FALL 2004 RAPTOR MIGRATION STUDIES IN THE MANZANO MOUNTAINS OF CENTRAL NEW MEXICO

HawkWatch International, Inc.
Salt Lake City, Utah

February 2005

FALL 2004 RAPTOR MIGRATION STUDIES IN THE MANZANO MOUNTAINS OF CENTRAL NEW MEXICO

Report prepared by:

Jeff P. Smith

Counts conducted by:

Paula Shannon and Frank Mayer

Trapping and banding conducted by:

Zach Hurst, Steve Alsup, Lindsay Reynolds, Shelly Johnson, Ken Etzel, Walt Lehman, and John DeLong

Project coordinated by:

HawkWatch International, Inc.

Principal Investigator: Dr. Jeff P. Smith

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

(801) 484-6808

February 2005

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

The Manzano Mountains raptor migration study in central New Mexico is an ongoing effort to monitor long-term trends in populations of raptors using the southern portion of the Rocky Mountain migratory flyway (Hoffman et al. 2002, Hoffman and Smith 2003). HawkWatch International (HWI) initiated standardized counts of the autumn raptor migration through this region in 1985, and began an extensive trapping and banding program at the project site in 1990. To date, HWI observers have recorded 18 species of migratory raptors at the site, with counts typically ranging between 4,000 and 7,000 migrants per season. The 2004 season marked the 20th consecutive count and the 15th consecutive season of trapping and banding conducted at the site by HWI. This report summarizes the 2004 count and banding results.

STUDY SITE

The project site is located in the Manzano Wilderness Area of the Cibola National Forest (Manzano Ranger District) near Capilla Peak, approximately 56 km south-southeast of Interstate 40 (34°42.25' N, 106°24.67' W; Figure 1). The observation post is located at an elevation of 2,805 m (9,195 ft) on a northwest-southeast facing outcrop of a limestone ridge. It is reached by walking up a 1.2 km trail from the main road leading up to Capilla Peak (FS 522). The predominant vegetation on the slopes of the ridge consists of Gambel oak (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 2004, two traditional banding stations were operated within 0.25–1 km of the observation point (Figure 1). **North** station, operated every year since 1990, was located 100 m east and 50 m north of the observation point at an elevation of 2,790 m. **West** station, operated every year since 1991, was located 0.5 km southwest of the observation point at an elevation of 2,684 m. **South** station, operated part to full-time most years since 1991, was not operated this year due to personnel limitations.

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

METHODS

STANDARDIZED COUNTS

Two official or designated observers, relieved or supplemented by other trained volunteers, conducted standardized daily counts of migrating raptors from a single, traditional observation site. Official observers Paula Shannon and Frank Mayer had three and two seasons, respectively, of previous migration counting experience (see Appendix A for a complete history of observer participation). Visitors and other crewmembers occasionally assisted with the counts, although much less frequently than in most years because in 2004 the project area was generally closed to public visitation due to a U.S. Forest Service campground remodeling project. Weather permitting, observations typically began by 0900 hrs Mountain Standard Time (MST) and ended by 1700 hrs MST.

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

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

Calculation of "adjusted" (to standardize sampling periods and adjust for incompletely identified birds) passage rates (migrants counted per 100 hours of observation) and analysis of trends follows Hoffman and Smith (2003). In comparing 2004 annual statistics against means and 95% confidence intervals for previous seasons, I equate significance with a 2004 value falling outside the bounds of the confidence interval for the associated mean.

TRAPPING AND BANDING

Weather permitting, rotating crews of 1–3 trappers and processors operated each trapping station, with crew size depending on trapper experience, characteristics of the station, and the flight volume. The crews generally trapped between 0800–0900 and 1600–1700 hrs MST. Capture devices included mist nets, dho-gaza nets, and remotely triggered bow nets. Trappers lured migrating raptors into the capture stations from camouflaged blinds using live, non-native avian lures attached to lines manipulated from the blinds. Unless already banded, all captured birds were fitted with a uniquely numbered USGS Biological Resources Division aluminum leg band. Data gathering and recording followed standardized protocols used at all HWI migration-banding sites (Hoffman et al. 2002). All birds were released within 45 minutes of capture unless outfitted with a satellite transmitter, which takes a bit longer.

RESULTS AND DISCUSSION

WEATHER

In 2004, inclement weather and heavy snow cover entirely precluded 14 full days of potential observation and on three other days reduced observation time to less than 4 hours. Only 2000 featured more weather days. The 1997–2003 averages are 5 full days and 2 partial days (see Appendix C for daily weather summaries). During active observations, the prevalence of at least scattered thundershowers or frontal-origin rain and snow also was above average (18% versus average of 30% of active observation days). There was, however, a noticeable lack of days where scattered fog and haze hampered but did not preclude observations entirely (4% of days in 2004 versus average of 32%). Otherwise, a near average

53% of the active observation days featured primarily fair skies, 33% transitional skies (i.e., changed from fair skies to mostly cloudy or overcast during the day, or vice versa); and 14% mostly cloudy to overcast skies (1997–2003 averages: 50%, 33%, and 17%). The combination translated to average overall visibility ratings of 85 km to the east and 92 km to the west (1997–2003 average of 90 km both ways.

Relative to wind speeds, no active observation days featured predominantly strong winds (>28 kph; average 2 days); however, a record high number of days featured predominantly moderate winds (12–28 kph; 39% versus average of 22% of active days) and light winds prevailed on a record low number of days (61% versus average of 75%). In terms of wind directions, the range of conditions seen in 2004 fell well within the range of variation seen since 1997. As usual, SW-W winds was the most common pattern and S-SW winds the second most common pattern; however, there was a shift toward the latter in 2004 (SW-W: 32 vs. avg. 39%; S-SW: 26 vs. avg. 14%).

The temperature during active observation periods averaged 16.5°C (the average of daily values, which in turn were averages of hourly readings), ranging from 3.0–25.9°C. The overall average matched the previous warmest, and both the minimum and maximum were above average. During four of the last five years, the average daily temperature has been 3–4°C warmer than from 1997–1999. We began recording hourly barometric pressure readings on site in 2001; in 2004, the overall average (30.18 inHg; an average of daily averages, which in turn are averages of hourly readings) and minimum (29.88) and maximum (30.44) daily averages were all either the highest or second highest yet recorded.

Sixty-four percent of the active observation days received a median (of hourly ratings) thermal-lift rating of poor to fair and 36% good to excellent, which is skewed toward below-average thermal conditions (1997–2003 averages 54% poor/fair and 46% good/excellent). This is consistent with moderate winds having been more common than usual.

In summary, compared to the previous seven seasons, in 2004 inclement weather entirely precluded a high number of potential observation days, and additional scattered rain or snow events were more common than usual during periods when observations did occur. Otherwise, however, temperatures during active observations were warmer than average, average barometric pressure was slightly above average, a near average array of cloud-cover conditions pertained, and scattered fog and haze were less prevalent than usual. There was also a modest shift toward more S-SW as opposed to SW-W winds, and a distinct shift from predominantly light winds to more moderate winds. The latter may have contributed to poorer than average thermal lift conditions.

OBSERVATION EFFORT

The observers worked on 57 of 71 possible days between 27 August and 5 November. The number of observation days matched that of 2000 but was otherwise the lowest since 1985; 12% lower than the 1985–2003 average of 64 ± 95% CI of 2.3 days. The total hours of observation (424.08) also was the lowest since 1985, 16% lower than the long-term average of 506.1 ± 25.63 hours. The 2004 average of 2.1 observers per hour (including official and guest observers; value is mean of daily values, which are in turn means of hourly values) was 2% lower than the 1985–2003 average of 2.2 ± 95% CI of 0.18 observers/hr.

FLIGHT SUMMARY

The observers counted 4,410 migrant raptors of 16 species during the 2004 season (see Appendix D for daily count records and Appendix E for annual summaries). The flight was composed of 56% accipiters, 23% buteos, 11% falcons, 7% vultures, 2% eagles, and ≤1% each of harriers, Ospreys, and unidentified raptors. This composition includes significantly lower than average proportions of eagles, falcons, and

harriers (Figure 2). Sharp-shinned and Cooper's Hawks were the two most abundant species, followed by Red-tailed Hawks, American Kestrels, Turkey Vultures, and Swainson's Hawks (Table 1, Appendix E). The count of American Kestrels fell to a new record low.

Adjusted passage rates were significantly above average for four species—Broad-winged and Red-tailed Hawks, Merlin, and Peregrine Falcon—and significantly below average for five species—Northern Harriers, Ferruginous Hawks, Golden and Bald Eagles, and American Kestrels (Table 1, Figures 3–7). Regression analyses indicated a significant ($P \leq 0.05$) quadratic trend for Turkey Vultures, loosely tracking an increasing pattern through 1998 and a subsequent decline, but with a slight recovery in 2003 and 2004 (Figure 3). Although the fit of the regression model was not statistically significant, Northern Harriers have followed roughly a similar overall pattern (Figure 3). A highly significant ($P \leq 0.01$) linear increasing trend was indicated for Ospreys, but more detailed examination shows an accelerating-increase pattern through 1995, followed by a moderate decline through 2001, a sharp increase to a record high passage rate in 2003, and an equally sharp drop back to a moderate level in 2004 (Figure 3). Among the accipiters, a significant long-term trend was indicated only for Cooper's Hawks, which show a distinct increasing pattern (Figure 4). Among the buteos, significant long-term increases were indicated for Broad-winged, Swainson's, and Red-tailed Hawks, whereas a highly significant decrease was indicated for Ferruginous Hawks (stabilized somewhat since 2001; Figure 5). No significant long-term trends were indicated for Bald or Golden Eagles (Figure 6). Among the falcons, no significant long-term trend was indicated for American Kestrels. A significant quadratic trend was indicated for Merlins, tracking an increasing pattern through 1998, followed by a sharp decline in 1999 and relative stability since then at moderate levels (Figure 7). A significant long-term increasing trend was indicated for Prairie Falcons, but after jumping to a record-high in 1998, passage rates dropped steadily for five years, and in 2003 and 2004 rates were again similar to the mid-1990s. A highly significant quadratic trend was indicated for Peregrine Falcons, continuing to track an accelerating increasing pattern that began around 1990 (Figure 7).

Among 10 species with data suited to comparisons, immature : adult ratios were significantly above average for all three accipiters and three relevant buteos (marginal value for Broad-winged Hawks due to small counts), whereas only Northern Harriers and Bald Eagles (marginal value due to small counts) showed significantly below average age ratios (Table 2). It appeared that the high age ratios in 2004 generally resulted from proportionally greater reductions in the abundance of adult birds rather than above-average counts of immature birds. We must consider these comparisons suspect, however, because the proportions of unaged birds were consistently well above average in 2004 (Table 2), which means that the total age-specific counts were biased low. There were no obvious temporal biases in the daily proportions of unaged birds, which might otherwise have skewed the observed age ratios because of unequal sampling of immature and adult birds (immature birds usually pass through earlier than adults of the same species). Thus, confounding factors reduce the robustness of the comparisons, but there was some suggestion that productivity and hence fall recruitment may have increased in 2004 for accipiters and several buteo species in the central Rocky Mountains, whereas regional productivity may have been below average for harriers.

The 2004 combined-species median passage date of 27 September was one day later than the 1985–2003 average (Table 3), and the overall seasonal distribution of activity followed a typical pattern except for showing activity spikes in mid-September and early and mid-October (Figure 8). Species-specific data revealed much more complexity, however. Median passage dates were later than average for 10 species, significantly so for six (Turkey Vulture, Northern Harrier, Cooper's Hawk, Broad-winged Hawk, Golden Eagle, and Prairie Falcon), and were earlier than average for four species, significantly so for three (Northern Goshawk, Swainson's Hawk, and American Kestrel; Table 3). Moreover, for all species seasonal patterns deviated significantly from long-term average distributions. Higher than usual variability through the season was the most common deviation from the norm (e.g., Figure 9), but Broad-

winged Hawks and Turkey Vultures showed distinct late shifts in their passage patterns (Figure 10). Age-specific median passage dates revealed no additional noteworthy patterns.

Despite the prevalence of late median passage dates, missing the last six days of scheduled observations due to heavy snowfall likely had little impact on the overall counts for most species because, as is typical, activity had already subsided substantially before that time. The primary exceptions include typically later-season adult Red-tailed Hawks and Golden Eagles; however, flight volume for both Merlins and Prairie Falcons was atypically high just before the final storm, so it is possible that we also missed some unusually late activity for these species due to the early closure.

RESIDENT RAPTORS

Local birds observed this season included a family of Red-tailed Hawks, with at least one offspring seen flying with an adult several times during the count. A probable family group of Golden Eagles was seen regularly in the area during the first half of the season, and an immature bird was active in the valley in late September. Several Turkey Vultures frequented the general area through the second week of September. A family group of Peregrine Falcons, including at least one hatch-year bird, made regular appearances in the study area until the third week of September. A pair of Prairie Falcons often coursed through the observation area, attracted by the banding operation, until the last week of October. A single observation of an apparently local Sharp-shinned Hawk occurred on 4 September. There was a conspicuous lack of American Kestrels around the site this season.

This is typical resident assemblage for the site, except for the lack of American Kestrels and Cooper's Hawks, and relatively few sightings of Sharp-shinned Hawks.

TRAPPING EFFORT

The crews operated at least one banding station on 45 of 53 possible days between 5 September and 28 October 2004, with effort totaling 84 station days and 756.15 station hours (see Appendix F daily trapping records and Appendix G for annual summaries). These effort values are 8–17% below the long-term average for the site (Appendix G).

TRAPPING AND BANDING SUMMARY

The 2004 capture total of 1,028 birds included 10 species, 1,026 newly banded birds, and 2 recaptures of birds previously banded in the Manzanos (Table 5, Appendix G). The 2004 effort raises the total number of birds captured since project inception to 15,082, including 29 recaptures of Manzano-banded birds and 22 foreign recaptures (i.e., birds originally banded elsewhere and subsequently recaptured in the Manzanos; Appendix G). Sharp-shinned and Cooper's Hawks accounted for 55% and 37% of the total captures, respectively, with Red-tailed Hawks (4%) and American Kestrels (2) the next most abundant species. Each of the remaining species accounted for less than 1% of the total.

The overall combined-species capture total was 3% below average; however, both the overall capture rate and capture success were significantly above average. Among 10 commonly captured species, capture totals, rates, and successes were significantly below average for Northern Harriers, Northern Goshawks, Golden Eagles, and American Kestrels (Table 6). This was only the second year since trapping began at the site in 1990 that no Northern Harriers were captured. Red-tailed Hawks also showed below average values for all three metrics, but only the difference in capture totals was significant. Merlins and Sharp-shinned Hawks were the only commonly captured species for which all three metrics were above average, in most cases significantly so. In addition, although the capture total for Cooper's Hawks was slightly below average, the capture rate was significantly above average. Capture of a Broad-winged Hawk marked only the fourth such occurrence for the project (all light-

morph, hatch-year birds), with single captures in each of the last three years and the first in 1998 (Appendix G).

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 2004 immature : adult capture ratios for Sharp-shinned and Cooper's Hawk were significantly above average (Table 6). This is the same pattern as indicated in the count data (Table 2), except that in this case the high age ratios definitely reflect, at least in part, greater representation of young birds, of both sexes. This suggests that immature birds of both species may have been particularly susceptible to capture in 2004, whereas adults, except for perhaps male Sharp-shinned Hawks, were simply less common than usual. Female : male capture ratios were slightly below average for both Sharp-shinned and Cooper's Hawks (Table 6). Among adults, capture totals were well below average for female Sharp-shinned Hawks and both sexes of Cooper's Hawks, but just about matched the long-term average for male Sharp-shinned Hawks.

For American Kestrels, the immature : adult capture ratio was significantly below average and the female : male capture ratio was significantly above average, reflecting a dearth of adult males, low totals for both sexes of immature birds but a greater proportional reduction for males, and a high capture total for adult females (Table 6). The count data yielded a sex ratio that was 39% above average, whereas the capture data indicated a sex ratio that was 205% above average, largely due to the absence of captured adult males. Low capture totals for three of four sex–age classes is consistent with the low overall and low sex-specific counts recorded for kestrels. Overall, the picture suggests that 2004 was not a particularly productive year for Rocky Mountain kestrels, with males particularly less common than usual on migration.

SATELLITE TELEMETRY

We succeeded in deploying satellite transmitters on two new Golden Eagles during the 2004 season. One was a hatch-year male and the other second-year male. We had hoped to also deploy two additional transmitters on adult Northern Goshawks, but did not succeed in capturing any suitable candidates, with two immature birds the only goshawks captured this year.

The two 2002 Manzano Red-tailed Hawks that were still alive and transmitting when we prepared our 2003 season report finally ceased transmitting in January and June 2004. The bird that ceased transmitting in January was at that time wintering for the second year in a row in Zacatecas, Mexico, and sensor data indicated that it was alive and well at that time its transmitter battery failed. The bird that continued transmitting through June 2004 had wintered two years in a row in Mexico State, and returned during spring 2004 for the second time to the same summer range in the Wasatch Mountains of southeastern Idaho, arriving 17 days earlier than in 2003. Sensor data indicated that this bird also was alive and well at that the time its transmitter battery finally failed. These two birds continue to illustrate high migration-route and winter/summer range fidelity among the adult Red-tailed Hawks that we have tracked to date.

At the time we prepared our 2003 season report, three Golden Eagles outfitted in the Manzanos in 2002 were still alive and transmitting, and at that time were all wintering in southeastern New Mexico or western Texas in similar areas as during winter 2002–2003. Signals from one of these birds abruptly ceased for unknown reasons in late March 2004 while the bird was still on its winter range in the Davis Mountains of west Texas. The last sensor data we received from this bird indicated that it was alive and well just before the transmitter signals ceased, suggesting that either the transmitter battery failed prematurely or the bird damaged its transmitter antenna. Another of the 2002 birds may have died in January 2004 on its winter range along the border of southeastern New Mexico and western Texas. Over the winter, sensor data from this transmitter gave confusing indicators and the reliability of signal transmissions degraded considerably, which confounded are ability to discern whether the bird actually

died or the transmitter simply became unreliable. Regardless, the signals from this unit ceased entirely in early April before we were able to mount a recovery attempt. As of January 2005, the third remaining 2002 eagle was still alive and transmitting and appeared to have settled for the winter in northwestern South Dakota. It spent the two previous winters in similar areas of southeastern New Mexico and far western Texas, but it also spent the summers of 2003 and 2004 in different areas (far northern Northwest Territories and the border area of central Alberta and Saskatchewan, respectively).

Our two 2003 eagles unfortunately have both died. One bird that wintered in central Sonora, Mexico, returned in the spring to southern Utah but died there of apparent starvation in late May 2004. The other full adult female bird initially wintered in Jalisco, Mexico, which was noteworthy because the location south of Puerto Vallarta was beyond the primary range for the species as indicated in the recently compiled Birds of North America account (Kochert et al. 2002). This bird then went on to complete a 6,800 km, 2.5-month spring migration to far northwestern Alaska, which is the longest migration ever documented for a Golden Eagle in North America! After spending the summer in Alaska, this bird took off again in mid-September 2004 and largely retraced its spring pathway back to the Alaska–Yukon border, where unfortunately it appeared to have met its demise. Logistical complications (distance and snow cover) have thus far precluded any attempt to recover this transmitter, but if it continues to transmit through this summer, we may be able to go after it with the hope of confirming this remarkable bird's fate.

As of this writing our two new 2004 eagles were still alive and transmitting, both having thus far moved only a short ways east of the project site to winter in the Estancia Valley of central New Mexico.

Complete tracking summaries and maps for all of HWI's telemetry birds can be found on our web site at www.hawkwatch.org. Initial summaries for the new 2004 eagles will be posted by March 2005.

IDENTIFYING MIGRANT ORIGINS THROUGH STABLE ISOTOPE ANALYSES

In 2004, we continued to collect feather samples from a variety of species to support our on-going stable-isotope research, which seeks to use analyses of hydrogen stable-isotope ratios to identify the approximate natal origins of migrants monitored at migration sites across the West (e.g., Meehan et al. 2001, Lott et al. 2003, and Smith et al. 2003). HWI scientists currently have in a review at a respected ornithological journal a manuscript detailing a new GIS-based approach for mapping the origins of raptors based on this technique, and we hope to begin producing several other relevant publications in the next year.

ENCOUNTERS WITH PREVIOUSLY BANDED BIRDS

Recaptures.—The 2004 captures included two recaptures of previously banded birds: one female Cooper's Hawk originally banded in the Manzanos as an after-second-year adult in 2001, and one male Sharp-shinned Hawk originally in the Manzanos as a hatch-year bird in 2003. The 2004 recaptures raise the total number Manzano recaptures since 1990 to 29 birds (Appendix G).

Foreign Encounters.—Five raptors originally banded in the Manzanos were encountered elsewhere in 2004 and early 2005 (Table 8), which brings the total foreign encounters since 1990 to 95 birds (Appendix G). The 2004/05 encounters included two Sharp-shinned Hawks and three Cooper's Hawks banded between 2000 and 2003. The two Sharp-shinned Hawks were recaptured during fall migration in passerine mist nets operated by long-time colleague Steve Fettig in Bandolier National Monument ~95 km northeast of the project site. One male Cooper's Hawk that was originally banded in 2000 as an after-second year adult was somehow injured, captured by hand, and then released again without its band in Michoacán, Mexico during March 2004. A female Cooper's Hawk originally banded in 2003 as a hatch-year bird was shot to death in Zacatecas, Mexico in November 2004. The third Cooper's Hawk, also a female banded in 2003, but as an after-hatch-year bird, was found dead of unknown causes near

Durango, Colorado in August 2004. These new encounters all fall within the expected range of Rocky Mountain migrants (Hoffman et al. 2002).

SITE VISITATION

In 2004, visitation to the site was largely precluded due to Cibola National Forest undertaking a wholesale remodeling of the Capilla Peak campground, which is the base camp for HWI's operation. Other than occasional local volunteers coming to assist with operations in conjunction with passage of full-time crewmembers up and down the mountain through locked gates, public visitation in 2004 was limited to one special weekend event in early October, which was attended by roughly two dozen HWI members and supporters from primarily the Albuquerque metropolitan area.

ACKNOWLEDGMENTS

Financial support for this project was provided by the USDA Forest Service, Cibola National Forest and Region 3; U.S. Fish and Wildlife Service, Region 2; National Fish and Wildlife Foundation; Public Service Company of New Mexico; Intel Corporation; New Belgium Brewing Company; Albuquerque Community Foundation, and HWI members. HWI and the field crew also thank Wild Oats, Whole Foods Markets, Einstein Brothers Bagels, and Sam's Club of Albuquerque for their generous contributions of food to support the field crew during the season. We also wish to extend our sincere appreciation to David and Judy Dain of Tijeras, NM for their continued, generous support of our New Mexico educational endeavors. Lastly, we extend our heartfelt thanks to the following individuals for their generous volunteer service during the season: Art Arenholz, Seamus Breslin, Larry Caldwell, Carol Cwiklinski, John DeLong, Geoff Evans, Jessie Jewell, Claire Lamos, Walt and Jennifer Lehman, Laura Simmons, Steve Small, and Don Wolfe.

LITERATURE CITED

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

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

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

Kochert, M. N., K. Steenhof, C. L. McIntyre, and E. H. Craig. 2002. Golden Eagle (*Aquila chrysaetos*). No. 684 in A. Poole and F. Gill [Editors]. The birds of North America. The Birds of North America, Inc., Philadelphia, Pennsylvania, USA.

Lott, C. A., T. D. Meehan, and J. A. Heath. 2003. Estimating the latitudinal origins of migratory raptors using hydrogen and sulfur stable isotopes in feathers: influence of marine prey base. Oecologia 134: 505-510.

Meehan, T. D., C. A. Lott, Z. D. Sharp, R. B. Smith, R. N. Rosenfield, A. C. Stewart, and R. K. Murphy. 2001. Using hydrogen isotope geochemistry to estimate the natal latitudes of immature Cooper's Hawks migrating through the Florida Keys. Condor 103:11–20.

Smith, R. B., T. D. Meehan, and B. O. Wolf. 2003. Assessing migration patterns of Sharp-shinned Hawks *Accipiter striatus* using stable-isotope and band encounter analysis. Journal of Avian Biology 34:387–392.

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: 1985–2003 versus 2004.

	COUNTS			RAPTORS / 100 HRS[1]		
SPECIES	1985–2003[2]	2004	% CHANGE	1985–2003[2]	2004	% CHANGE
Turkey Vulture	400 ± 115.8	289	-28	122.3 ± 33.77	103.9	-15
Osprey	30 ± 8.2	20	-33	8.5 ± 2.13	6.6	-23
Northern Harrier	61 ± 11.8	27	-55	12.3 ± 2.21	6.5	-47
Sharp-shinned Hawk	1485 ± 206.2	1268	-15	366.1 ± 46.77	375.2	+2
Cooper's Hawk	1010 ± 167.8	964	-5	287.5 ± 39.24	347.1	+21
Northern Goshawk	16 ± 4.3	15	-6	3.6 ± 1.15	3.9	+8
Unknown small accipiter[3]	160 ± 72.8	169	+6	–	–	–
Unknown large accipiter[3]	3 ± 2.8	4	+50	–	–	–
Unidentified accipiter	94 ± 28.6	28	-70	–	–	–
TOTAL ACCIPITERS	2631 ± 355.6	2448	-7	–	–	–
Broad-winged Hawk	6 ± 1.9	6	-7	2.3 ± 0.63	3.5	+53
Swainson's Hawk	593 ± 742.0	291	-51	218.6 ± 274.14	140.2	-36
Red-tailed Hawk	649 ± 84.0	636	-2	142.0 ± 15.78	171.1	+21
Ferruginous Hawk	13 ± 2.5	8	-39	2.8 ± 0.55	2.0	-30
Rough-legged Hawk	0 ± 0.2	0	-100	0.1 ± 0.04	0.0	-100
Zone-tailed Hawk	1 ± 0.4	0	-100	–	–	–
Unidentified buteo	21 ± 10.3	69	+225	–	–	–
TOTAL BUTEOS	1284 ± 747.0	1010	-21	–	–	–
Golden Eagle	122 ± 14.1	79	-35	26.5 ± 3.20	20.4	-23
Bald Eagle	4 ± 1.2	1	-72	1.2 ± 0.41	0.4	-65
Unidentified Eagle	1 ± 0.6	0	-100	–	–	–
TOTAL EAGLES	127 ± 14.1	80	-37	–	–	–
American Kestrel	575 ± 67.4	362	-37	159.9 ± 18.72	116.8	-27
Merlin	24 ± 6.3	26	+9	5.9 ± 1.49	7.6	+29
Prairie Falcon	21 ± 5.4	18	-15	4.6 ± 1.08	4.2	-8
Peregrine Falcon	46 ± 17.2	82	+77	11.1 ± 4.03	24.3	+119
Unknown small falcon[3]	2 ± 2.3	1	-50	–	–	–
Unknown large falcon[3]	6 ± 9.0	1	-83	–	–	–
Unidentified falcon	2 ± 1.3	5	+126	–	–	–
TOTAL FALCONS	670 ± 78.7	495	-26	–	–	–
Unidentified raptor	48 ± 19.5	41	-15	–	–	–
GRAND TOTAL	5250 ± 980.5	4410	-16	–	–	–

[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: 1992–2003 versus 2004.

	Total and Age-classified Counts								Immature : Adult Ratio	
	1992–2002 Average			2004			% Unknown Age			
	Total	Imm.	Adult	Total	Imm.	Adult	1992–2003[1]	2004	1992–2003[1]	2004
Northern Harrier	65	35	15	27	4	9	23 ± 6.2	52	2.4 ± 0.54	0.4
Sharp-shinned Hawk	1635	640	741	1268	547	386	16 ± 4.0	26	0.9 ± 0.13	1.4
Cooper's Hawk	1166	421	535	964	336	267	18 ± 4.5	37	0.8 ± 0.13	1.3
Northern Goshawk	16	7	7	15	8	1	11 ± 5.8	40	1.0 ± 0.33	8.0
Broad-winged Hawk	7	1	4	6	2	1	41 ± 20.2	50	0.1 ± 0.09	2.0
Red-tailed Hawk	737	244	401	636	205	200	12 ± 2.2	36	0.6 ± 0.13	1.0
Ferruginous Hawk	11	4	3	8	3	0	45 ± 11.3	63	1.7 ± 1.01	3.0
Golden Eagle	122	69	35	79	38	19	15 ± 4.7	28	2.4 ± 0.59	2.0
Bald Eagle	4	3	1	1	0	1	14 ± 19.1	0	2.3 ± 1.51	0.0
Peregrine Falcon	66	19	28	82	21	36	289 ± 12.8	30	0.9 ± 0.51	0.6

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

Table 3. First and last observed, bulk passage, and median passage dates by species for migrating raptors in the Manzano Mountains, NM in 2004, with comparisons of 2004 and 1985–2003 average median passage dates.

Species	2004				1985–2003
	First Observed	Last Observed	Bulk Passage Dates[1]	Median Passage Date[2]	Median Passage Date[2,3]
Turkey Vulture	28-Aug	13-Oct	9-Sep – 30-Sep	23-Sep	15-Sep ± 2.6
Osprey	5-Sep	21-Oct	5-Sep – 4-Oct	18-Sep	17-Sep ± 1.7
Northern Harrier	31-Aug	24-Oct	8-Sep – 17-Oct	7-Oct	1-Oct ± 2.0
Sharp-shinned Hawk	29-Aug	30-Oct	10-Sep – 19-Oct	29-Sep	28-Sep ± 1.2
Cooper's Hawk	29-Aug	29-Oct	14-Sep – 8-Oct	27-Sep	25-Sep ± 1.2
Northern Goshawk	7-Sep	15-Oct	9-Sep – 10-Oct	21-Sep	5-Oct ± 4.6
Broad-winged Hawk	27-Sep	10-Oct	27-Sep – 10-Oct	4-Oct	25-Sep ± 2.8
Swainson's Hawk	29-Aug	12-Oct	11-Sep – 3-Oct	12-Sep	21-Sep ± 3.4
Red-tailed Hawk	28-Aug	30-Oct	13-Sep – 21-Oct	4-Oct	3-Oct ± 2.2
Ferruginous Hawk	1-Sep	27-Oct	1-Sep – 27-Oct	1-Oct	1-Oct ± 4.6
Bald Eagle	18-Oct	18-Oct	–	–	20-Oct ± 5.5
American Kestrel	29-Aug	21-Oct	3-Sep – 6-Oct	15-Sep	21-Sep ± 1.6
Merlin	9-Sep	29-Oct	21-Sep – 28-Oct	8-Oct	7-Oct ± 3.2
Prairie Falcon	9-Sep	30-Oct	10-Sep – 24-Oct	29-Sep	24-Sep ± 3.4
Peregrine Falcon	31-Aug	19-Oct	12-Sep – 4-Oct	21-Sep	22-Sep ± 1.5
All species	25-Aug	30-Oct	11-Sep – 16-Oct	27-Sep	26-Sep ± 0.9

[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: 1992–2003 versus 2004.

	ADULT		IMMATURE / SUBADULT	
SPECIES	1992–2003[1]	2004	1992–2003[1]	2004
Northern Harrier	8-Oct ± 4.3	29-Sep	30-Sep ± 2.3	–
Sharp-shinned Hawk	5-Oct ± 1.5	10-Oct	19-Sep ± 1.5	16-Sep
Cooper's Hawk	28-Sep ± 2.3	1-Oct	21-Sep ± 2.1	24-Sep
Northern Goshawk	5-Oct ± 4.1	–	2-Oct ± 6.9	11-Sep
Red-tailed Hawk	7-Oct ± 2.3	15-Oct	26-Sep ± 1.9	27-Sep
Golden Eagle	15-Oct ± 2.4	16-Oct	12-Oct ± 1.7	15-Oct
Peregrine Falcon	25-Sep ± 2.3	21-Sep	17-Sep ± 3.4	16-Sep

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

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

Table 5. Capture totals, rates, and successes for migrating raptors in the Manzano Mountains, NM: 1991–2003 versus 2004.

	Capture Total		Capture Rate[1]		Capture Success (%)[2]	
Species	1991–2003[3]	2004	1991–2003[3]	2004	1991–2003[3]	2004
Northern Harrier	5 ± 2.1	0	0.5 ± 0.18	0.0	8 ± 3.4	0
Sharp-shinned Hawk	538 ± 103.6	566	56.8 ± 6.81	74.9	32 ± 3.0	41
Cooper's Hawk	394 ± 74.7	378	42.2 ± 5.88	50.0	33 ± 3.8	36
Northern Goshawk	6 ± 2.2	2	0.7 ± 0.29	0.3	34 ± 11.9	13
Broad-winged Hawk	0.2 ± 0.24	1	0.03 ± 0.028	0.1	2 ± 2.0	17
Swainson's Hawk	0.3 ± 0.46	0	0.03 ± 0.048	0.0	0 ± 0.3	0
Red-tailed Hawk	56.9 ± 12.66	43	6.11 ± 1.185	5.7	8 ± 1.6	6
Zone-tailed Hawk	0.1 ± 0.15	0	0.01 ± 0.011	0.0	6 ± 12.3	0
Golden Eagle	5 ± 0.9	2	0.5 ± 0.14	0.3	3 ± 0.6	3
American Kestrel	43 ± 12.5	18	4.6 ± 1.21	2.4	7 ± 1.5	5
Merlin	5 ± 2.1	10	0.5 ± 0.22	1.3	15 ± 7.8	38
Prairie Falcon	5 ± 1.7	3	0.5 ± 0.14	0.4	17 ± 3.4	17
Peregrine Falcon	6 ± 2.3	5	0.6 ± 0.25	0.7	8 ± 2.2	6
All Species	1062 ± 197.2	1028	113.0 ± 13.68	136.0	23 ± 2.4	27

[1] Captures / 100 station hours.

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

[3] Mean of annual values ± 95% confidence interval.

Table 6. Capture totals by sex and age (HY = hatching year; AHY = after hatching year), female : male capture ratios, and immature : adult capture ratios for selected species of migrating raptors in the Manzano Mountains, NM: 1990–2003 averages versus 2004.

		Female		Male		Female : Male	Immature : Adult
Species	Year	HY	AHY	HY	AHY	Ratio[1]	Ratio[1]
Sharp-shinned Hawk	1990-2003	153	127	147	80	1.3 ± 0.11	1.5 ± 0.23
	2004	220	90	178	78	1.2	2.4
Cooper's Hawk	1990-2003	86	107	89	91	1.1 ± 0.10	0.9 ± 0.14
	2004	112	74	129	63	1.0	1.8
American Kestrel	1990-2003	11	1	18	7	0.7 ± 0.11	4.5 ± 1.20
	2004	6	4	6	0	2.0	3.0

[1] Long-term value – mean ± 95% CI.

Table 7. Recaptures of previously banded raptors in the Manzano Mountains, NM: 2004.

BAND #	SPECIES	SEX	BANDING SITE	BANDING DATE	BANDING AGE[1]	RECAPTURE DATE	RECAPTURE AGE[1]
1212 – 71612	Sharp-shinned Hawk	M	Manzano Mts., NM	16-Sep-03	HY	06-Oct-04	SY
1005 – 11177	Cooper's Hawk	F	Manzano Mts., NM	01-Oct-01	ASY	15-Oct-04	>4th yr

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

Table 8. Foreign encounters with raptors originally banded in the Manzano Mountains, NM: 2004.

BAND #	SPECIES	SEX	BANDING AGE[1]	BANDING DATE	ENCOUNTER DATE	ENCOUNTER AGE[1]	ENCOUNTER LOCATION	DISTANCE (KM)	STATUS
1152 – 65288	SS	M	SY	12-Oct-01	09-Oct-04	5th yr	Bandolier National Monument, NM	98.05	research recapture
1204 – 51653	CH	M	ASY	23-Sep-00	20-Mar-04	>5th yr	Apatzingan, Michoacán, Mexico	1486.35	injured, released
1005 – 11077	CH	F	AHY	14-Sep-03	20-Aug-04	ASY	Durango, CO	273.59	found dead
1152 – 65288	SS	M	SY	12-Oct-01	09-Oct-04	5th yr	Bandolier National Monument, NM	90.91	research recapture
1005 – 21603	CH	F	HY	29-Sep-03	02-Nov-04	SY	San Icidro Ranch, Zacatecas, Mexico	1046.25	shot

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

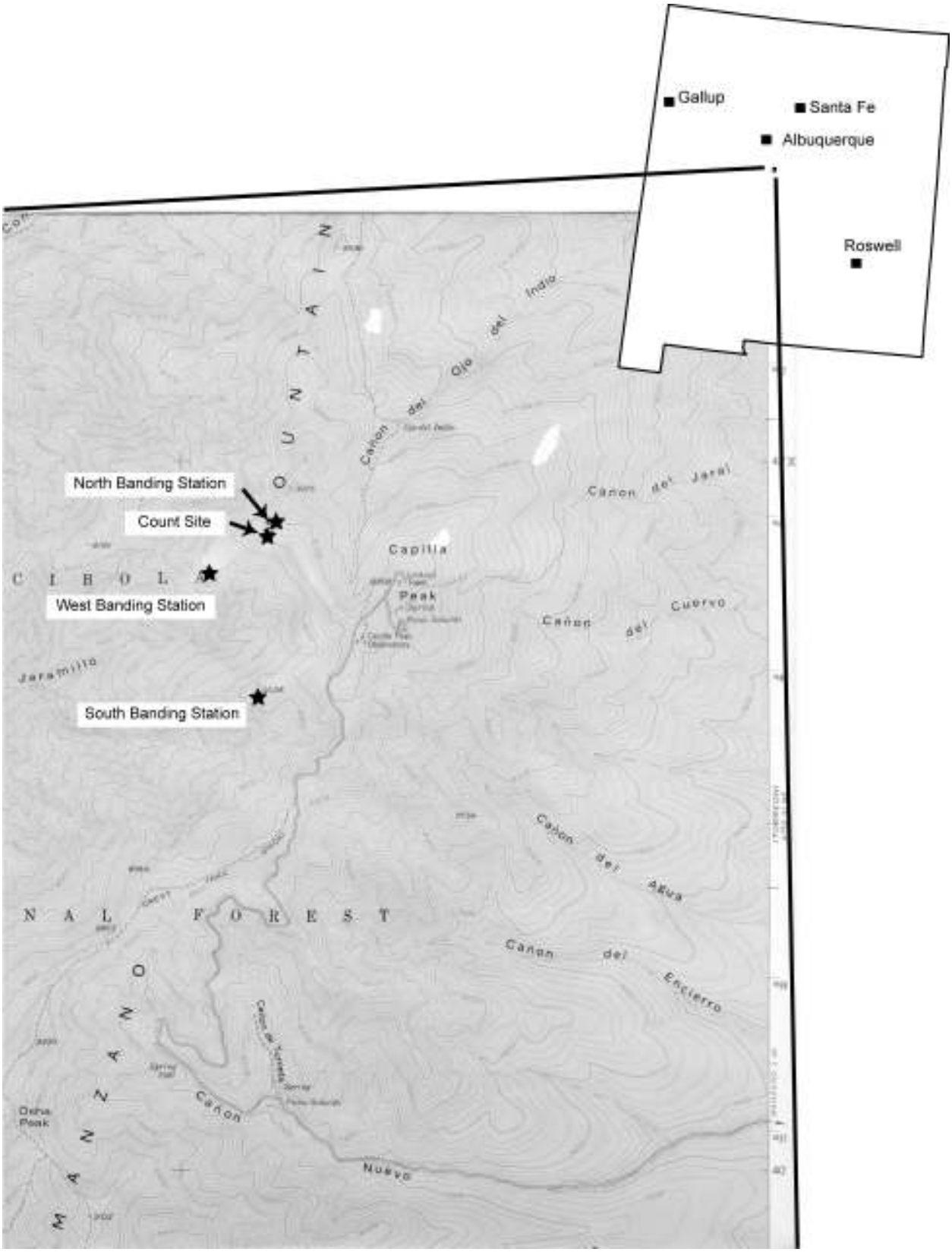

Figure 1. Map of the Manzano Mountains raptor-migration study site in central New Mexico.

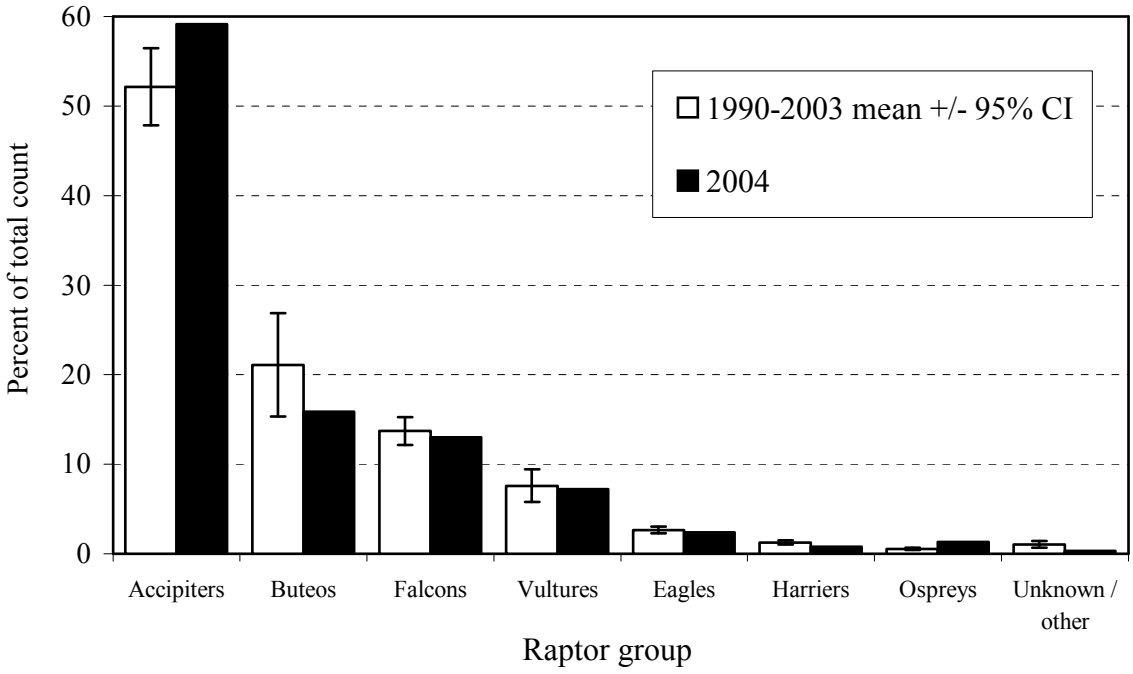

Figure 2. Fall raptor-migration flight composition by major species groups in the Manzano Mountains, NM: 1985–2003 versus 2004.

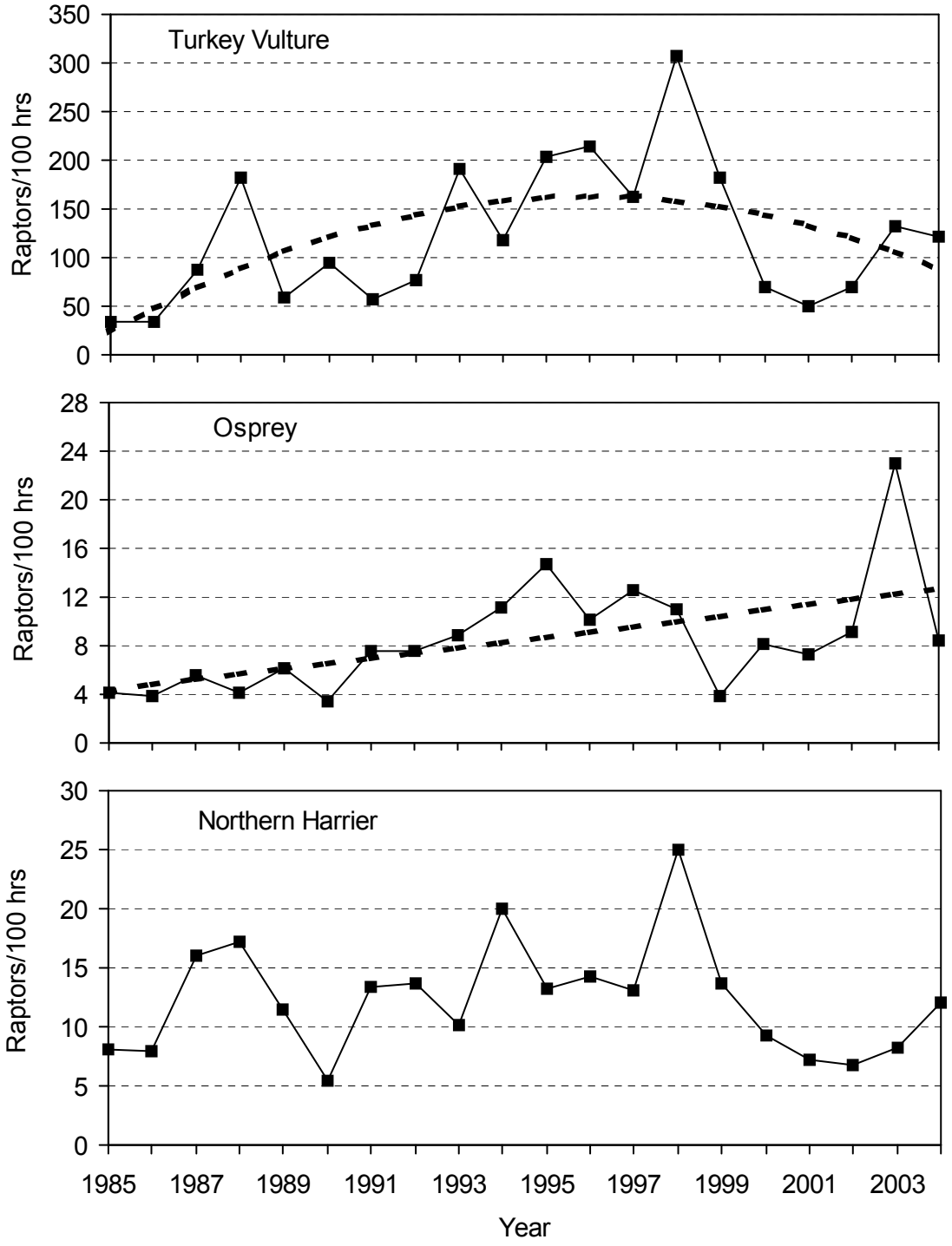

Figure 3. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) fall-migration passage rates for Turkey Vultures, Ospreys, and Northern Harriers in the Manzano Mountains, NM: 1985–2004. Dashed lines indicate significant ($P \leq 0.10$) regressions.

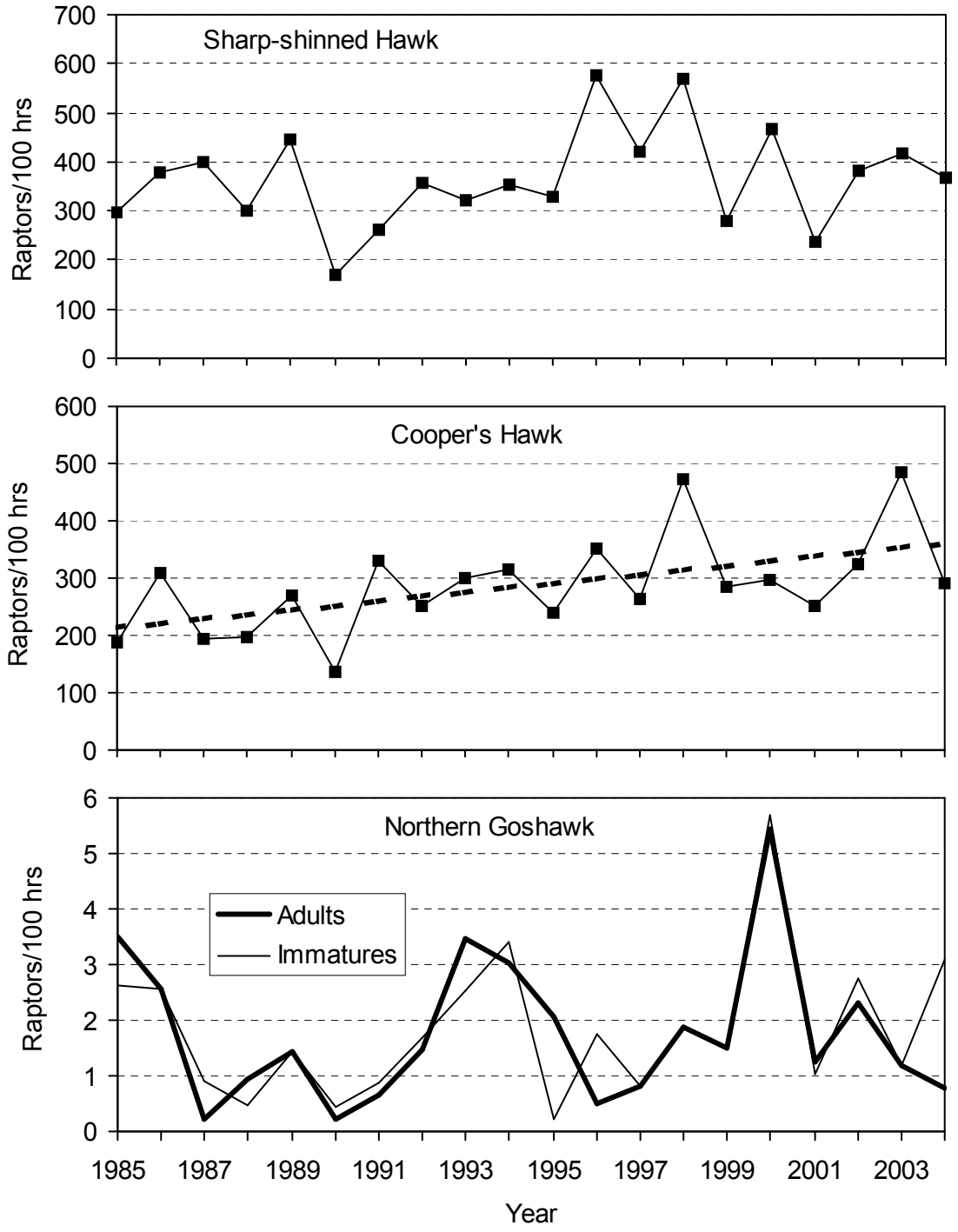

Figure 4. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) fall-migration passage rates for Sharp-shinned Hawks, Cooper's Hawks, and Northern Goshawks in the Manzano Mountains, NM: 1985–2004. Dashed lines indicate significant ($P \leq 0.10$) regressions.

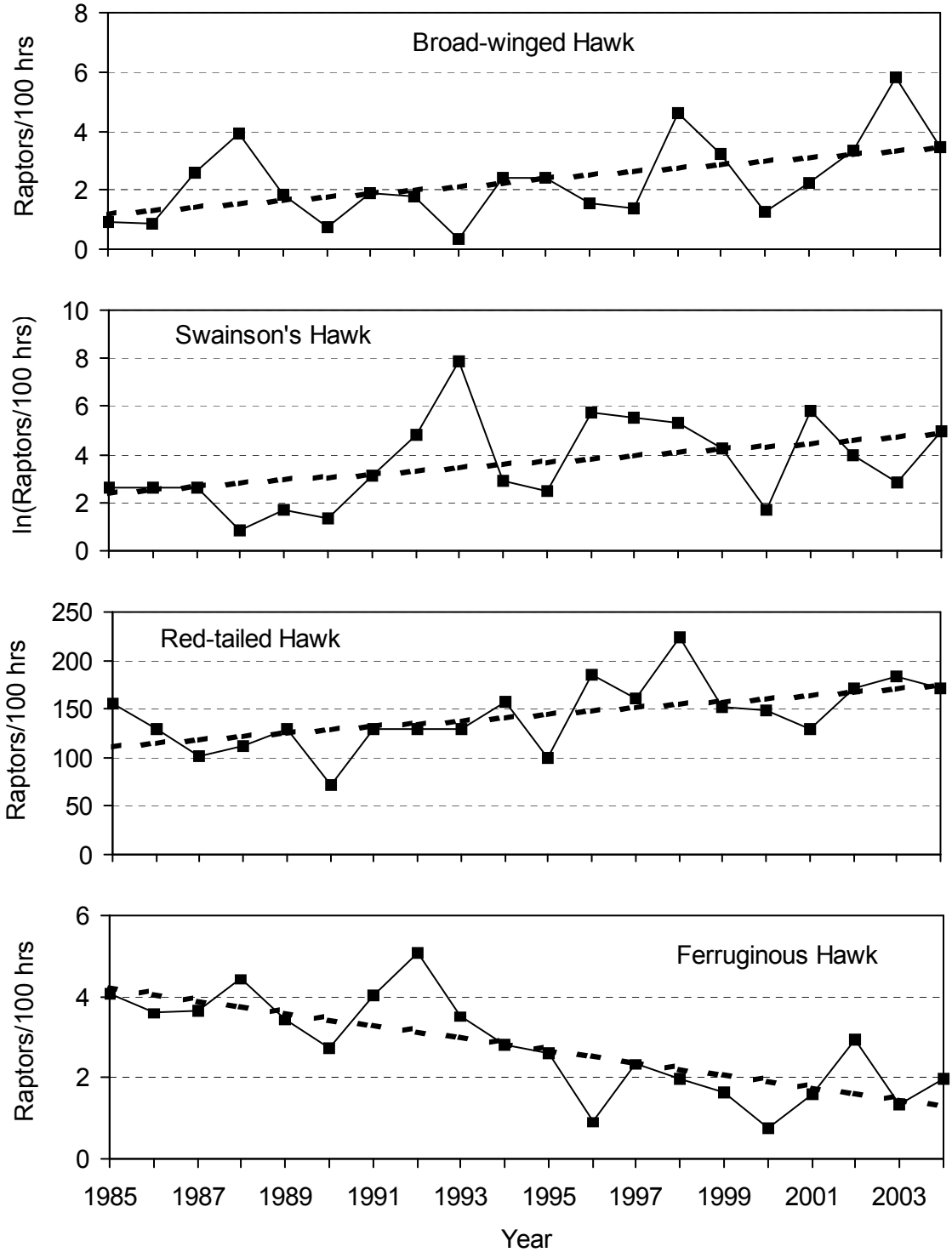

Figure 5. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) fall-migration passage rates for Broad-winged, Swainson's, Red-tailed and Ferruginous Hawks in the Manzano Mountains, NM: 1985–2004. Dashed lines indicate significant ($P \leq 0.10$) regressions.

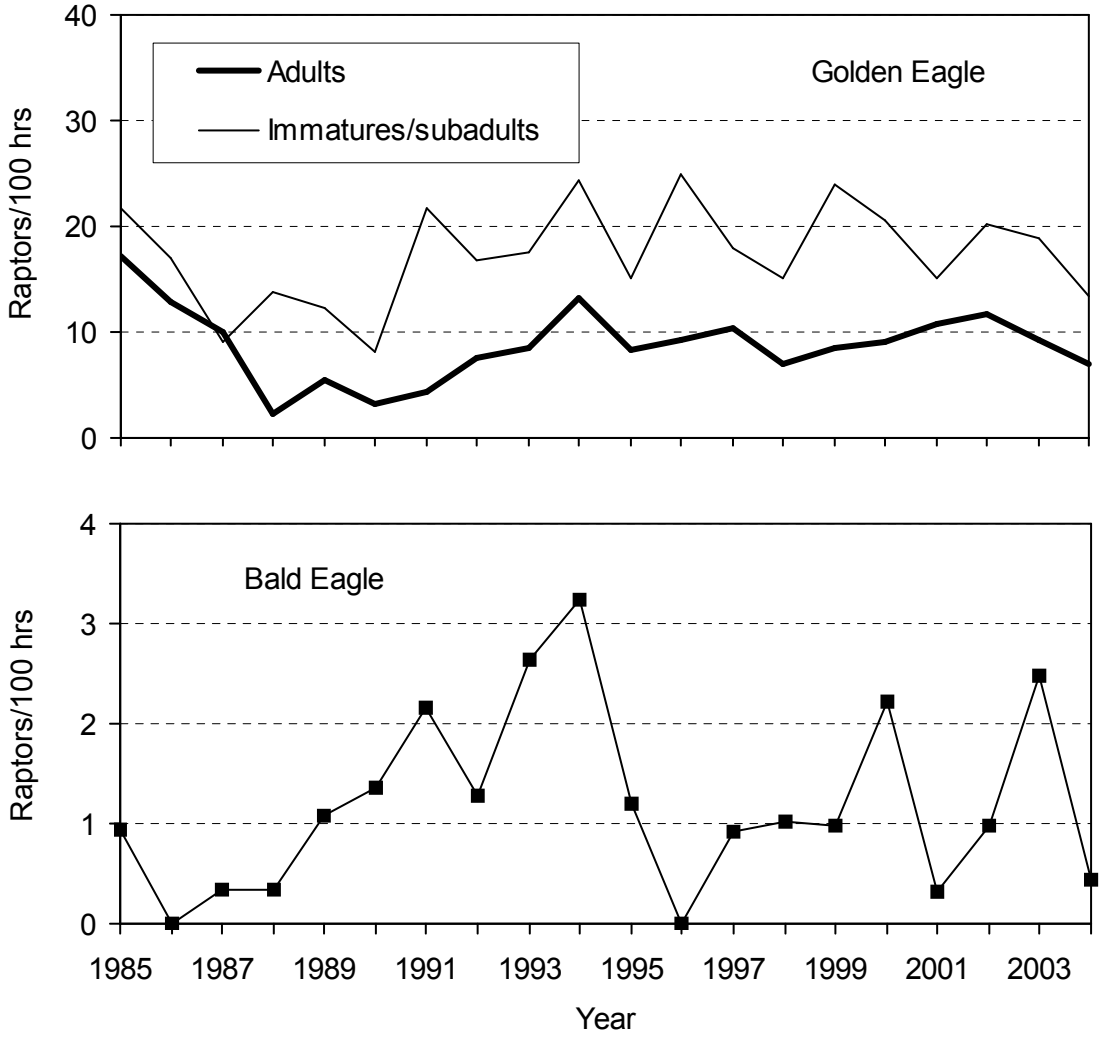

Figure 6. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) fall-migration passage rates for Golden and Bald Eagles in the Manzano Mountains, NM: 1985–2004. Dashed lines indicate significant ($P \leq 0.10$) regressions.

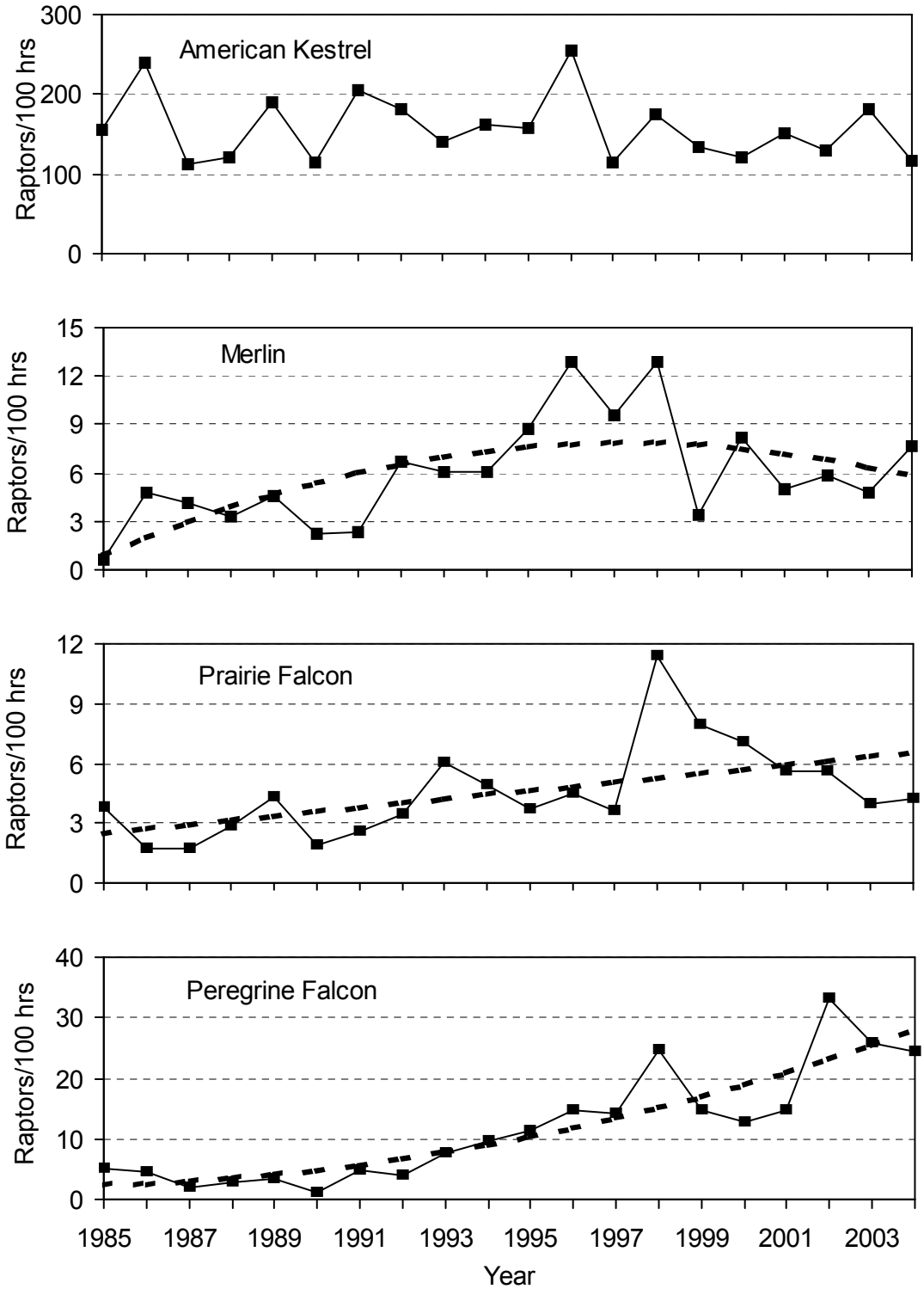

Figure 7. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) fall-migration passage rates for American Kestrels, Merlins, Prairie Falcons, and Peregrine Falcons: 1985–2004. Dashed lines indicate significant ($P \leq 0.10$) regressions.

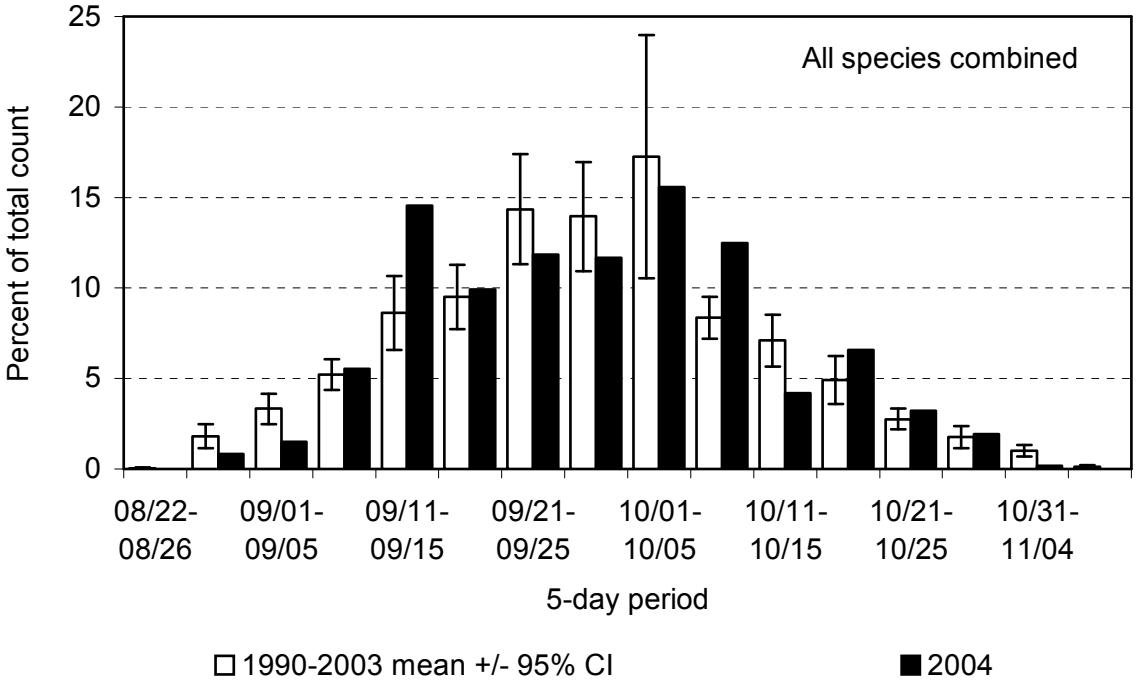

Figure 8. Combined-species, fall-migration passage volume by five-day periods for raptors in the Manzano Mountains, NM: 1985–2003 versus 2004.

Appendix A. History of official observer participation in the Manzano Mountains Raptor Migration Project: 1985–2004.

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 (0)

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

[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: 2004.

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	0.00			weather day									
28-Aug	3.00	2.0	0	clr	4.7	var	25.3	-	1	0	80	2	2.0
29-Aug	8.00	2.0	0	clr-pc	7.7	w-wnw	23.3	-	1	0	80	1	2.1
30-Aug	4.67	2.0	0	pc-ovc, PM ts	5.6	w, ene	20.8	-	2	0	84	2	3.9
31-Aug	5.00	2.0	0	clr-ovc/ PM ts	2.6	calm/var	18.8	30.44	2	0	97	2	2.2
1-Sep	7.75	2.0	0	clr-mc	1.8	calm/var	20.3	30.42	2	100	100	2.5	3.7
2-Sep	8.00	1.0	0	clr	9.2	sw-wnw	22.2	30.23	2	80	80	2	0.6
3-Sep	8.00	1.0	0	clr-ovc	11.1	w	20.9	30.14	4	75	75	1	2.4
4-Sep	1.50	2.0	0	ovc/rain	14.0	calm/ssw	17.7	30.19	4	57	57	-	1.3
5-Sep	8.00	2.0	0	clr-pc	16.1	w	14.0	30.21	4	100	100	1	1.9
6-Sep	8.08	2.0	0	clr	8.8	e-ese	19.7	30.36	3	100	100	2.5	3.8
7-Sep	8.50	2.0	0	clr-pc	2.4	calm/var	21.2	30.38	1	90	90	2	9.1
8-Sep	8.25	1.0	0	clr-pc	5.3	w	21.3	30.36	1	96	96	2	5.1
9-Sep	8.33	1.0	0	clr	7.4	wnw, sw	22.5	30.35	1	100	100	2	9.5
10-Sep	8.50	2.0	0	clr	11.1	ssw-w	22.0	30.37	3	100	100	1	9.5
11-Sep	8.50	2.0	0	clr-pc	3.1	calm/wsw	25.9	30.42	1	100	100	2	19.2
12-Sep	8.50	2.0	0	clr-pc	13.7	sw-w	25.4	30.31	1	98	100	1	13.5
13-Sep	7.83	2.3	0	clr-ovc/ PM ts	19.8	sw-w	22.0	30.16	4	100	100	1	14.4
14-Sep	9.00	2.0	0	clr	16.4	wsw-w	22.5	30.06	4	100	100	1	18.9
15-Sep	9.00	1.0	0	clr	5.7	wsw	22.7	30.20	1	96	96	1	13.6
16-Sep	8.25	2.0	0	clr	8.8	ssw	24.1	30.26	2	96	100	1	10.8
17-Sep	8.00	2.0	0	clr-pc	9.4	ssw-sw	25.1	30.30	2	100	100	2	13.1
18-Sep	8.00	1.9	0	pc-ovc, PM ts	4.1	var	20.2	30.22	3	70	63	2	15.3
19-Sep	0.00			weather day									
20-Sep	7.67	2.0	0	clr-pc	23.7	ssw	15.9	30.09	4	100	100	1	6.4
21-Sep	8.25	2.0	0	pc-mc	19.4	s-ssw	17.2	30.10	4	100	100	1	20.6
22-Sep	8.00	2.0	0	clr	14.7	sw-w	11.3	30.14	4	100	100	1	5.0
23-Sep	8.50	3.8	0	clr	5.4	ssw	17.1	30.30	1	100	100	2	17.2
24-Sep	7.50	4.6	0	mc-ovc/ PM ts	10.2	s-ssw	18.4	30.34	3	100	100	2	15.6
25-Sep	0.00			weather day									
26-Sep	0.00			weather day									
27-Sep	8.75	2.0	0	pc-mc/ PM ts	6.7	ne-se	15.0	30.29	3	100	100	3	46.5
28-Sep	0.00			weather day									
29-Sep	7.50	3.4	0	mc-ovc/ PM rain	10.0	calm/s	12.0	30.15	4	59	62	2	14.3
30-Sep	8.50	2.7	0	pc-mc	13.8	s-sw	13.6	30.02	3	90	92	2	17.1
1-Oct	8.00	4.6	0	clr-ovc	4.1	sw-w, calm	15.3	30.23	3	100	100	2.5	12.9
2-Oct	8.25	4.1	0	clr-mc	4.5	sw	17.3	30.41	1	89	91	2	20.6
3-Oct	8.00	5.1	1	pc-ovc, AM haze PM ts	5.8	ssw	16.5	30.36	2	62	59	2	15.1
4-Oct	8.25	3.1	0	pc-mc	11.7	se	18.8	30.34	3	80	77	4	17.9
5-Oct	0.00			weather day									
6-Oct	7.75	1.0	0	pc	10.2	sw	15.7	30.17	3	71	78	2	14.6
7-Oct	8.50	2.0	0	clr-pc	8.2	sw	14.6	30.26	3	100	100	2	8.5
8-Oct	8.75	2.0	0	clr-pc	5.5	ne-e	14.4	30.38	3	100	100	2	33.6
9-Oct	8.00	2.0	0	clr	5.8	ssw-sw	17.3	30.23	2	100	100	2	9.0
10-Oct	8.00	2.7	0	pc-ovc	5.5	sw	16.7	30.08	3	100	100	2	12.1
11-Oct	0.00			weather day									
12-Oct	6.75	2.7	0	pc-ovc/fog, clr	8.0	wsw-wnw	13.1	30.18	3	87	78	2	5.9
13-Oct	1.00	2.0	0	ovc	12.7	se	9.3	30.12	4	27	50	2	10.0
14-Oct	8.00	2.0	0	clr	6.8	sw-nw	8.5	30.13	4	100	100	2	4.6

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
15-Oct	8.00	2.0	0	clr	20.4	sw-w	13.8	30.01	4	100	100	1	6.4
16-Oct	8.00	2.4	0	pc-ovc	23.0	sw	16.0	30.04	4	100	100	1	8.4
17-Oct	8.00	1.8	0	pc-ovc, PM rain	23.5	sw	11.7	29.94	4	95	94	1	9.0
18-Oct	8.00	1.6	0	pc-mc	25.9	w-nw	9.1	29.88	4	100	100	2	6.3
19-Oct	8.00	2.4	0	clr	20.8	sw	11.2	30.01	4	99	100	2	6.3
20-Oct	7.50	2.0	0	clr-pc	26.6	ssw	14.0	30.08	4	100	100	2	5.5
21-Oct	8.00	2.0	0	ovc	18.2	ssw-sw	14.1	30.02	4	100	100	1	4.4
22-Oct	0.00			weather day									
23-Oct	7.75	2.0	0	clr	12.6	nw, ssw	8.6	30.05	4	100	100	1	1.4
24-Oct	8.00	1.0	0	clr	15.5	ssw	10.7	29.98	4	100	100	2	6.9
25-Oct	7.25	1.1	0	ovc	7.8	ssw, calm/s	12.3	30.00	3	100	100	2	4.0
26-Oct	6.50	2.0	0	ovc	10.9	ssw	13.0	30.04	4	98	100	1	3.1
27-Oct	7.00	1.0	0	ovc	8.1	sse-s	11.8	30.09	4	48	60	1	1.1
28-Oct	6.50	2.0	0	clr-mc	18.9	s-ssw	11.9	30.02	4	100	100	1	3.4
29-Oct	4.50	2.0	0	clr	20.2	w	3.0	30.00	4	100	100	1.5	1.3
30-Oct	4.50	2.0	0	clr-pc	16.8	sw	4.4	30.03	4	100	100	1.5	1.8
31-Oct	0.00			snow									
1-Nov	0.00			snow									
2-Nov	0.00			no access / observations									
3-Nov	0.00			no access / observations									
4-Nov	0.00			no access / observations									
5-Nov	0.00			no access / observations									

[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: 2004.

		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	0.00																													
28-Aug	3.00	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0.7
29-Aug	8.00	2	0	0	2	2	0	0	0	0	0	1	1	0	0	0	0	0	0	0	8	0	0	0	0	0	1	0	17	2.1
30-Aug	4.67	1	0	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	14	0	0	0	0	0	0	0	18	3.9
31-Aug	5.00	0	0	1	0	1	0	0	0	0	0	2	0	0	0	0	2	0	0	0	3	0	0	1	0	0	0	1	11	2.2
1-Sep	7.75	10	0	1	3	3	0	1	0	0	0	1	0	1	0	0	0	0	0	0	5	0	0	0	0	0	1	3	29	3.7
2-Sep	8.00	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	1	5	0.6
3-Sep	8.00	1	0	0	7	2	0	0	0	0	0	0	3	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	19	2.4
4-Sep	1.50	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1.3
5-Sep	8.00	3	2	0	4	1	0	0	0	0	0	1	2	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	15	1.9
6-Sep	8.08	4	1	0	11	0	0	4	0	0	0	0	5	0	0	0	1	0	0	0	1	0	0	2	0	0	0	2	31	3.8
7-Sep	8.50	3	1	0	31	11	1	3	1	0	0	2	8	0	0	0	1	3	0	0	6	0	0	2	0	0	0	4	77	9.1
8-Sep	8.25	1	1	1	13	3	0	1	0	0	0	3	12	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	42	5.1
9-Sep	8.33	3	1	0	33	8	2	1	0	0	0	6	12	0	0	0	0	0	0	0	11	1	1	0	0	0	0	0	79	9.5
10-Sep	8.50	9	1	1	32	19	1	1	0	0	0	6	4	0	0	0	1	0	0	0	4	0	1	1	0	0	0	0	81	9.5
11-Sep	8.50	3	0	1	34	19	1	3	0	2	0	70	2	1	0	0	7	1	0	0	18	0	0	0	0	0	0	1	163	19.2
12-Sep	8.50	2	0	1	20	7	0	1	0	0	0	63	9	0	0	0	0	1	0	0	6	0	0	5	0	0	0	0	115	13.5
13-Sep	7.83	26	0	2	28	15	0	2	0	0	0	1	12	0	0	0	0	0	0	0	24	0	1	0	0	0	0	2	113	14.4
14-Sep	9.00	7	0	0	46	24	0	4	0	0	0	5	11	0	0	0	0	1	0	0	60	1	1	9	0	0	1	0	170	18.9
15-Sep	9.00	3	1	1	46	34	0	4	0	0	0	4	12	0	0	0	0	0	0	0	13	0	0	3	0	0	0	1	122	13.6
16-Sep	8.25	7	0	0	44	19	0	0	0	0	0	0	10	0	0	0	0	0	0	0	7	0	0	2	0	0	0	0	89	10.8
17-Sep	8.00	36	0	0	21	23	0	2	0	0	0	1	5	0	0	0	0	0	0	0	12	0	0	5	0	0	0	0	105	13.1
18-Sep	8.00	2	2	0	42	20	0	19	0	0	0	14	11	0	0	0	0	0	0	0	5	0	0	5	0	0	2	0	122	15.3
19-Sep	0.00																													
20-Sep	7.67	2	1	0	19	14	1	2	0	0	0	0	4	0	0	0	0	1	0	0	2	0	1	2	0	0	0	0	49	6.4
21-Sep	8.25	3	2	0	68	55	2	7	0	3	0	7	4	0	0	0	0	0	0	0	6	1	1	10	1	0	0	0	170	20.6
22-Sep	8.00	3	2	0	11	6	0	1	0	0	0	2	4	0	0	0	1	0	0	0	5	0	0	5	0	0	0	0	40	5.0
23-Sep	8.50	85	0	0	19	21	0	2	0	0	0	0	9	0	0	0	0	0	0	0	5	0	0	4	0	0	0	1	146	17.2
24-Sep	7.50	0	1	1	30	50	0	5	0	0	0	2	13	0	0	0	0	0	0	0	9	0	0	6	0	0	0	0	117	15.6
25-Sep	0.00																													
26-Sep	0.00																													
27-Sep	8.75	24	0	0	62	153	1	29	1	9	1	12	83	1	0	0	11	1	0	0	8	0	2	2	0	0	0	7	407	46.5
28-Sep	0.00																													
29-Sep	7.50	14	0	1	30	27	0	1	0	0	0	0	8	0	0	0	0	0	0	0	22	2	1	1	0	0	0	0	107	14.3
30-Sep	8.50	8	0	0	33	50	0	6	0	1	0	4	12	0	0	0	0	1	0	0	20	1	1	4	0	1	0	3	145	17.1
1-Oct	8.00	2	0	0	26	43	0	5	0	1	0	0	8	1	0	0	2	1	0	0	11	2	0	1	0	0	0	0	103	12.9
2-Oct	8.25	3	1	1	42	62	1	10	0	3	0	2	24	1	0	0	4	3	0	0	11	0	0	1	0	0	0	1	170	20.6

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
3-Oct	8.00	0	0	1	16	25	0	3	0	0	1	54	9	0	0	0	5	1	0	0	4	1	0	1	0	0	0	0	121	15.1
4-Oct	8.25	2	2	0	13	21	0	6	0	4	2	22	44	0	0	0	19	1	0	0	2	0	1	2	0	0	0	7	148	17.9
5-Oct	0.00																													
6-Oct	7.75	2	0	0	28	32	0	10	0	1	1	3	9	1	0	0	2	4	0	0	16	2	1	1	0	0	0	0	113	14.6
7-Oct	8.50	0	0	4	23	22	0	4	0	0	0	0	10	0	0	0	3	2	0	0	3	0	0	0	0	0	0	1	72	8.5
8-Oct	8.75	2	0	0	91	84	2	20	0	3	0	0	70	0	0	0	4	5	0	0	5	4	0	1	0	0	0	3	294	33.6
9-Oct	8.00	1	0	3	26	12	1	2	0	0	0	0	11	0	0	0	0	5	0	0	9	1	1	0	0	0	0	0	72	9.0
10-Oct	8.00	11	0	1	49	9	1	0	0	0	1	0	7	0	0	0	4	5	0	0	7	0	0	1	0	0	0	1	97	12.1
11-Oct	0.00																													
12-Oct	6.75	0	0	0	20	6	0	0	1	0	0	1	7	0	0	0	0	1	0	0	3	1	0	0	0	0	0	0	40	5.9
13-Oct	1.00	3	0	0	2	2	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	10.0
14-Oct	8.00	0	0	2	13	1	0	2	1	0	0	0	17	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	37	4.6
15-Oct	8.00	0	0	1	23	9	1	2	0	0	0	0	5	0	0	0	0	9	0	0	0	0	0	1	0	0	0	0	51	6.4
16-Oct	8.00	0	0	0	30	13	0	3	0	0	0	0	11	0	0	0	0	6	0	0	1	1	0	1	0	0	0	1	67	8.4
17-Oct	8.00	0	0	1	21	8	0	0	0	1	0	0	33	0	0	0	0	4	0	0	0	1	1	2	0	0	0	0	72	9.0
18-Oct	8.00	0	0	1	19	2	0	2	0	0	0	0	24	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	50	6.3
19-Oct	8.00	0	0	0	32	2	0	0	0	0	0	0	10	0	0	0	0	2	0	0	0	1	1	1	0	0	0	1	50	6.3
20-Oct	7.50	0	0	0	23	4	0	0	0	0	0	0	7	1	0	0	0	5	0	0	0	0	1	0	0	0	0	0	41	5.5
21-Oct	8.00	0	1	0	13	7	0	0	0	0	0	0	10	0	0	0	1	2	0	0	1	0	0	0	0	0	0	0	35	4.4
22-Oct	0.00																													
23-Oct	7.75	0	0	0	6	3	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	11	1.4
24-Oct	8.00	0	0	1	26	6	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	55	6.9
25-Oct	7.25	0	0	0	7	1	0	0	0	0	0	0	19	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	29	4.0
26-Oct	6.50	0	0	0	12	1	0	0	0	0	0	0	3	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	20	3.1
27-Oct	7.00	0	0	0	1	0	0	0	0	0	0	0	4	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	8	1.1
28-Oct	6.50	0	0	0	9	1	0	0	0	0	0	0	9	0	0	0	0	1	0	0	0	2	0	0	0	0	0	0	22	3.4
29-Oct	4.50	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	6	1.3
30-Oct	4.50	0	0	0	1	0	0	0	0	0	0	0	4	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0	8	1.8
31-Oct	0.00																													
1-Nov	0.00																													
2-Nov	0.00																													
3-Nov	0.00																													
4-Nov	0.00																													
5-Nov	0.00																													
Total	424.08	289	20	27	1268	964	15	169	4	28	6	291	636	8	0	0	69	79	1	0	362	26	18	82	1	1	5	41	4410	10.4

[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: 1985–2004.

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Mean
Start date	6-Sep	23-Aug	25-Aug	30-Aug	28-Aug	27-Aug	27-Aug	25-Aug	25-Aug	25-Aug	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug	28-Aug	26-Aug
End date	2-Nov	31-Oct	4-Nov	31-Oct	31-Oct	31-Oct	5-Nov	5-Nov	5-Nov	2-Nov	8-Nov	5-Nov	5-Nov	5-Nov	5-Nov	2-Nov	4-Nov	3-Nov	5-Nov	30-Oct	2-Nov
Days of observation	50	63	65	60	63	62	67	70	68	66	70	59	68	65	70	57	68	65	69	57	64
Hours of observation	343.33	464.50	517.92	453.08	489.75	510.75	524.58	537.25	489.67	508.75	560.00	461.67	565.08	559.58	553.77	434.33	545.47	518.50	577.25	424.08	501.97
Raptors / 100 hours	843.2	863.9	758.6	772.3	955.4	494.6	825.6	946.3	2429.2	966.5	832.9	1545.9	1044.8	1594.2	873.1	991.6	855.8	972.0	1126.4	1039.9	1036.6
SPECIES	RAPTOR COUNTS																				
Turkey Vulture	74	118	283	466	178	295	176	268	601	430	636	640	563	1116	637	241	164	239	468	289	394
Osprey	10	14	19	13	22	12	24	26	31	38	53	33	47	44	14	25	26	32	86	20	29
Northern Harrier	28	36	78	78	59	27	66	69	48	97	72	64	69	133	69	38	37	33	50	27	59
Sharp-shinned Hawk	956	1300	1622	1118	1834	688	1080	1540	1193	1415	1519	2174	1872	2585	1212	1698	1032	1524	1861	1268	1475
Cooper's Hawk	531	881	679	604	929	471	1105	961	944	1054	907	1205	1018	2025	1069	984	913	1149	1758	964	1008
Northern Goshawk	21	20	7	6	14	3	8	16	27	30	11	9	9	19	14	42	13	23	12	15	16
Unknown small accipiter[1]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	86	188	205	169	162
Unknown large accipiter[1]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	3	5	4	3
Unknown accipiter	78	104	119	111	121	120	156	117	266	118	44	147	76	107	51	29	0	11	5	28	90
TOTAL ACCIPITERS	1586	2305	2427	1839	2898	1282	2349	2634	2430	2617	2481	3535	2975	4736	2346	2753	2044	2898	3846	2448	2621
Broad-winged Hawk	2	2	7	10	5	2	5	5	1	7	7	4	5	14	12	3	6	9	16	6	6
Swainson's Hawk	27	33	44	3	16	9	58	344	7301	67	32	867	679	572	194	19	815	139	53	291	578
Red-tailed Hawk	513	527	457	486	604	329	577	667	566	707	519	771	803	1151	733	591	632	778	924	636	649
Ferruginous Hawk	14	15	17	20	16	13	19	25	17	13	13	4	13	10	8	3	10	14	7	8	13
Rough-legged Hawk	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0
Zone-tailed Hawk	0	0	0	0	0	0	0	2	0	1	1	0	1	2	0	3	1	1	0	0	1
Unknown buteo	21	12	11	16	4	19	30	11	31	22	9	11	3	28	5	2	106	32	30	69	24
TOTAL BUTEOS	577	589	536	536	646	372	689	1054	7916	817	581	1657	1504	1778	953	621	1571	973	1030	1010	1271
Golden Eagle	133	123	86	67	85	52	124	119	120	172	136	151	145	115	159	115	128	149	146	79	120
Bald Eagle	2	0	1	1	3	4	7	4	7	9	4	0	3	4	3	5	1	3	8	1	4
Unknown Eagle	0	0	0	4	0	4	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1
TOTAL EAGLES	135	123	87	72	88	60	131	123	127	181	140	151	148	119	162	121	129	152	155	80	124
American Kestrel	421	755	426	385	677	409	728	704	520	582	584	905	455	742	525	397	560	470	686	362	565
Merlin	2	16	17	12	18	9	10	28	24	24	42	48	42	56	14	27	21	22	22	26	24
Prairie Falcon	13	7	8	12	19	9	14	17	27	22	18	19	19	58	38	30	28	24	20	18	21
Peregrine Falcon	14	15	7	10	15	5	21	18	31	37	49	60	67	116	64	49	63	127	112	82	48
Unknown small falcon[1]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	4	2	1	2
Unknown large falcon[1]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	15	3	1	5
Unknown falcon	4	0	1	0	3	5	3	1	0	1	0	1	0	12	2	1	5	2	1	5	2
TOTAL FALCONS	454	793	459	419	732	437	776	768	602	666	693	1033	583	984	643	504	677	664	846	495	661
Unknown raptor	31	35	40	76	56	41	120	142	140	71	8	24	15	11	11	4	20	49	21	41	48
TOTAL	2895	4013	3929	3499	4679	2526	4331	5084	11895	4917	4664	7137	5904	8921	4835	4307	4668	5040	6502	4410	5208

[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: 2004.

	STN.	SPECIES[1]														CAPTURES
DATE	HOURS	NH	SS	CH	NG	BW	SW	RT	ZT	GE	AK	ML	PR	PG	TOTAL	/ STN HR
5-Sep	6.88	0	0	1	0	0	0	0	0	0	0	0	1	0	2	0.3
6-Sep	10.50	0	9	1	0	0	0	0	0	0	0	0	0	0	10	1.0
7-Sep	14.50	0	17	3	1	0	0	4	0	0	0	0	0	0	25	1.7
8-Sep	15.00	0	9	6	0	0	0	2	0	0	0	0	0	0	17	1.1
9-Sep	15.75	0	19	3	0	0	0	3	0	0	1	0	0	0	26	1.7
10-Sep	15.50	0	13	7	0	0	0	1	0	0	0	0	1	1	23	1.5
11-Sep	15.91	0	21	9	1	0	0	0	0	0	2	0	0	0	33	2.1
12-Sep	15.15	0	14	2	0	0	0	1	0	0	0	0	0	2	19	1.3
13-Sep	15.00	0	10	5	0	0	0	3	0	0	0	0	0	0	18	1.2
14-Sep	7.75	0	6	8	0	0	0	0	0	0	2	0	0	0	16	2.1
15-Sep	15.50	0	31	13	0	0	0	1	0	0	1	0	0	0	46	3.0
16-Sep	15.75	0	25	8	0	0	0	0	0	0	1	0	0	0	34	2.2
17-Sep	16.00	0	17	13	0	0	0	0	0	0	2	0	0	1	33	2.1
18-Sep	14.75	0	40	11	0	0	0	1	0	0	2	0	0	0	54	3.7
19-Sep	0.00															
20-Sep	17.17	0	4	11	0	0	0	1	0	0	0	0	0	0	16	0.9
21-Sep	15.66	0	35	35	0	0	0	1	0	0	0	0	1	0	72	4.6
22-Sep	16.00	0	6	6	0	0	0	1	0	0	0	0	0	0	13	0.8
23-Sep	15.50	0	13	9	0	0	0	2	0	0	0	0	0	0	24	1.5
24-Sep	14.16	0	19	32	0	0	0	0	0	0	2	0	0	0	53	3.7
25-Sep	0.00															
26-Sep	0.00															
27-Sep	15.50	0	21	33	0	0	0	0	0	0	0	0	0	0	54	3.5
28-Sep	0.00															
29-Sep	16.25	0	14	8	0	0	0	1	0	0	2	2	0	0	27	1.7
30-Sep	23.66	0	11	22	0	0	0	4	0	0	1	1	0	0	39	1.6
1-Oct	22.75	0	12	13	0	0	0	1	0	0	0	1	0	1	28	1.2
2-Oct	23.50	0	23	16	0	0	0	4	0	0	0	1	0	0	44	1.9
3-Oct	22.50	0	8	12	0	0	0	1	0	0	0	1	0	0	22	1.0
4-Oct	15.50	0	2	7	0	0	0	1	0	0	0	0	0	0	10	0.6
5-Oct	0.00															
6-Oct	20.50	0	12	15	0	1	0	4	0	0	1	0	0	0	33	1.6
7-Oct	24.00	0	8	8	0	0	0	2	0	0	0	1	0	0	19	0.8
8-Oct	16.50	0	22	16	0	0	0	0	0	0	1	1	0	0	40	2.4
9-Oct	16.13	0	7	15	0	0	0	1	0	0	0	0	0	0	23	1.4
10-Oct	14.00	0	19	2	0	0	0	1	0	1	0	0	0	0	23	1.6
11-Oct	0.00															
12-Oct	21.00	0	8	2	0	0	0	0	0	0	0	0	0	0	10	0.5

Appendix F. continued

Date	Stn. Hours	Species[1] NH	SS	CH	NG	BW	SW	RT	ZT	GE	AK	ML	PR	PG	Captures Total	/ stn hr
13-Oct	4.00	0	1	2	0	0	0	0	0	0	0	0	0	0	3	0.8
14-Oct	20.50	0	7	2	0	0	0	0	0	0	0	0	0	0	9	0.4
15-Oct	23.25	0	6	4	0	0	0	0	0	1	0	0	0	0	11	0.5
16-Oct	23.80	0	15	6	0	0	0	0	0	0	0	0	0	0	21	0.9
17-Oct	12.75	0	6	3	0	0	0	1	0	0	0	0	0	0	10	0.8
18-Oct	13.75	0	4	0	0	0	0	0	0	0	0	0	0	0	4	0.3
19-Oct	22.00	0	7	0	0	0	0	0	0	0	0	1	0	0	8	0.4
20-Oct	23.30	0	10	2	0	0	0	0	0	0	0	0	0	0	12	0.5
21-Oct	23.25	0	6	3	0	0	0	1	0	0	0	0	0	0	10	0.4
22-Oct	0.00															
23-Oct	15.00	0	4	1	0	0	0	0	0	0	0	0	0	0	5	0.3
24-Oct	16.00	0	10	2	0	0	0	0	0	0	0	0	0	0	12	0.8
25-Oct	13.83	0	5	1	0	0	0	0	0	0	0	0	0	0	6	0.4
26-Oct	6.50	0	7	0	0	0	0	0	0	0	0	0	0	0	7	1.1
27-Oct	6.50	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0.2
28-Oct	7.50	0	2	0	0	0	0	0	0	0	0	1	0	0	3	0.4
Total	756.15	0	566	378	2	1	0	43	0	2	18	10	3	5	1028	1.4

[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: 1990–2004.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	TOTAL	MEAN
Start date	28-Aug	5-Sep	31-Aug	3-Sep	1-Sep	4-Sep	2-Sep	31-Aug	29-Aug	31-Aug	2-Sep	1-Sep	3-Sep	7-Sep	5-Sep		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		24-Oct
Blinds in operation	1	3	3	3	3	4	4	4	3	3	3	3	3	2	2		2.9
Trapping days	47	54	57	50	48	53	45	54	58	46	50	55	51	45	45		50.5
Station days	47	95	131	120	121	136	132	151	165	94	119	145	131	84	84		117.0
Station hours	511	693	967	889	926	1041	1030	1211	1352	664	791	1037	957	633	756.15		897.2
Northern Harrier	1	2	2	3	9	2	1	8	14	0	5	7	6	3	0	63	4.2
Sharp-shinned Hawk	124	262	589	430	502	493	778	612	987	321	495	426	635	458	566	7678	511.9
Cooper's Hawk	95	195	335	374	353	310	460	427	772	323	330	337	510	400	378	5599	373.3
Northern Goshawk	1	7	6	6	7	1	5	3	6	6	16	1	10	1	2	78	5.2
Broad-winged Hawk	0	0	0	0	0	0	0	0	1	0	0	0	1	1	1	4	0.3
Swainson's Hawk	0	0	0	0	0	0	0	0	0	0	0	1	3	0	0	4	0.3
Red-tailed Hawk	8	18	61	55	83	50	50	46	112	56	76	39	56	38	43	791	52.7
Zone-tailed Hawk	0	0	0	0	0	0	0	0	1	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	63	4.2
American Kestrel	10	13	42	14	59	28	92	32	75	44	25	56	37	43	18	588	39.2
Merlin	1	0	2	4	1	1	11	6	7	2	8	2	12	3	10	70	4.7
Prairie Falcon	1	1	3	5	3	1	3	5	13	6	3	7	5	4	3	63	4.2
Peregrine Falcon	2	1	2	1	4	2	5	7	12	8	1	10	13	7	5	80	5.3
All Species	244	502	1046	896	1025	892	1411	1150	2005	768	963	891	1295	966	1028	15082	1005.5
Captures / 100 hours	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	1653.0	110.2
Recaptures[1]	0	0	1	1	2	2	1	2	4	4	3	2	3	2	2	29	1.9
Foreign recaptures[2]	2	1	1	1	2	0	5	1	2	2	0	0	3	2	0	22	1.5
Foreign encounters[3]	0	2	2	3	6	6	7	8	13	12	6	7	10	7	5	95	6.3

[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.