Oct	8.50	1	0	1	70	34	1	0	1	0	1	0	7	0	0	0	1	1	0	0	5	1	0	0	0	0	0	37	4.6	

Appendix D. continued

DATE	HOURS	SPECIES <sup>1</sup>																							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				
6-Oct	9.00	1	1	1	165	143	0	9	0	0	0	1	23	0	0	0	1	0	0	0	5	0	0	1	0	0	1	0	0	1	352	39.1		
7-Oct	9.75	2	0	0	83	26	0	3	0	0	0	0	10	0	0	0	0	3	0	0	1	1	0	0	0	0	0	0	0	129	13.2			
8-Oct	9.25	2	1	1	86	31	1	0	0	0	1	0	14	1	0	0	0	2	0	0	18	1	1	4	0	0	0	0	0	164	17.7			
9-Oct	9.25	0	0	0	40	11	0	0	0	0	0	0	6	0	0	0	0	0	0	0	6	2	0	2	0	0	0	0	0	67	7.2			
10-Oct	9.00	0	0	0	28	9	1	1	0	0	1	1	13	0	0	0	2	2	0	0	0	1	1	0	0	0	0	0	0	60	6.7			
11-Oct	8.75	0	0	2	27	13	0	2	0	0	0	0	21	1	0	0	0	5	0	0	3	1	0	0	0	0	0	0	0	75	8.6			
12-Oct	9.00	22	0	4	60	29	0	1	1	0	0	0	19	0	0	0	1	4	0	0	1	3	0	1	0	0	0	0	146	16.2				
13-Oct	8.75	0	0	3	64	15	0	0	0	0	0	0	16	0	0	0	0	5	0	0	0	2	0	0	0	0	0	0	105	12.0				
14-Oct	9.00	0	0	1	19	4	0	0	0	0	0	0	4	0	0	0	0	7	0	0	2	1	0	1	0	0	0	0	39	4.3				
15-Oct	9.00	0	0	0	20	5	1	0	0	0	0	0	4	0	0	0	0	3	0	0	0	1	1	0	0	1	0	0	36	4.0				
16-Oct	8.67	0	0	2	24	5	1	1	0	0	0	0	9	1	0	0	0	2	1	0	3	1	0	0	0	0	0	1	51	5.9				
17-Oct	8.75	0	0	0	12	3	0	0	0	0	0	0	11	0	0	0	0	3	0	0	2	3	1	0	0	0	0	0	35	4.0				
18-Oct	8.50	0	0	1	26	1	0	0	1	0	0	0	5	0	0	0	0	3	0	0	3	2	0	0	0	0	0	0	42	4.9				
19-Oct	8.50	0	0	0	18	2	0	0	0	0	0	0	3	0	0	0	0	3	0	0	0	2	0	0	0	0	0	0	28	3.3				
20-Oct	4.50	0	0	0	3	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	5	1.1				
21-Oct	8.50	0	0	1	18	8	0	0	0	0	0	0	5	0	0	0	0	4	0	0	0	1	0	0	0	0	0	1	38	4.5				
22-Oct	5.25	0	0	1	3	0	1	0	0	0	0	0	6	0	0	0	0	2	0	0	0	1	0	1	0	0	0	0	15	2.9				
23-Oct	6.00	0	0	0	15	2	0	0	0	0	0	0	10	0	0	0	0	3	1	0	0	1	0	0	0	0	0	0	32	5.3				
24-Oct	6.00	0	0	1	14	0	0	0	0	0	0	0	11	0	0	0	0	5	0	0	0	0	0	1	0	0	0	0	32	5.3				
25-Oct	7.33	0	0	2	2	2	1	0	0	0	0	0	10	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	19	2.6				
26-Oct	8.00	0	2	2	10	6	0	0	0	0	0	0	25	0	0	0	0	5	0	1	3	2	1	0	0	0	0	0	57	7.1				
27-Oct	8.25	0	0	0	7	0	0	0	0	0	0	0	16	1	0	0	0	9	0	0	1	1	0	0	0	0	0	0	35	4.2				
28-Oct	8.25	0	0	0	11	2	1	0	0	0	0	0	13	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	31	3.8				
29-Oct	7.50	0	0	1	9	1	2	0	0	0	0	0	2	0	0	0	0	1	1	0	0	2	1	0	0	0	0	0	20	2.7				
30-Oct	7.50	0	0	0	13	1	1	0	0	0	0	0	16	1	0	0	0	8	1	1	1	1	0	0	0	0	0	0	44	5.9				
31-Oct	7.50	0	0	1	9	1	1	0	0	0	0	0	3	0	0	0	0	3	0	0	0	1	0	1	0	0	0	0	20	2.7				
1-Nov	7.75	0	0	0	10	0	1	0	0	0	0	0	2	0	0	0	0	5	0	2	0	2	0	0	0	0	0	0	22	2.8				
2-Nov	7.25	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	6	0.8				
3-Nov	6.50	0	0	0	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0.6				
4-Nov	7.00	0	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	4	0.6				
5-Nov	0.00																																	
Total	578.00	189	17	41	2067	1162	23	102	9	3	13	2906	491	9	0	1	22	130	4	4	359	54	13	40	2	5	0	8	7674	13.3				

<sup>1</sup> 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: 1985–2010.**

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Start date	06-Sep	23-Aug	25-Aug	30-Aug	28-Aug	27-Aug	27-Aug	25-Aug	25-Aug	25-Aug
End date	02-Nov	31-Oct	04-Nov	31-Oct	31-Oct	31-Oct	05-Nov	05-Nov	05-Nov	02-Nov
Days of observation	50	63	65	60	63	62	67	70	68	66
Hours of observation	343.33	464.50	517.92	453.08	489.75	510.75	524.58	537.25	489.67	508.75
Raptors / 100 hours	843.2	863.9	758.6	772.3	955.4	494.6	825.6	946.3	2429.2	966.5
SPECIES	RAPTOR COUNTS									
Turkey Vulture	74	118	283	466	178	295	176	268	601	430
Osprey	10	14	19	13	22	12	24	26	31	38
Northern Harrier	28	36	78	78	59	27	66	69	48	97
Sharp-shinned Hawk	956	1300	1622	1118	1834	688	1080	1540	1193	1415
Cooper's Hawk	531	881	679	604	929	471	1105	961	944	1054
Northern Goshawk	21	20	7	6	14	3	8	16	27	30
Unknown small accipiter <sup>1</sup>	-	-	-	-	-	-	-	-	-	-
Unknown large accipiter <sup>1</sup>	-	-	-	-	-	-	-	-	-	-
Unknown accipiter	78	104	119	111	121	120	156	117	266	118
TOTAL ACCIPITERS	1586	2305	2427	1839	2898	1282	2349	2634	2430	2617
Broad-winged Hawk	2	2	7	10	5	2	5	5	1	7
Swainson's Hawk	27	33	44	3	16	9	58	344	7301	67
Red-tailed Hawk	513	527	457	486	604	329	577	667	566	707
Ferruginous Hawk	14	15	17	20	16	13	19	25	17	13
Rough-legged Hawk	0	0	0	1	1	0	0	0	0	0
Zone-tailed Hawk	0	0	0	0	0	0	0	2	0	1
Unknown buteo	21	12	11	16	4	19	30	11	31	22
TOTAL BUTEOS	577	589	536	536	646	372	689	1054	7916	817
Golden Eagle	133	123	86	67	85	52	124	119	120	172
Bald Eagle	2	0	1	1	3	4	7	4	7	9
Unknown Eagle	0	0	0	4	0	4	0	0	0	0
TOTAL EAGLES	135	123	87	72	88	60	131	123	127	181
American Kestrel	421	755	426	385	677	409	728	704	520	582
Merlin	2	16	17	12	18	9	10	28	24	24
Prairie Falcon	13	7	8	12	19	9	14	17	27	22
Peregrine Falcon	14	15	7	10	15	5	21	18	31	37
Unknown small falcon <sup>1</sup>	-	-	-	-	-	-	-	-	-	-
Unknown large falcon <sup>1</sup>	-	-	-	-	-	-	-	-	-	-
Unknown falcon	4	0	1	0	3	5	3	1	0	1
TOTAL FALCONS	454	793	459	419	732	437	776	768	602	666
Unknown raptor	31	35	40	76	56	41	120	142	140	71
TOTAL	2895	4013	3929	3499	4679	2526	4331	5084	11895	4917

## Appendix E. continued

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Start date	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug	28-Aug
End date	08-Nov	05-Nov	5-Nov	5-Nov	5-Nov	2-Nov	4-Nov	3-Nov	5-Nov	30-Oct
Days of observation	70	59	68	65	70	57	68	65	69	57
Hours of observation	560.00	461.67	565.08	559.58	553.77	434.33	545.47	518.50	577.25	424.08
Raptors / 100 hours	832.9	1545.9	1044.8	1594.2	873.1	991.6	855.8	972.0	1126.4	1039.9
SPECIES	RAPTOR COUNTS									
Turkey Vulture	636	640	563	1116	637	241	164	239	468	289
Osprey	53	33	47	44	14	25	26	32	86	20
Northern Harrier	72	64	69	133	69	38	37	33	50	27
Sharp-shinned Hawk	1519	2174	1872	2585	1212	1698	1032	1524	1861	1268
Cooper's Hawk	907	1205	1018	2025	1069	984	913	1149	1758	964
Northern Goshawk	11	9	9	19	14	42	13	23	12	15
Unknown small accipiter <sup>1</sup>	-	-	-	-	-	-	86	188	205	169
Unknown large accipiter <sup>1</sup>	-	-	-	-	-	-	0	3	5	4
Unknown accipiter	44	147	76	107	51	29	0	11	5	28
TOTAL ACCIPITERS	2481	3535	2975	4736	2346	2753	2044	2898	3846	2448
Broad-winged Hawk	7	4	5	14	12	3	6	9	16	6
Swainson's Hawk	32	867	679	572	194	19	815	139	53	291
Red-tailed Hawk	519	771	803	1151	733	591	632	778	924	636
Ferruginous Hawk	13	4	13	10	8	3	10	14	7	8
Rough-legged Hawk	0	0	0	1	1	0	1	0	0	0
Zone-tailed Hawk	1	0	1	2	0	3	1	1	0	0
Unknown buteo	9	11	3	28	5	2	106	32	30	69
TOTAL BUTEOS	581	1657	1504	1778	953	621	1571	973	1030	1010
Golden Eagle	136	151	145	115	159	115	128	149	146	79
Bald Eagle	4	0	3	4	3	5	1	3	8	1
Unknown Eagle	0	0	0	0	0	1	0	0	1	0
TOTAL EAGLES	140	151	148	119	162	121	129	152	155	80
American Kestrel	584	905	455	742	525	397	560	470	686	362
Merlin	42	48	42	56	14	27	21	22	22	26
Prairie Falcon	18	19	19	58	38	30	28	24	20	18
Peregrine Falcon	49	60	67	116	64	49	63	127	112	82
Unknown small falcon <sup>1</sup>	-	-	-	-	-	-	0	4	2	1
Unknown large falcon <sup>1</sup>	-	-	-	-	-	-	0	15	3	1
Unknown falcon	0	1	0	12	2	1	5	2	1	5
TOTAL FALCONS	693	1033	583	984	643	504	677	664	846	495
Unknown raptor	8	24	15	11	11	4	20	49	21	41
TOTAL	4664	7137	5904	8921	4835	4307	4668	5040	6502	4410

## Appendix E. continued

	2005	2006	2007	2008	2009	2010	Mean
Start date	27- Aug	27- Aug	27-Aug	27-Aug	27-Aug	27-Aug	26-Aug
End date	5-Nov	5-Nov	5-Nov	5-Nov	5-Nov	4-Nov	2-Nov
Days of observation	69	68	63	69	68	70	65
Hours of observation	599.58	566.41	553.58	579.00	535.68	578.00	517.37
Raptors / 100 hours	937.8	1433.4	883.2	1327.5	577.0	1327.7	1046.7
SPECIES	RAPTOR COUNTS						
Turkey Vulture	363	150	499	315	82	189	367
Osprey	35	30	47	50	12	17	30
Northern Harrier	46	90	75	89	49	41	60
Sharp-shinned Hawk	1842	958	1283	1836	1051	2067	1479
Cooper's Hawk	1486	865	922	1084	620	1162	1010
Northern Goshawk	10	10	30	21	21	23	17
Unknown small accipiter <sup>1</sup>	129	119	74	57	94	102	122
Unknown large accipiter <sup>1</sup>	5	2	7	10	12	9	6
Unknown accipiter	1	6	10	16	12	3	71
TOTAL ACCIPITERS	3473	1960	2326	3024	1810	3366	2626
Broad-winged Hawk	13	9	10	17	6	13	8
Swainson's Hawk	52	4695	841	2952	274	2906	896
Red-tailed Hawk	823	534	537	575	398	491	629
Ferruginous Hawk	13	9	8	10	8	9	12
Rough-legged Hawk	0	0	0	1	0	0	0
Zone-tailed Hawk	1	0	0	0	0	1	1
Unknown buteo	33	23	19	11	57	22	25
TOTAL BUTEOS	935	5270	1415	3566	743	3442	1569
Golden Eagle	71	87	99	167	70	130	116
Bald Eagle	1	3	6	7	1	4	4
Unknown Eagle	4	1	9	2	4	4	1
TOTAL EAGLES	76	91	114	176	75	138	121
American Kestrel	520	412	298	350	216	359	517
Merlin	48	23	34	47	28	54	27
Prairie Falcon	16	13	10	11	6	13	19
Peregrine Falcon	61	43	51	42	43	40	48
Unknown small falcon <sup>1</sup>	2	1	0	1	4	2	2
Unknown large falcon <sup>1</sup>	5	3	2	2	3	5	4
Unknown falcon	6	1	1	1	2	0	2
TOTAL FALCONS	658	496	396	454	302	473	615
Unknown raptor	37	32	17	12	18	8	42
TOTAL	5623	8119	4889	7686	3091	7674	5431

<sup>1</sup> 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: 2010.**

DATE	STN.	SPECIES <sup>1</sup>													CAPTURES	
	HOURS	NH	SS	CH	NG	BW	SW	RT	ZT	GE	AK	ML	PR	PG	TOTAL	/STN HR
2-Sep	3.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
3-Sep	6.00	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0.2
4-Sep	7.50	0	1	0	0	0	0	1	0	0	0	0	0	0	2	0.3
5-Sep	4.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
6-Sep	4.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
7-Sep	7.00	0	1	2	0	0	0	1	0	0	0	0	0	0	4	0.6
8-Sep	5.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
9-Sep	5.75	0	2	3	0	0	0	0	0	0	0	0	0	0	5	0.9
10-Sep	15.00	0	8	4	0	0	0	1	0	0	1	0	1	0	15	1.0
11-Sep	7.00	0	1	2	0	0	0	0	0	0	0	0	0	0	3	0.4
12-Sep	7.00	0	3	2	0	0	0	0	0	0	0	0	0	0	5	0.7
13-Sep	8.00	0	5	1	0	0	0	0	0	0	0	0	0	0	6	0.8
14-Sep	7.75	0	12	5	0	0	0	0	0	0	0	0	0	0	17	2.2
15-Sep	7.50	0	1	2	0	0	0	0	0	0	0	0	0	0	3	0.4
16-Sep	15.50	0	4	4	0	0	0	0	0	0	0	0	0	0	8	0.5
17-Sep	15.82	0	16	17	0	0	0	0	0	0	0	0	0	0	33	2.1
18-Sep	7.33	0	5	5	0	0	0	0	0	0	0	0	0	0	10	1.4
19-Sep	8.00	0	1	0	0	0	0	1	0	0	1	0	0	0	3	0.4
20-Sep	3.50	0	1	1	0	0	0	0	0	0	0	0	0	0	2	0.6
21-Sep	3.83	0	1	2	0	0	0	0	0	0	1	0	0	0	4	1.0
22-Sep	8.00	0	8	6	0	0	0	1	0	0	0	0	0	0	15	1.9
23-Sep	16.41	0	15	9	1	0	0	1	0	0	0	0	0	1	27	1.6
24-Sep	8.50	0	2	3	0	0	0	0	0	1	0	0	0	0	6	0.7
25-Sep	7.75	0	4	10	0	0	0	0	0	0	0	0	0	0	14	1.8
26-Sep	8.25	0	3	6	0	0	0	0	0	0	1	0	0	0	10	1.2
27-Sep	7.58	0	1	5	0	0	0	1	0	0	0	0	1	0	8	1.1
28-Sep	7.91	0	0	7	0	0	0	1	0	0	0	0	0	0	8	1.0
29-Sep	7.58	0	1	3	0	0	0	0	0	0	0	0	0	0	4	0.5
30-Sep	14.75	0	7	13	0	0	0	1	0	0	0	0	0	0	21	1.4
1-Oct	13.66	0	6	13	0	0	0	0	0	0	0	1	0	0	20	1.5
2-Oct	7.60	0	5	3	0	0	0	0	0	0	1	0	0	0	9	1.2
3-Oct	4.41	0	4	2	0	0	0	0	0	0	0	0	0	0	6	1.4
4-Oct	3.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
5-Oct	6.00	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0.2

## Appendix F. continued

DATE	STN.		SPECIES <sup>1</sup>													CAPTURES	
	HOURS		NH	SS	CH	NG	BW	SW	RT	ZT	GE	AK	ML	PR	PG	TOTAL	/STN HR
6-Oct	8.00		0	15	9	0	0	0	0	0	0	0	0	0	0	24	3.0
7-Oct	8.00		0	3	4	0	0	0	1	0	0	0	0	0	0	8	1.0
8-Oct	8.00		0	7	2	0	0	0	0	0	0	0	0	0	0	9	1.1
9-Oct	16.50		0	7	3	0	0	0	1	0	0	0	0	0	0	11	0.7
10-Oct	10.99		0	2	1	0	0	0	1	0	0	0	0	0	0	4	0.4
11-Oct	7.25		1	1	2	0	0	0	0	0	0	0	0	0	0	4	0.6
12-Oct	8.00		0	8	3	0	0	0	1	0	0	0	0	0	0	12	1.5
13-Oct	5.66		1	4	1	0	0	0	2	0	0	0	1	0	0	9	1.6
14-Oct	8.00		0	2	0	0	0	0	0	0	0	0	0	0	0	2	0.3
15-Oct	0.00																
16-Oct	7.25		0	3	0	1	0	0	2	0	0	0	0	0	0	6	0.8
17-Oct	7.75		0	4	0	0	0	0	2	0	0	0	0	0	0	6	0.8
18-Oct	7.66		0	3	0	0	0	0	0	0	0	0	0	0	0	3	0.4
19-Oct	7.41		0	2	1	0	0	0	0	0	0	0	0	0	0	3	0.4
20-Oct	3.66		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
21-Oct	7.00		0	3	2	0	0	0	1	0	0	0	0	0	0	6	0.9
22-Oct	3.16		0	0	0	0	0	0	1	0	0	0	0	0	0	1	0.3
23-Oct	0.00																
24-Oct	4.00		0	1	0	0	0	0	0	0	0	0	0	0	0	1	0.3
25-Oct	5.75		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
26-Oct	5.75		0	0	1	0	0	0	1	0	0	0	0	1	0	3	0.5
27-Oct	6.50		0	1	0	0	0	0	0	0	0	0	0	0	0	1	0.2
Total	408.67		2.00	184.00	160.00	2.00	0.00	0.00	22.00	0.00	1.00	5.00	2.00	3.00	1.00	382.00	43.13

<sup>1</sup> 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: 1990–2010.**

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Start date	28-Aug	05-Sep	31-Aug	03-Sep	01-Sep	04-Sep	02-Sep	31-Aug	29-Aug	31-Aug	02-Sep	01-Sep	03-Sep	07-Sep	05-Sep	04-Sep	04-Sep	02-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	27-Oct
Blinds in operation	1	3	3	3	3	4	4	4	3	3	3	3	3	2	2	2	2	2
Trapping days	47	54	57	50	48	53	45	54	58	46	50	55	51	45	45	51	48	47
Station days	47	95	131	120	121	136	132	151	165	94	119	145	131	84	84	99	94	105
Station hours	511	693	967	889	926	1041	1030	1211	1352	664	791	1037	957	633	756.15	707.77	677.67	452.97
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	83.2
SPECIES	RAPTOR CAPTURES																	
Northern Harrier	1	2	2	3	9	2	1	8	14	0	5	7	6	3	0	3	6	3
Sharp-shinned Hawk	124	262	589	430	502	493	778	612	987	321	495	426	635	458	566	562	299	196
Cooper's Hawk	95	195	335	374	353	310	460	427	772	323	330	337	510	400	378	495	280	142
Northern Goshawk	1	7	6	6	7	1	5	3	6	6	16	1	10	1	2	3	3	3
Broad-winged Hawk	0	0	0	0	0	0	0	0	1	0	0	0	1	1	1	0	1	1
Swainson's Hawk	0	0	0	0	0	0	0	0	0	0	0	1	3	0	0	0	1	0
Red-tailed Hawk	8	18	61	55	83	50	50	46	112	56	76	39	56	38	43	35	35	9
Zone-tailed Hawk	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Golden Eagle	1	3	4	4	4	4	6	4	5	2	4	5	7	8	2	2	1	1
American Kestrel	10	13	42	14	59	28	92	32	75	44	25	56	37	43	18	37	10	9
Merlin	1	0	2	4	1	1	11	6	7	2	8	2	12	3	10	3	2	5
Prairie Falcon	1	1	3	5	3	1	3	5	13	6	3	7	5	4	3	4	4	2
Peregrine Falcon	2	1	2	1	4	2	5	7	12	8	1	10	13	7	5	10	12	6
All Species	244	502	1046	896	1025	892	1411	1150	2006	768	963	891	1295	966	1028	1154	654	377
Recaptures <sup>1</sup>	0	0	1	1	2	2	1	2	4	4	3	2	3	2	2	3	2	0
Foreign recaptures <sup>2</sup>	2	1	1	1	2	0	5	1	2	2	0	0	3	2	0	0	1	0
Foreign encounters <sup>3</sup>	0	2	2	3	6	6	7	8	13	12	6	7	10	7	5	3	4	6

<sup>1</sup> Recaptures in the Manzanos of birds originally banded in the Manzanos.

<sup>2</sup> Recaptures in the Manzanos of birds originally banded elsewhere.

<sup>3</sup> Birds originally banded in the Manzanos and subsequently encountered elsewhere.



Appendix G. continued

	2008	2009	2010	TOTAL	MEAN
Start date	3-Sep	3-Sep	2-Sep		1-Sep
End date	30-Oct	27-Oct	27-Oct		25-Oct
Blinds in operation	2	2	2		2.8
Trapping days	56	48	52		50.4
Station days	80	61	61		97.7
Station hours	586.04	390.25	408.67		794.4
Captures / 100 stn hrs	104.8	133.8	93.5		110.8
SPECIES	RAPTOR CAPTURES				
Northern Harrier	4	2	2	83	4.0
Sharp-shinned Hawk	315	255	184	9489	451.9
Cooper's Hawk	247	201	160	7124	339.2
Northern Goshawk	3	8	2	100	4.8
Broad-winged Hawk	0	0	0	6	0.3
Swainson's Hawk	0	0	0	5	0.2
Red-tailed Hawk	20	34	22	946	45.0
Zone-tailed Hawk	0	0	0	1	0.0
Golden Eagle	9	1	1	78	3.7
American Kestrel	4	16	5	669	31.9
Merlin	8	2	2	92	4.4
Prairie Falcon	1	1	3	78	3.7
Peregrine Falcon	3	2	1	114	5.4
All Species	614	522	382	18785	894.5
Recaptures <sup>1</sup>	1	1	2	38	1.8
Foreign recaptures <sup>2</sup>	0	1	0	24	1.1
Foreign encounters <sup>3</sup>	5	5	2	127	6.0

<sup>1</sup> Recaptures in the Manzanos of birds originally banded in the Manzanos.

<sup>2</sup> Recaptures in the Manzanos of birds originally banded elsewhere.

<sup>3</sup> Birds originally banded in the Manzanos and subsequently encountered elsewhere.