FALL 2008 RAPTOR MIGRATION STUDIES IN THE MANZANO MOUNTAINS OF CENTRAL NEW MEXICO

HawkWatch International, Inc.
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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 2008 season marked the 24th consecutive count and the 19th consecutive season of trapping and banding conducted at the site by HWI. This report summarizes the 2008 count and banding results.

The Manzanos project was 1 of 14 long-term, annual migration counts and 1 of 5 migration-banding studies conducted or co-sponsored by HWI in North America during 2008. 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 (Q*uercus 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 2007, 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, Tim Hanks and Aldo Raul Coutreras Reyes, had five previous seasons of migration counting experience, including four seasons and one season at this site, respectively (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 functioned largely as a fill-in observer in 2008. Weather permitting, observations typically began by 0900 H Mountain Standard Time (MST) and ended by 1800 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.

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 2008 data follows Hoffman and Smith (2003). In comparing 2008 annual statistics against means and 95% confidence intervals for previous seasons, we equate significance with a 2008 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 45 minutes of capture, unless outfitted with a satellite transmitter, which takes longer.

RESULTS AND DISCUSSION

WEATHER

In 2008, inclement weather entirely precluded two 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 1997–2007 average of 5.4 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 closely matched the 1997–2007 averages for the site: 52% of the active observation days featured predominantly fair skies (average 50%), 16% transitional skies (i.e., changed from fair skies to mostly cloudy or overcast during the day, or vice versa; average 17%), and 32% mostly cloudy to overcast skies (average 33%). However, although both were much less prevalent than in 2007, the prevalence of scattered rain/snow showers during active observation periods was well above average in 2008 (46% of active days vs. average of 33%), as was the prevalence of visibility reducing fog and especially haze (52% vs. average of 37%). Neither factor translated to reductions in average maximum-visibility ratings to the east (91 km vs. average of 89.9 km) and west (91 km vs. average of 89.9 km), however, and the proportion of days where the observers rated the thermal lift conditions as good to excellent was only slightly below average (38% of the active days vs. average of 44%).

In contrast to the past four years, the proportion of active observation days where light winds (<12 kph) prevailed was slightly above average (72% vs. 1997–2007 average of 70%), whereas the proportion of days with predominantly moderate winds (12–28 kph) was below average (22% vs. 1997–2007 average of 27%); however, strong winds (>28 kph) also prevailed on a slightly above-average proportion (6% vs. 1997–2007 average of 4%) of the active observation days in 2008.

In terms of wind directions, the range of conditions seen in 2008 differed from the long-term average pattern in several ways. As usual, SW–W winds were most common but, especially compared to the past two years, were much less common than usual in 2008 (29% of the active days vs. 1997–2007 average of 39%). In contrast, the prevalence of both the second most common pattern, more variable SW–NW winds, and the third most common pattern, NE–SE winds, comprised new record highs in 2008 (19% of the active days vs. average of 6%, and 13% vs. average of 5%, respectively), whereas the pattern that averages second-most common, S–SW winds, was less common than usual (10% vs. average of 14%).

The temperature during active observation periods averaged 13.0°C (the average of daily values, which in turn were averages of hourly readings), ranging from -0.3–19.8°C. The overall daily average was below the 1997–2007 average of 14.6°C, but the minimum and maximum daily-averages fell well within the ranges of values recorded since 1997. We began recording hourly barometric pressure readings on site in 2001. In 2008, the overall average (30.13 in Hg; the average of daily values, which in turn were averages of hourly readings) and minimum (29.71) and maximum (30.38) daily averages were slightly above average.

In summary, similar to the previous three years, in 2008 inclement weather had relatively little impact on the observer's ability to conduct daily counts. Cloud cover conditions nearly matched the averages for the previous 11 years; however, the prevalence of scattered rain/snow showers and haze remained well above average, as has been the case for the past three years. The haze likely resulted from fires raging in southern California and the rapid development occurring in Albuquerque, but did not appear to substantially hamper visibility. The winds also were more variable than usual in 2008, with both light and strong winds more prevalent than average, and relatively steady SW–W and S–SW patterns less prevalent than usual while more variable SW–NW and SE–SW patterns were more common than usual.

The higher prevalence of rain/snow showers and more variable wind patterns likely contributed to the slight reduction in favorable thermal-lift conditions.

OBSERVATION EFFORT

The observers worked on 69 of 71 possible days between 27 August and 5 November. The number of observation days was a significant 7% higher than the 1985–2007 average of 64 ± 95% CI of 2.1 days. The total hours of observation (579.00) also was a significant 13% above the long-term average of 511.26 ± 24.52 hours due to the reduction in days hampered by inclement weather. The 2008 average of 1.9 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 12% below the 1985–2007 average of 2.2 ± 95% CI of 0.15 observers/hr. This difference is due to two related factors: 1) absence of an on-site interpreter as part of the seasonal field crew; and 2) restricted public access due to heavy construction on the roadway leading to the site, which was due to damage caused by a major wildfire during the preceding summer and obviated the need for an interpreter to facilitate public visitation.

FLIGHT SUMMARY

The observers counted 7,686 migrant raptors of 17 species during the 2008 season (see Appendix D for daily count records and Appendix E for annual summaries). The flight was composed of 46% buteos, 39% accipiters, 6% falcons, 4% vultures, 2% eagles, 1% harriers, and ≤1% each of Ospreys and unidentified raptors. This composition includes significantly above-average proportions of buteos and significantly below-average proportions of accipiters, falcons, vultures, and unidentified raptors (Figure 2). No group proportions amounted to record levels in 2008, but very high abundance of Swainson's Hawks was the primary cause of the unusual prevalence of buteos. In fact, the Swainson's Hawk was the most abundant species seen in 2008, which is atypical for the site but also occurred in two previous years (1993 and 2006; see Appendix E), followed by Sharp-shinned Hawks, Cooper's Hawks, Red-tailed Hawks, American Kestrels, and Turkey Vultures (Table 1, Appendix E). The count of Broad-winged Hawks rose to a new record high (59% above average), whereas no record-low species counts occurred in 2008.

Passage Rates and Long-term Trends

Adjusted passage rates were significantly above average for five species (Osprey, Northern Goshawk, Broad-winged Hawk, Bald Eagle, and Merlin) and were significantly below average for six species (Sharp-shinned Hawk, Red-tailed Hawk, Ferruginous Hawk, Rough-legged Hawk, American Kestrel, and Prairie Falcon; 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 Harriers, except that counts had remained low since crashing from a high peak in 1998 but then rebounded in the past three years, such that no overall trend is currently indicated for this species (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, and a return to a gradual increasing pattern since then with a high spike in 2003 (Figure 3). Among the accipiters, low adjusted passage rates in 2006 and 2007 eliminated a previously significant increasing trend for Sharp-shinned Hawks, but 2008 passage rates returned to moderate levels. Lower passage rates during the past three seasons dampened but did not eliminate a still 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 eight 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 generally been on a downward trend, with flights in

the past three 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 2–3 years, with the flight of non-adult birds, in particular, actually reaching a near-record high in 2008. Overall, the recent ups-and-downs of this species mimic the pattern seen in the late 1980s and early 1990s (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 2008 has now tipped the trend to a significant long-term decline (Figure 7). A significant quadratic trend was indicated for Merlins, tracking a strong increasing pattern through about 1996, but a relatively stable 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 7–10 years (Figure 7). Despite a sharp decline since reaching a high peak in 2002, the 2008 passage rate for Peregrine Falcons was only a non-significant 17% below average and still much higher than during the late 1980s, whereas the 2008 passage rate for Prairie Falcons was a significant 44% below average and among the lowest to date.

Smith et al. (2008) present new trend analyses of data collected through 2005 for most of the long-term, on-going, 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 2008.

Differences between results presented in Smith et al (2008) and those presented herein that clearly relate to addition of three more years of data include: a) elimination of a significant second-order model fit for Northern Harriers due to addition of three years of moderately high counts; b) elimination of significant long-term increasing trends for Sharp-shinned and Red-tailed Hawks due to low counts in 2006 and 2007, and again in 2008 for Red-tailed Hawks; c) indications of a renewed, long-term increasing trend for Swainson's Hawks due to addition of three years of high counts; and d) a newly significant long-term decreasing trend for American Kestrels due to addition of three years of low counts. 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 review).

Age Ratios

Among 10 species with data suited to comparisons, immature : adult ratios were significantly above average only for Golden Eagles, but were significantly below average for Sharp-shinned Hawks, Cooper's Hawks, Broad-winged Hawks, Red-tailed Hawks, Ferruginous Hawks, and Peregrine Falcons (Table 2). Non-adult Golden Eagles were significantly more abundant than usual, whereas adult eagles were about as common as usual, suggesting that productivity has increased in the past few years. The opposite held true for Sharp-shinned Hawks, in particular, with identified immature birds much less common than usual but adults much more common than usual. This suggests that overwinter survival and adult recruitment may have been good in the previous year for Rocky Mountain Sharp-shinned Hawks, but productivity was probably below average. Note, however, that an above-average proportion of unaged birds may confound this comparison (Table 2). For Cooper's Hawks and Peregrine Falcons, immature birds clearly were less abundant than usual, whereas adults were about as common as usual, suggesting that the low age ratios for these species resulted from low productivity. In contrast, immature Northern Goshawks clearly were more abundant than usual, with adults about as common as usual, and this resulted in a high age ratio for this species (albeit a non-significant difference due to relatively high variability and low total counts) suggestive of good productivity. Red-tailed Hawks were overall less abundant than usual, but the proportion of immature birds was particularly low, suggesting that both reduced productivity and low adult recruitment in the past year contributed to the decline in numbers of this species in 2008. In contrast, the low age ratio for Broad-winged Hawks reflected a significant increase in the number of adults passing through rather than high abundance of immature birds. A similar pattern applied to Ferruginous Hawks; however, a low total count and a much lower than average proportion of unaged birds limits the utility of this comparison.

Seasonal Timing

The 2008 combined-species median passage date of 25 September nearly matched the 1985–2007 average of 26 September (Table 3). The overall seasonal distribution of activity differed from the average pattern, however, in showing significantly above-average proportional activity levels during the second half of September and comparatively reduced activity levels during the first three weeks of the season and during the first 10 days of October (Figure 8). The difference in pattern was driven largely by the unusual abundance of Swainson's Hawks, whose peak passage occurred during the last 10 days of October; however, the proportional activity levels of several other common species, especially Sharp-shinned and Cooper's Hawks and American Kestrels, also were unusually high during late September. At the species level, contrary to the near-average, combined-species median passage date, only 2 of 16 species for which a comparison was possible showed earlier than average median passage dates in 2008 (Broad-winged Hawk and American Kestrel), whereas 12 species showed significantly late timing (Table 3). Age- and sex-specific data further confirmed primarily late passage timing; the only exceptions were that adult Broad-winged Hawks were a significant 9 days early, and female American Kestrels and adult female and "brown" (combination of indistinguishable immature birds and adult females) Northern Harriers were all a non-significant 1 day earlier than average (Table 4).

TRAPPING EFFORT

The crews operated at least one banding station on 56 of 58 possible days between 3 September and 30 October 2008, with effort totaling 80 station days and 586.04 station hours (see Appendix F daily trapping records and Appendix G for annual summaries). The number of trapping days was 12% above the long-term average, whereas the number of station days and hours were 22 and 31% below average, respectively, primarily due to reduced crew size and experience levels (Appendix G).

TRAPPING AND BANDING SUMMARY

The 2008 capture total of 614 birds included 10 species and 1 recapture of bird previously banded at the site (Table 5, Appendix G). The 2008 effort raises the total number of birds captured since project

inception to 17,881, including 35 recaptures of Manzano-banded birds and 23 foreign recaptures (i.e., birds originally banded elsewhere and subsequently recaptured in the Manzanos; Appendix G). Sharp-shinned and Cooper's Hawks accounted for 51% and 40% of the total captures, respectively, with Red-tailed Hawks (3%), Golden Eagles (1.5%), and Merlins (1.3%) the only other species to comprise more than 1% of the total.

The overall combined-species capture total was 39% below average, the overall capture rate of 104.8 birds per 100 station hours was 9% below average, and the overall capture success of 14% was 36% below average (Table 5), again largely reflecting reduced crew size and experience levels. With a record-high capture total of nine birds, the Golden Eagle was the only species for which all three metrics were significantly above average in 2008. However, all three metrics also were above average for Merlins, but not significantly so for capture success. The only other above-average metric was the capture rate for Northern Harriers. Conversely, commonly captured species for which the 2008 capture totals, rates, and successes were all significantly below average included Red-tailed Hawk, American Kestrel, and Prairie Falcon, and this was also true for the uncommonly captured Broad-winged Hawk. For all other commonly captured species, the capture rates were non-significantly below average but both the capture totals and estimates of capture success were significantly below average.

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 2008 immature : adult capture ratio for Sharp-shinned Hawks of 1.9 was a significant 21% above average (Table 6), whereas the count-based age ratio of 0.6 was a significant 36% below average (Table 2). This suggests that immature birds were much more susceptible to capture than usual compared to adults in 2008. The 2008 capture age ratio for Cooper's Hawks of 0.9 matched the long-term average, whereas the count age ratio of 0.6 was a significant 30% below average. Again, this suggests that immature Cooper's Hawks also were more susceptible to capture than usual compared adults, but to a lesser degree than for Sharp-shinned Hawks. The banding data also uniquely suggested that the female : male ratio for captured Sharp-shinned Hawks was only slightly below average, whereas the sex ratio of captured Cooper's Hawks was significantly above average (Table 6).

Only one female American Kestrel was captured in 2008, which is less than 10% of the average total, whereas the capture total for male American Kestrels was only 63% below average, such that the 2008 female : male capture ratio of 0.11 was a significant 85% below average (Table 6). In contrast, the count-based sex ratio for kestrels of 0.98 was a significant 15% above the long-term average of 0.85 ± 95% CI of 0.09. This suggests that female kestrels were proportionately more abundant but much less susceptible to capture than usual in 2008 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 76% below average immature : adult ratio for kestrels in 2008, further suggesting that immature birds were either relatively scarce or much less susceptible to capture than usual in 2008.

ENCOUNTERS WITH PREVIOUSLY BANDED BIRDS

Recaptures.—One recapture of a bird previously banded in the Manzano Mountains occurred in 2008, which brings the total number of recaptures to 35 (Appendix G). This season's recapture was a female Sharp-shinned Hawk originally banded as a hatch-year (HY) bird in 2000, making her nearly 8.5 years old, and she still was very healthy! Although by no means a record-setting age for this species (19 years, 11 months currently is the longevity record recorded by the National Bird Banding Laboratory; see http://www.pwrc.usgs.gov/BBL/homepage/longvrec.htm), any Sharp-shinned that approaches 10 years or more in age has survived a relatively long time.

Foreign Encounters.—Five raptors originally banded in the Manzanos were encountered elsewhere in 2008 (Table 7), which brings the total foreign encounters since 1990 to 117 birds (Appendix G). The 2008 encounters included two female and two male Cooper's Hawks. The first female was banded as a HY bird in 2002 and was recaptured and released at HWI's spring migration monitoring site in the nearby

Sandias Mountains (~34 km north of the Manzanos site) on 6 April 2008. The second female was banded as a second-year (SY) bird in 2005 and was found injured (unknown reason) ~663 km north of the project site near Manila, Utah on 1 May 2008 and later died. One male was banded as an after-second-year (ASY) bird in 2002 and was found on 8 April 2008 after it was killed by a "miscellaneous" (i.e., unknown) animal ~28 km north of the project site near Cedar Crest, New Mexico. The second male was banded as a SY bird in 2006 and was found ~443 north of the project site near Glenwood Springs, Colorado on 12 June 2008 dead on a highway and presumed to be the victim of a car collision.

The fifth bird encountered in 2008 was a Red-tailed Hawk banded as a HY bird in 1997 and found on 8 April 2008 ~1,553 km north of the project site near Fort Macleod, Alberta, Canada after it collided with a communication tower or associated wires and was killed. This bird was nearly 11 years old and is only the second recovery HWI has ever recorded for a Red-tailed Hawk in Alberta and only the seventh band return HWI has ever recorded for a Red-tailed Hawk in Canada (several others tracked by satellite into Canada)!

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

SATELLITE TELEMETRY

We outfitted one new Golden Eagle with a satellite transmitter in the Manzanos in 2008. After capture, this HY female 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. Sensor data from the transmitter confirmed that this eagle was still alive and active as mid-January 2009.

In July 2008, after the solar-powered transmitter began signaling again and gave us additional reliable data to use, we finally were able to locate the carcass and recover the transmitter from the young male Golden Eagle we outfitted in the Manzanos during fall 2006. After having spent the winter of 2006/2007 in a large oil field near Midland, Texas, this eagle returned to north-central Wyoming for the summer, where he wandered extensively around and between primarily the Big Horn and Absaroka Mountains, with a brief venture up into southwestern Montana. Unfortunately, in mid-November 2007, before he began another fall migration, this eagle died in a remote area of dry shrubsteppe and wash habitat just south of Tensleep, Wyoming. Based on the breast-down position of the intact carcass on the ground but with the head twisted backwards, it appeared that he may have crash landed and broken his neck, possibly while chasing prey.

We also continued to receive sporadic data from the young female Golden Eagle we outfitted in the Manzanos during all 2005 through September 2008. After release, this bird traveled northwest ~450 km (280 mi) up into southwestern Colorado and remained there after that. We received regular location data from this bird through June 2007, received no useable location data for the next six months, and then all of a sudden started receiving location data again in mid-January 2008, which continued through September! Throughout this time, sensor data continued to indicate no problems with bird activity, temperature indicators or battery voltage, and the tracking data also continued to indicate regular movement at a localized level. It appears this eagle adopted as its permanent home range two areas separated by about 100 km in southwestern Colorado, and during the three years we tracked her, she moved between these two areas on several occasions both within and between seasons. The primary area was located on the Uncompahgre National Forest about 90 km northwest of Durango, and the other was located in the far southwest corner of Colorado in the vicinity of Ute Mountain about 20 km east-southeast of Cortez.

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

RESIDENT RAPTORS

Resident Turkey Vultures were common until the first week of October, with the largest groups numbering 6–8 birds. Throughout most of October, an immature Northern Harrier was seen frequently, mainly hunting the ridge behind observation and low to the west. In mid-October, an adult male harrier moved into the area and was seen almost daily through the remainder of the season.

A pair of adults and one juvenile Sharp-shined Hawk were observed early in the season. After that, various individuals were seen throughout the season, and towards the end of October an adult male and two juveniles were seen frequently. A pair of Cooper's Hawks with one juvenile were seen in the area in September, and throughout the rest of the season an adult and one immature often were seen hunting mainly low to the west and in front of the count site.

A family of Red-tailed Hawks—two adults and one immature—resided near the observation point, and another adult often was seen farther to the north. There were probably two pairs of adults in the general area, but generally only two or three were spotted at any one time. They were often seen displaying together, usually to the north. The immature bird was last seen in early October, and the local pair of adults appeared to leave in late October, at which point it appeared that a new single adult moved into the area and remained through the end of the season.

Local Swainson's Hawks also were common again this year, often seen hawking insects in all directions, although mostly to the north and northeast. Their numbers greatly decreased after mid-September and none were seen after September.

Two adult Golden Eagles were seen sporadically throughout the season, generally far out to the north and northwest. An immature eagle was seen with one adult a couple of times in September. After mid-October, the adults occasionally were seen escorting migrants through the area. An immature Golden Eagle was seen three times on 27 October flying the same south-to-north route, but was not seen after that. Sub-adult birds also were seen flying a non-migrant pattern at various times throughout the season, but never appeared to have an established territory in the area.

A pair of Prairie Falcons was seen often throughout the season, especially after September. They were mostly spotted in Canon de Jaramillo low to the south and west of the count site. A family of Peregrine Falcons—two adults and two juveniles—was seen frequently early in the season and through early October. Prairie Falcon sightings became more frequent after the peregrines left the area. During the first two days of the count, an adult male Taiga Merlin was seen hunting in the area, but it did not remain after that. A brown Taiga Merlin resided in the area during the third week of October, and another moved in towards the end of the month. They both seemed to be hatch-year birds and occasionally were seen chasing each other during the last week or so of the count.

For the fourth year in a row there seemed to be a significant number of aerial insects that migrating raptors took advantage of as a food source. Some of these insects were butterflies (a species of Lady); others were unidentified. Species seen catching these insects included Swainson's Hawks, Red-tailed Hawks, American Kestrels, Sharp-shined and Coopers Hawks, and Prairie and Peregrine Falcons.

This is a typical resident assemblage for the site.

SITE VISITATION

In 2008, the majority of the Mountainair Ranger District of the Cibola National Forest was closed to the general public because of damage caused by an extensive wildfire that burned the area during summer 2008. Thus, access to the project site was restricted to USFS and HWI personnel and closely affiliated guests during the season.

In 2008, 579 hourly assessments of visitor disturbance resulted in the following ratings: 91% none, 7% low, 2% moderate, and 0% high. These values reflect lower visitor-disturbance ratings than usual for the site due to the lack of general public visitors.

ACKNOWLEDGMENTS

Financial support for this project in 2008 was provided by the USDA Forest Service – Cibola National Forest and Region 3, New Mexico Department of Game and Fish, Arthur and Elaine Johnson Foundation, Walbridge Fund, and HWI private donors and members. We especially thank Karen Lessard, Bill Falvey, and Susan Johnson of the Forest Service for their logistical support. HWI and the field crew also thank Trader Joes, Whole Foods Market, and Art Arenholz of Albuquerque for their generous contributions of food to support the field crew during the season. Lastly, we extend our heartfelt thanks to the following individuals for their generous volunteer service and support during the season: Roger Grimshaw, Walt and Jennifer Lehman, Ken Babcock, Melanie Keithley, John Delong, Jessie Jewell, Tavo and Kirsten Cruz, and Steve and Nancy Cox.

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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: 1985–2007 versus 2008.

	COUNTS			RAPTORS / 100 HRS[1]		
SPECIES	1985–2007[2]	2008	% CHANGE	1985–2007[2]	2008	% CHANGE
Turkey Vulture	390 ± 98.1	315	-19	79.3 ± 18.84	61.3	-23
Osprey	31 ± 7.0	50	+64	8.1 ± 1.66	12.6	+56
Northern Harrier	60 ± 10.6	89	+47	12.2 ± 1.97	15.9	+31
Sharp-shinned Hawk	1457 ± 182.3	1836	+26	359.3 ± 41.07	398.3	+11
Cooper's Hawk	1017 ± 145.9	1084	+7	292.2 ± 34.52	285.0	-2
Northern Goshawk	16 ± 3.9	21	+32	3.6 ± 0.98	3.7	+3
Unknown small accipiter[3]	139 ± 37.3	57	-59	–	–	–
Unknown large accipiter[3]	4 ± 1.7	10	+169	–	–	–
Unidentified accipiter	79 ± 26.9	16	-80	–	–	–
TOTAL ACCIPITERS	2612 ± 312.2	3024	+16	–	–	–
Broad-winged Hawk	7 ± 1.7	17	+146	2.4 ± 0.55	5.7	+132
Swainson's Hawk	746 ± 706.5	2952	+296	279.9 ± 265.03	1099.9	+293
Red-tailed Hawk	647 ± 71.6	575	-11	140.7 ± 14.04	107.5	-24
Ferruginous Hawk	13 ± 2.1	10	-20	2.7 ± 0.49	1.9	-29
Rough-legged Hawk	0.2 ± 0.2	1	+360	0.0 ± 0.04	0.2	+307
Zone-tailed Hawk	1 ± 0.3	0	-100	–	–	–
Unidentified buteo	24 ± 9.4	11	-54	–	–	–
TOTAL BUTEOS	1436 ± 703.7	3566	+148	–	–	–
Golden Eagle	116 ± 13.2	167	+44	25.2 ± 3.10	32.1	+28
Bald Eagle	3 ± 1.0	7	+101	1.1 ± 0.34	1.9	+79
Unidentified Eagle	1 ± 0.9	2	+92	–	–	–
TOTAL EAGLES	120 ± 13.2	176	+46	–	–	–
American Kestrel	544 ± 63.9	350	-36	148.6 ± 17.34	88.6	-40
Merlin	25 ± 5.7	47	+85	6.4 ± 1.35	10.6	+65
Prairie Falcon	20 ± 4.7	11	-44	4.3 ± 0.89	2.4	-44
Peregrine Falcon	49 ± 14.5	42	-13	11.9 ± 3.51	9.9	-17
Unknown small falcon[3]	1 ± 1.0	1	-30	–	–	–
Unknown large falcon[3]	4 ± 3.7	2	-52	–	–	–
Unidentified falcon	2 ± 1.1	1	-58	–	–	–
TOTAL FALCONS	642 ± 71.6	454	-29	–	–	–
Unidentified raptor	45 ± 16.3	12	-74	–	–	–
GRAND TOTAL	5337 ± 848.7	7686	+44	–	–	–

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

[2] Mean ± 95% CI.

[3] Designations used for the first time in 2001.

Table 2. Annual raptor migration counts by age classes and immature : adult ratios for selected species in the Manzano Mountains, NM: 1990–2007 versus 2008.

	Total and Age-classified Counts								Immature : Adult Ratio	
	1990–2007 Average			2008			% Unknown Age			
	Total	Imm.	Adult	Total	Imm.	Adult	1990–2007[1]	2008	1990–2007[1]	2008
Northern Harrier	64	32	16	89	42	25	26 ± 6.1	25	2.1 ± 0.48	1.7
Sharp-shinned Hawk	1561	612	674	1836	494	840	18 ± 3.6	27	0.9 ± 0.13	0.6
Cooper's Hawk	1139	406	495	1084	283	494	21 ± 4.4	28	0.8 ± 0.12	0.6
Northern Goshawk	16	7	7	21	12	6	13 ± 6.3	14	1.6 ± 0.84	2.0
Broad-winged Hawk	8	1	4	17	1	9	40 ± 15.5	41	0.5 ± 0.36	0.1
Red-tailed Hawk	711	233	374	575	119	295	15 ± 3.5	28	0.7 ± 0.11	0.4
Ferruginous Hawk	11	3	3	10	1	6	48 ± 7.3	30	1.8 ± 0.74	0.2
Golden Eagle	116	62	31	167	109	35	17 ± 4.2	14	2.3 ± 0.48	3.1
Bald Eagle	4	2	1	7	5	2	10 ± 14.2	0	2.0 ± 1.08	2.5
Peregrine Falcon	64	18	28	42	6	26	23 ± 9.6	24	0.8 ± 0.39	0.2

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

Table 3. First and last observed, bulk passage, and median passage dates by species for migrating raptors in the Manzano Mountains, NM in 2008, with comparisons of 2008 and 1985–2007 average median passage dates.

	2008				1985–2007
Species	First Observed	Last Observed	Bulk Passage Dates[1]	Median Passage Date[2]	Median Passage Date[2,3]
Turkey Vulture	27-Aug	15-Oct	3-Sep – 7-Oct	25-Sep	17-Sep ± 3.0
Osprey	30-Aug	22-Oct	4-Sep – 12-Oct	18-Sep	17-Sep ± 1.4
Northern Harrier	6-Sep	4-Nov	16-Sep – 29-Oct	4-Oct	2-Oct ± 1.9
Sharp-shinned Hawk	28-Aug	4-Nov	15-Sep – 17-Oct	29-Sep	27-Sep ± 1.1
Cooper's Hawk	27-Aug	28-Oct	15-Sep – 13-Oct	27-Sep	25-Sep ± 1.1
Northern Goshawk	21-Sep	4-Nov	2-Oct – 2-Nov	22-Oct	5-Oct ± 4.4
Broad-winged Hawk	15-Sep	1-Oct	15-Sep – 1-Oct	16-Sep	26-Sep ± 2.5
Swainson's Hawk	3-Sep	6-Oct	18-Sep – 27-Sep	24-Sep	20-Sep ± 2.9
Red-tailed Hawk	28-Aug	4-Nov	15-Sep – 23-Oct	10-Oct	2-Oct ± 1.9
Ferruginous Hawk	13-Sep	27-Oct	13-Sep – 21-Oct	13-Oct	2-Oct ± 4.2
Rough-legged Hawk	7-Oct	7-Oct	–	–	–
Golden Eagle	1-Sep	4-Nov	20-Sep – 1-Nov	18-Oct	14-Oct ± 1.8
Bald Eagle	17-Oct	3-Nov	17-Oct – 3-Nov	30-Oct	22-Oct ± 5.5
American Kestrel	28-Aug	23-Oct	7-Sep – 3-Oct	18-Sep	20-Sep ± 1.5
Merlin	13-Sep	2-Nov	15-Sep – 27-Oct	16-Oct	7-Oct ± 2.9
Prairie Falcon	9-Sep	21-Oct	13-Sep – 19-Oct	4-Oct	25-Sep ± 3.0
Peregrine Falcon	9-Sep	24-Oct	13-Sep – 13-Oct	29-Sep	22-Sep ± 1.3
All species	27-Aug	4-Nov	15-Sep – 15-Oct	25-Sep	26-Sep ± 0.8

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

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

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

Table 4. Median passage dates by age classes for selected species of migrating raptors in the Manzano Mountains, NM: 1985–2007 versus 2008.

	ADULT		IMMATURE / SUBADULT	
SPECIES	1985–2007[1]	2008	1985–2007[1]	2008
Northern Harrier	8-Oct ± 3.6	15-Oct	1-Oct ± 2.2	4-Oct
Sharp-shinned Hawk	5-Oct ± 1.4	6-Oct	18-Sep ± 1.3	23-Sep
Cooper's Hawk	28-Sep ± 1.9	29-Sep	21-Sep ± 1.8	24-Sep
Northern Goshawk	7-Oct ± 4.4	26-Oct	3-Oct ± 6.4	13-Oct
Broad-winged Hawk	24-Sep ± 4.7	15-Sep	–	–
Red-tailed Hawk	7-Oct ± 2.0	10-Oct	25-Sep ± 1.8	29-Sep
Ferruginous Hawk	4-Oct ± 8.6	15-Oct	25-Sep ± 5.0	–
Golden Eagle	16-Oct ± 2.5	17-Oct	13-Oct ± 1.7	18-Oct
Bald Eagle	10-Oct [2]	–	16-Oct ± 6.9	1-Nov
Peregrine Falcon	25-Sep ± 2.0	2-Oct	16-Sep ± 2.6	18-Sep

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

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

[2] Data for 2003 only.

Table 5. Capture totals, rates, and successes for migrating raptors in the Manzano Mountains, NM: 1991–2007 versus 2008.

	Capture Total		Capture Rate[1]		Capture Success (%)[2]	
Species	1991–2007[3]	2008	1991–2007[3]	2008	1991–2007[3]	2008
Northern Harrier	4 ± 1.7	4	0.5 ± 0.15	0.7	7 ± 2.7	4
Sharp-shinned Hawk	507 ± 91.6	315	57.7 ± 6.56	53.8	31 ± 3.3	17
Cooper's Hawk	378 ± 66.0	247	43.6 ± 5.72	42.1	32 ± 3.6	22
Northern Goshawk	5 ± 1.8	3	0.6 ± 0.22	0.5	31 ± 9.7	14
Broad-winged Hawk	0.4 ± 0.23	0	0.05 ± 0.035	0.0	4 ± 2.6	0
Swainson's Hawk	0.3 ± 0.37	0	0.03 ± 0.040	0.0	0.1 ± 0.2	0
Red-tailed Hawk	51 ± 11.5	20	5.7 ± 1.02	3.4	7 ± 1.4	3
Zone-tailed Hawk	0.1 ± 0.12	0	0.004 ± 0.009	0.0	6 ± 10.9	-
Golden Eagle	4 ± 0.9	9	0.4 ± 0.12	1.5	3 ± 0.6	5
American Kestrel	37 ± 11.1	4	4.2 ± 1.05	0.7	6 ± 1.3	1
Merlin	5 ± 1.8	8	0.5 ± 0.21	1.4	16 ± 6.6	17
Prairie Falcon	4 ± 1.3	1	0.5 ± 0.11	0.2	18 ± 3.0	9
Peregrine Falcon	6 ± 2.0	3	0.8 ± 0.25	0.5	10 ± 2.8	7
All Species	1001 ± 174.8	614	114.6 ± 12.88	104.8	22 ± 2.4	14

[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 ± 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: 1990–2007 averages versus 2008.

		Female		Male		Female : Male	Immature : Adult
Species	Year	HY	AHY	HY	AHY	Ratio[1]	Ratio[1]
Sharp-shinned Hawk	1990-2007	157	120	149	77	1.3 ± 0.1	1.6 ± 0.2
	2008	73	42	67	14	1.4	2.5
Cooper's Hawk	1990-2007	89	105	93	87	1.1 ± 0.09	0.9 ± 0.2
	2008	46	31	35	30	1.2	1.3
American Kestrel	1990-2007	10	2	17	7	0.7 ± 0.20	4.2 ± 1.13
	2008	0	1	5	4	0.1	1.0

[1] Long-term value: mean ± 95% confidence interval.

Table 7. Foreign encounters with raptors originally banded in the Manzano Mountains, NM: 2008.

BAND #	SPECIES[1]	SEX	BANDING AGE[1]	BANDING DATE	ENCOUNTER DATE	ENCOUNTER AGE[2]	ENCOUNTER LOCATION	DISTANCE (KM)	STATUS
1005 – 24900	CH	F	SY	22-Sep-05	2-Apr-08	≥3rd yr	Manila, UT	663	injured/died
1005 – 01619	CH	F	HY	15-Sep-02	6-Apr-08	≥5th yr	Sandia Mts., NM	34	captured/released
1807 – 45937	RT	U	HY	6-Oct-97	8-Apr-08	≥10th yr	Fort Macleod, Alberta, Canada	1553	transmission tower wire collision/died
0804 – 15435	CH	M	ASY	04-Oct-02	11-Apr-08	≥7th yr	Cedar Crest, NM	28	depredated by "miscellaneous" animal
0804 – 31212	CH	M	SY	15-Sep-06	12-Jun-08	TY	Glenwood Springs, CO	444	car kill

[1] See Appendix B for explanation of species codes.

[2] HY = hatch year; SY = second year; TY = third year; AHY = after hatch year; ASY = after second year; ATY = after third year.

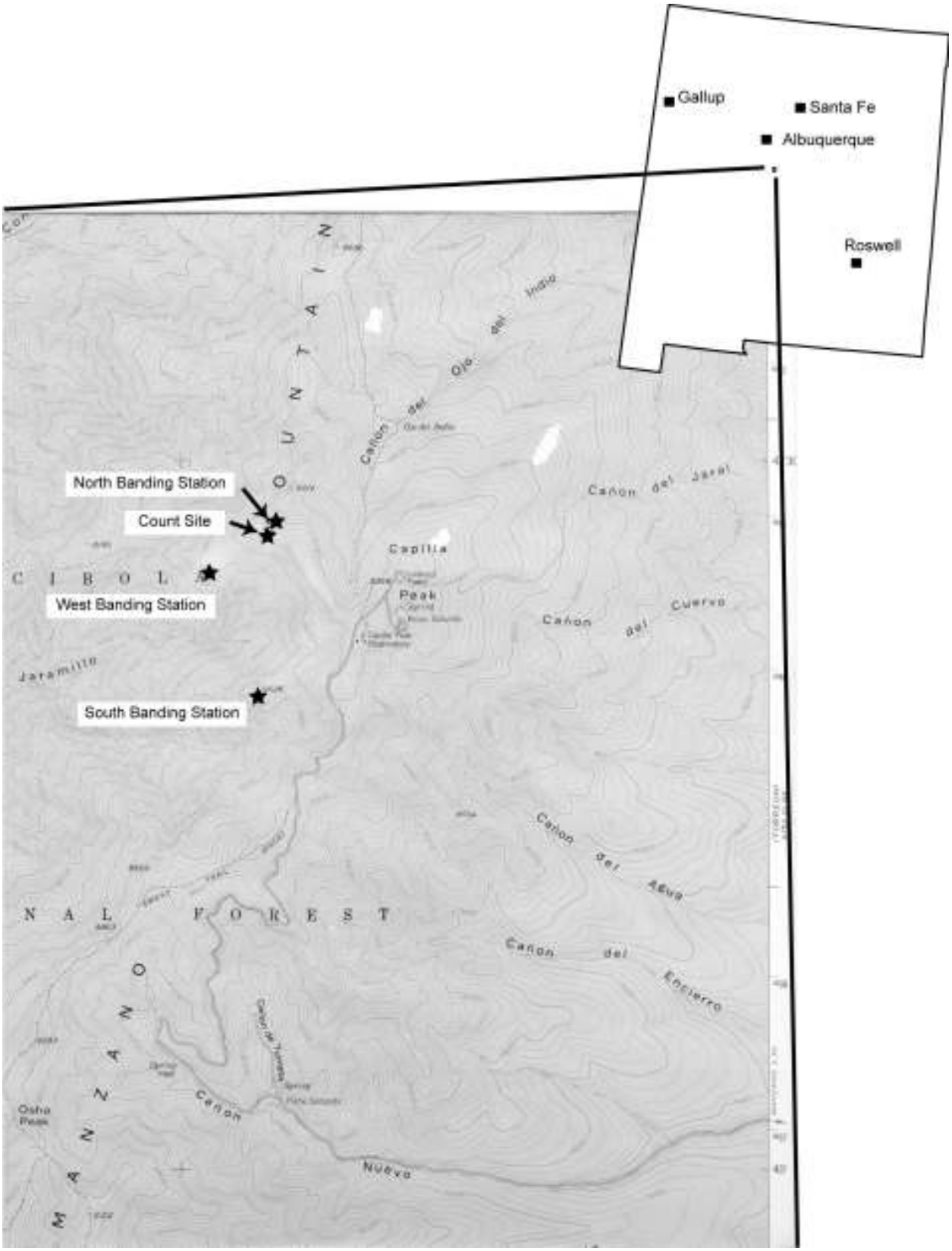

Figure 1. Map of the Manzano Mountains raptor-migration study site in central New Mexico.

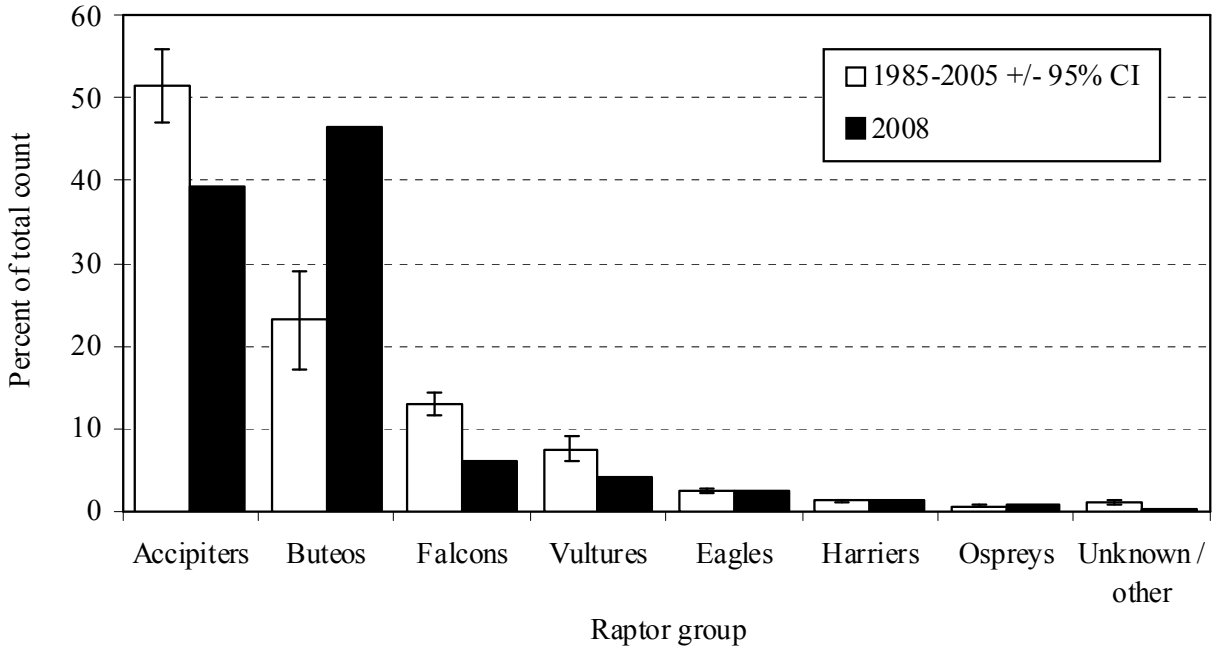

Figure 2. Fall raptor-migration flight composition by major species groups in the Manzano Mountains, NM: 1985–2007 versus 2008.

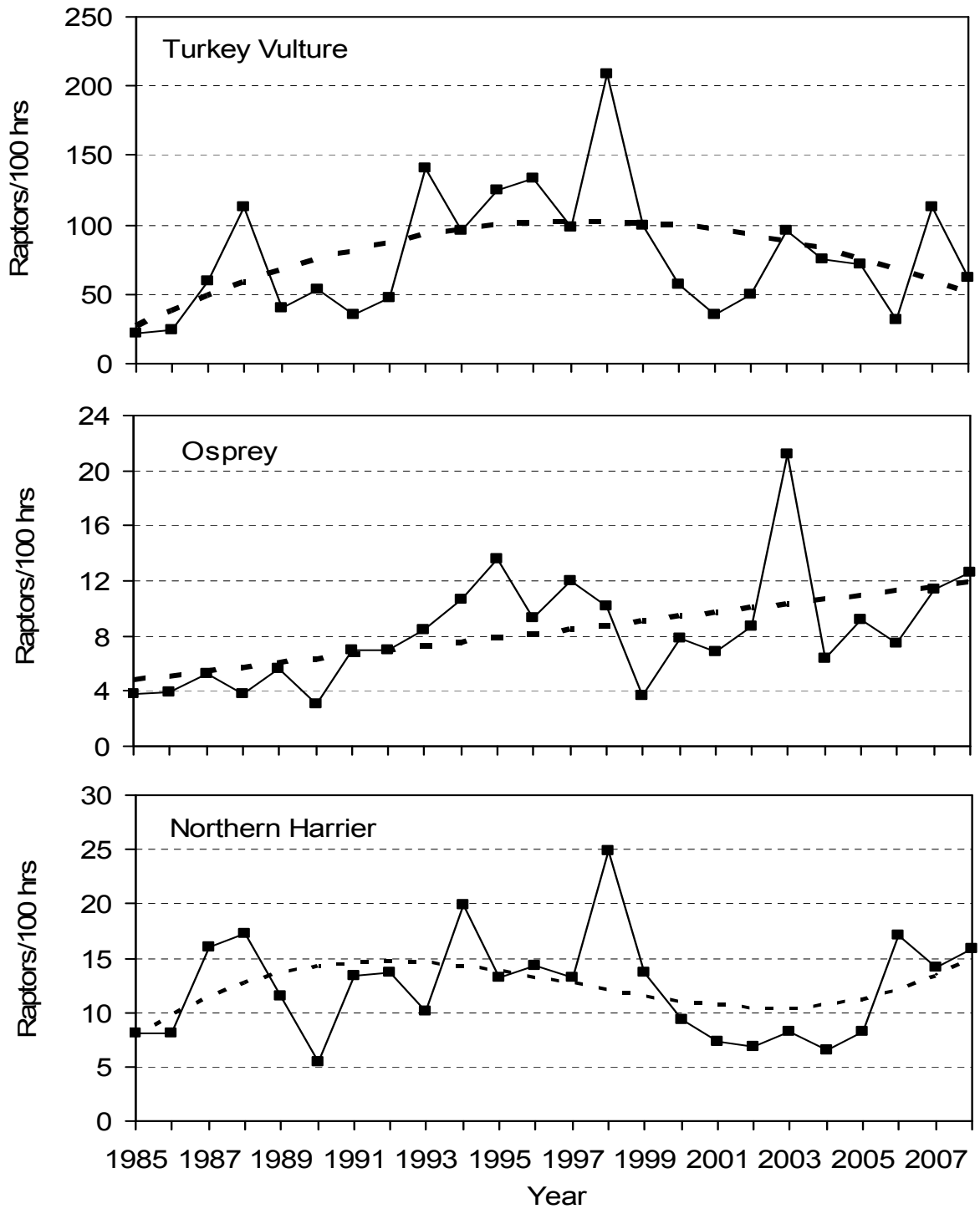

Figure 3. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) fall-migration passage rates for Turkey Vultures, Ospreys, and Northern Harriers in the Manzano Mountains, NM: 1985–2008. Dashed lines indicate significant ($P \leq 0.10$) regressions.

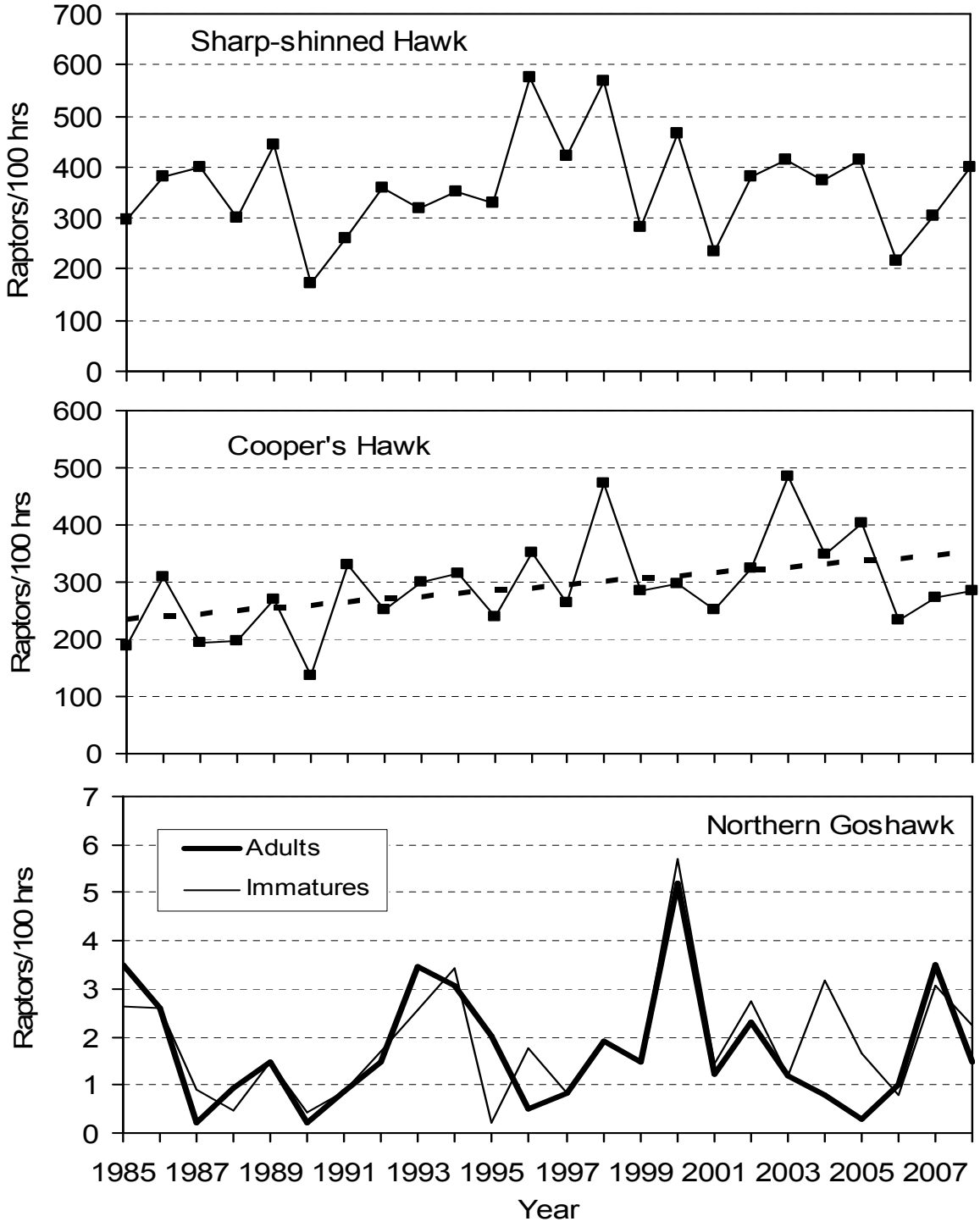

Figure 4. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) fall-migration passage rates for Sharp-shinned Hawks, Cooper's Hawks, and Northern Goshawks in the Manzano Mountains, NM: 1985–2008. Dashed lines indicate significant ($P \leq 0.10$) regressions.

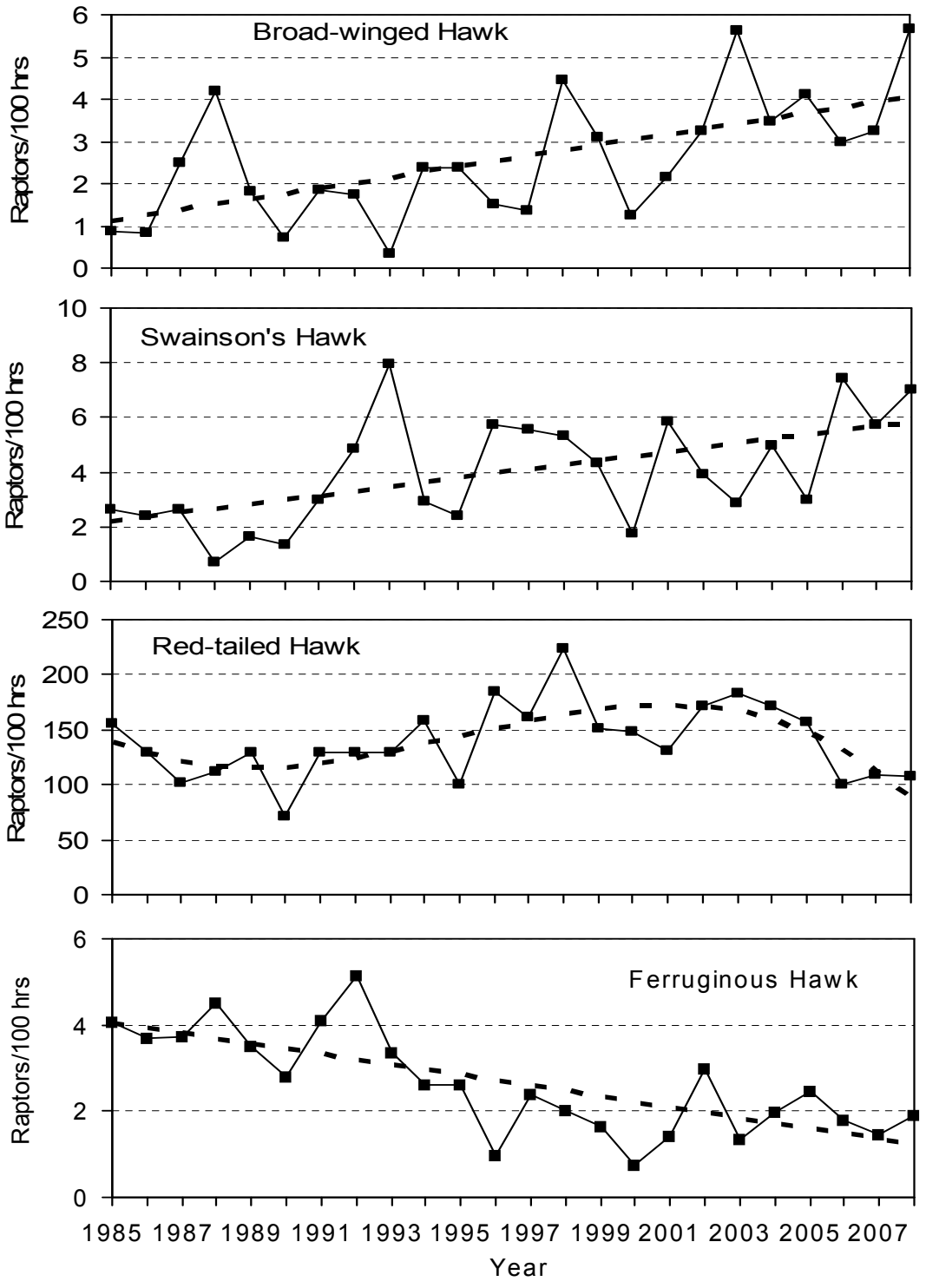

Figure 5. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) fall-migration passage rates for Broad-winged, Swainson's, Red-tailed and Ferruginous Hawks in the Manzano Mountains, NM: 1985–2008. Dashed lines indicate significant ($P \leq 0.10$) regressions.

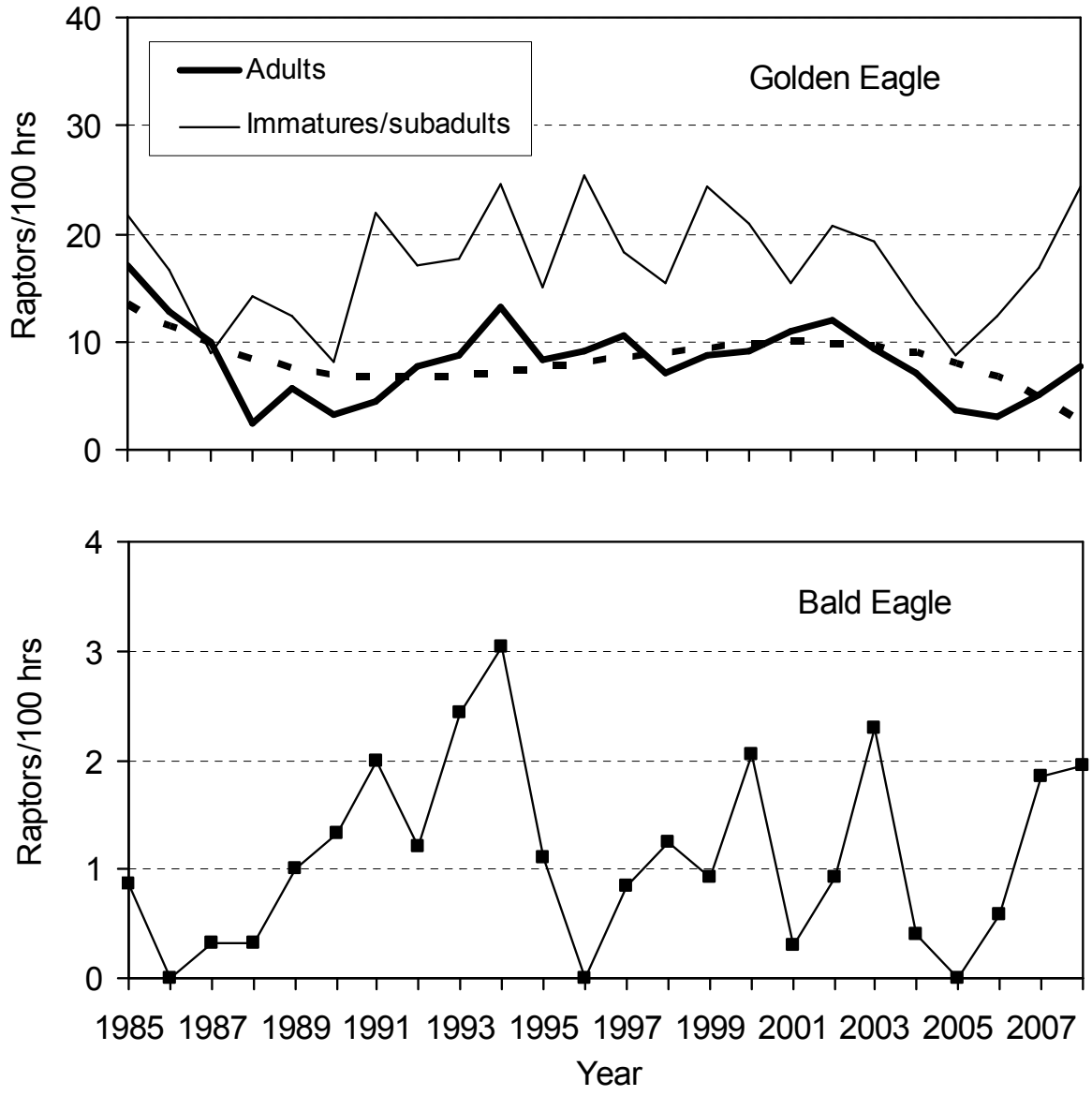

Figure 6. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) fall-migration passage rates for Golden and Bald Eagles in the Manzano Mountains, NM: 1985–2008. Dashed lines indicate significant ($P \leq 0.10$) regressions.

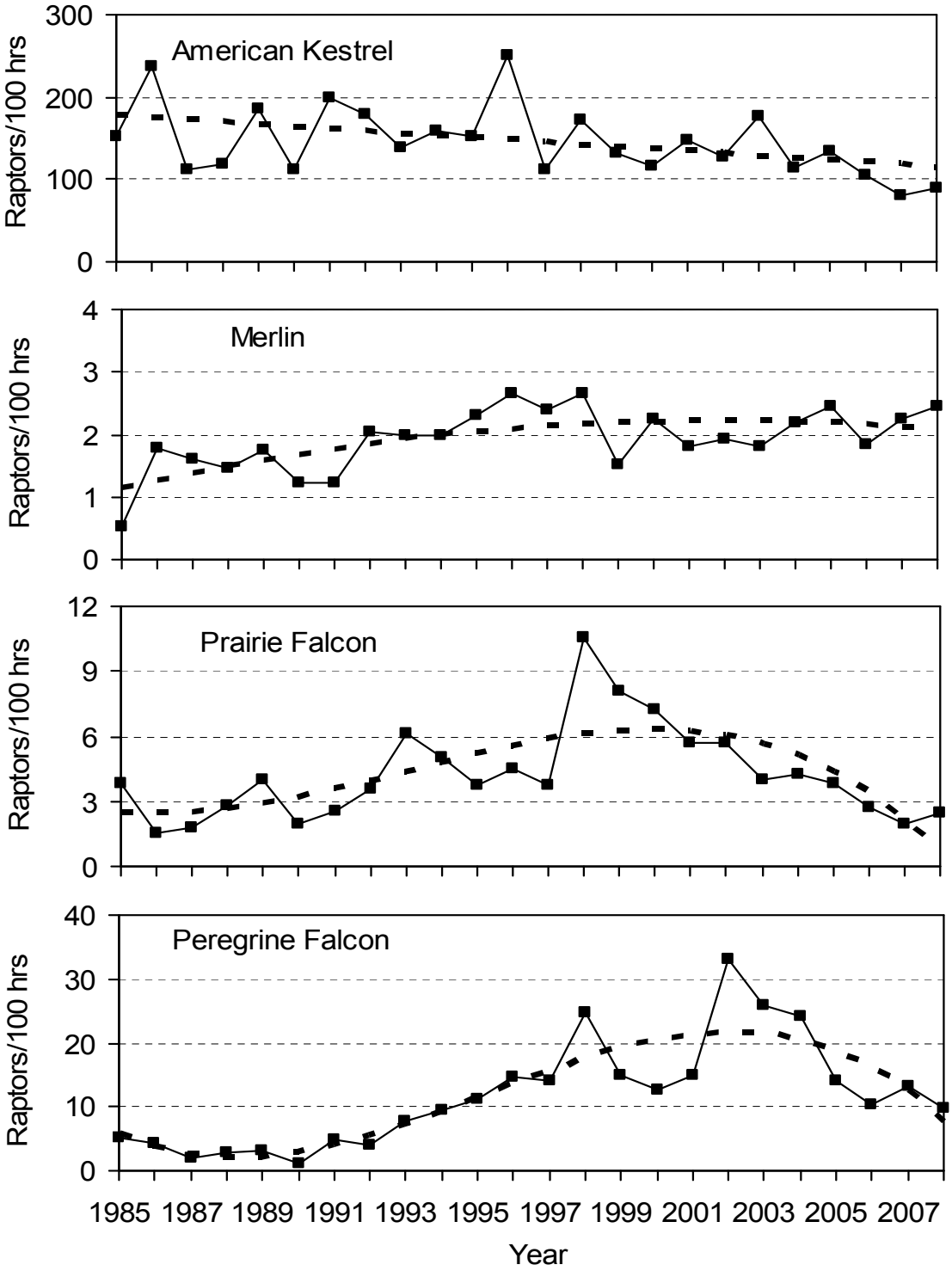

Figure 7. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) fall-migration passage rates for American Kestrels, Merlins, Prairie Falcons, and Peregrine Falcons: 1985–2008. Dashed lines indicate significant ($P \leq 0.10$) regressions.

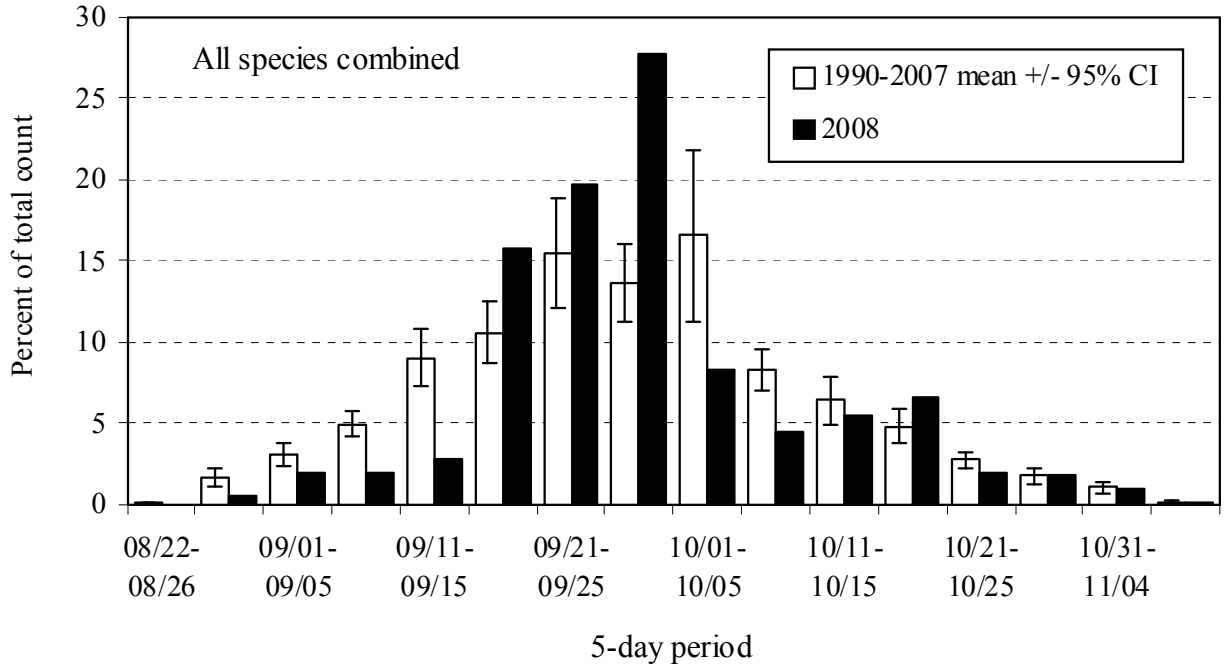

Figure 8. Combined-species, fall-migration passage volume by five-day periods for raptors in the Manzano Mountains, NM: 1985–2007 versus 2008.

Appendix A. History of official observer participation in the Manzano Mountains Raptor Migration Project: 1985–2008.

1985 Single observer throughout, shared duty: Gary Cress (0)[1], Jim Daly (1), Allen Hale (1)

1986 Single observer throughout: Jim Daly (2)

1987 Single observer throughout: Jim Daly (3)

1988 Single observer throughout: Gordon Vickrey (1)

1989 Two observers during peak 3/4 of the season, one observer otherwise: Brett Ewald (2), Tim Menard (0)

1990 Two observers during peak 3/4 of the season, one observer otherwise: David Curson (0), Gary Cress (1)

1991 Two observers throughout: Eric Meyer (1), Tylan Dean (0)

1992 Two observers throughout: Eric Meyer (3), Jessie Jewell (0)

1993 Two observers throughout: Jessie Jewell (2), John Haskell (0)

1994 Two observers throughout: Jessie Jewell (4), Jeff Ogburn (1)

1995 Two observers throughout: Jessie Jewell (6), Jeff Ogburn (2)

1996 Two observers throughout: Jessie Jewell (8), Sean O'Connor (3)

1997 Two observers throughout: Jeff Ogburn (4), Sean O'Connor (4)

1998 Two observers throughout: Dan Rossman (1), Lawry Sager (0)

1999 Two observers throughout: Jason Beason (4), Lawry Sager (1)

2000 Two observers throughout: Jorge Canaca (1), Laura Lutz (1)

2001 Two observers throughout: Tim Meehan (1), Carrie Hisaoka (0)

2002 Two observers throughout: Carrie Hisaoka (1), Richard Sim (0)

2003 Two observers throughout: Carrie Hisaoka (2), Tim Hanks (1)

2004 Two observers throughout: Paula Shannon (3), Frank Mayer (2)

2005 Two observers throughout: Tim Hanks (2), Geoff Gould (0)

2006 Two observers throughout: Tim Hanks (3), Greg Levandoski (3)

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

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

Common Name	Scientific Name	Species Code	Age[1]	Sex[2]	Color Morph[3]
Turkey Vulture	*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	A I U	U	NA
Cooper's Hawk	*Accipiter cooperii*	CH	A I U	U	NA
Northern Goshawk	*Accipiter gentilis*	NG	A I U	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	A I U	U	D L U
Swanson's Hawk	*Buteo swainsoni*	SW	U	U	D L U
Red-tailed Hawk	*Buteo jamaicensis*	RT	A I U	U	D L U
Ferruginous Hawk	*Buteo regalis*	FH	A I U	U	D L U
Rough-legged Hawk	*Buteo lagopus*	RL	U	U	D L U
Zone-tailed Hawk	*Buteo albonotus*	ZT	A I U	U	NA
Unknown buteo	*Buteo* spp.	UB	U	U	D L U
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	A I U	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

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

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

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

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

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

Appendix C. Daily observation effort, visitor disturbance ratings, weather records, and flight summaries for the Manzano Mountains Raptor Migration Project: 2008.

Date	Obs. Hours	Obsrvr / Hour[1]	Median Visitor Disturb[2]	Predominant Weather[3]	Wind Speed (kph)[1]	Wind Direction	Temp (°C)[1]	Barom. Press. (in Hg)[1]	Median Thermal Lift[4]	Visib. West (km)[1]	Visib. East (km)[1]	Median Flight Distance[5]	Birds / Hour
27-Aug	8.00	2.7	0	ovc, AM fog, PM ts	2.3	sw-wnw	15.3	30.11	4	63	69	1.5	0.3
28-Aug	7.75	2.8	0	clr-mc, PM ts	4.7	sw, ne-e	19.8	30.10	1	100	100	2.5	3.2
29-Aug	6.75	2.4	0	ovc-pc, fog/haze, PM ts	9.5	ne	16.5	30.15	3	60	60	2	0.6
30-Aug	5.00	1.8	0	mc-ovc, PM ts/rain	6.0	var	14.0	30.12	4	65	83	1	1.4
31-Aug	0.00			Weather Day: rain									
1-Sep	7.00	1.8	0	ovc-pc, AM fog	13.3	sw	15.8	30.05	3	76	80	1	0.7
2-Sep	8.50	1.5	0	clr-ovc, scat haze/rain	11.8	ene-ese	14.8	30.15	3	89	96	1.5	0.9
3-Sep	8.25	2.4	0	ovc-pc, haze, scat rain	3.6	sw-wnw	15.1	30.20	3	74	81	2	7.3
4-Sep	9.00	2.6	0	clr	7.2	wsw-nw	16.3	30.10	2	100	100	2	8.7
5-Sep	8.50	1.9	0	clr	12.6	sw-w	18.6	30.11	2	100	100	1	2.0
6-Sep	8.75	1.9	0	clr	11.1	ssw-sw	18.8	30.14	2	100	100	1	3.4
7-Sep	8.33	1.7	0	clr-ovc, PM ts	10.6	ssw-sw, ene-se	16.6	30.13	3	94	98	1	1.3
8-Sep	6.75	1.8	0	clr-ovc, AM haze, PM ts/rain	4.7	nw-nne/calm, ene	16.0	30.11	3	93	100	3	4.9
9-Sep	7.75	1.8	0	clr-ovc, PM ts	5.9	sw	14.8	30.11	3	83	90	2	7.7
10-Sep	8.75	2.5	0	pc, AM haze	12.7	sw-w	15.3	30.05	3	99	99	2	3.3
11-Sep	8.75	1.7	0	ovc, PM haze/rain	6.1	wnw-nw, nne-e	11.7	30.03	4	59	90	3	0.7
12-Sep	8.50	2.8	0	mc-ovc, AM fog, PM ts	6.1	sw-wnw	13.9	30.02	4	66	66	1.5	4.7
13-Sep	10.00	2.4	0	clr, AM haze	8.8	w-nw	14.5	30.03	2	100	100	2	8.2
14-Sep	8.50	1.0	0	pc-ovc	10.0	ne-se	12.6	30.20	2	99	97	1	6.1
15-Sep	9.75	2.0	0	clr-pc, AM fog	3.1	sw-wnw/var	14.5	30.27	1	100	100	2	23.5
16-Sep	10.00	2.6	0	clr-pc, AM haze	7.0	var, w-wnw	14.2	30.27	2	100	100	2	17.0
17-Sep	9.50	2.0	0	pc-mc	4.5	sw-w	12.9	30.21	3	100	99	1	15.5
18-Sep	8.75	2.1	0	clr-pc, AM haze	7.3	sw	15.6	30.16	2	100	99	2.5	65.3
19-Sep	8.75	2.0	0	pc-ovc	7.9	sw-w	16.0	30.16	2	100	100	1	10.5
20-Sep	10.00	1.7	0	clr-pc	9.9	s-sw	17.0	30.16	3	100	100	1	14.1
21-Sep	8.75	3.2	1	pc-ovc, PM ts	18.8	sw	16.8	30.15	3	100	95	1	9.3
22-Sep	9.00	2.2	0	pc, AM haze	16.1	ssw-sw	16.9	30.15	3	100	97	1	18.8
23-Sep	9.75	1.8	0	pc	12.0	sw	16.1	30.22	3	100	100	1	23.4
24-Sep	8.67	1.7	0	mc, AM haze	4.8	sw	18.0	30.27	3	97	95	2.5	102.8
25-Sep	9.50	1.6	0	clr-ovc, haze	3.9	sw-w/var	18.8	30.25	2	94	86	3	68.0
26-Sep	9.75	1.7	0	pc-ovc, haze	8.7	sw	15.1	30.19	3	97	85	3	58.9
27-Sep	9.75	2.2	1	pc-mc, haze	7.5	ne-ese	15.4	30.20	3	99	92	2	48.0
28-Sep	9.50	1.7	0	clr-pc, haze	5.2	ne-se	14.9	30.22	2	96	94	2	18.1
29-Sep	9.25	1.8	0	clr/haze	6.9	ne-se	14.9	30.26	2	95	88	3	29.9
30-Sep	9.50	1.9	0	clr-pc, haze	6.5	sw-w	14.5	30.29	2	88	80	1	15.6
1-Oct	9.25	1.5	0	clr-pc, haze	5.0	ne/var, w-wnw	17.8	30.23	2	89	86	2	18.8
2-Oct	9.25	1.9	0	clr-pc	10.1	sw-wnw	16.1	30.10	1	100	97	2	12.4
3-Oct	9.75	1.0	0	mc-ovc, haze	11.0	w-wnw	15.3	30.05	4	77	68	1	9.0
4-Oct	9.00	1.9	0	ovc, AM haze, PM rain	23.7	sw	13.1	29.96	4	94	90	1	13.1
5-Oct	1.25	1.0	0	ovc/fog	8.0	sw	6.5	29.85	4	0	0	-	0.0
6-Oct	8.75	1.9	0	mc-clr	11.0	sw-wnw	6.7	30.02	3	100	100	1	7.2
7-Oct	8.83	2.3	0	clr-pc	11.6	s-sw	10.7	30.21	2.5	100	100	2	14.8
8-Oct	9.00	2.0	0	clr	7.6	w-wnw	12.9	30.13	2	100	100	1	8.0
9-Oct	9.00	1.9	0	pc	17.5	sw-wnw	14.5	29.99	3	100	100	1	8.3
10-Oct	9.25	2.7	1.5	clr-mc	29.8	ssw-sw	12.9	29.91	4	100	100	1	13.4
11-Oct	7.75	2.8	0	ovc, AM rain, PM fog/ts	27.7	sse-ssw	11.7	29.88	4	41	44	1	2.1
12-Oct	8.50	2.1	1	ovc-clr, AM fog	27.3	sse-sw	11.4	29.86	4	71	64	1	8.8
13-Oct	8.75	1.5	0	clr-ovc	8.9	se-s/var, ene	8.6	30.05	2	89	96	1	23.9
14-Oct	0.00			Weather Day: rain/snow									
15-Oct	9.00	1.9	0	clr-pc	10.3	e-ese	5.8	30.16	3	100	97	2	16.7
16-Oct	9.00	1.9	0	clr-pc, haze	7.4	ssw-wnw	7.8	30.21	1.5	100	100	2	6.6
17-Oct	9.25	5.5	0	clr	6.6	ne-e, w	12.2	30.28	2	100	100	2	20.3
18-Oct	9.00	1.9	0	pc	9.5	sw-wnw	11.7	30.24	2	100	100	1.5	7.8
19-Oct	9.00	2.5	0	clr-pc	11.4	sw-wnw	11.7	30.18	3	100	100	1	5.0
20-Oct	7.33	1.0	0	mc-ovc, ts/rain	9.9	sw/var	12.3	30.16	4	73	91	1	2.6

Appendix C. continued

Date	Obs. Hours	Obsrvr / Hour[1]	Median Visitor Disturb[2]	Predominant Weather[3]	Wind Speed (kph)[1]	Wind Direction	Temp (°C)[1]	Barom. Press. (in Hg)[1]	Median Thermal Lift[4]	Visib. West (km)[1]	Visib. East (km)[1]	Median Flight Distance[5]	Birds / Hour
21-Oct	8.75	1.0	0	clr-pc, AM haze	25.2	sw	10.9	30.07	4	100	100	1	6.4
22-Oct	8.50	1.6	0	clr-pc	8.7	sw-nw	0.9	30.09	3	98	100	1	3.9
23-Oct	8.50	1.6	0	clr	18.6	sw-w	3.2	30.01	4	100	100	1	2.7
24-Oct	8.75	1.9	0	clr-pc	21.7	w-nw	6.0	30.04	4	100	100	1	2.4
25-Oct	8.25	2.0	0	clr-pc	14.2	w-nnw	8.5	30.13	3	100	100	1	3.3
26-Oct	8.50	1.8	1	pc	9.0	ne-ese	12.9	30.25	2	100	100	1	5.2
27-Oct	8.75	2.2	0	clr/haze	14.1	ssw-sw	8.9	30.38	3	100	87	1	3.7
28-Oct	8.50	2.0	0	clr/haze	5.8	nnw-n, w	12.2	30.30	1.5	100	100	1	1.6
29-Oct	8.42	1.0	0	clr	7.8	sw-w	11.5	30.22	2	100	100	1	1.8
30-Oct	8.50	2.3	0	clr/haze	6.2	w-nw	12.7	30.25	2	98	94	1	2.2
31-Oct	8.00	1.7	0	pc-ovc, haze	4.9	sw-nw	13.7	30.35	4	100	94	-	0.3
1-Nov	7.00	1.0	0	pc, AM haze	9.4	sw-w	13.2	30.29	2	100	100	1	2.1
2-Nov	7.00	1.0	0	pc-mc	11.6	sw-w	12.1	30.10	3	100	100	1	3.1
3-Nov	7.50	1.9	0	pc-ovc, AM haze	14.9	sw-wnw	9.7	30.01	3	100	99	1	1.7
4-Nov	6.67	1.7	0	pc-ovc	32.9	ssw-sw	8.6	29.87	4	96	100	1	0.9
5-Nov	1.50	1.0	0	ovc, fog/haze	34.0	w	-0.3	29.71	4	33	53	-	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.

Appendix D. Daily observation effort and fall raptor migration counts by species in the Manzano Mountains, NM: 2008.

		Species[1]																											Birds
Date	Hours	TV	OS	NH	SS	CH	NG	SA	LA	UA	BW	SW	RT	FH	RL	ZT	UB	GE	BE	UE	AK	ML	PR	PG	SF	LF	UF	UU	Total	/ Hour
27-Aug	8.00	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0.3
28-Aug	7.75	18	0	0	2	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	25	3.2
29-Aug	6.75	2	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0.6
30-Aug	5.00	0	1	0	1	2	0	1	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	7	1.4
31-Aug	0.00																													
01-Sep	7.00	0	0	0	0	2	0	0	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	5	0.7
02-Sep	8.50	0	1	0	2	3	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0.9
03-Sep	8.25	16	0	0	7	11	0	0	0	0	0	11	2	0	0	0	0	0	0	0	13	0	0	0	0	0	0	0	60	7.3
04-Sep	9.00	11	3	0	6	9	0	0	0	0	0	37	1	0	0	0	1	1	0	0	9	0	0	0	0	0	0	0	78	8.7
05-Sep	8.50	0	0	0	5	6	0	0	1	0	0	1	2	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	17	2.0
06-Sep	8.75	3	0	1	6	5	0	0	0	0	0	3	3	0	0	0	0	1	0	0	8	0	0	0	0	0	0	0	30	3.4
07-Sep	8.33	0	1	0	2	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	11	1.3
08-Sep	6.75	3	1	0	7	9	0	0	0	0	0	7	5	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	33	4.9
09-Sep	7.75	0	1	0	25	15	0	1	1	2	0	1	4	0	0	0	0	0	0	0	7	0	1	1	0	0	0	1	60	7.7
10-Sep	8.75	5	0	1	5	4	0	0	0	0	0	2	1	0	0	0	0	0	0	0	11	0	0	0	0	0	0	0	29	3.3
11-Sep	8.75	1	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0.7
12-Sep	8.50	3	4	1	16	8	0	0	0	0	0	1	3	0	0	0	0	1	0	0	2	0	0	1	0	0	0	0	40	4.7
13-Sep	10.00	0	2	1	28	18	0	1	0	0	0	5	12	1	0	0	0	0	0	0	6	1	2	5	0	0	0	0	82	8.2
14-Sep	8.50	0	1	1	14	11	0	1	0	1	0	16	2	1	0	0	1	0	0	0	2	1	0	0	0	0	0	0	52	6.1
15-Sep	9.75	9	6	2	63	57	0	3	1	0	8	53	14	0	0	0	1	2	0	0	4	3	0	1	0	0	0	2	229	23.5
16-Sep	10.00	0	2	2	46	36	0	3	0	0	1	14	12	0	0	0	1	1	0	0	52	0	0	0	0	0	0	0	170	17.0
17-Sep	9.50	10	1	1	50	24	0	0	0	0	0	0	11	0	0	0	0	1	0	0	46	2	0	1	0	0	0	0	147	15.5
18-Sep	8.75	16	1	3	35	13	0	0	0	0	0	475	5	0	0	0	0	2	0	0	17	0	0	4	0	0	0	0	571	65.3
19-Sep	8.75	5	0	3	38	16	0	1	0	0	0	8	4	0	0	0	0	1	0	0	15	0	0	0	0	0	0	1	92	10.5
20-Sep	10.00	2	0	0	23	20	0	0	0	1	0	71	7	0	0	0	0	5	0	0	12	0	0	0	0	0	0	0	141	14.1
21-Sep	8.75	8	0	0	28	25	1	0	1	0	0	2	9	0	0	0	0	2	0	0	2	1	0	2	0	0	0	0	81	9.3
22-Sep	9.00	30	1	2	24	30	0	0	0	0	0	79	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	169	18.8
23-Sep	9.75	1	0	0	40	28	0	0	0	0	0	137	5	0	0	0	0	0	0	0	14	1	1	1	0	0	0	0	228	23.4
24-Sep	8.67	1	0	3	35	23	0	0	0	0	2	808	9	0	0	0	0	0	0	0	8	1	0	0	0	0	0	1	891	102.8
25-Sep	9.50	17	0	0	89	54	0	1	0	3	0	456	10	0	0	0	0	1	0	0	12	1	0	2	0	0	0	0	646	68.0
26-Sep	9.75	4	2	0	46	48	0	4	0	1	2	427	25	0	0	0	0	1	0	0	12	0	0	1	0	0	0	1	574	58.9
27-Sep	9.75	8	2	1	169	125	0	11	2	2	2	122	14	0	0	0	2	3	0	0	3	0	0	1	0	0	0	1	468	48.0
28-Sep	9.50	4	2	2	82	40	0	1	0	0	0	33	5	0	0	0	2	0	0	0	0	0	1	0	0	0	0	0	172	18.1
29-Sep	9.25	3	5	4	92	55	1	4	1	3	0	85	7	0	0	0	1	2	0	0	10	1	0	2	0	1	0	0	277	29.9
30-Sep	9.50	0	2	0	50	30	0	2	0	0	0	48	6	0	0	0	1	0	0	0	9	0	0	0	0	0	0	0	148	15.6
01-Oct	9.25	26	0	5	42	23	0	0	1	0	2	40	10	1	0	0	1	4	0	0	15	0	0	3	0	0	0	1	174	18.8
02-Oct	9.25	41	2	3	24	13	1	0	0	0	0	3	12	1	0	0	0	3	0	0	9	0	0	2	1	0	0	0	115	12.4
03-Oct	9.75	0	0	3	32	25	2	2	0	0	0	2	9	0	0	0	0	1	0	0	8	2	0	2	0	0	0	0	88	9.0
04-Oct	9.00	0	0	7	64	24	1	2	0	0	0	4	6	0	0	0	0	4	0	0	2	1	1	2	0	0	0	0	118	13.1
05-Oct	1.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0

Appendix D. continued

		Species[1]																											Birds
Date	Hours	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
06-Oct	8.75	27	0	0	18	8	0	2	0	2	0	1	2	0	0	0	0	2	0	0	1	0	0	0	0	0	0	0	63	7.2
07-Oct	8.83	10	0	3	59	27	0	0	0	0	0	0	21	0	1	0	0	4	0	0	2	1	0	3	0	0	0	0	131	14.8
08-Oct	9.00	25	0	0	20	16	0	3	0	0	0	0	6	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	72	8.0
09-Oct	9.00	3	0	3	47	8	0	0	0	0	0	0	9	0	0	0	0	1	0	0	3	0	1	0	0	0	0	0	75	8.3
10-Oct	9.25	0	0	0	34	30	1	3	0	0	0	0	44	0	0	0	0	6	0	0	2	2	0	2	0	0	0	0	124	13.4
11-Oct	7.75	0	2	0	6	7	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	2.1
12-Oct	8.50	0	3	0	23	32	0	0	1	0	0	0	9	0	0	0	0	3	0	0	1	2	0	1	0	0	0	0	75	8.8
13-Oct	8.75	1	2	1	114	58	1	3	0	1	0	0	13	1	0	0	0	3	0	0	5	2	2	1	0	0	0	1	209	23.9
14-Oct	0.00																													
15-Oct	9.00	1	0	6	33	29	0	3	0	0	0	0	65	2	0	0	0	4	0	0	4	1	0	0	0	1	0	1	150	16.7
16-Oct	9.00	0	0	2	26	12	0	3	0	0	0	0	8	0	0	0	0	4	0	0	3	1	0	0	0	0	0	0	59	6.6
17-Oct	9.25	0	1	3	76	21	2	2	1	0	0	0	64	0	0	0	0	13	1	0	2	0	0	1	0	0	1	0	188	20.3
18-Oct	9.00	0	0	5	31	4	0	0	0	0	0	0	14	0	0	0	0	9	0	0	2	4	0	0	0	0	0	1	70	7.8
19-Oct	9.00	0	0	0	18	3	0	0	0	0	0	0	10	1	0	0	0	7	0	0	0	4	1	1	0	0	0	0	45	5.0
20-Oct	7.33	0	0	0	8	2	0	0	0	0	0	0	2	0	0	0	0	6	0	0	0	1	0	0	0	0	0	0	19	2.6
21-Oct	8.75	0	0	4	21	2	0	0	0	0	0	0	9	1	0	0	0	10	0	0	4	3	1	1	0	0	0	0	56	6.4
22-Oct	8.50	0	1	0	10	4	3	0	0	0	0	0	12	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0	33	3.9
23-Oct	8.50	0	0	3	5	0	0	0	0	0	0	0	8	0	0	0	0	4	0	0	1	2	0	0	0	0	0	0	23	2.7
24-Oct	8.75	0	0	1	9	1	0	0	0	0	0	0	5	0	0	0	0	3	0	0	0	1	0	1	0	0	0	0	21	2.4
25-Oct	8.25	0	0	0	14	1	0	0	0	0	0	0	3	0	0	0	0	8	0	0	0	1	0	0	0	0	0	0	27	3.3
26-Oct	8.50	0	0	1	8	2	1	0	0	0	0	0	26	0	0	0	0	3	1	0	0	1	0	0	0	0	0	1	44	5.2
27-Oct	8.75	0	0	1	13	0	1	0	0	0	0	0	2	1	0	0	0	11	1	0	0	2	0	0	0	0	0	0	32	3.7
28-Oct	8.50	0	0	1	7	1	1	0	0	0	0	0	0	0	0	0	0	3	0	1	0	0	0	0	0	0	0	0	14	1.6
29-Oct	8.42	0	0	2	6	0	0	0	0	0	0	0	1	0	0	0	0	4	0	0	0	2	0	0	0	0	0	0	15	1.8
30-Oct	8.50	0	0	3	11	0	2	0	0	0	0	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	19	2.2
31-Oct	8.00	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0.3
01-Nov	7.00	0	0	0	3	0	0	0	0	0	0	0	4	0	0	0	0	7	1	0	0	0	0	0	0	0	0	0	15	2.1
02-Nov	7.00	0	0	2	5	0	1	0	0	0	0	0	5	0	0	0	0	6	1	1	0	1	0	0	0	0	0	0	22	3.1
03-Nov	7.50	0	0	1	4	0	1	0	0	0	0	0	1	0	0	0	0	5	1	0	0	0	0	0	0	0	0	0	13	1.7
04-Nov	6.67	0	0	1	2	0	1	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	6	0.9
05-Nov	1.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Total	579.00	315	50	89	1836	1084	21	57	10	16	17	2952	575	10	1	0	11	167	7	2	350	47	11	42	1	2	1	12	7686	13.3

[1] See Appendix B for explanation of species codes.

Appendix E. Annual observation effort and fall raptor migration counts by species (unadjusted data) in the Manzano Mountains, NM: 1985–2008.

	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. 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[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

Appendix E. continued

	2005	2006	2007	2008	Mean
Start date	27- Aug	27- Aug	27-Aug	27-Aug	26-Aug
End date	5-Nov	5-Nov	5-Nov	5-Nov	2-Nov
Days of observation	69	68	63	69	65
Hours of observation	599.58	566.41	553.58	579.00	514.08
Raptors / 100 hours	937.8	1433.4	883.2	1327.5	1054.5
SPECIES	RAPTOR COUNTS				
Turkey Vulture	363	150	499	315	387
Osprey	35	30	47	50	31
Northern Harrier	46	90	75	89	62
Sharp-shinned Hawk	1842	958	1283	1836	1472
Cooper's Hawk	1486	865	922	1084	1020
Northern Goshawk	10	10	30	21	16
Unknown small accipiter[1]	129	119	74	57	128
Unknown large accipiter[1]	5	2	7	10	5
Unknown accipiter	1	6	10	16	77
TOTAL ACCIPITERS	3473	1960	2326	3024	2629
Broad-winged Hawk	13	9	10	17	7
Swainson's Hawk	52	4695	841	2952	838
Red-tailed Hawk	823	534	537	575	644
Ferruginous Hawk	13	9	8	10	12
Rough-legged Hawk	0	0	0	1	0
Zone-tailed Hawk	1	0	0	0	1
Unknown buteo	33	23	19	11	23
TOTAL BUTEOS	935	5270	1415	3566	1525
Golden Eagle	71	87	99	167	118
Bald Eagle	1	3	6	7	4
Unknown Eagle	4	1	9	2	1
TOTAL EAGLES	76	91	114	176	123
American Kestrel	520	412	298	350	536
Merlin	48	23	34	47	26
Prairie Falcon	16	13	10	11	19
Peregrine Falcon	61	43	51	42	48
Unknown small falcon[1]	2	1	0	1	1
Unknown large falcon[1]	5	3	2	2	4
Unknown falcon	6	1	1	1	2
TOTAL FALCONS	658	496	396	454	634
Unknown raptor	37	32	17	12	44
TOTAL	5623	8119	4889	7686	5435

[1] New designations used for the first time in 2001.

Appendix F. Daily trapping effort and capture totals of migrating raptors by species in the Manzano Mountains, NM: 2008.

	Stn.	Species[1]													Captures
Date	Hours	NH	SS	CH	NG	BW	SW	RT	ZT	GE	AK	ML	PR	PG	Total	/ stn hr
3-Sep	6.83	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0.1
4-Sep	7.58	0	2	2	0	0	0	0	0	0	0	0	0	0	4	0.5
5-Sep	7.92	0	2	1	0	0	0	0	0	0	0	0	0	0	3	0.4
6-Sep	8.25	0	2	1	0	0	0	1	0	0	0	0	0	0	4	0.5
7-Sep	7.16	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0.1
8-Sep	5.83	0	2	0	0	0	0	0	0	0	0	0	0	0	2	0.3
9-Sep	6.75	0	2	0	0	0	0	0	0	0	0	0	0	0	2	0.3
10-Sep	8.17	0	2	4	0	0	0	1	0	0	0	0	0	0	7	0.9
11-Sep	5.50	0	3	0	0	0	0	0	0	0	0	0	0	0	3	0.5
12-Sep	6.42	0	6	0	0	0	0	0	0	0	0	0	0	1	7	1.1
13-Sep	15.75	0	8	2	0	0	0	1	0	0	0	0	0	0	11	0.7
14-Sep	7.75	0	2	5	0	0	0	0	0	0	0	0	0	0	7	0.9
15-Sep	8.41	0	9	3	0	0	0	0	0	0	0	1	0	0	13	1.5
16-Sep	7.50	0	3	3	0	0	0	0	0	0	0	0	0	0	6	0.8
17-Sep	8.25	0	11	5	0	0	0	2	0	0	0	0	0	0	18	2.2
18-Sep	8.66	0	10	3	0	0	0	0	0	0	1	0	0	0	14	1.6
19-Sep	8.00	0	14	6	0	0	0	0	0	0	1	0	0	0	21	2.6
20-Sep	16.50	0	12	7	0	0	0	1	0	0	0	0	0	0	20	1.2
21-Sep	15.16	0	8	6	0	0	0	0	0	0	0	0	0	0	14	0.9
22-Sep	14.50	0	6	14	0	0	0	0	0	0	0	0	0	0	20	1.4
23-Sep	7.67	0	7	1	0	0	0	0	0	0	0	1	0	0	9	1.2
24-Sep	8.00	0	4	8	0	0	0	0	0	0	0	1	0	0	13	1.6
25-Sep	7.58	0	7	5	0	0	0	0	0	0	0	0	0	0	12	1.6
26-Sep	6.75	0	5	2	0	0	0	0	0	0	0	0	0	0	7	1.0
27-Sep	15.74	0	14	34	0	0	0	1	0	0	0	0	0	0	49	3.1
28-Sep	8.25	0	6	13	0	0	0	0	0	0	0	0	0	0	19	2.3
29-Sep	7.83	0	7	9	0	0	0	0	0	0	0	0	0	0	16	2.0
30-Sep	7.83	0	7	9	0	0	0	0	0	0	0	0	0	0	16	2.0
1-Oct	7.75	0	7	7	0	0	0	2	0	0	0	0	0	0	16	2.1
2-Oct	7.75	0	4	3	1	0	0	0	0	0	0	0	0	1	9	1.2
3-Oct	11.75	0	5	5	0	0	0	2	0	1	0	0	0	0	13	1.1
4-Oct	15.25	0	12	10	0	0	0	0	0	1	1	0	0	0	24	1.6
5-Oct	0.00															
6-Oct	7.50	0	3	2	0	0	0	0	0	0	0	0	0	0	5	0.7

Appendix F. continued

Date	Stn. Hours	Species[1] NH	SS	CH	NG	BW	SW	RT	ZT	GE	AK	ML	PR	PG	Captures Total	Captures / stn hr
7-Oct	10.75	0	12	7	0	0	0	1	0	0	0	0	0	0	20	1.9
8-Oct	15.33	0	5	2	0	0	0	0	0	0	0	0	0	0	7	0.5
9-Oct	15.58	0	10	4	0	0	0	1	0	0	0	0	0	0	15	1.0
10-Oct	15.58	0	5	11	0	0	0	1	0	0	0	0	0	0	17	1.1
11-Oct	12.75	0	2	3	0	0	0	1	0	0	0	0	0	0	6	0.5
12-Oct	15.50	0	1	8	0	0	0	0	0	0	0	1	0	1	11	0.7
13-Oct	15.00	0	18	20	0	0	0	0	0	1	0	1	1	0	41	2.7
14-Oct	0.00															
15-Oct	14.50	0	6	5	0	0	0	0	0	0	0	0	0	0	11	0.8
16-Oct	15.75	1	8	5	0	0	0	0	0	1	0	1	0	0	16	1.0
17-Oct	15.67	1	10	9	0	0	0	1	0	0	0	0	0	0	21	1.3
18-Oct	14.75	1	8	1	0	0	0	0	0	0	1	1	0	0	12	0.8
19-Oct	15.33	0	5	0	0	0	0	0	0	0	0	0	0	0	5	0.3
20-Oct	7.00	0	4	0	0	0	0	0	0	1	0	0	0	0	5	0.7
21-Oct	7.03	1	3	0	0	0	0	1	0	1	0	0	0	0	6	0.9
22-Oct	7.33	0	4	1	1	0	0	2	0	0	0	0	0	0	8	1.1
23-Oct	12.16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
24-Oct	14.33	0	3	0	0	0	0	0	0	1	0	0	0	0	4	0.3
25-Oct	13.16	0	6	0	0	0	0	0	0	1	0	0	0	0	7	0.5
26-Oct	7.25	0	1	1	0	0	0	1	0	0	0	0	0	0	3	0.4
27-Oct	14.58	0	6	0	0	0	0	0	0	1	0	1	0	0	8	0.5
28-Oct	14.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
29-Oct	7.25	0	3	0	0	0	0	0	0	0	0	0	0	0	3	0.4
30-Oct	4.17	0	1	0	1	0	0	0	0	0	0	0	0	0	2	0.5
Total	586.04	4	315	247	3	0	0	20	0	9	4	8	1	3	614	1.0

[1] See Appendix B for explanation of species codes.

Appendix G. Annual trapping and banding effort and capture totals of migrating raptors by species in the Manzano Mountains, NM: 1990–2008.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	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		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		25-Oct
Blinds in operation	1	3	3	3	3	4	4	4	3	3	3	3	3	2	2	2	2	2	2		2.8
Trapping days	47	54	57	50	48	53	45	54	58	46	50	55	51	45	45	51	48	47	56		50.5
Station days	47	95	131	120	121	136	132	151	165	94	119	145	131	84	84	99	94	105	80		101.5
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		835.9
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		110.6
SPECIES	RAPTOR CAPTURES																				
Northern Harrier	1	2	2	3	9	2	1	8	14	0	5	7	6	3	0	3	6	3	4	79	4.2
Sharp-shinned Hawk	124	262	589	430	502	493	778	612	987	321	495	426	635	458	566	562	299	196	315	9050	476.3
Cooper's Hawk	95	195	335	374	353	310	460	427	772	323	330	337	510	400	378	495	280	142	247	6763	355.9
Northern Goshawk	1	7	6	6	7	1	5	3	6	6	16	1	10	1	2	3	3	3	3	90	4.7
Broad-winged Hawk	0	0	0	0	0	0	0	0	1	0	0	0	1	1	1	0	1	1	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	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	890	46.8
Zone-tailed Hawk	0	0	0	0	0	0	0	0	1	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	76	4.0
American Kestrel	10	13	42	14	59	28	92	32	75	44	25	56	37	43	18	37	10	9	4	648	34.1
Merlin	1	0	2	4	1	1	11	6	7	2	8	2	12	3	10	3	2	5	8	88	4.6
Prairie Falcon	1	1	3	5	3	1	3	5	13	6	3	7	5	4	3	4	4	2	1	74	3.9
Peregrine Falcon	2	1	2	1	4	2	5	7	12	8	1	10	13	7	5	10	12	6	3	111	5.8
All Species	244	502	1046	896	1025	892	1411	1150	2006	768	963	891	1295	966	1028	1154	654	377	614	17881	941.1
Recaptures[1]	0	0	1	1	2	2	1	2	4	4	3	2	3	2	2	3	2	0	1	37	1.9
Foreign recaptures[2]	2	1	1	1	2	0	5	1	2	2	0	0	3	2	0	0	1	0	0	22	1.2
Foreign encounters[3]	0	2	2	3	6	6	7	8	13	12	6	7	10	7	5	3	4	6	5	117	6.2

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

[2] Recaptures in the Manzanos of birds originally banded elsewhere.

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