

**FALL 2003 RAPTOR MIGRATION STUDIES IN THE
MANZANO MOUNTAINS OF CENTRAL NEW MEXICO**



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

January 2004

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January 2004

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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 2003 season marked the 19th consecutive count and the 14th consecutive season of trapping and banding conducted at the site by HWI. This report summarizes the 2003 count and banding results.

STUDY SITE

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

During 2003, 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 observer Carrie Hisaoka conducted two previous full-season counts at this site for HWI (see Appendix A for a complete history of observer participation). This was official observer Tim Hanks first full-season of migration counting, but he received considerable training helping out as part-time volunteer on the 2002 count. Visitors also frequently assisted with spotting migrants. 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 2003 annual statistics against means and 95% confidence intervals for previous seasons, I equate significance with a 2003 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

Compared to the last six seasons (the extent for which detailed comparisons are currently possible), 2003 featured a moderate proportion of days severely hampered by inclement weather, with only 2 days of observations entirely precluded by inclement weather (1997–2002 average of 5.5 days) and four other days where observations were reduced to less than four hours by weather (average 1.8 days; see Appendix C for daily weather summaries). The active observation periods featured a typical suite of cloud-cover conditions: 50% of days featured primarily clear to partly cloudy skies; 30% transitional skies (i.e., changed from fair skies to mostly cloudy or overcast during the day, or vice versa); and 19%

mostly cloudy to overcast skies (1997–2002 averages: 50%, 33%, and 17%). The prevalence of at least scattered thundershowers or frontal-origin rain and snow also was typical (18% vs. average of 17% of active observation days). A relatively high proportion of days featured some visibility reducing fog and especially haze (45% vs. average of 30%); however, this did not translate to significantly reduced estimates of visibility (92–93 km on average vs. average of 89–90 km).

Relative to wind speeds, conditions in 2003 exactly matched the 1997–2002 averages: 75% of the active observation days featured predominantly light winds (<12 kph), 22% moderate winds (12–28 kph), and 3% stronger winds. In terms of wind directions, however, conditions in 2003 were more variable than usual, with easterly (28% of the active observation days featured some easterly winds compared to an average of 17%), variable southwest to northwest (19% vs. average of 7%), and south to southwest (41% vs. average of 10%) winds all more common than usual, whereas southwest to westerly winds (typically the most common wind pattern) were much less common than usual (7% vs. average of 45%).

The temperature during active observation periods averaged 15.9°C (the average of daily values, which in turn were averages of hourly readings), ranging from 2.8–21.9°C. This is the second warmest average recorded during the last seven seasons, but the minimum and maximum are both moderate. We began recording hourly barometric pressure readings on site in 2001; in 2003, the overall average (30.21 in Hg; an average of daily averages, which in turn are averages of hourly readings) and minimum (29.81) and maximum (30.49) daily averages were all the highest yet recorded.

Forty-six percent of the active observation days received a median (of hourly ratings) thermal-lift rating of poor to fair and 54% good to excellent, which is skewed toward better-than-average thermal conditions (1997–2002 averages 56% poor/fair and 44% good/excellent).

In summary, compared to the previous six seasons, 2003 featured an average array of cloud cover conditions and inclement weather, except that visibility reducing fog and especially haze were more common than usual. Active observation periods averaged warmer than usual, with higher average barometric pressure readings than during the past three years. The array of wind speeds was typical, but wind directions were more variable than usual. Warmer temperatures, higher average barometric pressure, and more variable wind directions contributed to better than average thermal-lift conditions, or at least increased evidence of birds' relying on thermals for energy-saving lift.

OBSERVATION EFFORT

The observers worked on 69 of 71 possible days between 27 August and 5 November. The number of observation days and hours (577.25) were both significantly higher (7% and 15%, respectively) than the 1985–2002 averages of $64 \pm 95\%$ CI of 2.4 days and 502.11 ± 29.822 hours. The 2003 average of 2.2 observers per hour (including official and guest observers; value is mean of daily values, which are in turn means of hourly values) matched the 1985–2002 average of $2.2 \pm 95\%$ CI of 0.19 observers/hr.

FLIGHT SUMMARY

The observers counted 6,502 migrant raptors of 16 species during the 2003 season, including new record-high counts for Ospreys and Broad-winged Hawks (see Appendix D for daily count records and Appendix E for annual summaries). The flight was composed of 59% accipiters, 16% buteos, 13% falcons, 7% vultures, 2% eagles, and $\leq 1\%$ each of harriers, Ospreys, and unidentified raptors. This composition includes significantly higher than average proportions of accipiters and Ospreys and a significantly lower than average proportion of harriers (Figure 2). As usual, Sharp-shinned and Cooper's Hawks were the two most abundant species, followed by Red-tailed Hawks, American Kestrels, Turkey Vultures, Golden Eagles, and Peregrine Falcons (Table 1, Appendix E).

Adjusted passage rates were significantly above average in 2003 for eight species (Osprey, Sharp-shinned Hawk, Cooper's Hawk, Broad-winged Hawk, Red-tailed Hawk, Bald eagle, American Kestrel, and Peregrine Falcon), but were significantly below average for Northern Harriers, Northern Goshawks, and Ferruginous and Rough-legged Hawks (Table 1, Figures 3–7). Regression analyses showed a significant ($P \leq 0.05$) quadratic trend for Turkey Vultures (strong increase through 1998, followed by a sharp three-year decline, then a slight recovery the past two years; Figure 3); a highly significant ($P \leq 0.01$) linear increase for Ospreys (Figure 3); a marginally significant ($P \leq 0.010$) quadratic trend for Northern Harriers (increase through 1998, followed by decline; Figure 3); a highly significant linear increase for Cooper's Hawks (Figure 4); marginally significant or significant linear increases for Broad-winged, Swainson's, and Red-tailed Hawks (Figure 5); a highly significant linear decrease for Ferruginous Hawks (Figure 5); a significant quadratic trend for Merlins (increase through 1998, followed by decline; Figure 7); a highly significant linear increase for Prairie Falcons (Figure 7); a highly significant quadratic trend for Peregrine Falcons (accelerating increase; Figure 7); and no significant trends for other species.

Most species showed distinct downturns for at least 2–3 years after 1998, most likely reflecting the cumulative, negative effects of the widespread drought and wildfires that have plagued much of the West since then (Hoffman and Smith 2003). Some species have shown upswings again in the past two years (e.g., Turkey Vulture, Osprey, and Sharp-shinned and Cooper's Hawks; Figures 3 and 4), perhaps indicating a degree of recovery. Another possibility is that many individuals from northern latitudes that have thus far survived the drought and would normally use the Intermountain Flyway as their primary migratory corridor have begun to alter their migratory routes to avoid the most heavily drought-stricken regions of the normally more xeric Great Basin. This possibility is suggested by two years of dismally low counts at HWI's Goshute Mountains site in the heart of the Intermountain Flyway (Nevada) at the same time that counts in California (Pacific Coast Flyway) rose sharply (e.g., see Behr 2003) and HWI's Rocky Mountain counts began to rise again. Especially the Pacific Coast Flyway to the west, but also the Rocky Mountain Flyway to the east, offer more continuous stretches of relatively mesic habitat for migratory birds to exploit than the central Intermountain Flyway.

Immature : adult ratios were below average for 7 of 10 species with data suited to comparisons, but significantly so only for Ferruginous Hawks and Bald Eagles (Table 2). The Broad-winged Hawk was the only species that showed a significantly above-average age ratio; however, for Red-tailed Hawks, Golden Eagles, and Peregrine Falcons, the abundance of immature birds was actually above average, with the low immature : adult ratio due to a proportionately greater increase in the abundance of adult birds. Thus, with the Ferruginous Hawk a likely exception, age-ratio statistics suggest that productivity was probably at least average in 2003 for most species using the southern Rocky Mountain Flyway.

Species-level data suggested a slightly greater tendency for earlier as opposed to late passage timing in 2003, with nine species showing earlier than average median passage dates (6 significant differences) and seven species showing later than average median dates (3 significant differences; Table 3). This tendency was reflected in an earlier than average peak in the combined-species seasonal activity pattern (Figure 8). There was also some consistency within some of the major species groups, with the two smallest accipiters and two smallest falcons all showing significantly earlier than average timing, and both Golden and Bald Eagles showing at least slightly earlier than average timing. However, age-specific timing data revealed several additional clarifying details (Table 4). Species-level data indicated slightly later than average timing for Northern Harriers; however, age-specific data indicated that this was misleading, because immature birds were a significant 3 days earlier than average, whereas adult harriers were a highly significant 15 days later than average. For Sharp-shinned, Cooper's, and Red-tailed Hawks, the species-level data indicated significantly early passage for all three species, whereas age-specific data indicated no significant differences. In contrast, for Golden Eagles, the species-level data indicated only slightly early timing, whereas age-specific data indicating significantly early timing

for adults but slightly late timing for immatures/subadults. Lastly, for Peregrine Falcons, the species-level data indicated slightly early timing, whereas age-specific data indicated that pattern only for adults, with immature birds significantly later than average. Thus, with a few prominent exceptions, overall the 2003 data suggest that timing patterns were fairly typical for the site.

RESIDENT RAPTORS

This season, local birds included at least one family of Red-tailed Hawks; adults were seen throughout the season, with one immature bird seen regularly through the third week of September. A pair of adult Golden Eagles and one subadult bird were seen intermittently throughout the season. At least 10 resident Turkey Vultures were seen regularly until the third week of September. At least one immature Cooper's Hawk was seen on several occasions early in September. An apparently local adult Sharp-shinned Hawk was seen once in late October. Three Swainson's Hawks were seen heading north through the area in early September. At least one adult and one immature Peregrine Falcons were seen regularly in early September. At least two Prairie Falcons were seen regularly through the third week of late October.

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

TRAPPING EFFORT

The crews operated at least one banding station on 45 of 48 possible days between 7 September and 24 October 2003, with effort totaling 84 station days and 632.5 station hours (see Appendix F for 2003 daily trapping records and Appendix G for annual summaries). These effort values are ~30% below the long-term average for the site because we reduced the number of banders to accommodate a limited budget (Appendix G).

TRAPPING AND BANDING SUMMARY

The 2003 capture total of 966 birds included 11 species, 962 newly banded birds, 2 recaptures of birds previously banded in the Manzanos, and 2 recaptures of birds previously banded at HWI's Sandia Mountains, NM spring migration site (Table 5, Appendix G). The 2003 effort raises the total number of birds captured since project inception to 14,054, including 27 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 47% and 41% of the total captures, respectively, followed by American Kestrels and Red-tailed Hawks (4% each). Each of the remaining species accounted for less than 1% of the total.

Capture totals and successes were mostly below average in 2003 due to the reduced crew size and operation of only two trapping stations, with both metrics significantly below average for Northern Goshawks and Red-tailed Hawks and capture success significantly below average for Sharp-shinned and Cooper's Hawks and Peregrine Falcons (Table 5). The capture total for Golden Eagles was significantly above average, however, and a Broad-winged Hawk was only the third individual of this species ever caught at the site (Table 5). In addition, capture rates were significantly below average only for Northern Goshawks, whereas capture rates were significantly above average for seven species.

Compared to the counts, banding yields unique and substantial sex-age specific data only for Sharp-shinned Hawks, Cooper's Hawks, and American Kestrels. The 2003 and long-term average immature : adult capture ratios for Sharp-shinned and Cooper's Hawk (Table 6) showed the same patterns as the age ratios derived from the count data; i.e., in all cases close matches to the long-term averages (Table 2). The female : male capture ratio for Sharp-shinned Hawks was significantly below average. Both immature and especially adult females were captured less often than usual, whereas capture totals for both age classes of males were nearly identical to the long-term averages (Table 6). The 2003 sex ratio

for captured Cooper's Hawks did not differ significantly from the long-term average, with all sex-age classes slightly more abundant than usual.

For American Kestrels, both the immature : adult and female : male ratios were significantly above average in 2003 (Table 6). Males of both age classes were captured less often than usual, whereas the capture total for immature females was 60% above average (Table 6). The count data yielded a sex ratio that was only 10% above average, whereas the capture data indicated a sex ratio that was 50% above average. In both cases, high female abundance contributed to the high sex ratios; however, the count data also indicated a slightly above average total for males, whereas male capture totals were below average. This suggests that juvenile recruitment was probably decent in 2003 for kestrels and that immature females were more readily captured in 2003 than usual, whereas males of all ages were less susceptible to capture than usual.

SATELLITE TELEMETRY

We succeeded in deploying satellite transmitters on two new Golden Eagles during the 2003 Manzanos season. One was a hatch-year male and the other a full adult female. The latter is of great significance because captures of full adult Golden Eagles are a rarity at any HWI migration site! We had hoped to also deploy two transmitters on adult Northern Goshawks and another on an adult Red-tailed Hawk, but unfortunately no birds of sufficient size and good health were captured.

At the time of this writing, two of the four telemetered 2002 Manzano Red-tailed Hawks were still alive and transmitting, both having returned the same basic areas of Mexico (Zacatecas and Mexico state) as during winter 2002–2003. Another bird that spent the summer in southwest Colorado appears to have died in late September 2003, but we have yet to mount a recovery effort to retrieve this transmitter. The fourth bird had returned to its same wintering ground in Nayarit, Mexico as of early November 2003 and appeared to be doing fine, but the signals from this bird have since ceased entirely, perhaps due to an early battery failure.

Three of the four 2002 Manzano eagles were still alive and transmitting as of mid-January 2004, all wintering in southeastern New Mexico or western Texas in similar areas as during winter 2002–2003. The fourth bird spent the summer wandering along the eastern Rocky Mountains in Montana and southern Alberta and appeared to be doing fine as of late August, but then the signals from this bird ceased abruptly in early September for unknown reasons. Our two new 2003 eagles have been a real surprise so far, with both wintering in Mexico, one in central Sonora and the other in Jalisco! The latter location is beyond the primary range for the species as indicated in the recently compiled Birds of North America account (Kochert et al. 2002); however, scattered local breeders have been recorded nearby (Wheeler 2003).

Complete tracking summaries and maps for all of HWI's telemetry birds can be found on our web site at www.hawkwatch.org. Summaries for the new 2003 birds will be posted by early February 2004.

IDENTIFYING MIGRANT ORIGINS THROUGH STABLE ISOTOPE ANALYSES

During the 2003 season, HWI continued to collect feather samples to contribute to two Boise State University graduate student studies designed to use analyses of stable-isotope ratios to identify the origins of migrant Red-tailed Hawks and Northern Goshawks in western North America. This technique has already yielded valuable insight concerning the origins and migration ecology (relative passage timing of different subpopulations) of migrants sampled at HWI migration project sites in Florida (Meehan et al. 2001, Lott et al. 2003) and New Mexico (Smith et al. 2003, DeLong 2003). Compared to complimentary satellite-telemetry studies, the stable-isotope technique can be applied to any size bird.

In 2003, HWI received a new grant from the National Fish and Wildlife Foundation that is enabling us to greatly expand our involvement in application of this technique to western migratory raptors. This grant supported sampling and analysis of feathers from migrant Sharp-shinned Hawks, Cooper's Hawks, and American Kestrels captured at nine migration-trapping sites in western North America from Alaska to Mexico, including the Manzanos. The results of this investigation will be known by late summer 2004.

ENCOUNTERS WITH PREVIOUSLY BANDED BIRDS

Recaptures—The 2003 captures included four recaptures of previously banded Cooper's Hawks: two originally banded in the Manzanos as hatch-year or second-year birds in 2001 and 2002, and two originally banded by HWI as after-second-year adults in the Sandia Mountains, NM in 1999 and 2001 (Table 7). For reference purposes, I also include in Table 7 an accounting of all recaptures that occurred during the 2002 season. The 2003 recaptures raise the total number of Manzano–Sandia exchanges since 1990 to 42 birds, and the total number of Manzano recaptures since 1990 to 27 birds (Appendix G).

Foreign Encounters—Seven raptors originally banded in the Manzanos were encountered elsewhere in 2003 (Table 8), which brings the total foreign encounters since 1990 to 90 birds (Appendix G). For reference purposes, I also include in Table 8 an accounting of all foreign encounters during 2002. The 2003 encounters included three Sharp-shinned Hawks banded as second-year or older birds between 1997 and 2001 that were found dead (cause of death unknown) between May and December 2003 in northern and southwestern Colorado and near Santa Fe, New Mexico. One Cooper's Hawk banded as a hatch-year bird in 1999 was later recaptured at HWI's Sandia Mountains migration site during spring 2003, and another banded as a hatch-year bird in 2002 was found dead (cause unknown) during July 2003 in southwestern Colorado. One American Kestrel banded as an after-hatch-year adult in 2001 was found dead (cause unknown) during April 2003 near Idaho Falls, Idaho. One Red-tailed Hawk banded as a hatch-year bird in 2001 was found dead (cause unknown) during February 2003 in central New Mexico.

These new encounters all fall within the expected range of Rocky Mountain migrants (Hoffman et al. 2002). Of particular significance is the fact that the American Kestrel encounter is only the fourth ever recorded for migrants of this species banded in the Manzanos, and only the second recorded to date for this species north of the Manzanos. The April recovery date is too early to ensure that the location represents a breeding site, but at least it provides some additional insight about the potential summer range of New Mexico migrants. The Red-tailed Hawk recovery also is of particular significance because, according to the Bird Banding Laboratory, this bird was purposefully killed in conjunction with some manner of wildlife control operation! This is the first time in HWI's 25-year history of recording band returns (now numbering more than 700) that we have received such a tragic report.

SITE VISITATION

In 2003, 333 individuals from eight states (NM, TX, AZ, CO, CA, IL, NY, GA) signed the Manzano visitor logs (including repeat visitors). Organized community groups visiting the site included those from Outdoor Adventures for Singles in Albuquerque (two groups), Albuquerque Academy, Cottonwood Valley Charter School of Socorro, NM, and a scout troop from Albuquerque.

Visitation in 2003 was about 30% less than last year because up until shortly before the season began the plan was for the Capilla Peak campground to be closed for remodeling, which would have precluded all visitation to the site. In the end, the remodeling did not occur, so the camp was fully open for the season.

Because of the late date of this decision, however, advertising for visitor opportunities in advance of the season (e.g., encouraging plans for groups visits) was essentially nonexistent; in fact planning for such was actively discouraged until just weeks before the season began. Moreover, because of the expectation of minimal visitation, HWI did not recruit an on-site educator for the season. Nevertheless, despite the

lack of a dedicated educator, the rest of the crew, with the usual stellar assistance of HWI's many, dedicated local volunteers, still achieved a robust educational program for our guests.

In 2003, 603 hourly assessments of visitor disturbance resulted in the following ratings: 66% none, 25% low, 7% moderate, and 3% high. This is a bit higher level of observer disturbance than usual, reflecting the lack of a dedicated educator to facilitate visitor interactions.

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; and HWI members. HWI and the field crew also thank Wild Oats (Menaul, Carlisle, and San Mateo stores in Albuquerque) and Whole Foods of Albuquerque for their generous contributions of food to support the field crew during the season, and Kathryn Gross for her generous donation in support of a volunteer-appreciation party that culminated 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, Chris and John Acklen, Ryan Beaulieu, Seamus Breslin, Larry Caldwell, Steve and Nancy Cox, Geoff Evans, Jessie Jewell, Claire Lamos, Walt and Jennifer Lehman, Tim Meehan, Bill and Tracey Ostheimer, Robert Pasztor, Steve de la Peña, Andrew Rominger, Prairie Bob Schwaller, Ruthie Smith, and Geri Velasquez.

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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: 1985–2002 versus 2003.

SPECIES	COUNTS			RAPTORS / 100 HRS ¹		
	1985–2002 ²	2003	% CHANGE	1985–2002 ²	2003	% CHANGE
Turkey Vulture	396 ± 122.1	468	+18	121.7 ± 35.68	132.7	+9
Osprey	27 ± 5.8	86	+220	7.7 ± 1.52	22.9	+197
Northern Harrier	61 ± 12.4	50	-18	12.4 ± 2.27	8.2	-34
Sharp-shinned Hawk	1465 ± 213.7	1861	+27	363.4 ± 49.11	415.6	+14
Cooper's Hawk	968 ± 155.1	1758	+82	276.5 ± 34.76	484.2	+75
Northern Goshawk	16 ± 4.5	12	-26	3.7 ± 1.20	2.4	-35
Unknown small accipiter ³	137 ± 100.0	205	+50	–		
Unknown large accipiter ³	2 ± 2.9	5	+233	–		
Unidentified accipiter	99 ± 28.4	5	-95	–		
TOTAL ACCIPITERS	2563 ± 348.9	3846	+50	–		
Broad-winged Hawk	6 ± 1.7	16	+172	2.1 ± 0.55	6.0	+180
Swainson's Hawk	623 ± 782.0	53	-91	229.9 ± 288.87	15.9	-93
Red-tailed Hawk	634 ± 82.9	924	+46	139.7 ± 16.00	183.1	+31
Ferruginous Hawk	14 ± 2.5	7	-48	2.9 ± 0.56	1.3	-54
Rough-legged Hawk	0 ± 0.2	0	-100	0.1 ± 0.05	0.0	-100
Zone-tailed Hawk	1 ± 0.4	0	-100	–		
Unidentified buteo	21 ± 10.8	30	+45	–		
TOTAL BUTEOS	1298 ± 789.1	1030	-21	–		
Golden Eagle	121 ± 14.6	146	+21	26.4 ± 3.38	28.1	+7
Bald Eagle	3 ± 1.1	8	+136	1.2 ± 0.41	2.5	+112
Unidentified Eagle	1 ± 0.6	1	+100	–		
TOTAL EAGLES	125 ± 14.5	155	+24	–		
American Kestrel	569 ± 70.1	686	+21	158.7 ± 19.63	182.0	+15
Merlin	24 ± 6.7	22	-8	6.0 ± 1.57	4.8	-19
Prairie Falcon	21 ± 5.7	20	-6	4.6 ± 1.14	4.0	-13
Peregrine Falcon	43 ± 16.5	112	+163	10.3 ± 3.90	25.9	+152
Unknown small falcon ³	2 ± 3.9	2	0	–		
Unknown large falcon ³	8 ± 14.7	3	-60	–		
Unidentified falcon	2 ± 1.4	1	-56	–		
TOTAL FALCONS	660 ± 80.6	846	+28	–		
Unidentified raptor	50 ± 20.4	21	-58	–		
GRAND TOTAL	5180 ± 1026.5	6502	+26	–		

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: 1992–2002 versus 2003.

	TOTAL AND AGE-CLASSIFIED COUNTS						IMMATURE : ADULT			
	1992–2002 AVERAGE			2003			% UNKNOWN AGE		RATIO	
	TOTAL	IMM.	ADULT	TOTAL	IMM.	ADULT	1992–2002 ¹	2003	1992–2002 ¹	2003
Northern Harrier	66	35	16	50	30	14	24 ± 6.4	12	2.4 ± 0.58	2.1
Sharp-shinned Hawk	1615	644	745	1861	605	692	14 ± 3.4	30	0.9 ± 0.15	0.9
Cooper's Hawk	1112	410	524	1758	541	657	17 ± 4.1	32	0.8 ± 0.14	0.8
Northern Goshawk	16	7	7	12	5	6	11 ± 6.4	8	1.1 ± 0.35	0.8
Broad-winged Hawk	7	0	3	16	3	11	44 ± 21.4	13	0.1 ± 0.09	0.3
Red-tailed Hawk	720	241	393	924	285	491	12 ± 2.3	16	0.6 ± 0.15	0.6
Ferruginous Hawk	12	4	3	7	1	2	44 ± 12.2	57	1.8 ± 1.09	0.5
Golden Eagle	121	68	34	146	86	40	15 ± 5.1	14	2.4 ± 0.63	2.2
Bald Eagle	4	3	1	8	2	6	15 ± 20.9	0	2.6 ± 1.62	0.3
Peregrine Falcon	62	18	26	112	34	54	288 ± 14.1	21	0.9 ± 0.55	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 2003, with comparisons of 2003 and 1985–2002 average median passage dates.

SPECIES	2003				1985–2002
	FIRST OBSERVED	LAST OBSERVED	BULK PASSAGE DATES ¹	MEDIAN PASSAGE DATE ²	MEDIAN PASSAGE DATE ^{2,3}
Turkey Vulture	27-Aug	22-Oct	6-Sep – 28-Sep	18-Sep	14-Sep ± 2.9
Osprey	27-Aug	26-Oct	13-Sep – 28-Sep	16-Sep	17-Sep ± 1.7
Northern Harrier	28-Aug	5-Nov	9-Sep – 3-Nov	3-Oct	1-Oct ± 2.1
Sharp-shinned Hawk	27-Aug	5-Nov	14-Sep – 17-Oct	25-Sep	28-Sep ± 1.3
Cooper's Hawk	28-Aug	5-Nov	14-Sep – 9-Oct	23-Sep	25-Sep ± 1.4
Northern Goshawk	22-Sep	30-Oct	22-Sep – 29-Oct	6-Oct	3-Oct ± 4.9
Broad-winged Hawk	21-Sep	5-Oct	21-Sep – 30-Sep	25-Sep	24-Sep ± 3.6
Swainson's Hawk	28-Aug	9-Oct	15-Sep – 9-Oct	22-Sep	20-Sep ± 3.9
Red-tailed Hawk	28-Aug	5-Nov	14-Sep – 22-Oct	27-Sep	3-Oct ± 2.6
Ferruginous Hawk	19-Sep	20-Oct	19-Sep – 20-Oct	10-Oct	2-Oct ± 4.9
Golden Eagle	5-Sep	5-Nov	27-Sep – 29-Oct	12-Oct	13-Oct ± 1.8
Bald Eagle	25-Sep	1-Nov	25-Sep – 1-Nov	8-Oct	23-Oct ± 2.7
American Kestrel	27-Aug	26-Oct	8-Sep – 30-Sep	18-Sep	21-Sep ± 1.8
Merlin	14-Sep	3-Nov	18-Sep – 31-Oct	28-Sep	7-Oct ± 3.6
Prairie Falcon	8-Sep	1-Nov	12-Sep – 29-Oct	4-Oct	22-Sep ± 3.6
Peregrine Falcon	4-Sep	29-Oct	14-Sep – 9-Oct	23-Sep	23-Sep ± 2.0
All species	27-Aug	5-Nov	14-Sep – 15-Oct	23-Sep	26-Sep ± 1.0

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: 1992–2002 versus 2003.

SPECIES	ADULT		IMMATURE / SUBADULT	
	1992–2002 ¹	2003	1992–2002 ¹	2003
Northern Harrier	6-Oct ± 3.3	21-Oct	1-Oct ± 2.5	28-Sep
Sharp-shinned Hawk	5-Oct ± 1.8	5-Oct	19-Sep ± 1.4	19-Sep
Cooper's Hawk	28-Sep ± 2.6	27-Sep	22-Sep ± 2.0	23-Sep
Northern Goshawk	4-Oct ± 4.4	9-Oct	2-Oct ± 7.4	8-Oct
Broad-winged Hawk	24-Sep ± 7.8	26-Sep	–	–
Red-tailed Hawk	7-Oct ± 2.7	8-Oct	25-Sep ± 1.8	24-Sep
Golden Eagle	15-Oct ± 2.3	13-Oct	13-Oct ± 1.2	14-Oct
Bald Eagle	–	10-Oct	16-Oct ± 6.9	–
Peregrine Falcon	25-Sep ± 2.5	23-Sep	16-Sep ± 3.3	26-Sep

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

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: 1991–2002 versus 2003.

SPECIES	CAPTURE TOTAL		CAPTURE RATE ¹		CAPTURE SUCCESS (%) ²	
	1991–2002 ³	2003	1991–2002 ³	2003	1991–2002 ³	2003
Northern Harrier	5 ± 2.3	3	0.5 ± 0.19	0.5	8 ± 3.6	6
Sharp-shinned Hawk	544 ± 111.7	458	55.5 ± 6.86	72.4	33 ± 2.9	23
Cooper's Hawk	394 ± 81.2	400	40.5 ± 5.19	63.2	34 ± 3.6	21
Northern Goshawk	6 ± 2.3	1	0.7 ± 0.30	0.2	36 ± 12.1	8
Broad-winged Hawk	0.2 ± 0.22	1	0.01 ± 0.020	0.2	2 ± 2.1	6
Swainson's Hawk	0.3 ± 0.50	0	0.03 ± 0.052	0.0	0 ± 0.3	0
Red-tailed Hawk	58.5 ± 13.35	38	6.12 ± 1.289	6.0	8 ± 1.5	4
Zone-tailed Hawk	0.1 ± 0.16	0	0.01 ± 0.012	0.0	6 ± 12.3	0
Golden Eagle	4 ± 0.7	8	0.5 ± 0.07	1.3	3 ± 0.5	5
American Kestrel	43 ± 13.5	43	4.4 ± 1.25	6.8	7 ± 1.6	6
Merlin	5 ± 2.3	3	0.5 ± 0.24	0.5	16 ± 8.4	14
Prairie Falcon	5 ± 1.8	4	0.5 ± 0.15	0.6	16 ± 3.7	20
Peregrine Falcon	6 ± 2.5	7	0.6 ± 0.25	1.1	9 ± 2.4	6
All Species	1070 ± 213.7	966	109.7 ± 13.10	152.7	23 ± 2.3	16

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: 1990–2002 averages versus 2003.

SPECIES	YEAR	FEMALE		MALE		FEMALE : MALE	IMMATURE:ADULT
		HY	AHY	HY	AHY	RATIO ¹	RATIO ¹
Sharp-shinned Hawk	1990–2002	155	130	147	80	1.3±0.11	1.5 ± 0.25
	2003	133	98	146	81	1.0	1.6
Cooper's Hawk	1990–2002	86	106	88	91	1.1±0.11	0.9 ± 0.15
	2003	89	115	99	97	1.0	0.9
American Kestrel	1990–2002	10	1	18	7	0.6±0.12	4.3 ± 1.24
	2003	16	1	11	3	0.9	6.8

¹ Long-term values – mean ± 95% CI.

Table 7. Recaptures of previously banded raptors in the Manzano Mountains, NM: 2002–2003.

BAND #	SPECIES	SEX	BANDING SITE	BANDING DATE	BANDING AGE ¹	RECAPTURE DATE	RECAPTURE AGE ¹
0745 – 96154	Cooper's Hawk	F	Sandia Mts., NM	17-Apr-98	ASY	07-Sep-02	>7 th yr
1705 – 17597	Cooper's Hawk	F	Sandia Mts., NM	03-Apr-93	ATY	17-Sep-02	>12 th yr
1705 – 17581	Cooper's Hawk	F	Sandia Mts., NM	25-Mar-93	TY	17-Sep-02	12 th yr
1005 – 01321	Cooper's Hawk	F	Manzano Mts., NM	22-Sep-99	HY	27-Sep-02	4 th yr
1204 – 49451	Cooper's Hawk	M	Manzano Mts., NM	23-Sep-97	HY	01-Oct-02	6 ^h yr
1705 – 28493	Cooper's Hawk	F	Manzano Mts., NM	07-Oct-97	SY	07-Oct-02	7 th yr
1807 – 50595	Northern Goshawk	M	*	*	HY	22-Oct-02	HY
0804 – 15118	Cooper's Hawk	M	Manzano Mts., NM	22-Sep-02	HY	18-Sep-03	SY
1005 – 11215	Cooper's Hawk	M	Manzano Mts., NM	15-Sep-01	SY	25-Sep-03	4 ^h yr
0745 – 80786	Cooper's Hawk	F	Sandia Mts., NM	15-Apr-99	ASY	25-Sep-03	>6 th yr
0614 – 83865	Cooper's Hawk	M	Sandia Mts., NM	05-Apr-01	ASY	20-Oct-03	>4 th yr

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

* Awaiting full report from Bird Banding Laboratory.

Table 8. Foreign encounters with raptors banded in the Manzano Mountains, NM: 2002–2003.

BAND #	SPECIES	SEX	BANDING AGE ¹	BANDING DATE	ENCOUNTER DATE	ENCOUNTER AGE ¹	ENCOUNTER LOCATION	DISTANCE (KM)	STATUS	
1807	81714	RT	U	HY	21-Oct-01	17-Jan-02	SY	San Pedro River, AZ	491	found dead
1005	01524	CH	F	SY	25-Sep-00	16-Feb-02	4th yr	Rancho el Jaralillo, Durango, MEX	982	found dead
1523	71975	SS	F	SY	24-Sep-01	19-Apr-02	TY	Gypsum, CO	434	injured—to rehab
1705	24572	CH	F	AHY	25-Oct-98	21-Apr-02	>5th yr	Sandia Mts., NM	34	research recapture
1593	03065	SS	F	HY	19-Sep-01	19-May-02	SY	Littleton, CO	460	found dead
1005	01309	CH	F	HY	16-Sep-99	11-Aug-02	4th yr	Golden, CO	468	collision kill
1204	56688	CH	M	ASY	24-Sep-98	15-Sep-02	>6th yr	Edwards, CO	432	found dead
1177	06577	RT	U	HY	29-Sep-00	2002	TY	Las Cruces, NM	230	control operation kill ²
1807	81760	RT	U	HY	14-Oct-01	18-Feb-03	TY	Polvadera, NM	68	found dead
0804	04168	CH	M	HY	21-Sep-99	31-Mar-03	5th yr	Sandia Mts., NM	34	research recapture
1523	71965	AK	M	AHY	19-Sep-01	28-Apr-03	ATY	Idaho Falls, ID	1000	found dead
1593	03102	SS	F	SY	24-Sep-01	12-May-03	4th yr	Walden, CO	537	found dead
1204	51630	CH	M	HY	16-Sep-00	05-Jul-03	4th yr	Ignacio, CO	240	found dead
2003	92972	SS	F	ASY	26-Sep-97	23-Sep-03	>8th yr	Curecanti, CO	357	found dead
1523	71853	SS	F	AHY	14-Oct-99	05-Dec-03	>5 th yr	Santa Fe, NM	134	found dead

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

² This is a first for HWI foreign encounters and according to the Bird Banding Laboratory indicates that the bird was purposefully killed in conjunction with some manner of wildlife control operation!

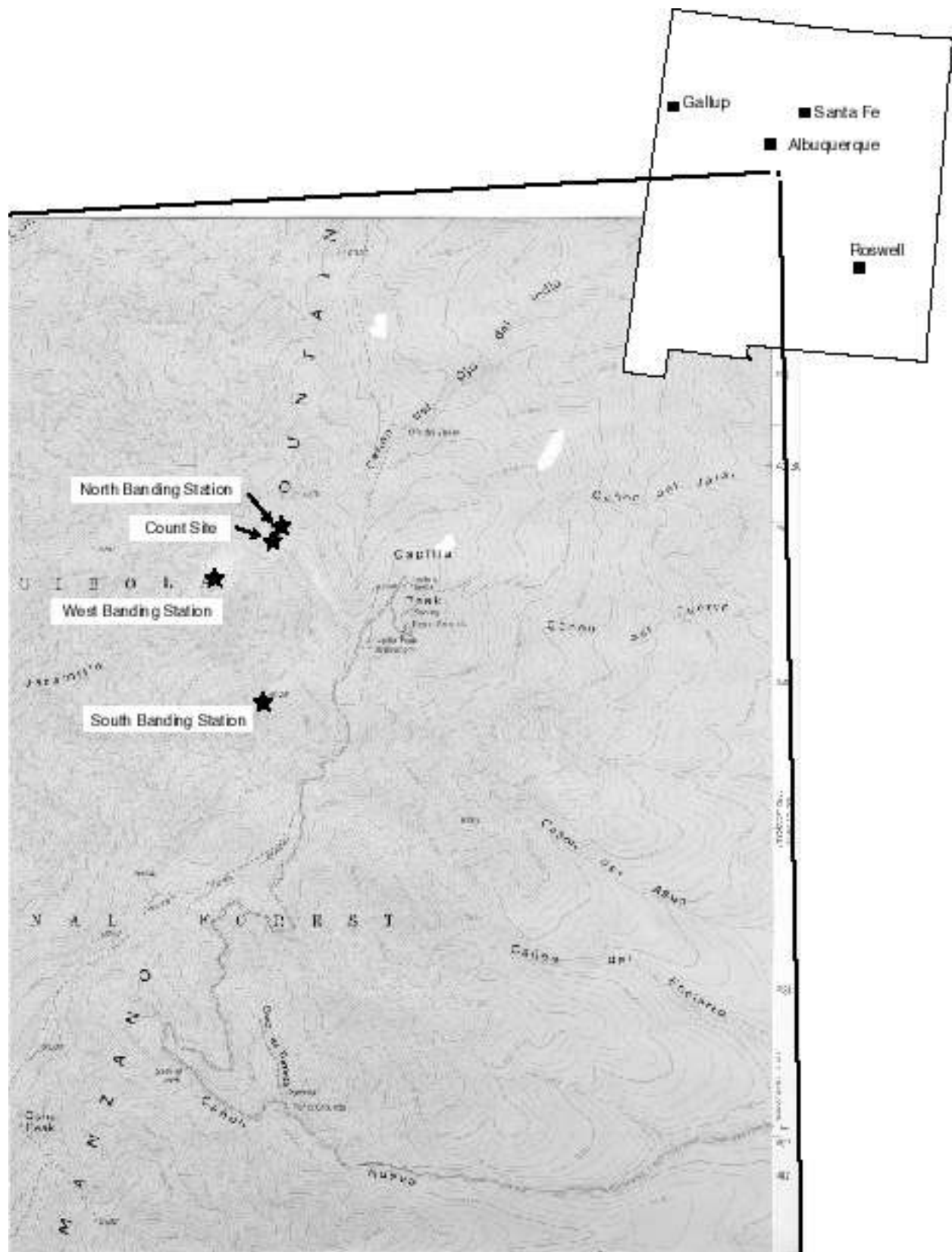


Figure 1. Map of the Manzano Mountains raptor-migration study site in central New Mexico.

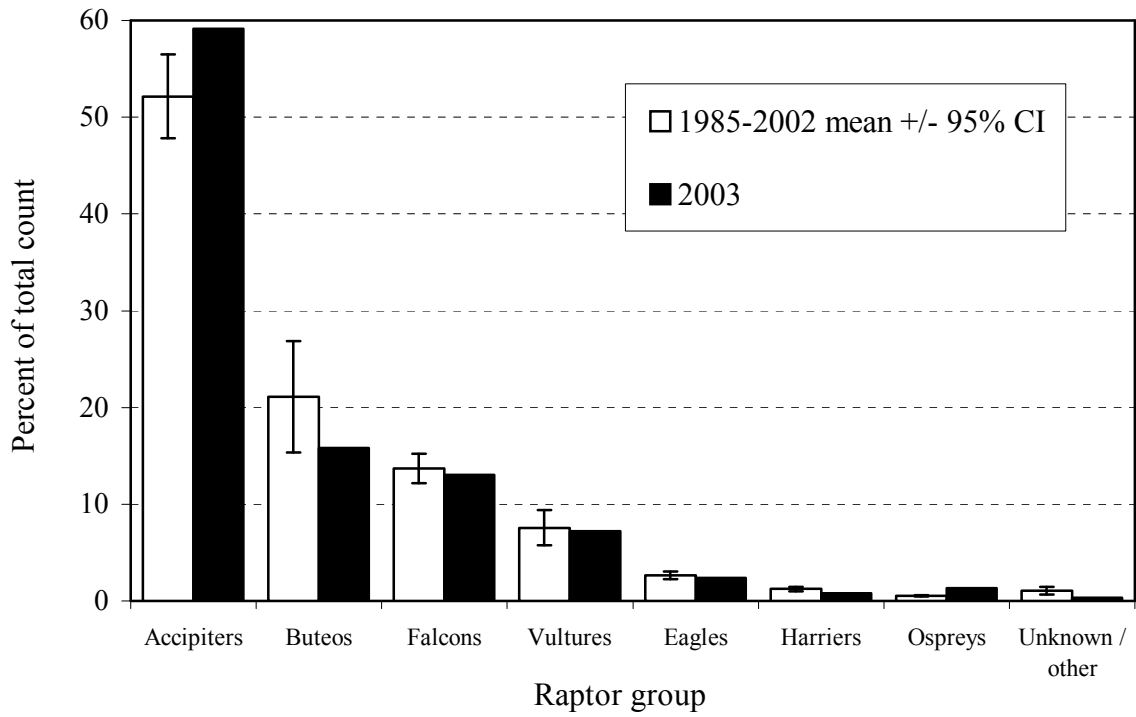


Figure 2. Fall raptor-migration flight composition by major species groups in the Manzano Mountains, NM: 1985–2002 versus 2003.

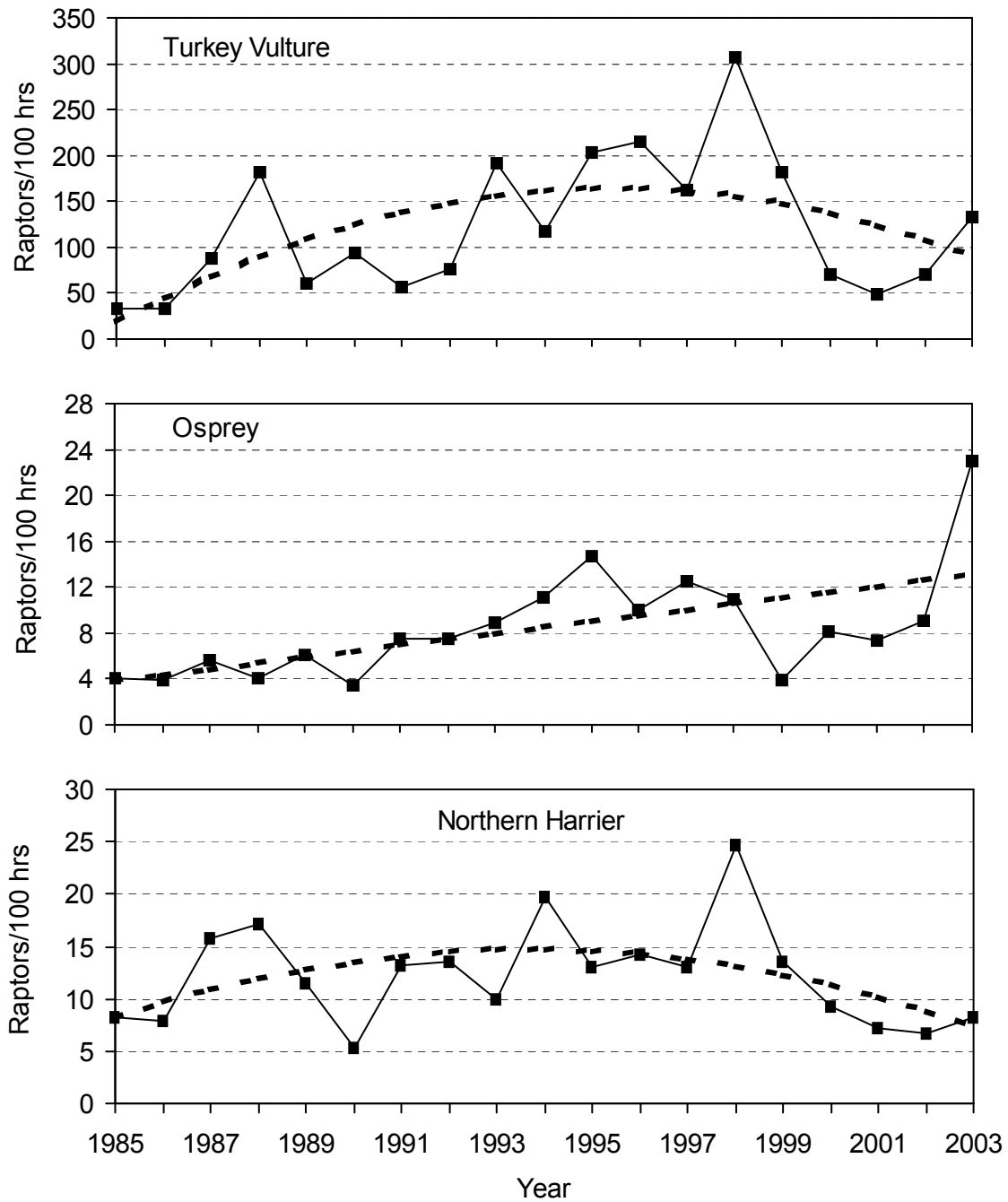


Figure 3. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) fall-migration passage rates for Turkey Vultures, Ospreys, and Northern Harriers in the Manzano Mountains, NM: 1985–2003. Dashed lines indicate significant ($P \leq 0.10$) regressions.

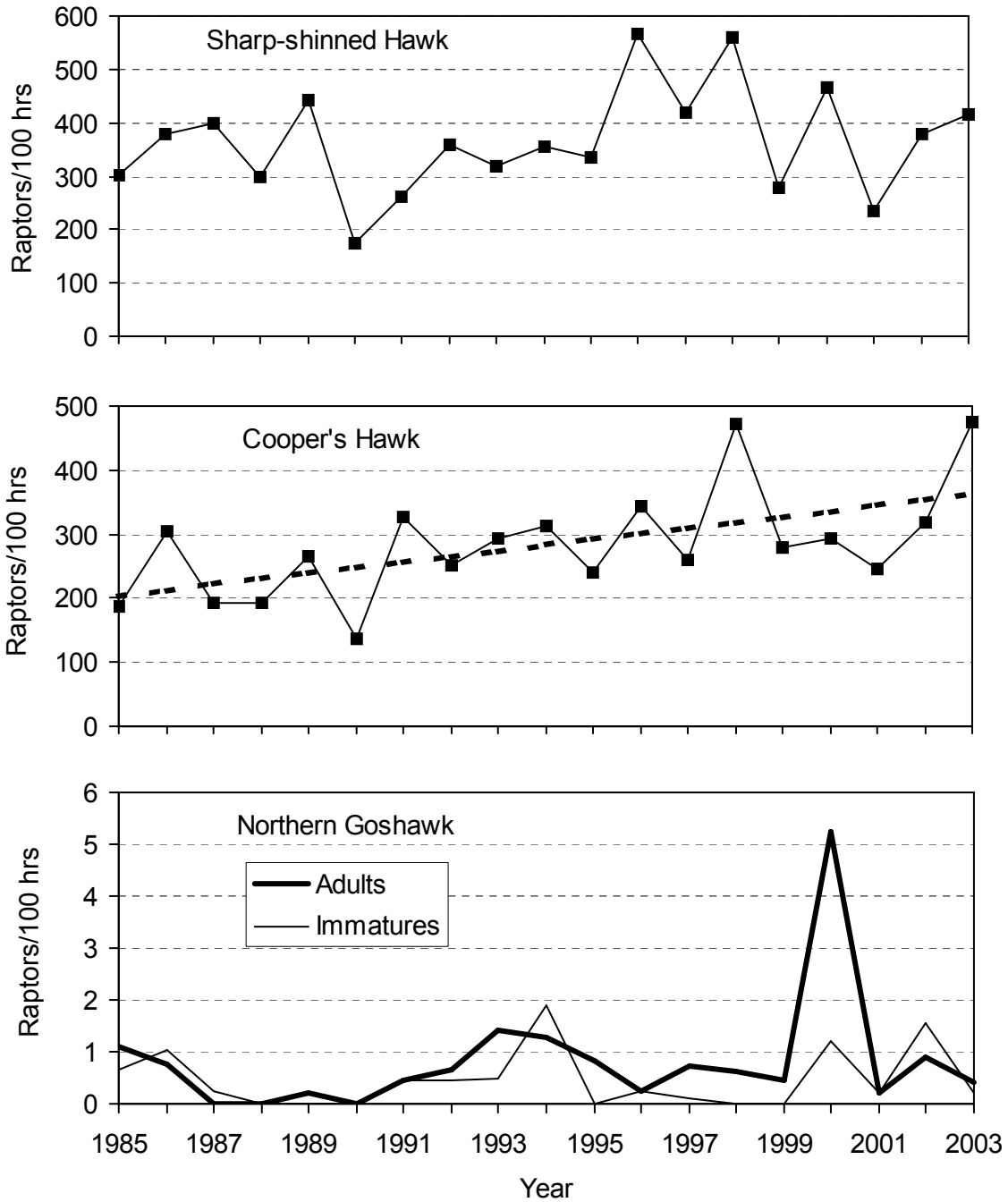


Figure 4. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) fall-migration passage rates for Sharp-shinned Hawks, Cooper's Hawks, and Northern Goshawks in the Manzano Mountains, NM: 1985–2003. Dashed lines indicate significant ($P \leq 0.10$) regressions.

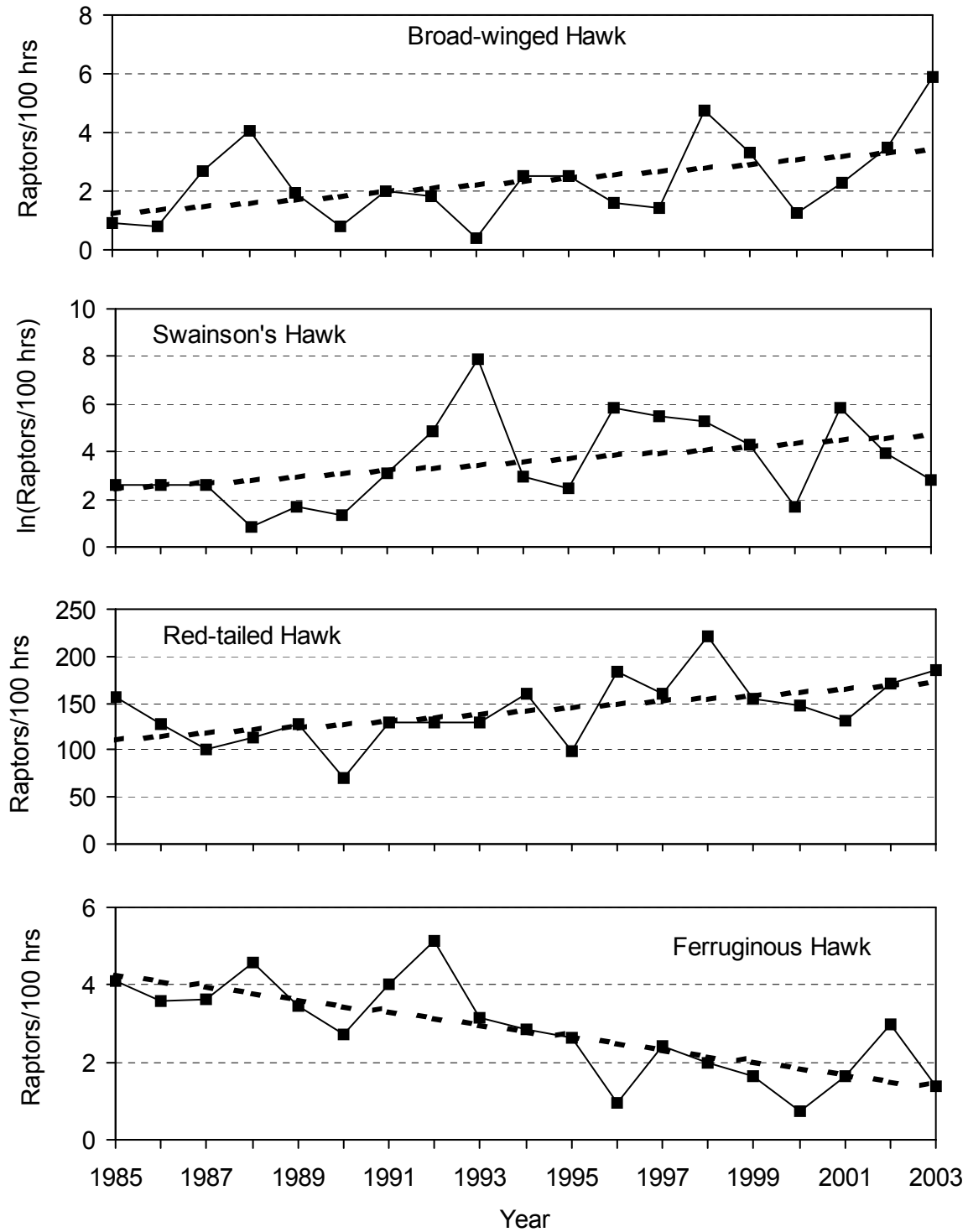


Figure 5. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) fall-migration passage rates for Broad-winged, Swainson's, Red-tailed and Ferruginous Hawks in the Manzano Mountains, NM: 1985–2003. Dashed lines indicate significant ($P \leq 0.10$) regressions.

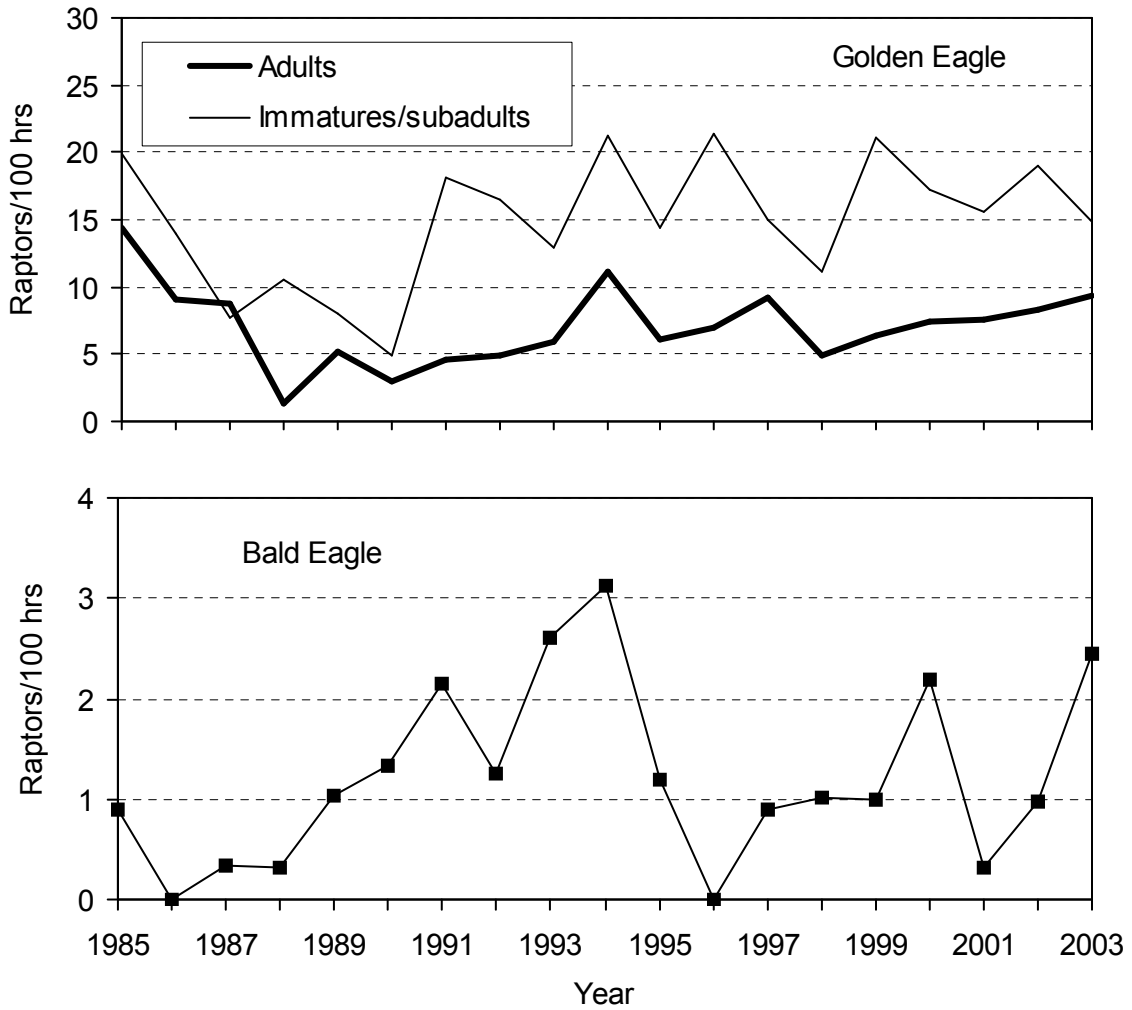


Figure 6. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) fall-migration passage rates for Golden and Bald Eagles in the Manzano Mountains, NM: 1985–2003. Dashed lines indicate significant ($P \leq 0.10$) regressions.

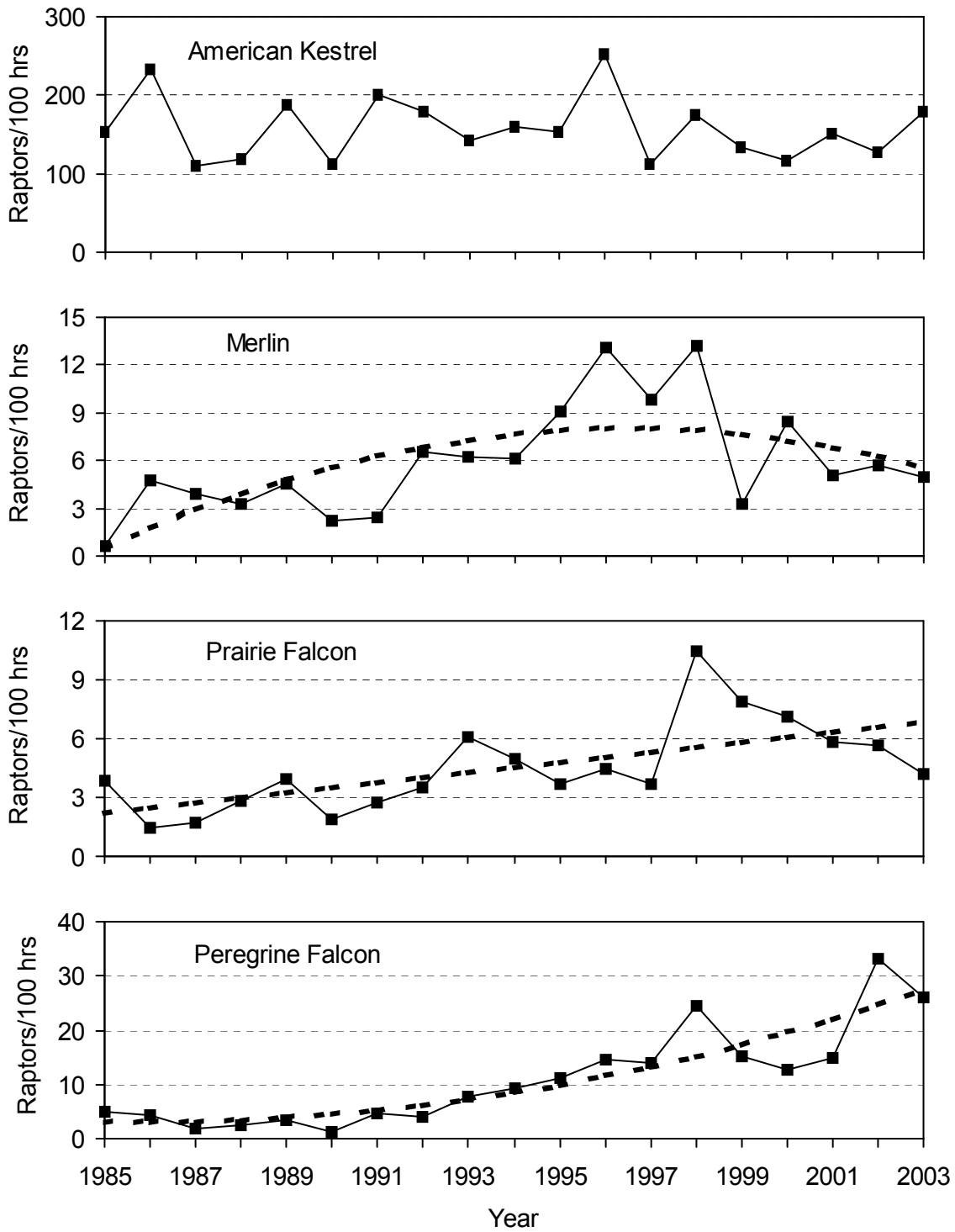


Figure 7. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) fall-migration passage rates for American Kestrels, Merlins, Prairie Falcons, and Peregrine Falcons: 1985–2003. Dashed lines indicate significant ($P \leq 0.10$) regressions.

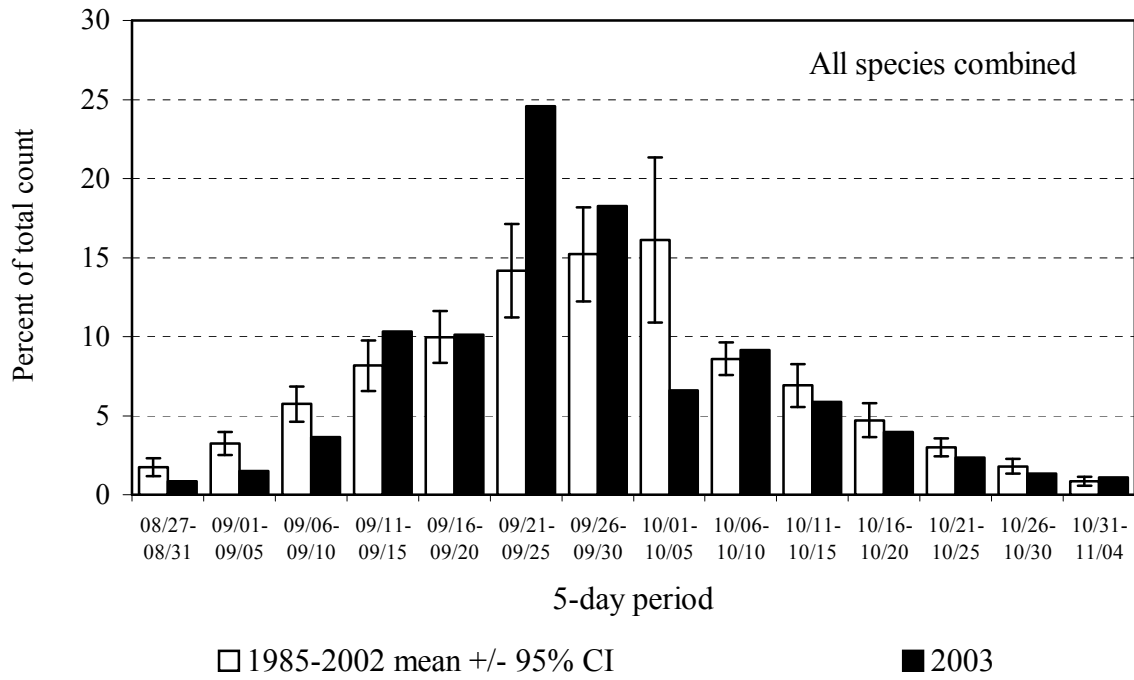


Figure 8. Combined-species, fall-migration passage volume by five-day periods for raptors in the Manzano Mountains, NM: 1985–2002 versus 2003.

Appendix A. History of official observer participation in the Manzano Mountains Raptor Migration Project: 1985–2001.

- 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)

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

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

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

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

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

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

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

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

Appendix C. Daily observation effort, visitor disturbance ratings, weather records, and flight summaries for the Manzano Mountains Raptor Migration Project: 2001.

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	1.0	0	pc-mc, scat rain	7.4	calm, s	20.8	30.27	2	97	95	2	0.9
28-Aug	7.50	1.5	0	pc-mc	5.2	ssw	21.3	30.38	1	89	88	2	2.4
29-Aug	7.00	1.1	0	ovc, AM fog, scat rain	1.8	calm/ssw-w	20.4	30.28	4	69	74	2	0.4
30-Aug	3.50	1.0	1	ovc-pc	1.2	ne	20.2	30.32	2	92	80	1	1.4
31-Aug	8.00	2.8	1	clr-pc	2.9	calm, se-sw	20.7	30.32	2	74	86	2.5	2.6
1-Sep	8.00	2.8	0	clr-pc	3.8	s-sw/var	21.5	30.35	1	88	79	1	2.0
2-Sep	7.00	1.8	0	pc-ovc, haze	1.3	calm/var	21.4	30.38	3	99	99	2	1.9
3-Sep	7.50	1.3	0	clr-pc, AM haze, PM ts	0.4	calm/sse-sw	21.9	30.38	2	89	86	3	1.9
4-Sep	8.50	1.3	0	pc-ovc, AM fog/rain, PM ts	3.0	calm, sw	19.5	30.41	3	81	85	1	3.8
5-Sep	9.00	2.0	0	mc-ovc, PM ts/rain	3.7	sw	19.2	30.35	4	100	99	2	2.6
6-Sep	7.50	2.8	1	pc-ovc, PM ts/rain	5.7	ssw-sw	19.0	30.28	4	99	83	2	4.8
7-Sep	8.25	1.9	0	clr-ovc/ts-rain	11.2	sw-wnw	14.6	30.19	3	95	93	1.5	4.8
8-Sep	9.00	2.2	0	clr-mc, AM haze, PM ts	9.6	sw	18.1	30.15	3	100	97	1.5	9.3
9-Sep	8.75	1.9	0	ovc, PM ts	12.1	s-sw	17.2	30.14	4	100	100	2	8.7
10-Sep	0.00			weather day									
11-Sep	9.25	1.8	0	clr-ovc, AM fog	7.0	sw-nw	14.3	30.21	4	63	59	2	4.2
12-Sep	9.25	3.4	0	clr	8.3	sw-wnw	14.8	30.11	3	100	100	2	8.2
13-Sep	9.50	2.6	0	clr	12.3	ene	14.4	30.17	3	100	100	2	15.1
14-Sep	9.50	1.9	1	clr, haze	2.3	calm, wnw	15.9	30.34	1	92	96	2	29.1
15-Sep	9.50	1.9	0	clr-pc	9.9	sw	18.5	30.31	2	100	100	2	14.3
16-Sep	9.00	1.9	0	clr-pc, PM ts/rain	18.1	s-sw	18.3	30.22	3	100	100	2	16.9
17-Sep	9.50	1.8	0	pc	20.3	ssw-sw	18.6	30.07	3	100	100	2	11.6
18-Sep	10.00	2.1	0	clr, haze	4.3	calm, e-se	15.2	30.23	2	86	83	3	10.4
19-Sep	9.50	2.0	1	clr, haze	8.5	se-ssw	16.3	30.23	2	97	97	2	10.5
20-Sep	10.00	2.8	1	clr-ovc, AM haze, PM ts	11.3	ssw	16.3	30.15	3	96	97	2	19.3
21-Sep	10.00	3.5	0	clr	4.1	ene, sw	17.8	30.21	1	100	100	2	43.2
22-Sep	10.00	3.0	1	clr-ovc	3.0	calm, ssw-sw	18.2	30.31	2	100	100	2	22.7
23-Sep	10.00	2.5	0	mc-ovc	10.8	ssw-sw	17.8	30.25	3	100	100	2	14.7
24-Sep	10.00	2.0	0	pc-ovc, haze	4.9	ne/var	18.2	30.22	2	98	91	2.5	50.0
25-Sep	10.00	2.8	0	ovc-pc, fog/haze	1.1	calm, sw-w	18.0	30.23	2	78	85	2	29.2
26-Sep	10.00	2.4	1	clr, haze	3.5	ssw	19.8	30.17	1	100	100	2	18.5
27-Sep	10.00	3.5	2.5	clr, haze	4.7	nne, calm/var	17.1	30.28	2	100	91	2	39.1
28-Sep	10.00	3.9	1	clr, haze	4.8	ssw-sw	19.4	30.30	1	100	98	2	32.4
29-Sep	10.00	2.2	1	clr-pc, AM/PM haze	11.8	ssw-sw	20.0	30.27	2	100	100	2	16.5
30-Sep	9.75	2.0	0	clr, AM haze	4.4	sw-wnw, calm	20.3	30.39	1	100	98	2	12.6
1-Oct	9.75	2.4	0	clr-pc, fog/haze	7.4	s-ssw	19.5	30.39	2	96	90	2	8.8
2-Oct	9.75	1.8	0	mc-ovc	14.3	sse	17.6	30.18	4	98	100	2	15.8
3-Oct	6.75	2.7	1	ovc, PM fog/ts-rain	6.9	ssw	11.2	30.11	4	77	78	2	12.6
4-Oct	2.75	2.0	1	ovc/fog-pc	9.2	ssw	13.8	30.13	3	80	74	1.5	2.2
5-Oct	9.75	3.7	2	pc	7.7	ssw-sw, calm	14.3	30.18	2	100	100	2	10.2
6-Oct	9.75	3.6	1	clr-ovc	1.8	calm/s-ssw	16.4	30.18	2	100	100	2	22.4
7-Oct	0.00			weather day									
8-Oct	2.25	3.0	0	ovc-pc, fog	0.3	calm/wsw	11.5	29.98	4	90	65	2	5.3
9-Oct	9.75	2.0	2.5	clr-mc	7.3	ne	14.3	30.14	3	100	100	2	34.5
10-Oct	2.75	2.0	0	mc-ovc, ts	10.0	ssw	16.4	29.96	3	100	100	2	10.2
11-Oct	9.25	2.8	0	clr-ovc, fog/haze	9.4	n-e	12.1	30.18	3	83	88	2	8.1
12-Oct	9.50	2.8	1.5	clr, AM haze	4.2	calm, s-sw	14.5	30.25	1	100	100	2	8.3
13-Oct	9.50	3.0	0	clr	19.3	sw-wnw	13.2	30.12	3	100	100	1	8.1

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
14-Oct	9.50	2.0	1	clr-mc, AM haze	5.8	ssw	11.9	30.26	2	100	100	2	7.6
15-Oct	9.50	2.9	0	clr	16.9	ssw-sw	13.8	30.19	3	100	100	1	8.4
16-Oct	9.25	1.9	0	clr-pc	13.9	sw-w	13.6	30.28	3	100	100	2	3.8
17-Oct	9.25	2.0	0	clr, haze	2.7	calm, sw-wnw	16.2	30.47	1	100	100	2	10.4
18-Oct	9.00	1.9	1	clr	1.4	ne-e, calm/sw	19.9	30.45	1	100	100	2	5.1
19-Oct	9.25	2.0	1	clr	2.7	calm, ssw	20.0	30.42	1	100	100	2	5.0
20-Oct	9.00	1.9	0	clr	4.2	sw-wnw	18.2	30.43	1	100	100	2	3.8
21-Oct	9.00	2.0	0	clr	2.8	calm/e, ssw-sw	19.1	30.49	1	100	100	1	4.7
22-Oct	8.50	2.0	0	pc-clr	3.1	variable	18.6	30.44	1	100	100	2	6.8
23-Oct	8.50	1.9	0	clr	3.9	wsw-wnw	17.5	30.23	1	100	100	2	2.0
24-Oct	8.75	1.7	0	pc	7.0	w-nw	15.0	30.14	2	100	100	2	2.3
25-Oct	7.50	1.9	0	ovc-mc, AM haze	18.2	ene-ese	2.8	30.15	4	100	99	2	2.0
26-Oct	6.50	2.0	1	clr	1.3	calm/ne, calm/sw	5.0	30.27	1	100	100	2	2.6
27-Oct	7.00	2.0	0	pc-ovc	14.8	sw-wnw	8.8	30.12	3	100	100	2	2.0
28-Oct	6.75	1.5	0	mc-ovc	5.2	s-sw	14.4	29.99	2	100	100	2	1.6
29-Oct	7.50	1.8	0	pc-mc, haze	21.2	ssw-sw	13.5	29.86	3	100	98	1	3.3
30-Oct	7.50	1.7	1.5	mc-ovc, blowing snow, haze	31.5	ssw	9.8	29.81	4	69	72	1	2.7
31-Oct	7.50	1.9	0	ovc, blowing snow, haze	9.3	se-ssw	12.9	30.05	4	68	68	1	2.3
1-Nov	7.50	1.0	0	mc-ovc, blowing snow, haze	13.2	se-ssw	13.7	30.07	4	53	52	1.5	2.8
2-Nov	7.50	1.3	0	clr, haze	9.8	s-ssw	15.1	30.02	2	46	46	2	1.2
3-Nov	7.00	2.0	0	ovc, AM rain	39.6	ssw	8.1	29.81	4	100	100	2	1.7
4-Nov	6.50	2.0	0	clr	16.6	sw	3.0	29.84	2	100	100	1	1.8
5-Nov	5.25	2.0	0	clr	19.4	ssw-sw	6.6	29.95	2	100	100	2	4.8

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: 2003.

DATE	HOURS	SPECIES ¹																								BIRDS				
		TV	OS	NH	SS	CH	NG	SA	LA	UA	BW	SW	RT	FH	RL	ZT	UB	GE	BE	UE	AK	ML	PR	PG	SF	LF	UF	UU	TOTAL	/HOUR
27-Aug	8.00	1	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	7	2.1
28-Aug	7.50	0	0	1	5	4	0	0	0	0	0	1	2	0	0	0	0	0	0	0	4	0	0	0	0	0	0	1	18	0.7
29-Aug	7.00	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1.0	
30-Aug	3.50	4	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	5	1.5	
31-Aug	8.00	5	1	0	3	4	0	4	0	0	0	1	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	21	3.7	
1-Sep	8.00	3	0	0	3	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	7	0	0	0	0	0	0	16	1.9	
2-Sep	7.00	4	0	0	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	13	4.1	
3-Sep	7.50	0	0	0	4	4	0	0	0	0	0	0	5	0	0	0	0	0	0	0	1	0	0	0	0	0	0	14	4.0	
4-Sep	8.50	12	0	0	7	7	0	1	0	1	0	0	1	0	0	0	0	0	0	0	1	0	0	2	0	0	0	32	6.9	
5-Sep	9.00	2	0	0	6	7	0	0	0	0	0	0	2	0	0	0	0	3	0	0	3	0	0	0	0	0	0	23	9.8	
6-Sep	7.50	19	0	0	7	4	0	1	0	0	0	0	0	0	0	1	0	0	0	3	0	0	1	0	0	0	0	36	7.3	
7-Sep	8.25	1	2	1	5	4	0	0	0	0	0	0	2	0	0	0	0	0	0	21	0	0	3	0	1	0	0	40	8.2	
8-Sep	9.00	12	0	2	15	16	0	2	0	0	0	1	10	0	0	0	0	1	0	0	22	0	1	1	0	0	1	84	5.8	
9-Sep	8.75	31	0	2	10	16	0	1	0	0	0	0	11	0	0	0	0	1	0	0	0	0	1	2	0	0	1	76	5.3	
10-Sep	0.00																													
11-Sep	9.25	4	3	1	7	6	0	0	0	0	0	0	6	0	0	0	0	0	0	10	0	0	1	0	0	0	1	39		
12-Sep	9.25	6	1	1	20	13	0	0	0	0	0	2	13	0	0	0	0	0	0	18	0	1	1	0	0	0	0	76	7.5	
13-Sep	9.50	68	9	0	30	19	0	2	0	0	0	0	8	0	0	0	2	0	0	5	0	0	0	0	0	0	0	143	8.5	
14-Sep	9.50	7	12	1	94	70	0	11	0	0	0	0	33	0	0	0	2	0	0	41	1	2	2	0	0	0	0	276	12.6	
15-Sep	9.50	18	0	1	43	26	0	0	0	0	0	2	7	0	0	0	0	0	0	35	0	1	3	0	0	0	0	136	26.7	
16-Sep	9.00	10	0	0	41	19	0	0	0	0	0	0	8	0	0	0	1	1	0	68	0	1	3	0	0	0	0	152	12.9	
17-Sep	9.50	15	1	1	35	22	0	3	0	0	0	0	6	0	0	0	0	1	0	23	0	0	2	0	0	0	1	110	14.1	
18-Sep	10.00	6	26	0	27	21	0	3	0	1	0	1	14	0	0	0	0	0	0	3	2	0	0	0	0	0	0	104	4.0	
19-Sep	9.50	0	0	0	30	14	0	1	0	0	0	2	7	2	0	0	0	1	0	39	1	0	3	0	0	0	0	100	8.4	
20-Sep	10.00	23	1	0	50	44	0	0	0	0	0	0	26	0	0	0	0	0	0	35	0	0	14	0	0	0	0	193	11.2	
21-Sep	10.00	15	4	0	100	164	0	36	0	0	2	1	40	0	0	0	0	0	0	69	0	0	1	0	0	0	0	432	17.7	
22-Sep	10.00	6	0	3	60	87	2	10	0	0	0	2	24	0	0	0	1	1	0	22	2	0	7	0	0	0	0	227	24.9	
23-Sep	10.00	10	3	2	35	39	0	2	0	0	0	2	15	0	0	0	0	1	0	32	1	0	4	0	0	0	1	147	8.7	
24-Sep	10.00	15	3	3	113	211	0	16	1	0	0	16	65	0	0	0	2	1	0	47	2	1	4	0	0	0	0	500	10.8	
25-Sep	10.00	4	3	1	84	106	0	24	0	0	3	5	39	0	0	0	4	0	1	14	0	0	4	0	0	0	0	292	9.1	
26-Sep	10.00	30	2	0	44	52	0	7	0	0	1	0	10	0	0	0	0	3	0	30	0	0	6	0	0	0	0	185	18.0	
27-Sep	10.00	56	4	0	94	120	1	26	0	0	6	3	48	1	0	0	3	1	0	14	1	0	9	1	0	0	3	391	20.8	
28-Sep	10.00	37	2	0	93	118	0	6	0	0	2	3	37	0	0	0	1	5	0	17	0	0	3	0	0	0	0	324	11.7	
29-Sep	10.00	7	0	2	53	44	0	1	0	0	0	1	25	0	0	0	0	3	1	22	0	1	5	0	0	0	0	165	14.5	
30-Sep	9.75	3	0	0	35	40	0	1	0	1	1	3	22	0	0	0	0	0	0	11	1	0	4	0	0	0	1	123	23.1	
1-Oct	9.75	1	0	0	27	33	0	1	0	0	0	0	12	0	0	0	0	2	0	6	0	0	4	0	0	0	0	86	22.4	
2-Oct	9.75	3	1	2	45	51	0	1	0	0	0	0	29	0	0	0	0	3	0	14	0	0	5	0	0	0	0	154	23.1	

Appendix D. continued

DATE	HOURS	SPECIES ¹																								BIRDS				
		TV	OS	NH	SS	CH	NG	SA	LA	UA	BW	SW	RT	FH	RL	ZT	UB	GE	BE	UE	AK	ML	PR	PG	SF	LF	UF	UU	TOTAL	/HOUR
3-Oct	6.75	0	0	0	41	32	0	6	0	0	0	0	4	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	85	18.4
4-Oct	2.75	0	0	0	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	10.4
5-Oct	9.75	18	0	1	27	31	0	1	0	0	1	0	7	0	0	0	0	1	0	0	7	2	0	1	0	0	0	2	99	19.0
6-Oct	9.75	0	0	0	91	63	2	15	1	0	0	0	16	0	0	0	5	4	0	0	9	0	3	3	0	1	1	4	218	22.3
7-Oct	0.00																													11.7
8-Oct	2.25	0	0	0	3	3	0	1	0	0	0	0	2	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	12	10.7
9-Oct	9.75	8	2	0	85	85	2	7	2	0	0	7	123	0	0	0	3	7	0	0	3	0	0	2	0	0	0	0	336	8.3
10-Oct	2.75	0	0	0	10	4	1	0	0	0	0	0	4	0	0	0	0	4	1	0	2	0	0	1	0	0	0	1	28	8.8
11-Oct	9.25	3	0	2	22	14	1	5	0	0	0	0	18	0	0	0	0	3	2	1	0	1	0	0	0	0	0	3	75	9.2
12-Oct	9.50	0	0	3	33	18	0	1	0	0	0	0	12	0	0	0	0	4	0	0	4	1	1	0	1	1	0	0	79	7.4
13-Oct	9.50	0	0	2	25	18	0	1	0	1	0	0	15	1	0	0	0	8	0	0	3	1	1	1	0	0	0	0	77	10.8
14-Oct	9.50	0	0	0	34	15	0	1	0	1	0	0	10	1	0	0	3	5	0	0	1	0	0	1	0	0	0	0	72	5.0
15-Oct	9.50	0	1	0	26	20	0	0	0	0	0	0	13	0	0	0	0	13	1	0	2	0	1	3	0	0	0	0	80	9.8
16-Oct	9.25	0	0	0	14	6	0	0	1	0	0	0	4	0	0	0	0	6	0	0	1	1	0	2	0	0	0	0	35	5.2
17-Oct	9.25	0	0	0	51	17	0	3	0	0	0	0	19	1	0	0	0	2	0	0	2	0	0	0	0	0	0	1	96	2.8
18-Oct	9.00	0	1	1	17	10	0	1	0	0	0	0	13	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0	46	4.5
19-Oct	9.25	0	0	1	25	5	0	0	0	0	0	0	11	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	46	4.7
20-Oct	9.00	0	0	4	11	4	0	0	0	0	0	0	9	1	0	0	1	4	0	0	0	0	0	0	0	0	0	0	34	5.1
21-Oct	9.00	0	0	0	12	5	0	1	0	0	0	0	20	0	0	0	0	3	0	0	1	0	0	0	0	0	0	0	42	5.9
22-Oct	8.50	1	1	1	14	8	1	0	0	0	0	0	25	0	0	0	0	5	0	0	0	0	1	1	0	0	0	0	58	5.0
23-Oct	8.50	0	0	0	5	2	0	0	0	0	0	0	3	0	0	0	0	6	0	0	0	0	1	0	0	0	0	0	17	3.4
24-Oct	8.75	0	0	2	11	1	0	0	0	0	0	0	3	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	20	2.0
25-Oct	7.50	0	1	0	0	0	0	0	0	0	0	0	8	0	0	0	0	5	1	0	0	0	0	0	0	0	0	0	15	3.9
26-Oct	6.50	0	1	1	5	0	0	0	0	0	0	0	3	0	0	0	0	6	0	0	1	0	0	0	0	0	0	0	17	
27-Oct	7.00	0	0	0	2	0	0	0	0	0	0	0	4	0	0	0	0	6	0	0	0	1	1	0	0	0	0	0	14	2.5
28-Oct	6.75	0	0	0	7	0	0	0	0	0	0	0	3	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	11	
29-Oct	7.50	0	0	1	7	2	1	0	0	0	0	0	3	0	0	0	0	8	0	0	0	1	1	1	0	0	0	0	25	2.3
30-Oct	7.50	0	0	0	4	0	1	0	0	0	0	0	11	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	20	1.4
31-Oct	7.50	0	0	0	10	0	0	0	0	0	0	0	5	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	17	1.9
1-Nov	7.50	0	0	0	5	1	0	0	0	0	0	0	11	0	0	0	0	1	1	0	0	1	1	0	0	0	0	0	21	0.6
2-Nov	7.50	0	0	2	4	0	0	0	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	9	3.4
3-Nov	7.00	0	0	2	4	0	0	0	0	0	0	0	4	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	12	0.7
4-Nov	6.50	0	0	2	6	1	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	
5-Nov	5.25	0	0	1	15	1	0	0	0	0	0	0	6	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	25	
Total	577.25	468	86	50	1861	1758	12	205	5	5	16	53	924	7	0	0	30	146	8	1	686	22	20	112	2	3	1	21	6502	9.7

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: 1985–2003.

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	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	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	2-Nov
Days of observation	50	63	65	60	63	62	67	70	68	66	70	59	68	65	70	57	68	65	69	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	506.06
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	1036.4
SPECIES	RAPTOR COUNTS																			
Turkey Vulture	74	118	283	466	178	295	176	268	601	430	636	640	563	1116	637	241	164	239	468	400
Osprey	10	14	19	13	22	12	24	26	31	38	53	33	47	44	14	25	26	32	86	30
Northern Harrier	28	36	78	78	59	27	66	69	48	97	72	64	69	133	69	38	37	33	50	61
Sharp-shinned Hawk	956	1300	1622	1118	1834	688	1080	1540	1193	1415	1519	2174	1872	2585	1212	1698	1032	1524	1861	1485
Cooper's Hawk	531	881	679	604	929	471	1105	961	944	1054	907	1205	1018	2025	1069	984	913	1149	1758	1010
Northern Goshawk	21	20	7	6	14	3	8	16	27	30	11	9	9	14	42	13	23	12	16	
Unknown small accipiter ¹	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	86	188	205	160
Unknown large accipiter ¹	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	3	5	3
Unknown accipiter	78	104	119	111	121	120	156	117	266	118	44	147	76	107	51	29	0	11	5	94
TOTAL ACCIPITERS	1586	2305	2427	1839	2898	1282	2349	2634	2430	2617	2481	3535	2975	4736	2346	2753	2044	2898	3846	2631
Broad-winged Hawk	2	2	7	10	5	2	5	5	1	7	7	4	5	14	12	3	6	9	16	6
Swainson's Hawk	27	33	44	3	16	9	58	344	7301	67	32	867	679	572	194	19	815	139	53	593
Red-tailed Hawk	513	527	457	486	604	329	577	667	566	707	519	771	803	1151	733	591	632	778	924	649
Ferruginous Hawk	14	15	17	20	16	13	19	25	17	13	13	4	13	10	8	3	10	14	7	13
Rough-legged Hawk	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	0	1	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	1
Unknown buteo	21	12	11	16	4	19	30	11	31	22	9	11	3	28	5	2	106	32	30	21
TOTAL BUTEOS	577	589	536	536	646	372	689	1054	7916	817	581	1657	1504	1778	953	621	1571	973	1030	1284
Golden Eagle	133	123	86	67	85	52	124	119	120	172	136	151	145	115	159	115	128	149	146	122
Bald Eagle	2	0	1	1	3	4	7	4	7	9	4	0	3	4	3	5	1	3	8	4
Unknown Eagle	0	0	0	4	0	4	0	0	0	0	0	0	0	0	0	1	0	0	1	1
TOTAL EAGLES	135	123	87	72	88	60	131	123	127	181	140	151	148	119	162	121	129	152	155	127
American Kestrel	421	755	426	385	677	409	728	704	520	582	584	905	455	742	525	397	560	470	686	575
Merlin	2	16	17	12	18	9	10	28	24	24	42	48	42	56	14	27	21	22	22	24
Prairie Falcon	13	7	8	12	19	9	14	17	27	22	18	19	19	58	38	30	28	24	20	21
Peregrine Falcon	14	15	7	10	15	5	21	18	31	37	49	60	67	116	64	49	63	127	112	46
Unknown small falcon ¹	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	4	2	2
Unknown large falcon ¹	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	15	3	6
Unknown falcon	4	0	1	0	3	5	3	1	0	1	0	1	0	12	2	1	5	2	1	2
TOTAL FALCONS	454	793	459	419	732	437	776	768	602	666	693	1033	583	984	643	504	677	664	846	670
Unknown raptor	31	35	40	76	56	41	120	142	140	71	8	24	15	11	11	4	20	49	21	48
TOTAL	2895	4013	3929	3499	4679	2526	4331	5084	11895	4917	4664	7137	5904	8921	4835	4307	4668	5040	6502	5250

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: 2003.

DATE	STN.	SPECIES ¹													TOTAL	CAPTURES /STN HR
	HOURS	NH	SS	CH	NG	BW	SW	RT	ZT	GE	AK	ML	PR	PG		
7-Sep	5.50	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0.2
8-Sep	7.41	0	5	3	0	0	0	0	1	0	0	0	0	0	9	1.2
9-Sep	7.08	0	4	2	0	0	0	0	0	0	0	0	0	0	6	0.8
10-Sep	0.00															
11-Sep	9.50	0	0	1	0	0	0	0	0	0	1	0	0	0	2	0.2
12-Sep	15.75	0	11	2	0	0	0	0	0	0	5	0	0	0	18	1.1
13-Sep	12.50	0	6	5	0	0	0	0	0	0	0	0	0	0	11	0.9
14-Sep	15.75	0	25	15	0	0	0	2	0	0	3	0	0	0	45	2.9
15-Sep	16.25	0	12	7	0	0	0	1	0	0	7	0	0	0	27	1.7
16-Sep	15.83	0	20	8	0	0	0	3	0	0	10	0	1	0	42	2.7
17-Sep	8.67	0	4	7	0	0	0	0	0	0	1	0	0	0	12	1.4
18-Sep	16.25	0	10	6	0	0	0	1	0	0	2	1	0	0	20	1.2
19-Sep	12.50	0	13	7	0	0	0	1	0	0	2	0	0	1	24	1.9
20-Sep	15.50	0	17	10	0	0	0	2	0	0	1	0	0	1	31	2.0
21-Sep	16.25	0	9	31	0	0	0	2	0	0	1	0	0	0	43	2.6
22-Sep	16.50	0	21	26	0	0	0	0	0	0	0	0	0	2	49	3.0
23-Sep	8.50	0	4	3	0	0	0	0	0	0	1	0	0	0	8	0.9
24-Sep	16.75	0	11	37	0	0	0	6	0	0	0	1	0	1	56	3.3
25-Sep	14.88	0	26	19	0	0	0	1	0	0	0	0	0	0	46	3.1
26-Sep	17.68	0	19	22	0	0	0	1	0	1	5	0	0	0	48	2.7
27-Sep	16.25	0	14	27	0	1	0	2	0	0	1	1	0	0	46	2.8
28-Sep	16.00	0	17	27	0	0	0	2	0	1	1	0	1	0	49	3.1
29-Sep	17.75	0	18	14	0	0	0	3	0	0	2	0	0	0	37	2.1
30-Sep	17.75	0	9	14	0	0	0	0	0	0	0	0	0	1	24	1.4
1-Oct	15.42	0	8	15	0	0	0	1	0	0	0	0	0	1	25	1.6
2-Oct	17.67	0	18	19	0	0	0	1	0	0	0	0	0	0	38	2.2
3-Oct	10.00	0	10	7	0	0	0	0	0	1	0	0	0	0	18	1.8
4-Oct	7.00	0	2	2	0	0	0	0	0	0	0	0	0	0	4	0.6
5-Oct	17.33	0	11	7	0	0	0	1	0	0	0	0	0	0	19	1.1
6-Oct	14.92	0	11	7	0	0	0	0	0	1	0	0	1	0	20	1.3
7-Oct	0.00															
8-Oct	0.00															
9-Oct	16.83	0	20	24	1	0	0	5	0	0	0	0	0	0	50	3.0
10-Oct	1.83	0	2	0	0	0	0	0	0	0	0	0	0	0	2	1.1
11-Oct	16.00	0	6	7	0	0	0	0	0	0	0	0	0	0	13	0.8
12-Oct	17.00	0	12	4	0	0	0	0	0	1	0	0	0	0	17	1.0
13-Oct	16.33	0	7	4	0	0	0	0	0	1	0	0	0	0	12	0.7
14-Oct	16.50	0	19	1	0	0	0	0	0	0	0	0	0	0	20	1.2
15-Oct	16.33	0	8	3	0	0	0	0	0	0	0	0	1	0	12	0.7
16-Oct	15.75	1	3	1	0	0	0	0	0	0	0	0	0	0	5	0.3
17-Oct	16.50	0	10	2	0	0	0	0	0	0	0	0	0	0	12	0.7
18-Oct	14.75	0	4	1	0	0	0	0	0	0	0	0	0	0	5	0.3
19-Oct	15.75	1	8	0	0	0	0	0	0	0	0	0	0	0	9	0.6
20-Oct	16.00	1	8	1	0	0	0	0	0	0	0	0	0	0	10	0.6
21-Oct	15.50	0	6	0	0	0	0	1	0	0	0	0	0	0	7	0.5
22-Oct	14.25	0	5	0	0	0	0	1	0	1	0	0	0	0	7	0.5
23-Oct	15.08	0	3	0	0	0	0	0	0	1	0	0	0	0	4	0.3
24-Oct	9.00	0	2	1	0	0	0	0	0	0	0	0	0	0	3	0.3
Total	632.54	3	458	400	1	1	0	38	0	8	43	3	4	7	966	64.5

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: 1990–2003.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	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		31-Aug
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		24-Oct
Blinds in operation	1	3	3	3	3	4	4	4	3	3	3	3	3	2		3.0
Trapping days	47	54	57	50	48	53	45	54	58	46	50	55	51	45		50.9
Station days	47	95	131	120	121	136	132	151	165	94	119	145	131	84		119.4
Station hours	511	693	967	889	926	1041	1030	1211	1352.58	663.75	791.42	1036.65	956.92	632.54		907.3
SPECIES	RAPTOR CAPTURES															
Northern Harrier	1	2	2	3	9	2	1	8	14	0	5	7	6	3	63	4.5
Sharp-shinned Hawk	124	262	589	430	502	493	778	612	987	321	495	426	635	458	7112	508.0
Cooper's Hawk	95	195	335	374	353	310	460	427	772	323	330	337	510	400	5221	372.9
Northern Goshawk	1	7	6	6	7	1	5	3	6	6	16	1	10	1	76	5.4
Broad-winged Hawk	0	0	0	0	0	0	0	0	1	0	0	0	1	1	3	0.2
Swainson's Hawk	0	0	0	0	0	0	0	0	0	0	0	1	3	0	4	0.3
Red-tailed Hawk	8	18	61	55	83	50	50	46	112	56	76	39	56	38	748	53.4
Zone-tailed Hawk	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0.1
Golden Eagle	1	3	4	4	4	4	6	4	5	2	4	5	7	8	61	4.4
American Kestrel	10	13	42	14	59	28	92	32	75	44	25	56	37	43	570	40.7
Merlin	1	0	2	4	1	1	11	6	7	2	8	2	12	3	60	4.3
Prairie Falcon	1	1	3	5	3	1	3	5	13	6	3	7	5	4	60	4.3
Peregrine Falcon	2	1	2	1	4	2	5	7	12	8	1	10	13	7	75	5.4
All Species	244	502	1046	896	1025	892	1411	1150	2005	768	963	891	1295	966	14054	1003.9
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	1517.1	108.4
Recaptures ¹	0	0	1	1	2	2	1	2	4	4	3	2	3	2	27	1.9
Foreign recaptures ²	2	1	1	1	2	0	5	1	2	2	0	0	3	2	22	1.6
Foreign encounters ³	0	2	2	3	6	6	7	8	13	12	6	7	10	7	90	6.4

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.