FALL 2009 RAPTOR MIGRATION STUDIES IN THE MANZANO MOUNTAINS OF CENTRAL NEW MEXICO



HawkWatch International, Inc. Salt Lake City, Utah



December 2009

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December 2009

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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 a trapping and banding program at the 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 2009 season marked the 25th consecutive count and the 20th consecutive season of trapping and banding conducted at the site by HWI. This report summarizes the 2009 count and banding results.

The Manzanos project was 1 of 10 long-term, annual migration counts and 1 of 5 migration-banding studies conducted or co-sponsored by HWI in North America during 2009. 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, 2008a, 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 2009, 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. Both official observers, Kimberly Cullen and Amber Wingert, had one previous season of migration counting experience (see Appendix A for a complete history of observer participation). Volunteers and other crewmembers occasionally assisted with the counts, particularly seasoned volunteer Roger Grimshaw, who regularly functioned as a substitute observer when the full-time observers took days off. Weather permitting, observations typically began by 0900 H and ended by 1700 H Mountain Standard Time (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.

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 2009 follows Hoffman and Smith (2003). In comparing 2009 annual statistics against means and 95% confidence intervals for previous seasons, we equate significance with a 2009 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 North blind most days and West blind when crew availability was sufficient, generally 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 45 minutes of capture, usually much quicker.

RESULTS AND DISCUSSION

WEATHER

In 2009, inclement weather entirely precluded three full days of potential observations and severely hampered (≤ 4 hours observation) observations on two other days (see Appendix C for daily weather summaries). The number of days fully precluded by weather was below the 1997–2008 average of 5.3 days (range 1–14), whereas the number of otherwise severely hampered days essentially matched the average of 1.8 days (range 0–5). Sky conditions during active observation periods were slightly more unsettled than usual; 49% of the active observation days featured predominantly fair skies (average 50%), 12% transitional skies (i.e., changed from fair skies to mostly cloudy or overcast during the day, or vice versa; average 17%), and 40% mostly cloudy to overcast skies (average 33%). Moreover, the prevalence of scattered rain/snow showers during active observation periods was well above average in 2009 (57% of active days vs. average of 38%), as was the prevalence of visibility reducing fog and especially haze (56% vs. average of 34%). These factors translated to record-low average visibility ratings to the east (83 km vs. average of 90 km) and west (81 km vs. average of 90 km), and the proportion of days where the observers rated the thermal lift conditions as good to excellent also was significantly below average (46% of the active days vs. average of 59%).

In contrast to last year, the 2009 season also was windier than usual. Light winds (<12 kph) prevailed on a record-low 51% of the active observation days (1997–2008 average of 70%), whereas the proportion of days with predominantly moderate winds (12–28 kph) was a record high (43% vs. average of 26%) and strong winds (>28 kph) prevailed on a slightly above-average proportion of the active days (6% vs. average of 4%). In terms of wind directions, the range of conditions seen in 2009 differed from the long-term average pattern, but less so than last year. As usual, SW–W winds were most common but their prevalence rose to a new record high in 2009 (63% of the active days vs. 1997–2008 average of 38%). In contrast, S–SW winds average second most common (14% of the active days), but were less than half as prevalent as usual in 2009 (6%). In addition, W–NW winds average third most common pattern, more variable SW–NW winds (average prevalence 6% of the active days), was almost absent in 2009 (1% of the active days). Other patterns that prevailed on more than 5% of the active days and were all at least slightly more prevalent than usual in 2009 included SE–SW (6% vs. average of 4%), NE–SE (9% vs. average of 6%), and mixes of NE–SE and SW–NW winds (7% vs. average of 3%).

The temperature during active observation periods averaged a record low 11.9°C (the average of daily values, which in turn were averages of hourly readings), ranging from -7.4–22.3°C. The overall daily average was substantially below the 1997–2008 average of 14.5°C and the minimum daily average also was a new record low and more than 5° colder than the previous minimum recorded since 1997. In contrast, the maximum daily average fell about in the middle of the range of previous values. We began recording hourly barometric pressure readings on site in 2001. In 2009, the grand average (30.08 in Hg; the average of daily values, which in turn were averages of hourly readings) was slightly above average, whereas the minimum (29.47) and maximum (30.30) daily averages were both the second lowest to date.

In summary, in contrast to the past four years, inclement weather did affect the observer's ability to conduct daily counts in 2009, but still kept them away from the observation site less often than average. Nevertheless, the skies during active observations were more unsettled than usual, with mostly cloudy to overcast skies, scattered rain/snow showers, and visibility reducing fog and especially haze more prevalent than usual. The haze likely resulted from seasonally prescribed burns and the rapid development occurring in Albuquerque, and contributed to record-low visibility ratings. Temperatures also averaged colder and the winds stronger than usual in 2009, with moderate SW–W winds prevailing

during 2/3 of the season and roughly 50% more often than usual, NE–SE winds also about twice as common as usual, but S–SW winds about half as common as usual. The higher prevalence of cloud cover, rain/snow showers, and stronger winds all contributed to a significant reduction in favorable thermal-lift conditions.

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 5% higher than the 1985–2008 average of $65 \pm 95\%$ CI of 2.0 days, whereas the total hours of observation (535.68) was a non-significant 4% above average (514.08 ± 24.12 hours). The 2009 average of 2.5 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 14% above the 1985–2008 average of 2.2 ± 95% CI of 0.14 observers/hr due to the influence of two related factors: 1) presence of an on-site interpreter as part of the field crew with no interpretive duties due unexpected closure to the general public of the access road; and 2) regular presence of dedicated, local citizen-science volunteers to assist with the count.

FLIGHT SUMMARY

The observers counted 3,091 migrant raptors of 16 species during the 2009 season (see Appendix D for daily count records and Appendix E for annual summaries). The flight was composed of 59% accipiters, 24% buteos, 10% falcons, 3% 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 Ospreys (Figure 2). The Sharp-shinned Hawk was the most abundant species seen in 2009 (34% of the total count), followed by the Cooper's Hawk (20%), Red-tailed Hawk (13%), Swainson's Hawk (9%), American Kestrel (7%), and Turkey Vulture (3%; Table 1). The count of American Kestrels dropped to a new record low (60% below average), whereas no record-high species counts occurred in 2009 (Appendix E).

Passage Rates and Long-term Trends

Adjusted passage rates were significantly below average for all species except Northern Goshawk, Swainson's Hawk, Merlin, and Peregrine Falcon, and were not significantly above average for any species (Table 1, Figures 3–7). Updated regression analyses (after Hoffman and Smith 2003) indicated a significant ($P \le 0.05$) hill-shaped second-order, or 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, except that the 2009 passage rate dropped to a new record low (Figure 3). A roughly similar pattern applied to Northern Harriers, except that passage rates remained low for seven years after crashing from a high peak in 1998, but then rebounded from 2006–2008 and remained at least moderate in 2009, such that no overall trend is currently indicated for this species (Figure 3). A significant ($P \le 0.05$), hill-shaped quadratic trend also applied to Ospreys, tracking an increasing pattern through the mid-1990s and no overall trend since then, but with the 2009 passage rate again dropping to a near-record low (Figure 3). Among the accipiters, no overall trends are currently shown for Sharp-shinned Hawks or Northern Goshawks, whereas a significant third-order model now provides the best fit to the data for Cooper's Hawks, tracking a mostly stable pattern in the late 1980s, then an increasing trend through the 1990s, and finally a sharp drop-off in the past six years (Figure 4). Lower passage rates during the past four seasons dampened what had been a highly significant ($P \le 0.01$) 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, whereas a continued, highly significant ($P \le 0.01$) decline was indicated for the Ferruginous Hawk (Figure 5). Following a strong slide between 1992 and 2000, however, Ferruginous Hawk passage rates have remained relatively stable for the past nine years. Similar to the situation for Cooper's Hawks, a highly significant third-order model now provides the best fit to the data for Red-tailed Hawks, in this case tracking a slight decline during the late 1980s, an increasing pattern through the late 1990s, and finally a sharp decline since about

2003 (Figure 5). No significant long-term trends are currently indicated for Golden or Bald Eagles at the species level; however, a significant third-order model fit the data for adult Golden Eagles, tracking a pattern similar to that shown for Red-tailed Hawk (Figure 6). Among the falcons, significant quadratic models fit the data for both American Kestrels and Merlins; however, the pattern for kestrels is an accelerating decline since the late 1990s after about 15 years of a mostly stable pattern, whereas for Merlins the pattern is stabilization since the late 1990s of a previously strong increasing trend (Figure 7). For the two larger falcons, significant third-order models fit both datasets and tracked similar patterns of strong increases through the late 1990s, followed by sharp declines for the past 7–10 years; however, while recent passage rates for Peregrine Falcons have remained moderately high, the passage rate for Prairie Falcons dropped to a new record low in 2009 (Figure 7).

Smith et al. (2008a) present trend analyses of data collected through 2005 for most of the long-term, ongoing, autumn migration studies in western North America. These analyses, which cover many of the same sites, are based on a more complex analytical approach (also see Farmer et al. 2007) than that represented in Hoffman and Smith (2003). Among other refinements, this new approach both fits complex polynomial trajectories to the complete series of annual count indices and allows for estimating rates of change between various periods, while also allowing for assessments of trend significance and precision. This new modeling approach allowed for fitting up to fourth-order polynomials to the 21-year Manzano dataset that was analyzed, which for several species resulted in the fitting of higher-order models than those represented herein using the approach of Hoffman and Smith (2003; except that we have now expanded this approach to include third-order modeling), and therefore more closely tracked the patterns of interannual variation for these species. Species for which this was true included Turkey Vulture, Swainson's Hawk, Golden Eagle, Prairie Falcon, and Peregrine Falcon. Note, however, that restrictions related to the mathematical assumptions behind the new approach precluded analyzing data for rare species, which in this case included Northern Goshawk, Broad-winged Hawk, Ferruginous Hawk, and Bald Eagle. Otherwise, with a few notable exceptions, the overall patterns of change suggested by the new modeling and the derived trend estimates generally yielded similar inferences as the simpler methodology used in Hoffman and Smith (2003) and herein to provide trend assessments updated through 2009.

Differences between results presented in Smith et al (2008a) and those presented herein that clearly relate to addition of four more years of data include: a) elimination of a significant, hill-shaped, second-order model fit for Northern Harriers in the RPI analyses due to addition of four years of at least moderate counts since 2005; b) elimination of significant long-term increasing trends for Sharp-shinned, Cooper's, and Red-tailed Hawks due to addition of four years of mostly low to moderate counts since 2005, which now translate to significant, recent declines for Cooper's and Red-tailed Hawks; c) indications of a renewed, long-term increasing trend for Swainson's Hawks due to addition of four years of high counts; and d) a newly significant, accelerating-decrease pattern for American Kestrels since the late 1990s, with new record-low passage rates in three of the past four years. The newly significant decline for American Kestrels renders the data from this site more similar to the finding of widespread declines across the continent highlighted in Farmer et al. (2008) and Farmer and Smith (in press).

Age Ratios

Among 10 species with data suited to comparisons, immature : adult ratios were significantly above average only for Cooper's Hawks and Northern Goshawks, whereas they were significantly below average for Sharp-shinned Hawks, Red-tailed Hawks, Golden Eagles, Bald Eagles, and Peregrine Falcons (Table 2). Note, however, that low overall counts limit the utility of such comparisons for Bald Eagles. Otherwise, both immature and adult Cooper's Hawks were significantly less abundant than usual in 2009, suggesting that the elevated age ratio reflected primarily low adult recruitment and/or survival in the past year rather than a boost in productivity during 2009. In contrast, although the count of adult Northern Goshawks also was below average, the count of immature goshawks was well above average, indicating that high productivity in the southern Rocky Mountains likely contributed to the high age ratio for this

species in 2009. For Sharp-shinned Hawks, Red-tailed Hawks, Golden Eagles, and Peregrine Falcons, the low 2009 age ratios clearly reflected proportionately low abundances of immature birds, suggesting that low productivity was a contributing factor. For the first three of these species, the adult counts also were well below average, suggesting that the overall low counts of these species in 2009 reflected both low productivity and low adult recruitment/survival in the past year.

Seasonal Timing

The 2009 combined-species median passage date of 3 October was significantly later the 1985–2008 average of 26 September \pm 95% CI of 0.8 days (Table 3). The overall seasonal distribution of activity differed from the average pattern in showing significantly below-average proportional activity levels during the second half of September and above-average activity levels during mid-October and the last five days of the season (Figure 8). The difference in pattern was driven largely by the combination of: unusually low abundances of Turkey Vultures and American Kestrels, whose peak passage usually occurs during the second half of September, and later than average peak passage of several other common species, especially the accipiters and Red-tailed Hawks, in early to mid October. At the species level, all species showed later than average median passage dates in 2009, with the differences significant for all species except the Ferruginous Hawk (Table 3), and age- and sex-specific data revealed only minor variations compared to the species-level indicators (Table 4).

TRAPPING EFFORT

The crews operated at least one banding station on 48 of 55 possible days between 3 September and 27 October 2009, with effort totaling 61 station days and 390.25 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 40 and 53% below average, respectively, primarily due to a purposefully limited crew size (Appendix G).

TRAPPING AND BANDING SUMMARY

The 2009 capture total of 522 birds included 10 species, 1 recapture of bird previously banded at the site, and 1 recapture of a bird previously banded elsewhere (Table 5, Appendix G). The 2009 effort raises the total number of birds captured since project inception to 18,403, including 36 recaptures of Manzano-banded birds and 24 foreign recaptures (i.e., birds originally banded elsewhere and subsequently recaptured in the Manzanos; Appendix G). The most commonly captured species were the Sharp-shinned Hawk (49% of all captures) and Cooper's Hawk (39%), followed by the Red-tailed Hawk (7%), American Kestrel (3%), and Northern Goshawk (2%). All other species each comprised <1% of the total.

The overall combined-species capture total was 47% below average and overall capture success (19%) was 11% below average (Table 5), again largely reflecting the influence of a reduced crew size. That said, the overall capture rate of 133.8 birds per 100 station hours was 17% above average (Table 5), indicating that the operation was relatively efficient. With a high capture total of eight birds (third highest to date; Appendix G), the Northern Goshawk was the only species for which all three metrics were above average in 2009 and was the only species for which the capture total was above average. However, capture rates were significantly above average for all three accipiters and Red-tailed Hawks, and capture success was at least slightly above average for Red-tailed Hawks and American Kestrels. Commonly captured species for which all three metrics were significantly below average in 2009 included Broadwinged Hawk and Golden Eagle, with at least two of the three significantly below average and none significantly above average for Northern Harriers and the three larger falcons.

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. For Sharp-shinned Hawks, the 2009 count-based (0.67) and capture-based (1.1) immature : adult ratios were both similarly below average (33% and 25%, respectively; Tables 2 and 6). Together these data suggest that in 2009 immature birds were proportionately less abundant compared to adults than average and that, as usual, immature birds

were more susceptible to capture than adults (higher capture-based age ratio), but the lesser reduction in the capture-based age ratio suggests that this was at least slightly more true than usual in 2009. For Cooper's Hawks, the 2009 count (1.0) and capture (1.5) ratios were both above average, but the count ratio rose by only 21% whereas the capture ratio rose by 62%. Together these data suggest that immature Cooper's Hawks were proportionately more common than usual in 2009 compared to adults and were overall more susceptible to capture than adults, which is typical, but were also proportionately much more susceptible to capture (hungrier) than usual compared adults (much greater increase in the capture age ratio compared to the count ratio). The banding data also uniquely suggested that the female : male ratio for captured Sharp-shinned Hawks was significantly below average, whereas the sex ratio of captured Cooper's Hawks matched the long-term average (Table 6).

Only two female American Kestrels were captured in 2009, which is 80% below average, whereas the capture total for male American Kestrels was only 33% below average, such that the 2009 female : male capture ratio of 0.10 was a significant 83% below average (Table 6). Similarly, the count-based sex ratio for kestrels of 0.50 was a significant 41% below the long-term average of $0.86 \pm 95\%$ CI of 0.09. This suggests that female kestrels were proportionately less abundant and much less susceptible to capture than usual in 2009 compared to males. Due to a dearth of immature females as well as proportionately low abundance of immature males, the capture data also uniquely indicated a 56% below average immature : adult ratio for kestrels in 2009, further suggesting that immature birds were either relatively scarce or much less susceptible to capture than usual in 2009.

ENCOUNTERS WITH PREVIOUSLY BANDED BIRDS

Recaptures.—One recapture of a bird previously banded in the Manzano Mountains occurred in 2009, which brings the total number of same-site recaptures to 36 (Appendix G). This season's recapture was a female Northern Goshawk originally banded as a hatch-year (HY) bird in 2008, and comprises only the second same-site recapture of this species at this site since 1990.

Foreign Recaptures.—One foreign recapture of a bird previously banded elsewhere occurred in 2009, which brings the total number of foreign recaptures at this site to 24 (Appendix G). This season's foreign recapture was a female Cooper's Hawk originally banded as a second-year (SY) bird in 2004 at HWI's Commissary Ridge migration study site in southwest Wyoming, making her nearly 6.5 years old. This bird was in great health and represents the first such exchange within the HWI network of a bird banded at Commissary Ridge!

Foreign Encounters.—Five raptors originally banded in the Manzanos were encountered elsewhere in 2009 (Table 7), which raises to 123 the total number of foreign encounters with Manzano-banded birds since 1990 (Appendix G). The 2009 encounters all involved female Cooper's Hawks, with four banded as HY birds between 2002 and 2008, and one as an after-hatch-year adult in 2008. The first bird, banded as HY bird in 2006, was found dead of unknown causes in February 2009 ~605 km south of the project site near Juarez in Chihuahua, Mexico. The second bird to be recovered was the AHY adult, which was caught in building and released again in Bernalillo, New Mexico ~42 km north of the project site on 2 March 2009. The third bird was banded in 2008 and later found dead of unknown causes ~405 km north of the project site near Eckert, Colorado on 4 April 2009. The fourth bird was banded in 2002 and later found dead of unknown causes ~543 north of the project site near Hayden, Colorado on 28 July 2009.

These new encounters all fall within the expected range of Rocky Mountain migrants (Hoffman et al. 2002).

SATELLITE TRACKING

We did not outfit any new birds with satellite transmitters in 2009, but report here on the final fate of the female Golden Eagle that we outfitted as a HY bird at this site in 2008. After capture, this eagle

immediately headed south and essentially followed the I-25 freeway corridor to an area about 100 km north of Las Cruces and 20 km east of Truth or Consequences, New Mexico, where it appeared to have settled for the winter by mid-November. Unfortunately, this bird did not survive the winter and died in February 2009. We found the bird and recovered its transmitter in April. It was located in a dry desert wash inhabited by burned mesquite, yucca, rabbit brush, and miscellaneous shrubs, with the wash area surrounded by broad expanses of primarily creosote bush. There was an inactive small "resort" compound nearby with the other nearest human activity a lone ranch ~5 km to the west. The desiccated carcass was intact with no obvious signs of trauma. Red-tailed and Swainson's Hawks, Turkey Vultures, and Common Ravens were all present in the general area during the recovery visit, as were several jackrabbits and cottontails.

Tracking summaries and maps for HWI's telemetry birds can be found at http://www.hawkwatch.org.

RESIDENT RAPTORS

Resident Turkey Vultures were common from the first day of observation until 20 September, usually seen alone or in groups of 2–8 individuals, with the largest group of eight seen on 2 September.

An immature Sharp-shinned Hawk was observed regularly from late August through mid-September, and a pair of adult birds was seen regularly from mid-September to mid-October. A pair of immature Cooper's Hawks was seen multiple times during the first eight days of the season in various places including Comanche Canyon, near the decoy owl and observation site, and stooping near the point north of North Blind. Frequent observations of various birds continued through mid-September, but with no resident adults ever confirmed.

A family of light-morph Red-tailed Hawks—two adults and four immature birds—were frequently observed early in the season near the West Blind and hunting and flying in various locations visible from the observation site (near the point, near the towers, in Comanche Canyon, out in the forested and burn areas to the east, and in the desert to the west). Up to three birds were often seen simultaneously throughout the day, with greater numbers typically observed in late afternoon interacting with one another or hunting near the West Blind or relatively close to the observation site. The two adult birds were present throughout the season and were seen nearly every day, often escorting migrants through the area and occasionally displaying. At least one immature bird also was still present at the end of the season. Two unknown-age and one immature light-morph Swainson's Hawks were observed on 27 August displaying apparent resident behavior. Several more resident sightings of individual Swainson's Hawks occurred on four other dates between 29 August and 21 September.

An apparent resident, non-adult Golden Eagle was first seen on 31 August to the north-northwest of the observation site, and probably again on 1 September to the south-southwest of the observation point. Additional sightings of unknown-age, apparent locals occurred the next day and on 7 September, with no other sightings of apparent local Golden Eagles recorded during the season.

One resident, male American Kestrel was recorded on the first day of observations and another bird of unknown sex was seen on 2 September. No other resident or non-migratory American Kestrels were recorded during the season. Prior to (on 2 August) and early in the season, a breeding pair of Peregrine Falcons and their two kids were seen regularly around the project site, often seen harassing migrants as well as other residents. The two immature birds were seen simultaneously on only two occasions during the first two weeks of observation, but other unaged pairs of birds were seen on six other days through the third week of September. It appeared that the immature birds dispersed from the area by late September, but the adults were still present at the end of the season. The peregrines were most commonly observed cruising in the area between the three trapping blinds and likely nested and roosted on the shield-like cliffs just south of South Blind.

This is a typical resident assemblage for the site except for the apparent absence of adult Golden Eagles and Prairie Falcons.

SITE VISITATION

In 2009, the access road (FR 245) was closed above New Canyon Campground due to hazardous conditions caused by an extensive wildfire that burned the area during spring 2008. Thus, access to the project site was restricted to U.S. Forest Service, New Mexico Department of Game and Fish, and HWI personnel, and selected citizen-science volunteers throughout the 2009 season.

In 2009, 573 hourly assessments of visitor disturbance resulted in the following ratings: 98% none, <1% low, 1% moderate, and <1% high. These values reflect much lower visitor-disturbance ratings than usual due to the lack of general public visitation.

ACKNOWLEDGMENTS

Financial support for this project in 2009 was provided by the USDA Forest Service – Cibola National Forest and Region 3, New Mexico Department of Game and Fish, Walbridge Fund, Palladium Foundation, and HWI private donors and members. We especially thank Karen Lessard, Tyler Hunning, and Beverly DeGruyter of the Forest Service for their 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 also 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, Ken Babcock, Stephanie Eyes, and Jennifer Yoo. Lastly, we 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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	Со	UNTS		RAPTORS / 100 Hrs^1				
SPECIES	1985–2008 ²	2009	% CHANGE	1985-2008 ²	2009	% CHANGE		
Turkey Vulture	387 ± 94.1	82	-79	77.5 ± 17.84	18.0	-77		
Osprey	31 ± 6.9	12	-62	8.2 ± 1.62	3.1	-63		
Northern Harrier	62 ± 10.5	49	-20	12.3 ± 1.91	10.2	-17		
Sharp-shinned Hawk	1472 ± 177.3	1051	-29	360.9 ± 39.45	264.3	-27		
Cooper's Hawk	1020 ± 139.8	620	-39	291.9 ± 33.05	179.9	-38		
Northern Goshawk	16 ± 3.7	21	+30	3.6 ± 0.94	4.4	+22		
Unknown small accipiter ³	128 ± 38.0	94	-27	_	_	-		
Unknown large accipiter ³	5 ± 2.1	12	+167	_	_	-		
Unidentified accipiter	77 ± 26.3	12	-84	_	_	-		
TOTAL ACCIPITERS	2629 ± 300.8	1810	-31	_	_	_		
Broad-winged Hawk	7 ± 1.8	6	-18	2.6 ± 0.59	1.9	-27		
Swainson's Hawk	838 ± 700.0	274	-67	314.0 ± 262.44	114.9	-63		
Red-tailed Hawk	644 ± 68.8	398	-38	139.3 ± 13.72	87.5	-37		
Ferruginous Hawk	12 ± 2.1	8	-36	2.6 ± 0.47	1.5	-43		
Rough-legged Hawk	0.3 ± 0.2	0	-100	0.1 ± 0.04	0.0	-100		
Zone-tailed Hawk	1 ± 0.3	0	-100	_	_	-		
Unidentified buteo	23 ± 9.1	57	145	_	_	-		
TOTAL BUTEOS	1525 ± 695.8	743	-51	_	_	-		
Golden Eagle	118 ± 13.3	70	-41	25.6 ± 2.96	15.2	-41		
Bald Eagle	4 ± 1.0	1	-72	1.0 ± 0.27	0.3	-73		
Unidentified Eagle	1 ± 0.9	4	+269	_	—	-		
TOTAL EAGLES	123 ± 13.4	75	-39	_	_	-		
American Kestrel	536 ± 63.2	216	-60	146.1 ± 17.31	55.9	-62		
Merlin	26 ± 5.7	28	+6	6.6 ± 1.34	7.7	+17		
Prairie Falcon	19 ± 4.5	6	-69	4.2 ± 0.87	1.1	-73		
Peregrine Falcon	48 ± 13.9	43	-11	11.6 ± 3.31	10.8	-7		
Unknown small falcon ³	1 ± 0.9	4	+191	_	_	-		
Unknown large falcon ³	4 ± 3.3	3	-23	_	_	-		
Unidentified falcon	2 ± 1.1	2	-14	_	_	-		
TOTAL FALCONS	634 ± 70.3	302	-52	_	-	-		
Unidentified raptor	44 ± 15.9	18	-59	_	_	_		
GRAND TOTAL	5435 ± 834.9	3091	-43	_	_			

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: 1985–2008 versus 2009.

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

² Mean \pm 95% CI.

³ Designations used for the first time in 2001.

	Тс	TAL A	ND AGE-C	LASSIFIE	o Cou			IMMATURE : A	ADULT	
	1990–2	1990–2008 Average			2009		% Unknown Age		RATIO	
	TOTAL	Імм.	ADULT	TOTAL	IMM.	ADULT	1990–2008 ¹	2009	1990–2008 ¹	2009
Northern Harrier	65	33	16	49	20	9	26 ± 5.7	41	2.1 ± 0.45	2.22
Sharp-shinned Hawk	1577	605	684	1051	329	489	19 ± 3.6	22	0.9 ± 0.13	0.67
Cooper's Hawk	1136	398	495	620	220	227	22 ± 4.3	28	0.8 ± 0.12	0.97
Northern Goshawk	16	7	7	21	13	4	13 ± 5.9	19	1.6 ± 0.80	3.25
Broad-winged Hawk	8	1	4	6	1	3	$40~\pm~14.6$	33	0.5 ± 0.34	0.33
Red-tailed Hawk	703	226	369	398	98	209	15 ± 3.6	23	0.6 ± 0.11	0.47
Ferruginous Hawk	11	3	3	8	2	0	47 ± 7.1	75	1.7 ± 0.72	2.00
Golden Eagle	118	64	31	70	37	21	17 ± 3.9	17	2.3 ± 0.46	1.76
Bald Eagle	4	2	1	1	1	0	9 ± 13.3	0	2.1 ± 1.00	1.00
Peregrine Falcon	63	18	28	43	5	28	23 ± 9.1	23	$0.8~\pm~0.37$	0.18

 Table 2. Annual raptor migration counts by age classes and immature : adult ratios for selected species in the Manzano Mountains, NM: 1990–2008 versus 2009.

¹ Mean \pm 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.

			2009		1985–2008	
	FIRST	LAST	BULK	MEDIAN	MEDIAN	
SPECIES	OBSERVED	OBSERVED	PASSAGE DATES ¹	PASSAGE DATE ²	PASSAGE DATE ^{2,3}	
Turkey Vulture	30-Aug	8-Oct	2-Sep – 27-Sep	21-Sep	$17-\text{Sep} \pm 2.9$	
Osprey	29-Aug	9-Oct	30-Aug - 7-Oct	22-Sep	$17-\text{Sep} \pm 1.3$	
Northern Harrier	6-Sep	1-Nov	22-Sep - 25-Oct	11-Oct	$2-Oct \pm 1.8$	
Sharp-shinned Hawk	28-Aug	5-Nov	11-Sep – 16-Oct	6-Oct	$28\text{-}\text{Sep} \pm 1.0$	
Cooper's Hawk	27-Aug	4-Nov	11-Sep - 14-Oct	1-Oct	$25-\text{Sep} \pm 1.0$	
Northern Goshawk	11-Sep	4-Nov	24-Sep – 3-Nov	14-Oct	$6-Oct \pm 4.4$	
Broad-winged Hawk	4-Sep	11-Oct	4-Sep - 11-Oct	29-Sep	$26-Sep \pm 2.6$	
Swainson's Hawk	29-Aug	9-Oct	13-Sep – 28-Sep	28-Sep	20-Sep ± 2.8	
Red-tailed Hawk	28-Aug	5-Nov	26-Sep - 31-Oct	13-Oct	$3-Oct \pm 1.9$	
Ferruginous Hawk	25-Sep	5-Nov	25-Sep – 5-Nov	7-Oct	3-Oct - 4.1	
Golden Eagle	27-Aug	5-Nov	1-Oct - 3-Nov	22-Oct	$14-Oct \pm 1.8$	
Bald Eagle	17-Oct	17-Oct	_	—	$23-Oct \pm 5.1$	
American Kestrel	27-Aug	5-Nov	6-Sep – 12-Oct	24-Sep	$20-\text{Sep} \pm 1.4$	
Merlin	27-Sep	3-Nov	7-Oct - 3-Nov	19-Oct	$7-Oct \pm 2.9$	
Prairie Falcon	27-Sep	2-Nov	27-Sep – 2-Nov	14-Oct	25 -Sep ± 3.0	
Peregrine Falcon	6-Sep	5-Nov	19-Sep – 19-Oct	30-Sep	22-Sep ± 1.4	
All species	27-Aug	5-Nov	11-Sep – 19-Oct	3-Oct	$26-\text{Sep} \pm 0.8$	

Table 3. First and last observed, bulk passage, and median passage dates by species for migrating raptors in the Manzano Mountains, NM in 2009, with comparisons of 2008 and 1985–2008 average median passage dates.

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

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

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

	ADULT		Immature / subadult			
SPECIES	1985–2008 ¹	2009	1985–2008 ¹	2009		
Northern Harrier	8-Oct \pm 3.5	22-Oct	$1-\text{Oct} \pm 2.1$	11-Oct		
Sharp-shinned Hawk	5-Oct \pm 1.3	10-Oct	$19-\text{Sep} \pm 1.3$	24-Sep		
Cooper's Hawk	$28\text{-}\text{Sep}~\pm~1.8$	7-Oct	21 -Sep ± 1.7	24-Sep		
Northern Goshawk	$8-Oct \pm 4.7$	_	$3-\text{Oct} \pm 6.1$	12-Oct		
Broad-winged Hawk	$22\text{-}\text{Sep}~\pm~5.8$	_	_	_		
Red-tailed Hawk	7-Oct \pm 1.9	13-Oct	25-Sep ± 1.7	11-Oct		
Ferruginous Hawk	7-Oct \pm 7.9	_	25 -Sep \pm 5.0	_		
Golden Eagle	16 -Oct ± 2.4	15-Oct	13 -Oct ± 1.6	24-Oct		
Bald Eagle	10-Oct ²	_	$21-Oct \pm 10.9$	_		
Peregrine Falcon	25 -Sep ± 2.0	30-Sep	$16\text{-}\text{Sep} \pm 2.4$	22-Sep		

Table 4. Median passage dates by age classes for selected species of migrating raptors in the Manzano Mountains, NM: 1985–2008 versus 2009.

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

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

² Data for 2003 only.

	CAPTURE TOTAL CAPTURE RATE ¹		ATE ¹	CAPTURE SUCCESS $(\%)^2$		
SPECIES	1991-2008 ³	2009	1991-2008 ³	2009	1991–2008 ³	2009
Northern Harrier	4 ± 1.6	2	0.5 ± 0.15	0.5	7 ± 2.6	4
Sharp-shinned Hawk	496 ± 88.9	255	57.4 ± 6.20	65.3	30 ± 3.5	23
Cooper's Hawk	370 ± 63.9	201	43.5 ± 5.40	51.5	31 ± 3.5	30
Northern Goshawk	5 ± 1.7	8	0.6 ± 0.21	2.0	30 ± 9.3	38
Broad-winged Hawk	0.3 ± 0.22	0	0.05 ± 0.03	0.0	3 ± 2.5	0
Swainson's Hawk	0.3 ± 0.35	0	0.03 ± 0.04	0.0	0 ± 0.2	0
Red-tailed Hawk	49 ± 11.3	34	5.6 ± 1.00	8.7	7 ± 1.4	8
Zone-tailed Hawk	0.1 ± 0.11	0	0.004 ± 0.008	0.0	6 ± 10.9	_
Golden Eagle	4 ± 1.0	1	0.5 ± 0.16	0.3	3 ± 0.6	1
American Kestrel	35 ± 11.0	16	4.0 ± 1.06	4.1	6 ± 1.4	7
Merlin	5 ± 1.7	2	0.6 ± 0.21	0.5	16 ± 6.2	7
Prairie Falcon	4 ± 1.3	1	0.5 ± 0.11	0.3	17 ± 3.0	17
Peregrine Falcon	6 ± 1.9	2	0.7 ± 0.24	0.5	10 ± 2.7	4
All Species	980 ± 170.1	522	114.0 ± 12.19	133.8	22 ± 2.4	19

 Table 5. Capture totals, rates, and successes for migrating raptors in the Manzano Mountains,

 NM: 1991–2008 versus 2009.

¹ Captures / 100 station hours.

² 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.

³ Mean of annual values \pm 95% confidence interval.

		FEMALE		MALE		FEMALE : MALE	IMMATURE : ADULT
SPECIES	YEAR HY AHY		HY	AHY	RATIO ¹	RATIO ¹	
Sharp-shinned Hawk	1990-2008	149	113	149	77	1.3 ± 0.08	1.6 ± 0.24
	2009	54	79	67	14	1.1	1.1
Cooper's Hawk	1990-2008	85	100	93	87	1.1 ± 0.09	1.0 ± 0.15
	2009	65	41	35	30	1.1	1.5
American Kestrel	1990-2008	9	1	15	6	0.6 ± 0.19	3.8 ± 1.08
	2009	2	0	8	6	0.1	1.7

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: 1990–2008 averages versus 2009.

¹ Long-term value: mean \pm 95% confidence interval.

BAND #	SPECIES ¹	SEX	BANDING AGE ²	Banding Date	Encounter Date	ENCOUNTER AGE ²	ENCOUNTER LOCATION	DISTANCE (KM)	STATUS
2206 - 55026	СН	F	HY	04-Sep-06	22-Feb-09	4 th yr	Juarez, Chihuahua, Mexico	605	found dead – cause unknown
1075 - 02141	СН	F	AHY	18-Oct-08	2-Mar-09	$\geq 3^{rd} yr$	Bernalillo., NM	43	captured in building/released
1705 - 40114	СН	F	HY	16-Sep-08	4-Apr-09	SY	Eckert, CO	405	found dead – cause unknown
1005 - 01689	СН	F	HY	29-Sep-02	7-Jun-09	8 th yr	Nederland, CO	488	found dead – cause unknown
1005 - 21989	СН	F	HY	20-Sep-05	28-Jul-09	5 th yr	Hayden, CO	543	found dead – cause unknown

Table 7. Foreign encounters in 2009 of raptors originally banded in the Manzano Mountains, NM.

¹ CH = Cooper's Hawk.

 2 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: 1985–2008 versus 2009.



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: 1985–2009. Dashed lines indicate significant ($P \le 0.10$) 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: 1985–2009. Dashed lines indicate significant ($P \le 0.10$) 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: 1985–2009. Dashed lines indicate significant ($P \le 0.10$) 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: 1985–2009. Dashed lines indicate significant ($P \le 0.10$) 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: 1985–2009. Dashed lines indicate significant ($P \le 0.10$) regressions.



Figure 8. Combined-species, fall-migration passage volume by five-day periods for raptors in the Manzano Mountains, NM: 1985–2008 versus 2009.

Appendix A. History of official observer participation in the Manzano Mountains Raptor Migration Project: 1985–2009.

- **1985** Single observer throughout, shared duty: Gary Cress $(0)^1$, Jim Daly (1), Allen Hale (1)
- Single observer throughout: Jim Daly (2)
- Single observer throughout: Jim Daly (3)
- Single observer throughout: Gordon Vickrey (1)
- Two observers during peak 3/4 of the season, one observer otherwise: Brett Ewald (2), Tim Menard (0)
- Two observers during peak 3/4 of the season, one observer otherwise: David Curson (0), Gary Cress (1)
- Two observers throughout: Eric Meyer (1), Tylan Dean (0)
- Two observers throughout: Eric Meyer (3), Jessie Jewell (0)
- Two observers throughout: Jessie Jewell (2), John Haskell (0)
- Two observers throughout: Jessie Jewell (4), Jeff Ogburn (1)
- Two observers throughout: Jessie Jewell (6), Jeff Ogburn (2)
- Two observers throughout: Jessie Jewell (8), Sean O'Connor (3)
- Two observers throughout: Jeff Ogburn (4), Sean O'Connor (4)
- Two observers throughout: Dan Rossman (1), Lawry Sager (0)
- Two observers throughout: Jason Beason (4), Lawry Sager (1)
- Two observers throughout: Jorge Canaca (1), Laura Lutz (1)
- Two observers throughout: Tim Meehan (1), Carrie Hisaoka (0)
- Two observers throughout: Carrie Hisaoka (1), Richard Sim (0)
- Two observers throughout: Carrie Hisaoka (2), Tim Hanks (1)
- Two observers throughout: Paula Shannon (3), Frank Mayer (2)
- Two observers throughout: Tim Hanks (2), Geoff Gould (0)
- 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 (+)
- 2009 Two observers throughout: Kimberly Cullen (1), Amber Wingert (1), Roger Grimshaw (+)

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

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

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.

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.

			Median		WIND			BAROM.	Median	VISIB.	VISIB.	Median	
	OBS.	OBSRVR	VISITOR	Predominant	SPEED	WIND	Темр	PRESS.	THERMAL	WEST	EAST	FLIGHT	BIRDS
DATE	HOURS	/HOUR1	DISTURB ²	WEATHER ³	$(KPH)^1$	DIRECTION	$(^{\circ}C)^{1}$	(IN HG) ¹	LIFT ⁴	(KM) ¹	$(KM)^1$	DISTANCE ⁵	/ Hour
27-Aug	7.50	3.4	0	clr-mc, ts/rain	4.0	ne-e, nw	19.1	30.28	2	91	96	2	0.7
28-Aug	8.75	3.5	0	clr-pc, haze	8.8	ne-e	19.8	30.30	2	82	76	2	0.8
29-Aug	8.67	3.5	0	pc, haze	8.9	SW-W	21.4	30.23	2	69	63	1	3.8
30-Aug	7.92	3.2	0	clr-mc, fog/haze	11.2	w	22.3	30.19	2	62	58	2	2.7
31-Aug	8.17	1.9	0	clr-pc, haze	12.2	w-wnw	22.0	30.21	3	78	69	1	0.6
01-Sep	6.92	2.3	0	pc-mc, haze, scat PM rain	3.4	SW-W	18.1	30.25	3	71	66	2	1.2
02-Sep	8.17	2.7	0	clr-pc, haze	8.4	w	22.0	30.24	2	74	69	1	1.5
03-Sep	7.25	2.0	0	ovc. ts/rain	8.6	w	21.0	30.21	3	66	61	2	4.1
04-Sep	5.65	2.0	0	clr-ovc. AM haze PM ts/rain	5.6	ne, se	20.0	30.17	2	75	75	2	1.1
05-Sep	5.67	3.0	0	pc-ovc. haze. ts/rain	8.4	e-se. w	15.3	30.21	4	79	72	1.5	2.1
06-Sep	8.25	2.6	0	ovc. haze. AM rain	8.6	w	16.6	30.21	4	78	76	2	3.8
07-Sep	8.33	2.0	0	pc-mc, haze, ts/rain	6.7	SW-W	17.3	30.14	2	81	80	1.5	2.6
08-Sep	6.92	2.0	0	pc-ovc. AM haze PM ts/rain	6.9	w	17.0	30.11	3	77	77	1	2.2
09-Sep	8 25	3.0	0	clr-ove PM ts/rain	99	se	16.1	30.20	4	86	87	2	11
10-Sep	8.00	29	0	ovc	3.8	e-se	15.0	30.23	3	80	83	2	6.9
11-Sep	7.50	3.0	0	ovc haze	3.2	ne wnw	16.2	30.23	3	75	73	3	73
12-Sep	8 50	3.0	0	pc-ove AM haze PM ts/rain	5.0	e-se w	12.2	30.12	4	72	65	1	1.2
13-Sep	8.17	2.0	0	nc haze	6.5	w	14.7	30.12	2	81	73	15	13.2
14-Sep	8.92	2.0	0	pe, naze	11.5	wsw	15.6	30.14	3	86	82	1	5.6
15-Sep	8 42	1.8	0	clr-nc PM haze	9.0	wsw	16.8	30.14	2	89	90	1	67
16-Sep	6.75	2.0	0	nc-ove PM ts/rain	15.1	e-se	11.8	30.19	4	72	68	2	1.6
17-Sep	0.00	2.0	0	Weather Day: rain	10.1	0 50	11.0	50.17		12	00	-	1.0
18-Sep	0.00			Weather Day: rain									
10-Sep	8.50	3.0	0	nc-ove AM fog PM haze	9.0	w	127	30.16	4	51	32	1	26
20 Sep	7.08	2.0	0	clr ove PM ts/rain	14.6	vv XV	12.7	30.10	3	80	87	1	2.0 8.3
20-Sep	8.67	1.9	0	clr-mc	12.2	w	12.9	30.10	4	88	83	1	8.4
22-Sen	8 25	5.9	0	clr-ove	63	w	63	30.15	3	03	95	2	11.3
22-50p	8.42	2.8	0	nc	73	W	8.5	30.13	3	82	91	1	63
23-50p	8.00	2.0	0	clr-ne	6.9	wsw	87	30.13	3	82	82	2	0.5 7.6
25 Sen	8.00	2.7	0	clr	15.6	vv XV	127	30.15	2	87	80	1	1.0
25-50p	8 33	2.2	0	clr	15.0	w	16.1	30.15	1.5	00	80	2	4.2
20-Sep	8.55	2.4	0	olr haza	147	W W	16.7	30.12	2	90 74	67	2	8 1
27-Sep	8.07	2.9	0	olr haza	14.7	w5w-w	0.9	30.12	4	65	56	2	17.2
20-Sep	0.23	2.0	0	cli, lidze	0.7		9.0 16.9	20.16	4	03 77	30 72	2	17.5
29-Sep	0.0J	2.0	0	ch-pc, haze	9.7 22.4	SW-W	15.0	30.10	4	82	02	1	10.4
01 Oct	0.07	2.0	0	pe-ove	32.4 19.9	55W	2.0	30.00	4	02	92	1	5.0
01-001	9.00	2.0	0	olr haza	10.0	Sw-w	5.9 0.7	30.02	4	95	90 97	1.5	3.0 4.0
02-001	0.00 0.25	2.0	0	cii, liaze	0.6	w	9.7	20.00	4	92	0/ 80	1	4.9
03-0cl	0.23 0.25	2.9	0	pc, naze	9.0	SW	11.9	29.69	2	04	09	1	4.0
04-0ct	8.23 8.00	1.9	0	pc, Alvi naze	20.0	SSW	12.5	29.80	5	94	91	1	3.2
05-0ct	8.00	1.0	0	pc-ovc	50.9	SSW	10.5	29.80	4	95	94	1	4.0
06-Oct	9.00	1.9	0	ovc, naze	5.4	SW-W	10.5	30.01	4	84 76	81 79	1.5	5.0 17.0
07-Oct	8.92	4.5	0	pc-mc, AM haze	10.4	se-sw	13.0	29.90	2	/0	/8	1.5	17.0
	9.33	2.8	0	pc-ovc, Alvi naze	16.5	SW-W	0.7	29.90	4	85	85	1.5	4.5
09-Oct	9.17	3.0	0	clr	15.5	W	8.8	30.01	4	93	85	1	10.1
10-Oct	8.75	4.0	0	pc-ovc	11.0	sse, ssw-w	10.9	30.00	5	93	90	1	16.7
11-Oct	9.25	5.6	0	pc, AM tog	21.8	SSW	11.5	29.93	3	89	86	2	1/./
12-Oct	8.50	2.6	0	cir-pc, AM haze	9.2	SW-W	10.5	29.98	2.5	94	85	1	9.9 11 7
13-Oct	8.83	2.0	0	cir-ovc, AM tog	21.4	SW-W	12.5	30.01	5	92	94	2	11./
14-Oct	9.25	3.0	0	cir-pc	20.1	SW	11.9	30.06	4	98	9/	1	1.4
15-Oct	8.50	2.5	0	cir, PM haze	12.8	W	12.0	30.12	4	96	88	1	4.6

Appendix C. Daily observation effort, visitor disturbance ratings, weather records, and flight summaries for the Manzano Mountains Raptor Migration Project: 2009.

Appendix C. continued

			MEDIAN		WIND			BAROM.	MEDIAN	VISIB.	VISIB.	MEDIAN	
	OBS.	OBSRVR	VISITOR	PREDOMINANT	Speed	WIND	TEMP	PRESS.	THERMAL	WEST	EAST	FLIGHT	BIRDS
DATE	HOURS	/HOUR ¹	DISTURB ²	WEATHER ³	$(KPH)^1$	DIRECTION	$(^{\circ}C)^{1}$	$(IN HG)^1$	$LIFT^4$	$(KM)^1$	$(KM)^1$	DISTANCE ⁵	/ Hour
16-Oct	8.42	2.0	0	clr, PM haze	5.0	e-se, sw-w	13.8	30.18	1	92	93	1	6.3
17-Oct	8.58	2.2	0	clr, AM fog PM haze	7.4	se, sw	13.5	30.27	1.5	81	84	3	12.4
18-Oct	8.50	2.0	0	pc	11.0	SW-W	13.9	30.19	3	84	90	1	4.2
19-Oct	8.50	1.9	0	clr-mc	18.0	SW	13.5	30.06	4	86	90	1	6.7
20-Oct	3.83	2.0	0	pc-ovc	13.4	SW-W	11.4	29.91	3	86	87	1	6.8
21-Oct	0.00			Weather Day: rain/snow									6.4
22-Oct	5.42	1.8	0	pc-ovc	18.4	W	2.3	29.88	4	77	72	1	3.9
23-Oct	8.67	1.9	0	pc	6.8	SW-W	4.9	29.99	3	95	91	2	2.7
24-Oct	9.00	3.3	0	clr-mc	29.5	W	6.4	29.88	4	93	94	2	2.4
25-Oct	8.67	2.8	0	pc-mc	15.7	w-nw	4.8	29.92	4	84	93	2	3.3
26-Oct	2.25	1.0	0	clr	14.0	nw	-0.8	29.98	3	90	73	2	5.2
27-Oct	8.33	1.8	0	mc-ovc, PM rain	28.4	SW	4.4	29.63	4	89	83	1	3.7
28-Oct	4.75	2.0	0	ovc, fog/snow	17.2	SW-W	-4.5	29.47	4	44	57	2	1.6
29-Oct	4.00	2.0	0	ovc, fog, PM snow	11.4	SW	-7.4	29.57	4	43	62	2	1.8
30-Oct	8.25	2.0	0	pc-mc	17.9	W	-5.6	29.84	4	91	88	2	2.2
31-Oct	8.33	1.5	0	clr, PM fog/haze	7.4	sw, w-wnw	7.1	30.16	3	100	92	2	0.3
01-Nov	8.08	1.7	0	clr, PM fog	10.9	w-nw	9.2	30.12	4	95	91	2	2.1
02-Nov	8.17	1.9	0	clr, PM fog	4.9	w-nw	10.5	30.21	2	93	91	2	3.1
03-Nov	8.00	1.8	0	clr, haze	15.0	W	10.0	30.21	4	89	87	2	1.7
04-Nov	7.50	1.8	0	clr-pc, PM haze	9.3	e-se	11.9	30.27	3	93	90	2	0.9
05-Nov	7.00	2.0	0	clr, PM haze	14.8	SW-W	11.5	30.24	2.5	91	86	1	0.0

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.

														S	PECIES	1														BIRDS
DATE	HOURS	TV	OS	NH	SS	СН	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	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3	0	0	0	0	0	0	0	5	0.7
28-Aug	8.75	0	0	0	2	1	0	0	0	0	0	0	2	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	7	0.8
29-Aug	8.67	0	1	0	8	5	0	0	0	0	0	9	5	0	0	0	2	0	0	0	2	0	0	0	0	0	0	1	33	3.8
30-Aug	7.92	1	1	0	4	2	0	1	0	0	0	1	1	0	0	0	7	0	0	0	3	0	0	0	0	0	0	0	21	2.7
31-Aug	8.17	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	5	0.6
01-Sep	6.92	4	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	1.2
02-Sep	8.17	7	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	12	1.5
03-Sep	7.25	11	1	0	7	1	0	0	0	0	0	0	2	0	0	0	0	0	0	1	7	0	0	0	0	0	0	0	30	4.1
04-Sep	5.65	0	0	0	2	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	6	1.1
05-Sep	5.67	0	0	0	9	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	12	2.1
06-Sep	8.25	0	0	1	10	5	0	1	0	0	0	3	1	0	0	0	0	0	0	0	6	0	0	3	0	0	0	1	31	3.8
07-Sep	8.33	0	0	0	13	3	0	1	0	0	0	1	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	22	2.6
08-Sep	6.92	1	0	0	9	1	0	1	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	15	2.2
09-Sep	8.25	0	0	0	3	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	9	1.1
10-Sep	8.00	2	0	0	25	21	0	4	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	55	6.9
11-Sep	7.50	0	0	1	29	14	1	5	0	0	0	0	2	0	0	0	1	0	0	0	2	0	0	0	0	0	0	0	55	7.3
12-Sep	8.50	0	0	0	4	1	0	2	0	0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	10	1.2
13-Sep	8.17	0	0	0	9	4	0	0	0	0	0	90	2	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	108	13.2
14-Sep	8.92	4	2	0	18	10	0	1	0	0	0	3	2	0	0	0	0	0	0	0	8	0	0	0	0	0	0	2	50	5.6
15-Sep	8.42	7	0	1	26	15	0	0	0	0	0	1	1	0	0	0	0	0	0	0	4	0	0	1	0	0	0	0	56	6.7
16-Sep	6.75	0	0	0	5	4	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	1.6
17-Sep	0.00																													
18-Sep	0.00																													
19-Sep	8.50	0	0	0	8	6	0	1	0	0	0	0	1	0	0	0	0	0	0	0	4	0	0	2	0	0	0	0	22	2.6
20-Sep	7.08	0	0	0	23	4	0	0	1	0	0	0	2	0	0	0	0	0	0	0	23	0	0	5	0	0	1	0	59	8.3
21-Sep	8.67	9	0	1	31	19	0	1	0	0	0	1	0	0	0	0	3	1	0	0	6	0	0	1	0	0	0	0	73	8.4
22-Sep	8.25	2	2	1	28	32	0	5	3	1	0	0	7	0	0	0	2	0	0	0	7	0	0	1	0	0	0	2	93	11.3
23-Sep	8.42	22	0	1	9	13	1	0	0	0	0	0	2	0	0	0	0	0	0	0	3	0	0	1	0	0	0	1	53	6.3
24-Sep	8.00	1	0	2	21	17	1	1	2	0	0	0	1	0	0	0	0	1	0	0	13	0	0	1	0	0	0	0	61	7.6
25-Sep	8.08	0	0	2	3	7	1	0	0	0	0	0	1	1	0	0	0	0	0	0	19	0	0	0	0	0	0	0	34	4.2
26-Sep	8.33	2	1	0	25	27	2	1	0	2	0	1	12	0	0	0	0	0	0	0	8	0	0	3	0	0	0	0	84	10.1
27-Sep	8.67	1	0	2	30	18	0	3	0	0	0	1	3	0	0	0	0	0	0	0	6	1	1	2	0	1	0	1	70	8.1
28-Sep	8.25	0	0	1	0	5	0	1	0	0	0	135	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	143	17.3
29-Sep	8.83	0	0	0	31	33	0	2	0	0	2	19	2	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	92	10.4
30-Sep	6.67	1	1	1	34	26	0	3	0	0	1	3	5	0	0	0	0	0	0	0	9	0	0	5	1	0	0	1	91	13.6
01-Oct	9.00	0	0	1	18	16	0	2	0	0	0	0	3	0	0	0	0	2	0	0	0	0	0	3	0	0	0	0	45	5.0
02-Oct	8.00	0	0	1	19	11	0	2	0	0	0	0	4	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	39	4.9

Appendix D. Daily observation effort and fall raptor migration counts by species in the Manzano Mountains, NM: 2009.

Appendix D.	continued
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														5	SPECIES	5 ¹														BIRDS
DATE	HOURS	TV	OS	NH	SS	СН	NG	SA	LA	UA	BW	SW	RT	FH	RL	ZT	UB	GE	BE	UE	AK	ML	PR	PG	SF	LF	UF	UU	TOTAL	/ HOUR
03-Oct	8.25	0	0	1	23	8	0	1	0	0	0	0	5	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	40	4.8
04-Oct	8.25	5	0	0	20	6	0	1	0	0	0	0	3	0	0	0	0	3	0	0	2	0	1	1	0	0	1	0	43	5.2
05-Oct	8.00	0	0	0	10	13	0	4	1	0	0	0	3	0	0	0	1	1	0	0	3	0	0	1	0	0	0	0	37	4.6
06-Oct	9.00	0	1	1	27	14	0	4	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	5.6
07-Oct	8.92	0	1	1	66	57	0	7	0	1	0	0	14	2	0	0	0	0	0	0	1	1	0	1	0	0	0	0	152	17.0
08-Oct	9.33	2	0	0	16	10	0	0	0	1	0	0	3	0	0	0	0	1	0	0	6	1	0	1	0	0	0	1	42	4.5
09-Oct	9.17	0	1	1	36	13	0	0	0	0	0	1	25	0	0	0	3	3	0	0	6	0	0	2	1	1	0	0	93	10.1
10-Oct	8.75	0	0	1	74	29	0	4	2	1	1	0	19	1	0	0	4	5	0	0	4	0	0	1	0	0	0	0	146	16.7
11-Oct	9.25	0	0	5	60	39	0	7	0	0	1	0	34	0	0	0	0	3	0	0	12	1	0	1	0	0	0	1	164	17.7
12-Oct	8.50	0	0	0	42	10	4	6	0	0	0	0	9	0	0	0	1	2	0	0	10	0	0	0	0	0	0	0	84	9.9
13-Oct	8.83	0	0	1	41	24	0	1	0	0	0	0	28	0	0	0	0	0	0	0	5	2	0	0	0	1	0	0	103	11.7
14-Oct	9.25	0	0	1	41	12	1	2	0	1	0	0	5	0	0	0	0	1	0	1	0	0	1	0	0	0	0	2	68	7.4
15-Oct	8.50	0	0	1	19	4	0	2	0	0	0	0	8	0	0	0	1	1	0	0	0	1	0	2	0	0	0	0	39	4.6
16-Oct	8.42	0	0	2	12	4	2	0	0	0	0	0	4	0	0	0	26	0	0	0	1	2	0	0	0	0	0	0	53	6.3
17-Oct	8.58	0	0	3	9	15	3	9	3	4	0	0	49	0	0	0	5	2	1	0	0	0	0	0	0	0	0	3	106	12.4
18-Oct	8.50	0	0	5	14	1	0	1	0	0	0	0	12	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	36	4.2
19-Oct	8.50	0	0	3	19	8	1	2	0	0	0	0	10	1	0	0	0	1	0	0	4	5	1	1	0	0	0	1	57	6.7
20-Oct	3.83	0	0	0	14	5	0	0	0	0	0	0	0	0	0	0	0	1	0	0	4	1	0	1	0	0	0	0	26	6.8
21-Oct	0.00																													
22-Oct	5.42	0	0	1	3	1	0	0	0	0	0	0	1	0	0	0	0	3	0	1	1	1	0	1	0	0	0	0	13	2.4
23-Oct	8.67	0	0	0	2	3	1	0	0	0	0	0	12	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1	21	2.4
24-Oct	9.00	0	0	1	8	2	0	0	0	0	0	0	21	1	0	0	0	5	0	0	1	2	0	1	0	0	0	0	42	4.7
25-Oct	8.67	0	0	1	4	2	0	0	0	0	0	0	9	0	0	0	0	2	0	0	0	2	0	0	1	0	0	0	21	2.4
26-Oct	2.25	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	3	0	1	0	0	0	0	0	0	0	0	9	4.0
27-Oct	8.33	0	0	0	1	1	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0.8
28-Oct	4.75	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3	0.6
29-Oct	4.00	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0.5
30-Oct	8.25	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	5	0	0	0	0	1	0	0	0	0	0	11	1.3
31-Oct	8.33	0	0	1	1	0	0	0	0	0	0	0	4	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0	9	1.1
01-Nov	8.08	0	0	3	2	0	0	0	0	0	0	0	2	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	9	1.1
02-Nov	8.17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0.1
03-Nov	8.00	0	0	0	3	1	1	0	0	0	0	0	4	0	0	0	0	8	0	0	1	3	0	0	0	0	0	0	21	2.6
04-Nov	7.50	0	0	0	10	3	2	2	0	1	0	0	24	0	0	0	0	4	0	0	0	0	0	0	1	0	0	0	47	6.3
05-Nov	7.00	0	0	0	5	0	0	0	0	0	0	0	7	1	0	0	0	1	0	0	1	0	0	1	0	0	0	0	16	2.3
Total	535.68	82	12	49	1051	620	21	94	12	12	6	274	398	8	0	0	57	70	1	4	216	28	6	43	4	3	2	18	3091	5.8

¹ See Appendix B for explanation of species codes.

	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 ¹	-	-	-	-	-	-	-	-	-	-
Unknown large accipiter ¹	-	-	-	-	-	-	-	-	-	-
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 ¹	-	-	-	-	-	-	-	-	-	-
Unknown large falcon ¹	-	-	-	-	-	-	-	-	-	-
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. Annual observation effort and fall raptor migration counts by species (unadjusted data) in the Manzano Mountains, NM: 1985–2009.

Appendix E. Commune	Ap	pendix	E.	continued
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	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Start date	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 ¹	-	-	-	-	-	-	86	188	205	169
Unknown large accipiter ¹	-	-	-	-	-	-	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 ¹	-	-	-	-	-	-	0	4	2	1
Unknown large falcon ¹	-	-	-	-	-	-	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

	2005	2006	2007	2008	2009	Mean
Start date	27- Aug	27- Aug	27-Aug	27-Aug	27-Aug	26-Aug
End date	5-Nov	5-Nov	5-Nov	5-Nov	5-Nov	2-Nov
Days of observation	69	68	63	69	68	65
Hours of observation	599.58	566.41	553.58	579.00	535.68	514.94
Raptors / 100 hours	937.8	1433.4	883.2	1327.5	577.0	1035.4
SPECIES			RAPTOR	COUNTS		
Turkey Vulture	363	150	499	315	82	374
Osprey	35	30	47	50	12	31
Northern Harrier	46	90	75	89	49	61
Sharp-shinned Hawk	1842	958	1283	1836	1051	1456
Cooper's Hawk	1486	865	922	1084	620	1004
Northern Goshawk	10	10	30	21	21	16
Unknown small accipiter ¹	129	119	74	57	94	125
Unknown large accipiter ¹	5	2	7	10	12	5
Unknown accipiter	1	6	10	16	12	74
TOTAL ACCIPITERS	3473	1960	2326	3024	1810	2597
Broad-winged Hawk	13	9	10	17	6	7
Swainson's Hawk	52	4695	841	2952	274	815
Red-tailed Hawk	823	534	537	575	398	634
Ferruginous Hawk	13	9	8	10	8	12
Rough-legged Hawk	0	0	0	1	0	0
Zone-tailed Hawk	1	0	0	0	0	1
Unknown buteo	33	23	19	11	57	25
TOTAL BUTEOS	935	5270	1415	3566	743	1494
Golden Eagle	71	87	99	167	70	116
Bald Eagle	1	3	6	7	1	4
Unknown Eagle	4	1	9	2	4	1
TOTAL EAGLES	76	91	114	176	75	121
American Kestrel	520	412	298	350	216	523
Merlin	48	23	34	47	28	26
Prairie Falcon	16	13	10	11	6	19
Peregrine Falcon	61	43	51	42	43	48
Unknown small falcon ¹	2	1	0	1	4	2
Unknown large falcon ¹	5	3	2	2	3	4
Unknown falcon	6	1	1	1	2	2
TOTAL FALCONS	658	496	396	454	302	621
Unknown raptor	37	32	17	12	18	43
TOTAL	5623	8119	4889	7686	3091	5342

Appendix E. continued

¹ New designations used for the first time in 2001.

	Stn.						S	PECIE	s ¹							CAPTURES
DATE	Hours	NH	SS	СН	NG	BW	SW	RT	ZT	GE	AK	ML	PR	PG	TOTAL	/ STN HR
03-Sep	3.50	0	0	1	0	0	0	1	0	0	0	0	0	0	2	0.6
04-Sep	4.25	0	1	2	1	0	0	1	0	0	0	0	0	0	5	1.2
05-Sep	4.75	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0.2
06-Sep	7.00	0	2	4	0	0	0	0	0	0	0	0	0	1	7	1.0
07-Sep	7.00	0	0	2	0	0	0	0	0	0	0	0	0	1	3	0.4
08-Sep	5.75	0	1	2	0	0	0	0	0	0	0	0	0	0	3	0.5
09-Sep	0.00															
10-Sep	7.00	0	4	5	0	0	0	0	0	0	0	0	0	0	9	1.3
11-Sep	0.00															
12-Sep	2.00	0	4	0	0	0	0	0	0	0	0	0	0	0	4	2.0
13-Sep	12.75	0	7	5	0	0	0	3	0	0	0	0	0	0	15	1.2
14-Sep	6.66	0	6	6	0	0	0	0	0	0	1	0	0	0	13	2.0
15-Sep	6.75	0	3	5	0	0	0	1	0	0	0	0	0	0	9	1.3
16-Sep	2.25	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0.4
17-Sep	0.00															
18-Sep	0.00															
19-Sep	12.80	0	4	3	1	0	0	3	0	0	0	0	0	0	11	0.9
20-Sep	7.00	0	7	2	0	0	0	0	0	0	4	0	0	0	13	1.9
21-Sep	7.08	0	10	6	0	0	0	0	0	0	0	0	0	0	16	2.3
22-Sep	5.75	1	5	8	0	0	0	1	0	0	0	0	0	0	15	2.6
23-Sep	8.00	0	5	7	1	0	0	0	0	0	1	0	0	0	14	1.8
24-Sep	7.50	0	10	9	0	0	0	0	0	0	2	0	0	0	21	2.8
25-Sep	7.00	0	2	1	1	0	0	2	0	0	3	0	0	0	9	1.3
26-Sep	15.00	0	6	18	0	0	0	1	0	0	0	0	0	0	25	1.7
27-Sep	13.75	0	9	9	1	0	0	1	0	0	0	1	0	0	21	1.5
28-Sep	5.50	0	1	5	0	0	0	0	0	0	0	0	0	0	6	1.1
29-Sep	7.00	0	5	4	0	0	0	1	0	0	0	0	0	0	10	1.4
30-Sep	7.25	0	4	7	0	0	0	0	0	0	0	0	0	0	11	1.5
01-Oct	6.30	0	3	0	0	0	0	0	0	0	0	0	0	0	3	0.5
02-Oct	8.00	0	11	7	0	0	0	0	0	0	0	0	0	0	18	2.3
03-Oct	10.75	0	12	9	0	0	0	2	0	0	0	0	0	0	23	2.1
04-Oct	16.00	0	12	4	0	0	0	2	0	0	0	0	1	0	19	1.2
05-Oct	7.25	0	2	8	0	0	0	0	0	0	0	0	0	0	10	1.4
06-Oct	8.00	0	3	8	0	0	0	1	0	0	0	0	0	0	12	1.5

Appendix F. Daily trapping effort and capture totals of migrating raptors by species in the Manzano Mountains, NM: 2009.

Appendix F. continued

	STN.						S	PECIE	S^1							CAPTURES
DATE	HOURS	NH	SS	СН	NG	BW	SW	RT	ZT	GE	AK	ML	PR	PG	TOTAL	/ STN HR
07-Oct	15.50	0	15	13	0	0	0	2	0	0	0	0	0	0	30	1.9
08-Oct	15.00	0	9	3	0	0	0	3	0	0	1	0	0	0	16	1.1
09-Oct	6.75	0	6	1	0	0	0	0	0	0	1	0	0	0	8	1.2
10-Oct	13.00	0	18	11	0	0	0	1	0	0	1	0	0	0	31	2.4
11-Oct	13.50	0	13	6	0	0	0	1	0	0	0	0	0	0	20	1.5
12-Oct	5.25	0	8	1	2	0	0	0	0	0	0	0	0	0	11	2.1
13-Oct	7.25	0	8	3	0	0	0	0	0	0	0	0	0	0	11	1.5
14-Oct	7.00	0	9	4	0	0	0	0	0	0	0	0	0	0	13	1.9
15-Oct	3.50	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0.3
16-Oct	7.33	0	4	0	0	0	0	0	0	0	0	0	0	0	4	0.5
17-Oct	14.00	0	10	8	0	0	0	1	0	0	0	0	0	0	19	1.4
18-Oct	12.50	0	1	2	0	0	0	0	0	0	0	0	0	0	3	0.2
19-Oct	6.25	1	4	0	1	0	0	1	0	0	1	1	0	0	9	1.4
20-Oct	2.83	0	4	0	0	0	0	0	0	1	1	0	0	0	6	2.1
21-Oct	0.00															
22-Oct	0.00															
23-Oct	6.00	0	2	0	0	0	0	2	0	0	0	0	0	0	4	0.7
24-Oct	12.50	0	1	0	0	0	0	2	0	0	0	0	0	0	3	0.2
25-Oct	6.00	0	3	0	0	0	0	0	0	0	0	0	0	0	3	0.5
26-Oct	0.00															
27-Oct	6.50	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0.2
Total	390.25	2	255	201	8	0	0	34	0	1	16	2	1	2	522	1.3

 $\frac{1 \text{ fotal } 390.25 \quad 2 \quad 255 \quad 201 \quad 8 \quad 0 \quad 0}{^{1} \text{ See Appendix B for explanation of species codes.}}$

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	TOTAL	MEAN
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	3-Sep	3-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	27-Oct	30-Oct	27-Oct		25-Oct
Blinds in operation	1	3	3	3	3	4	4	4	3	3	3	3	3	2	2	2	2	2	2	2		2.8
Trapping days	47	54	57	50	48	53	45	54	58	46	50	55	51	45	45	51	48	47	56	48		50.4
Station days	47	95	131	120	121	136	132	151	165	94	119	145	131	84	84	99	94	105	80	61		99.5
Station hours	511	693	967	889	926	1041	1030	1211	1352	664	791	1037	957	633	756.15	707.77	677.67	452.97	586.04	390.25		813.6
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	104.8	133.8		111.7
Northern Harrier	1	2	2	3	9	2	1	8	14	0	5	7	6	3	0	3	6	3	4	2	81	4.1
Sharp-shinned Hawk	124	262	589	430	502	493	778	612	987	321	495	426	635	458	566	562	299	196	315	255	9305	465.3
Cooper's Hawk	95	195	335	374	353	310	460	427	772	323	330	337	510	400	378	495	280	142	247	201	6964	348.2
Northern Goshawk	1	7	6	6	7	1	5	3	6	6	16	1	10	1	2	3	3	3	3	8	98	4.9
Broad-winged Hawk	0	0	0	0	0	0	0	0	1	0	0	0	1	1	1	0	1	1	0	0	6	0.3
Swainson's Hawk	0	0	0	0	0	0	0	0	0	0	0	1	3	0	0	0	1	0	0	0	5	0.3
Red-tailed Hawk	8	18	61	55	83	50	50	46	112	56	76	39	56	38	43	35	35	9	20	34	924	46.2
Zone-tailed Hawk	0	0	0	0	0	0	0	0	1	0	0	0	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	1	9	1	77	3.9
American Kestrel	10	13	42	14	59	28	92	32	75	44	25	56	37	43	18	37	10	9	4	16	664	33.2
Merlin	1	0	2	4	1	1	11	6	7	2	8	2	12	3	10	3	2	5	8	2	90	4.5
Prairie Falcon	1	1	3	5	3	1	3	5	13	6	3	7	5	4	3	4	4	2	1	1	75	3.8
Peregrine Falcon	2	1	2	1	4	2	5	7	12	8	1	10	13	7	5	10	12	6	3	2	113	5.7
All Species	244	502	1046	896	1025	892	1411	1150	2006	768	963	891	1295	966	1028	1154	654	377	614	522	18403	920.2
Recaptures ¹	0	0	1	1	2	2	1	2	4	4	3	2	3	2	2	3	2	0	1	1	36	1.8
Foreign recaptures ²	2	1	1	1	2	0	5	1	2	2	0	0	3	2	0	0	1	0	0	1	24	1.2
Foreign encounters ³	0	2	2	3	6	6	7	8	13	12	6	7	10	7	5	3	4	6	5	5	122	6.1

Appendix G. Annual trapping and banding effort and capture totals of migrating raptors by species in the Manzano Mountains, NM: 1990–2009.

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.