FALL 2001 RAPTOR MIGRATION STUDIES IN THE MANZANO MOUNTAINS OF CENTRAL NEW MEXICO

HawkWatch International, Inc.
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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 (*sensu* Hoffman et al. in press). 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 2001 season marked the 17th consecutive count and the 12th consecutive season of trapping and banding conducted at the site by HWI. This report summarizes the 2001 count and banding results.

The Manzano project was 1 of 15 long-term, annual migration counts (12 fall, 3 spring) and 1 of 8 migration banding studies (6 fall, 2 spring) conducted or co-sponsored by HWI in North America during 2001. The primary objective of these efforts is to track long-term population trends of diurnal raptors throughout primarily western North America (Smith and Hoffman 2000). Raptors feed atop food pyramids, inhabit most ecosystems, occupy large home ranges, and are sensitive to environmental contamination and other human disturbances. Therefore, they serve as important biological indicators of ecosystem health (Cade et al. 1988, Bednarz et al. 1990a, Bildstein 2001). Moreover, due to the remoteness and widespread distribution of most raptor populations, migration counts likely represent the most cost-effective and efficient method for monitoring the regional status and trends of multiple raptor species (Bednarz and Kerlinger 1989, Bednarz et al. 1990b, Titus et al. 1989, Bildstein et al. 1995, Dunn and Hussell 1995, Dixon et al. 1998, Smith and Hoffman 2000, Zalles and Bildstein 2000).

The intensive counting and banding operations also provide valuable information about breeding and wintering distributions, migratory routes and timing, migratory behavior, population demographics, mortality factors and longevity, morphometric variation, molt timing and sequences, and health assessments (e.g., Hoffman et al. in press). This information enables us to better understand the life histories, ecology, status, and conservation needs of raptor populations in North America. In addition, these migration studies offer unique opportunities for the public to learn about raptors and the natural environment, and providing such opportunities is another important component of HWI's mission. Accordingly, since 1995 the Manzano field crew has included a trained educator dedicated to conducting environmental education programs at the site and facilitating interactions between visitors and the field biologists.

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 2001, three banding stations were distributed around the observation point within 0.25–1.5 km (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. **South** station, operated part to full-time most years since 1991, was located 1.4 km south of the observation point at an elevation of 2,745 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.

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 Tim Meehan and Carrie Hisaoka had 1 and 0 full seasons, respectively, of previous experience counting migrating raptors (see Appendix A for a complete history of observer participation). 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.

The observers routinely recorded the following data:

1. Species, age, sex, and color morph of each migrant raptor, whenever possible and applicable (Appendix B 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 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 (none, low, moderate, high) for each hour, recorded on the hour.
7. Daily start and end times for each official observer.

The observers used high quality 7–10x binoculars to spot and identify birds. Clark and Wheeler (1987), Dunne et al. (1988), and Wheeler and Clark (1995) served as primary identification references, as needed. Assessments of wind speed, cloud type, cloud cover, and flight altitude followed guidelines published by the Hawk Migration Association of North America (HMANA). Assessments of thermal lift

conditions as poor, fair, good, or excellent involved subjective evaluations of solar intensity, wind speed, and migrant behavior.

The observers classified as residents and excluded from daily counts any raptor that exhibited hunting, territorial display, or perching behaviors for extended periods. The observers occasionally recorded as migrants birds that were not moving in a southerly direction, if such birds otherwise displayed migrant characteristics; i.e., continuous flight without stopping or substantially changing directions for several kilometers. Such birds may be dispersing juveniles or adults dispersing relatively short-distances from their nesting territories to favored wintering grounds in the same general region. However, we also know from recent satellite telemetry work that species such as Golden Eagles, Prairie Falcons and Ferruginous Hawks frequently "migrate" in non-standard directions to take advantage of favored post-breeding and wintering grounds (Steenhof et al. 1984, personal communication; Watson and Pierce 2000; HWI unpublished data).

The North trapping station lies a short distance in front of the count site. The observers identified and recorded all birds they saw trapped at North. To avoid double counting of trapped and released birds, the North banders used two-way radios to call observation upon release of a raptor to help the observers identify and avoid double-counting released raptors. In contrast, the observers largely ignored birds responding to the South and West trapping operations, because these trapping stations are located downstream of the count site and do not affect what the observers see to any appreciable degree.

For purposes of examining long-term variation in annual count statistics, I manipulated the count data to standardize annual sampling periods and adjust for daily variation in observation effort. The seasonal and daily duration of observation effort can greatly affect count statistics (Hussell 1985, Kerlinger 1989, Bednarz et al. 1990b), and both have varied in the Manzanos during the course of the study, particularly during the first several years of observations. To generally adjust for variation in sampling effort due to inclement weather and other unforeseeable events, before analyzing population trends I converted counts to annual passage rates for each species (adjusted total count / total hours of observation for a given year * 100 = raptors/100 hrs). To further standardize seasonal sampling effort, I defined a consistent annual sample period following conventions proposed by Bednarz and Kerlinger (1989) and Bednarz et al. (1990b). Specifically, I converted counts to passage rates on a daily basis (raptors/10 hours of observation) to adjust for daily variation in sampling effort, summed daily rates by Julian date across all years, and defined standardized passage periods for each species by eliminating approximately 2.5% from each extreme of the cumulative passage-rate distributions. Because entire count days must be either included or excluded, the defined sample period for a given species included between 95–100% of the detected number of migrants. For some species, the sample periods defined in this way encompassed dates earlier or later than periods of continuous observations. In these cases, I further restricted the adjusted sample periods to between mean starting and ending dates of continuous observations for 1985–2001: 26 August – 2 November.

Observers commonly identified distant or otherwise poorly observed migrants only to genus or other common non-specific groupings (e.g., unidentified eagle or buteo, which each can include multiple genera). Such identifications sometimes constituted a sizeable proportion of the birds seen, especially for accipiters, varying with observer experience and weather conditions. Excluding these birds from population trend analyses may render inaccurate assessments of true flight volume. Accordingly, prior to analyzing trends in annual passage rates, I also adjusted the daily counts by distributing incompletely identified birds across relevant species in proportion to the relative abundance of birds identified to each species that day. In this regard, beginning in 2001, HWI adopted a new standard for recording information about incompletely identified accipiters and falcons that should improve the accuracy of classifying incompletely identified birds for trend analysis (see Appendix B). Whenever possible, all observers now seek to classify any accipiters or falcons for which a species identification is not certain as small or large, using the simpler classifications of "unknown accipiter" or "unknown falcon" only as a

last resort. For falcons, identification debates usually center on distinguishing kestrels and Merlins or prairie falcons and peregrines (rarely gyrfalcons), and the small and large size classes distinguish which debate applied. For the accipiters, most debates concern distinguishing Sharp-shinned Hawks and Cooper's Hawks, and designation of the small size class confirms this. Occasionally, however, an observer struggles with distinguishing a large female Cooper's Hawk from a goshawk, and designation of the large size class confirms this and enables a more informed adjustment of the data prior to trend analyses.

Hereafter, I refer to as "adjusted" any data based on counts adjusted for incompletely identified birds and/or truncated to standardized annual sampling periods.

In most cases, I limit the analyses in this report to comparing 2001 annual statistics against means ± 95% confidence intervals (CI) for previous seasons, in which case I equate significance with a 2001 value falling outside of the CI for the associated mean. I also limit most comparisons of age and sex statistics to 2001 values versus means for 1992–2000, because pre-1992 class data have not been fully computerized. To provide additional context, I refer to but do not provide in-depth details concerning recently completed analyses of long-term trends in adjusted annual passage rates (manuscript in review for publication). These analyses involved linear and quadratic regressions examining trends in annual passage rates for 1985–2001. I commonly refer to the results of these analyses as not significant ($P > 0.10$), marginally significant ($P < 0.10$), significant ($P \leq 0.05$), or highly significant ($P < 0.01$).

TRAPPING AND BANDING

Rotating crews of 1–3 trappers and processors operated each trapping station, with crew size depending on trapper experience levels, 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, remotely triggered standard bow nets, remotely triggered surge bow nets, and dho-gaza nets (Bloom 1987). Each banding station operated 3–5 bow nets, 2–4 dho-gazas, and 1–2 mist nets. Trappers lured migrating raptors into the capture stations from camouflaged blinds using live, non-native Rock Doves (*Columba livia*; hereafter called pigeons), Ringed Turtle-doves (*Streptopelia risoria*), and House Sparrows (*Passer domesticus*) attached to lure lines manipulated from the blinds. Unless already banded, all captured birds were fitted with a uniquely numbered USGS Biological Resources Division aluminum leg band. Processors identified species, subspecies, sexes, and ages using morphological characteristics described in the U.S. Bird Banding Laboratory (BBL) Manual, Clark and Wheeler (1985), Wheeler and Clark (1995), and Hoffman et al. (1990). Processors also recorded a series of standard morphometric, health, and molt data for each bird. Unless chosen to be outfitted for satellite telemetry, all birds were released within 45 minutes from the time of capture.

RESULTS AND DISCUSSION

WEATHER

Compared to the last four seasons (the extent for which detailed comparisons are currently possible), 2001 featured a low proportion of days severely hampered by inclement weather, with only 4 days of observations entirely or severely (<4 hours) restricted by weather (see Appendix C for daily weather summaries). The proportion of active observation days that included some frontal-origin rain or snow (6%; as opposed to afternoon thundershowers) also was slightly lower than 1997–2000 average of 9%. Otherwise, the active observation periods featured a typical suite of sky conditions: 40% of days featured primarily clear to partly cloudy skies; 15% fair skies but with some fog, haze or scattered

thundershowers; 15% transitional weather (i.e., changed from fair skies to mostly cloudy or overcast during the day); 15% transitional skies with some fog, haze or scattered thundershowers; 6% transitional skies with some frontal rain or snow; 6% mostly cloudy to overcast skies; and 3% mostly cloudy to overcast skies with some fog, haze or scattered thundershowers. In 2001, 78% of the active observation days featured predominantly light winds (<12 kph), 22% moderate winds (12–28 kph), and none predominantly stronger winds, which compared to the previous four seasons is slightly skewed towards lighter winds. For the most part, compared to the last four seasons, 2001 featured an average array of predominant wind directions, with 46% of days featuring primarily southwesterly to westerly winds. However, another 26% of days featured predominantly westerly winds but with some northwesterly component, which is a slightly higher than average representation of northwesterly winds, and southeasterly to southerly winds were slightly less common than usual. 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 4.1–25.4°C, which is the warmest average and minimum recorded during the last five seasons. Fifty-four percent of active observation days received a median (of hourly ratings) thermal-lift rating of fair to poor and 46% good to excellent, which is average for the site.

In summary, compared to the previous four seasons, 2001 featured less stormy weather, somewhat lighter winds, slightly more northwesterly and fewer southeasterly/southerly winds, and warmer temperatures.

OBSERVATION EFFORT

The observers worked on 68 of 71 possible days between 27 August and 5 November (Table 1). The number of observation days and hours (545.47) were both significantly higher (6% and 9%, respectively) than the 1985–2000 averages of 64 ± 95% CI of 2.7 days and 502.65 ± 29.123 hours. The 2001 average of 2.5 observers per hour (including official and guest observers; value is mean of daily values, which are in turn means of hourly values) was a significant 14% higher than the 1985–2000 average of 2.2 ± 95% CI of 0.21 observers/hr.

FLIGHT SUMMARY

The observers counted 4,668 migrant raptors of 18 species during the 2001 season (see Appendix D for daily count records and Appendix E for annual summaries). They recorded no record high or low counts and no new species; however, a Rough-legged Hawk was only the fifth individual of this species ever recorded at the site (Appendix E).

The 2001 flight was composed of 44% accipiters, 34% buteos, 14% falcons, 4% vultures, 3% eagles, and <1% each of harriers, Ospreys, and unidentified raptors. This composition includes a significantly higher than average proportion of buteos and significantly lower than average proportions of accipiters, vultures, and harriers (Figure 2). As usual, Sharp-shinned and Cooper's Hawks were the two most abundant species, followed by Swainson's Hawks, Red-tailed Hawks, and American Kestrels (Table 1, Appendix E).

Adjusted passage rates were significantly above average only for Peregrine Falcons, and were significantly below average for six species (Turkey Vulture, Northern Harrier, Sharp-shinned Hawk, Northern Goshawk, Ferruginous Hawk, and Bald Eagle; Table 1, Figures 3–7). The regression analyses showed marginally to highly significant linear increasing trends in adjusted passage rates for Cooper's Hawk, Red-tailed Hawk, Swainson's Hawk, Merlin, Prairie Falcon, and Peregrine Falcon (Figures 4, 5, 7). In addition, significant quadratic trends were indicated for Turkey Vulture and Osprey, in both cases tracking strong increasing trends through the mid-1990s followed by pronounced downturns since 1998 (Figure 3). In fact, most species have shown a distinct downturn over the past 3–4 years (Figures 3–7), which probably reflects the cumulative, negative effects of the widespread drought and wildfires that

have plagued the West for the past several years. Of potentially greater concern, however, is a highly significant, long-term decline for Ferruginous Hawks (Figure 5).

Immature : adult ratios were below average for all species with data suited to comparisons, significantly so for Golden Eagles and Sharp-shinned, Cooper's, Red-tailed and Ferruginous Hawks (Table 2). Moreover, for all species except Peregrine Falcons, the lower age ratios reflected lower than average abundances of immature birds (Table 2). Low abundance of immature birds for most species probably reflects the negative effects on recruitment of the prolonged drought and extensive wildfires that have plagued much of the interior West for the past 2–3 years.

There were no distinct multi-species patterns of variation in seasonal timing in 2001, with 6 species showing significantly earlier than average median passage dates and 4 species showing significantly late timing (Table 3). The combined-species median passage date also was only 1 day later than average (Table 3); however, the seasonal distribution varied significantly from the norm between the third week of September and mid-October (Figure 8). This variation in pattern primarily reflects the occurrence of unusually large flights of Swainson's Hawks on 24 September (59), 1 October (648), and 3 October (64). Age-specific timing data revealed no markedly different details except for indicating that immature Peregrine Falcons were later than average while adults were slightly early (Table 4).

RESIDENT AND NON-SOUTHBOUND RAPTORS

This season, local birds included a pair of Prairie Falcons with a known nest site near the south banding station, at least one family of Red-tailed Hawks, at least one local kestrel early in the season, a family of Peregrine Falcons, at least 1 or 2 Golden Eagles, at least 1 Sharp-shinned Hawk, and several Turkey Vultures.

The observers recorded one westbound Ferruginous Hawk as a migrant this season.

TRAPPING EFFORT

The crews operated at least one banding station every day (55 days) between 1 September and 25 October, with effort totaling 145 station days and 1037 stations hours (see Appendix F for 2001daily trapping records and Appendix G for annual summaries). These effort values are among the highest for the study (Appendix G).

TRAPPING AND BANDING SUMMARY

The 2001 capture total of 891 birds included 11 species, 889 newly banded birds and 2 recaptures of birds previously banded in the Manzanos (Table 5, Appendix G). The 2001 effort raises the total number of birds captured since project inception to 11,806, including 22 recaptures of Manzano-banded birds and 17 foreign recaptures (i.e., birds originally banded elsewhere and subsequently recaptured in the Manzanos; Appendix G). Sharp-shinned and Cooper's Hawks accounted for 48% and 38% of the total captures, respectively, followed by American Kestrels (6%), Red-tailed Hawks (4%), and Peregrine Falcons (1%). Each of the remaining six species accounted for less than 1% of the total.

Both the 2001 combined-species capture total and rate (86 captures per station hour) were below average, with the difference in capture rate significant; however, the combined-species capture success of 24% was slightly above average (Table 5). Furthermore, species-specific statistics indicated substantial variability (Table 5). All three capture statistics were above average for Northern Harrier, Golden Eagle, American Kestrel, and Prairie and Peregrine Falcons, and the first Swainson's Hawk ever captured at the site was a special treat! Most notably, capture success was significantly above average for all these species. All other species showed below average capture totals and rates; however, capture success was

above average for Sharp-shinned and Cooper's Hawks. All three capture statistics were significantly below average only for Northern Goshawks and Red-tailed Hawks.

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 2001 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 (Table 2; lower than average in 2001 with low immature abundances). The female : male ratio for Sharp-shinned Hawks matched the long-term average; however, adult males were slightly more abundant than usual whereas immature males and both immature and adult females were less abundant than usual (Table 6). The sex ratio for Cooper's Hawks was significantly below average, but the pattern of abundance shown by the four age-sex classes was the same as for Sharp-shinned Hawks (Table 6). These data provide additional support for the contention that accipiter productivity was generally below average in 2001. Similarly, for American Kestrels both the immature : adult and female : male ratios were significantly below average in 2001, due primarily to lower than average abundance of immature males but much higher than average abundance of adult males (Table 6; the count data also indicated a 7% below average sex ratio). Thus, for kestrels the data suggest that there may have been a slight decline in juvenile recruitment, but the unusual abundance of adult males among those captured appears more noteworthy. The count data indicated below average totals for both males (6% lower) and females (12%; Table 2), so it is possible that adult males were disproportionately represented among the captures.

The 2001 banding operation also afforded opportunities to support three other noteworthy activities. First, the HWI banders succeeded in outfitting four Red-tailed Hawks and two Golden Eagles with satellite transmitters that enable tracking of their long-distances movements. All four Red-tailed Hawks subsequently wintered in south-central and southeastern Mexico and were alive and well at the end of March. One of the Golden Eagles wintered near the Arizona border in west-central New Mexico, but unfortunately ceased transmitting reliably in early March for unknown reasons. The second eagle wintered in west-central Texas near Odessa, but unfortunately appeared to have been electrocuted along with another young eagle by late winter—we discovered both birds dead together under the same power pole in early March. Complete tracking summaries and maps can be found at www.hawkwatch.org.

Second, HWI began a collaborative project with Dr. Mike Hooper and graduate student Toby McBride of Texas Tech University to collect blood samples from Manzano migrants for analysis of lead contamination. This sampling compliments HWI's newly initiated Wildlife Lead Poisoning Reduction Program, which seeks to educate the public concerning the dangers of lead poisoning in the environment due to use of lead-based ammunition and fishing tackle, and to promote development of broad-based coalitions to develop and promote use of suitable alternatives. Blood samples were collected from more than 60 Cooper's Hawks (thought to be a potential contamination target due to their predation of small game birds such as doves), and, in this case, revealed healthy birds.

Third, University of New Mexico graduate student and long-time HWI affiliate Ruth Smith collected blood and feather samples from migrant Sharp-shinned Hawks to support her thesis study of relationships between occurrence of blood-borne parasites and migration ecology. The feather samples enable Ruth to analyze stable-isotope signatures to identify the geographic origins of Manzano migrants (see Meehan et al. 2001), which when completed will constitute a valuable new addition to our knowledge of New Mexico raptor migration ecology.

ENCOUNTERS WITH PREVIOUSLY BANDED BIRDS

Recaptures—The 2001 captures included two recaptures of birds originally banded in the Manzanos (Table 7), which brings the total number of Manzano recaptures since 1990 to 22 birds (Appendix G).

The 2001 recaptures included one male Sharp-shinned Hawk originally banded as a hatch-year bird in 1999 and 1 male Cooper's Hawk originally banded as an adult in 2000.

Foreign Encounters—Seven raptors originally banded in the Manzanos were encountered elsewhere in 2001 (Table 8), which brings the total foreign encounters since 1990 to 72 birds (Appendix G). Three Cooper's Hawks were recaptured and released during their northbound (spring) migration at HWI's Sandia Mountains (NM) site 2–10 years after being banded in the Manzanos. This brings the total number of exchanges between the two projects to 34 birds, which is strong testimony to the fact that the two sites lie along the same flyway and that both inter-season and inter-annual flyway fidelity are high (Hoffman et al. in press). Another Cooper's Hawk was recaptured and released by a new fall raptor-banding operation near Rogers Pass in western Montana, almost exactly one year after being banded in the Manzanos. Two other Cooper's Hawks were found dead of unknown causes in central New Mexico and north-central central Wyoming 1 and 6 years after being banded as adults in the Manzanos. Lastly, we know that one Red-tailed Hawk banded during the 2001 season was recovered, but have not yet received a full-report about this bird from the Bird Banding Laboratory.

SITE VISITATION

In 2001, 477 individuals from 10 states and 3 foreign countries (England, Germany, and Scotland) signed the Manzano visitor logs. Arizona and Texas represented the most common points of origin besides New Mexico, with 6% of visitors originating in these two states. Other U.S points of origin included Alaska, California, Colorado, Connecticut, Delaware, Massachusetts, and Virginia. The visitors included 256 members of 15 organized groups (54% of the visitation), including two elementary school groups, students from the College of Santa Fe, two scout troops, four other youth groups, five Arizona/New Mexico birding groups, and environmental staff from Public Service Company of New Mexico. Interacting with visitors, affording them an opportunity to experience field research first hand, and instilling in them a passion for raptors is one of the most rewarding aspects of HWI's migration projects. It was therefore very gratifying for HWI to see Manzano visitation, especially the diversity of visitors, remain strong in 2001 in the wake of the 11 September atrocities.

Beginning with the fall 2001 season, HWI adopted a new approach to quantifying the influence of visitors on counts at all of its project sites. Encouraging visitation and achieving positive public education and outreach are important goals for all HWI projects; however, during migration counts, visitors can represent a distraction for the official observers that may compromise the integrity of the count. Tolerating a certain level of distraction in the interest of positive outreach is a tradeoff that we gladly accept as part of our operations; however, because the distraction potential fluctuates considerably through time, it is important that the data we record include a means of quantifying the distraction potential through statistical modeling. Previously, at each site we had the observers estimate the number of visitors present during each hour of active counts. Two primary problems confounded use of this system for quantifying the visitor-distraction factor.

First, during busy periods (in terms of birds to count or visitors present) tracking visitors often became a difficult task for the observers. This difficulty led to both inconsistent estimation and, in some cases, in and of itself represented an unnecessary distraction. Second, careful reflection over the years suggested that simply recording the number of visitors often failed to capture the true effect of specific situations. For example, a single, highly curious, and talkative individual often represents more of a distraction for the observers than a large group of relatively quiet visitors.

In an effort to overcome these limitations, we have adopted a new system for recording visitor effects, whereby the observers record a subjective, visitor-distraction rating for each hour (none, low, moderate, or high). The new system still requires that the observers keep track of the effects of visitors through the hour, but the task is much easier without having to specify numbers. Furthermore, the new rating system

allows the observers to incorporate a broader range of input to generate a more representative index of true visitor effects on their performance. Thus, although data-recording protocol changes such as this can be troublesome with regard to analysis of long-term trends, we believe that in the end this new approach to estimating visitor-distraction effects will significantly improve the integrity of our count systems.

In 2001 at the Manzanos, 591 hourly assessments of visitor disturbance resulted in the following ratings: 74% none, 23% low, 3% moderate, and <1% high.

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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: 1985–2000 versus 2001.

	COUNTS			RAPTORS / 100 HRS[1]		
SPECIES	1985–2000[2]	2001	% CHANGE	1985–2000[2]	2001	% CHANGE
Turkey Vulture	420 ± 132.7	164	-61	128.9 ± 37.89	48.6	-62
Osprey	27 ± 6.6	26	-2	7.8 ± 1.72	7.6	-3
Northern Harrier	64 ± 13.1	37	-43	13.2 ± 2.34	7.4	-44
Sharp-shinned Hawk	1488 ± 234.6	1032	-31	370.1 ± 52.89	235.8	-36
Cooper's Hawk	960 ± 173.4	913	-5	275.2 ± 38.67	251.8	-8
Northern Goshawk	16 ± 5.0	13	-19	3.6 ± 1.32	2.3	-38
Unknown small accipiter[3]	–	86	–	–	–	–
Unknown large accipiter[3]	–	0	–	–	–	–
Unidentified accipiter	110 ± 26.8	0	–	–	–	–
TOTAL ACCIPITERS	2575 ± 386.1	2044	-21	–	–	–
Broad-winged Hawk	6 ± 1.8	6	+5	1.7 ± 0.50	1.8	+7
Swainson's Hawk	642 ± 880.4	815	+27	234.3 ± 325.10	337.5	+44
Red-tailed Hawk	625 ± 91.7	632	+1	138.3 ± 17.58	130.1	-6
Ferruginous Hawk	14 ± 2.8	10	-27	3.0 ± 0.60	1.6	-47
Rough-legged Hawk	0.3 ± 0.22	1	+300	0.1 ± 0.05	0.2	+277
Zone-tailed Hawk	0.6 ± 0.47	1	+60	–	–	–
Unidentified buteo	15 ± 4.7	106	+622	–	–	–
TOTAL BUTEOS	1301 ± 889.4	1570	+21	–	–	–
Golden Eagle	119 ± 16.1	128	+8	25.8 ± 3.71	25.7	0
Bald Eagle	4 ± 1.3	1	-72	1.0 ± 0.35	0.3	-75
Unidentified Eagle	0.6 ± 0.67	0	-100	–	–	–
TOTAL EAGLES	123 ± 16.0	129	+5	–	–	–
American Kestrel	576 ± 78.1	560	-3	161.0 ± 21.80	151.9	-6
Merlin	24 ± 7.6	21	-14	6.1 ± 1.81	5.1	-17
Prairie Falcon	21 ± 6.3	28	+36	4.5 ± 1.27	5.6	+26
Peregrine Falcon	36 ± 14.7	63	+74	8.5 ± 3.14	14.6	+72
Unknown small falcon[3]	–	0	–	–	–	–
Unknown large falcon[3]	–	0	–	–	–	–
Unidentified falcon	2 ± 1.5	5	+135	–	–	–
TOTAL FALCONS	659 ± 91.0	677	+3	–	–	–
Unidentified raptor	52 ± 22.7	20	-61	–	–	–
GRAND TOTAL	5221 ± 1157.0	4668	-11	–	–	–

[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: 1992–2000 versus 2001.

	Total and Age-classified Counts								Immature : Adult Ratio	
	1992–2000 Average			2001			% Unknown Age			
	Total	Imm.	Adult	Total	Imm.	Adult	1992–2000[1]	2001	1992–2000[1]	2001
Northern Harrier	73	40	18	37	18	9	22 ± 6.5	27	2.3 ± 0.64	2.0
Sharp-shinned Hawk	1690	685	782	1032	350	474	13 ± 3.8	20	0.9 ± 0.18	0.7
Cooper's Hawk	1130	428	540	913	255	423	15 ± 4.2	26	0.8 ± 0.17	0.6
Northern Goshawk	20	8	9	13	6	6	12 ± 7.6	8	1.2 ± 0.59	1.0
Broad-winged Hawk	6	1	3	6	0	1	38 ± 23.9	83	0.1 ± 0.10	0.0
Red-tailed Hawk	723	259	380	632	151	405	11 ± 2.6	12	0.7 ± 0.15	0.4
Ferruginous Hawk	12	4	3	10	1	5	42 ± 13.9	40	2.0 ± 1.29	0.2
Golden Eagle	137	80	37	128	67	48	15 ± 5.7	10	2.2 ± 0.26	1.4
Bald Eagle	4	3	1	1	0	0	6 ± 12.3	100	2.6 ± 1.86	–
Peregrine Falcon	55	16	22	63	21	35	22 ± 16.9	11	1.0 ± 0.68	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 2001, with comparisons of 2001 and 1985–2000 average median passage dates.

Species	2001				1985–2000
	First Observed	Last Observed	Bulk Passage Dates[1]	Median Passage Date[2]	Median Passage Date[2,3]
Turkey Vulture	27-Aug	8-Oct	4-Sep – 1-Oct	20-Sep	14-Sep ± 2.9
Osprey	5-Sep	31-Oct	12-Sep – 6-Oct	18-Sep	17-Sep ± 1.7
Northern Harrier	6-Sep	21-Oct	12-Sep – 15-Oct	26-Sep	1-Oct ± 2.1
Sharp-shinned Hawk	28-Aug	4-Nov	11-Sep – 19-Oct	25-Sep	28-Sep ± 1.3
Cooper's Hawk	27-Aug	26-Oct	12-Sep – 6-Oct	23-Sep	25-Sep ± 1.4
Northern Goshawk	7-Oct	3-Nov	7-Oct – 3-Nov	20-Oct	3-Oct ± 4.9
Broad-winged Hawk	21-Sep	6-Oct	21-Sep – 6-Oct	29-Sep	24-Sep ± 3.6
Swainson's Hawk	28-Aug	3-Oct	24-Sep – 1-Oct	30-Sep	20-Sep ± 3.9
Red-tailed Hawk	27-Aug	4-Nov	14-Sep – 24-Oct	2-Oct	3-Oct ± 2.6
Ferruginous Hawk	27-Aug	26-Oct	29-Aug – 26-Oct	19-Sep	2-Oct ± 4.9
Rough-legged Hawk	23-Oct	23-Oct	–	–	–
Zone-tailed Hawk	6-Sep	6-Sep	–	–	–
Golden Eagle	8-Sep	4-Nov	23-Sep – 25-Oct	12-Oct	13-Oct ± 1.8
Bald Eagle	12-Oct	12-Oct	–	–	23-Oct ± 2.7
American Kestrel	27-Aug	25-Oct	6-Sep – 2-Oct	19-Sep	21-Sep ± 1.8
Merlin	16-Sep	25-Oct	17-Sep – 23-Oct	1-Oct	7-Oct ± 3.6
Prairie Falcon	8-Sep	29-Oct	8-Sep – 21-Oct	25-Sep	22-Sep ± 3.6
Peregrine Falcon	1-Sep	30-Oct	8-Sep – 7-Oct	22-Sep	23-Sep ± 2.0
All species	27-Aug	4-Nov	12-Sep – 15-Oct	27-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: 1992–2000 versus 2001.

	ADULT		IMMATURE / SUBADULT	
SPECIES	1992–2000[1]	2001	1992–2000[1]	2001
Northern Harrier	6-Oct ± 3.5	1-Oct	1-Oct ± 2.6	26-Sep
Sharp-shinned Hawk	5-Oct ± 2.2	6-Oct	20-Sep ± 1.5	16-Sep
Cooper's Hawk	29-Sep ± 3.1	26-Sep	22-Sep ± 2.4	21-Sep
Northern Goshawk	2-Oct ± 4.6	19-Oct	29-Sep ± 8.4	14-Oct
Red-tailed Hawk	7-Oct ± 3.3	6-Oct	25-Sep ± 2.2	23-Sep
Ferruginous Hawk	9-Oct ± 2.0	26-Sep	22-Sep ± 4.9	–
Golden Eagle	16-Oct ± 2.7	15-Oct	13-Oct ± 2.2	13-Oct
Peregrine Falcon	24-Sep ± 3.0	29-Sep	17-Sep ± 3.4	15-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: 1991–2000 versus 2001.

	Capture Total		Capture Rate[1]		Capture Success (%)[2]	
Species	1991–2000[3]	2001	1991–2000[3]	2001	1991–2000[3]	2001
Northern Harrier	5 ± 2.7	7	0.4 ± 0.22	0.7	6 ± 2.9	19
Sharp-shinned Hawk	547 ± 131.7	426	55.9 ± 7.43	41.1	32 ± 2.8	40
Cooper's Hawk	388 ± 94.5	337	40.0 ± 5.45	32.5	33 ± 4.0	35
Northern Goshawk	6 ± 2.4	1	0.7 ± 0.33	0.1	38 ± 13.3	8
Broad-winged Hawk	0.1 ± 0.20	0	0.01 ± 0.014	0.0	1 ± 1.4	0
Swainson's Hawk	0 ± 0.00	1	0.00 ± 0.000	0.1	0 ± 0.0	0
Red-tailed Hawk	60.7 ± 15.58	39	6.38 ± 1.472	3.8	8 ± 1.8	6
Zone-tailed Hawk	0 ± 0.2	0	0.01 ± 0.014	0.0	8 ± 16.3	0
Golden Eagle	4 ± 0.7	5	0.4 ± 0.05	0.5	3 ± 0.6	4
American Kestrel	42 ± 16.1	56	4.4 ± 1.50	5.4	7 ± 1.9	10
Merlin	4 ± 2.3	2	0.4 ± 0.23	0.2	12 ± 5.8	10
Prairie Falcon	4 ± 2.1	7	0.4 ± 0.18	0.7	15 ± 4.0	25
Peregrine Falcon	4 ± 2.3	10	0.4 ± 0.23	1.0	8 ± 2.4	16
All Species	1066 ± 251.9	891	109.5 ± 14.12	85.9	23 ± 2.6	24

[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: 1990–1999 averages versus 2001.

		Female		Male		Female : Male	Immature:Adult
Species	Year	HY	AHY	HY	AHY	Ratio[1]	Ratio[1]
Sharp-shinned Hawk	1990-1999	155	130	146	78	1.3 ± 0.12	1.5 ± 0.30
	2001	136	104	106	80	1.3	1.3
Cooper's Hawk	1990-1999	85	102	88	86	1.1 ± 0.13	0.9 ± 0.17
	2001	67	96	73	102	0.9	0.7
American Kestrel	1990-1999	11	1	19	6	0.7 ± 0.13	4.8 ± 1.26
	2001	11	3	13	20	0.5	1.0

[1] Long-term values – mean ± 95% CI.

Table 7. Recaptures of previously banded raptors in the Manzano Mountains, NM during 2001.

Species	Sex	Band #	Banding Site	Banding Date	Banding Age[1]	Recapture Date	Recapture Age[1]
Cooper's Hawk	Male	0804 – 04167	Manzano Mountains, NM	21-Sep-99	HY	06-Oct-01	TY
Sharp-shinned Hawk	Male	0972 – 57481	Manzano Mountains, NM	15-Oct-00	ASY	08-Oct-01	ATY

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

Table 8. Foreign encounters during 2001 with raptors banded in the Manzano Mountains, NM.

Band #	Species	Sex	Banding Age[1]	Banding Date	Encounter Date	Encounter Age[1]	Encounter Location	Distance (km)	Status
1705 – 28378	CH	F	ASY	14-Oct-95	06-Feb-01	8th yr	Corrales, NM	43	found dead
1204 – 42975	CH	M	HY	02-Oct-93	15-Apr-01	8th yr	Sandia Mts., NM	34	captured/released
1005 – 01336	CH	F	ASY	30-Sep-99	15-Apr-01	4th yr	Sandia Mts., NM	34	captured/released
1705 – 34948	CH	F	AHY	13-Oct-97	15-Apr-01	5th yr	Sandia Mts., NM	34	captured/released
1204 – 51695	CH	M	ASY	18-Oct-00	17-Jul-01	4th yr	Big Horn, WY	898	found dead
0804 – 01121	CH	M	HY	23-Sep-00	28-Sep-01	SY	Rogers Pass, MT	1280	captured/released
1807 – 81714	RT	U	HY	21-Oct-01	*	*	*	*	*

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

* Awaiting full report from Bird Banding Laboratory.

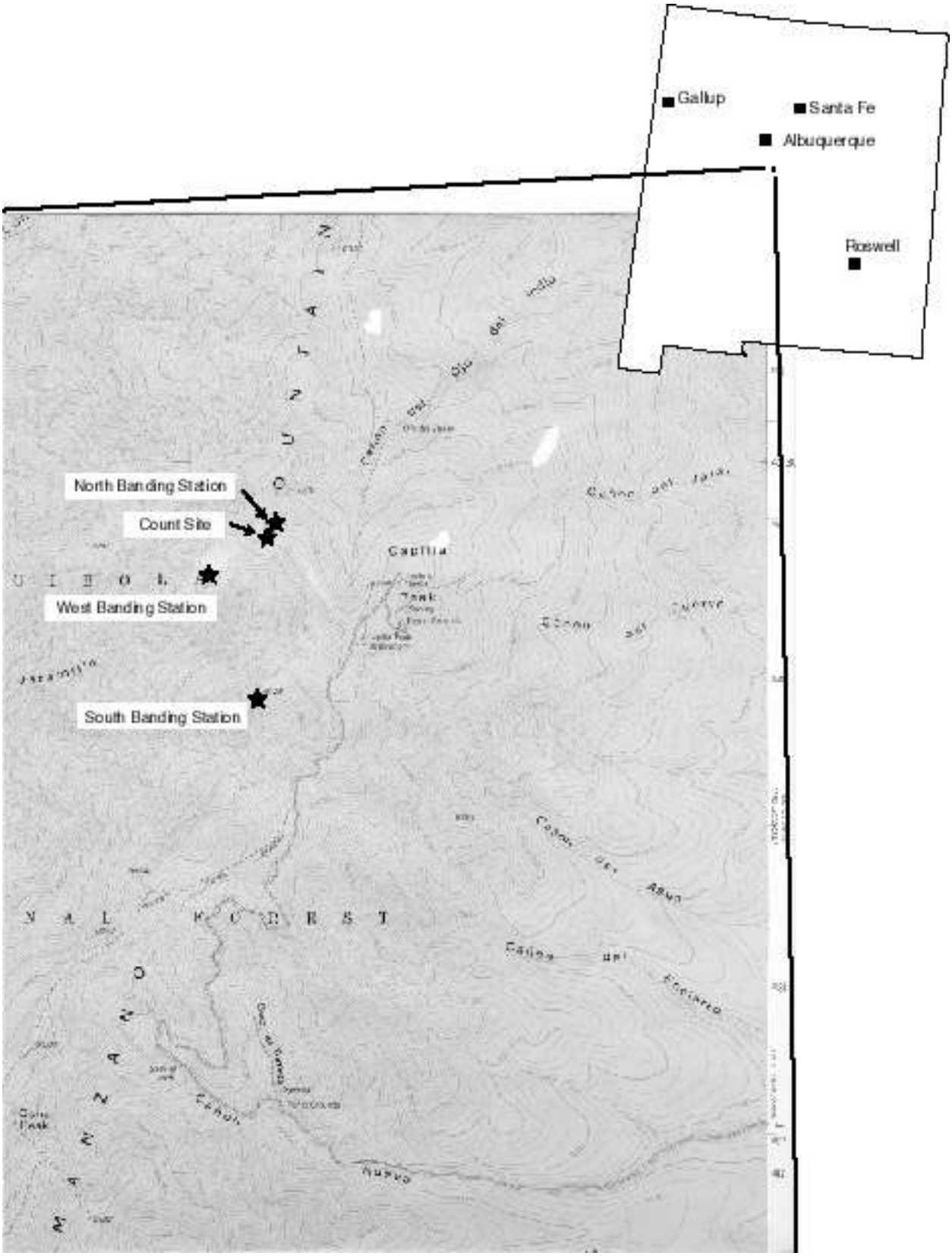

Figure 1. Map of the Manzano Mountains raptor-migration study site in central New Mexico.

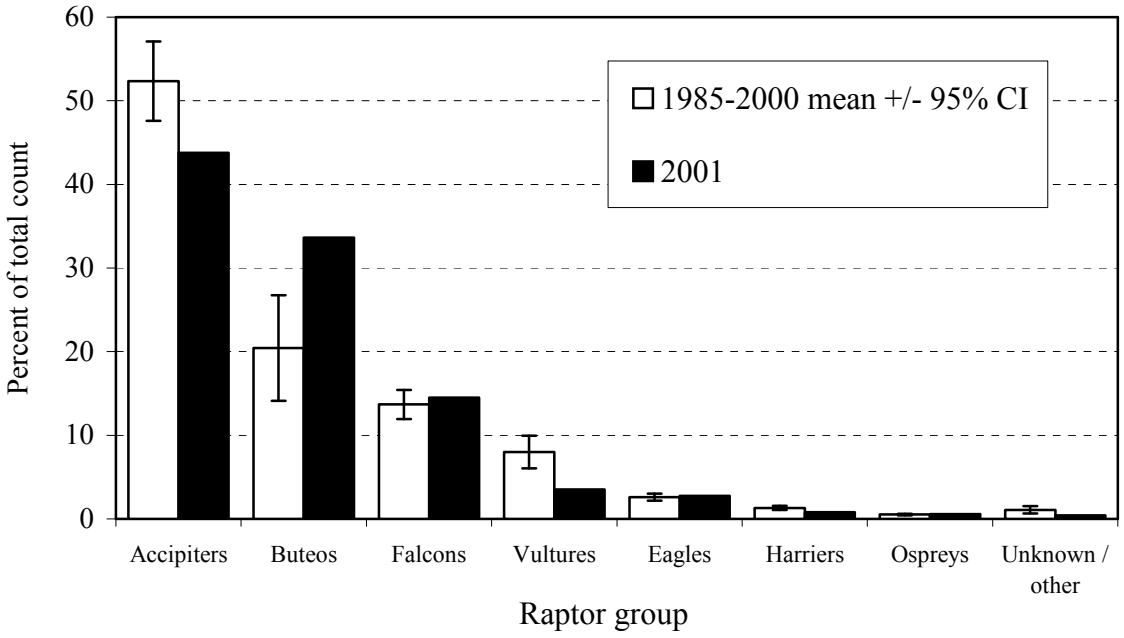

Figure 2. Fall raptor-migration flight composition by major species groups in the Manzano Mountains, NM: 1985–1999 versus 2001.

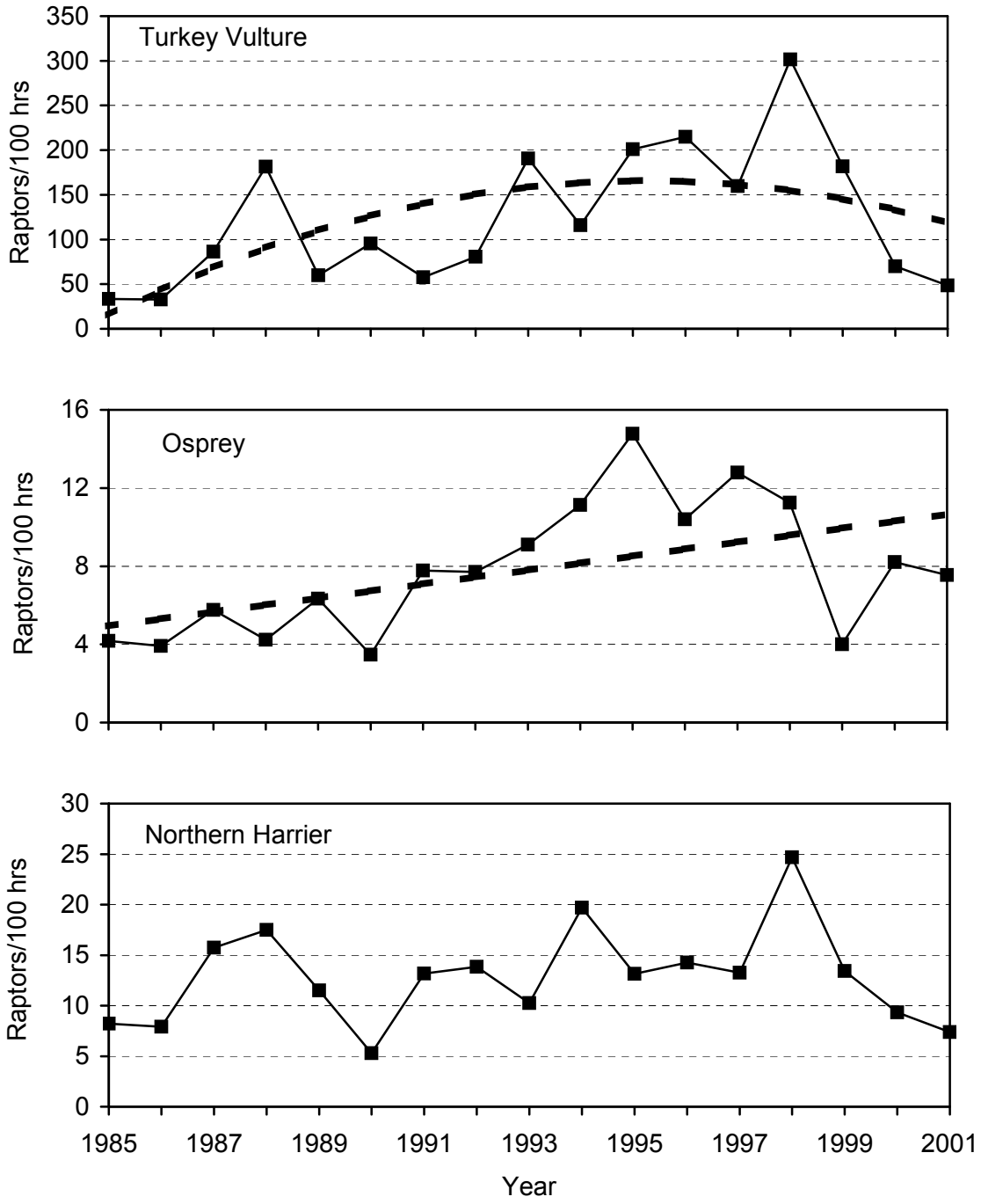

Figure 3. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) fall-migration passage rates for Turkey Vultures, Ospreys, and Northern Harriers in the Manzano Mountains, NM: 1985–2001. Dashed lines indicate significant ($P \leq 0.10$) regressions.

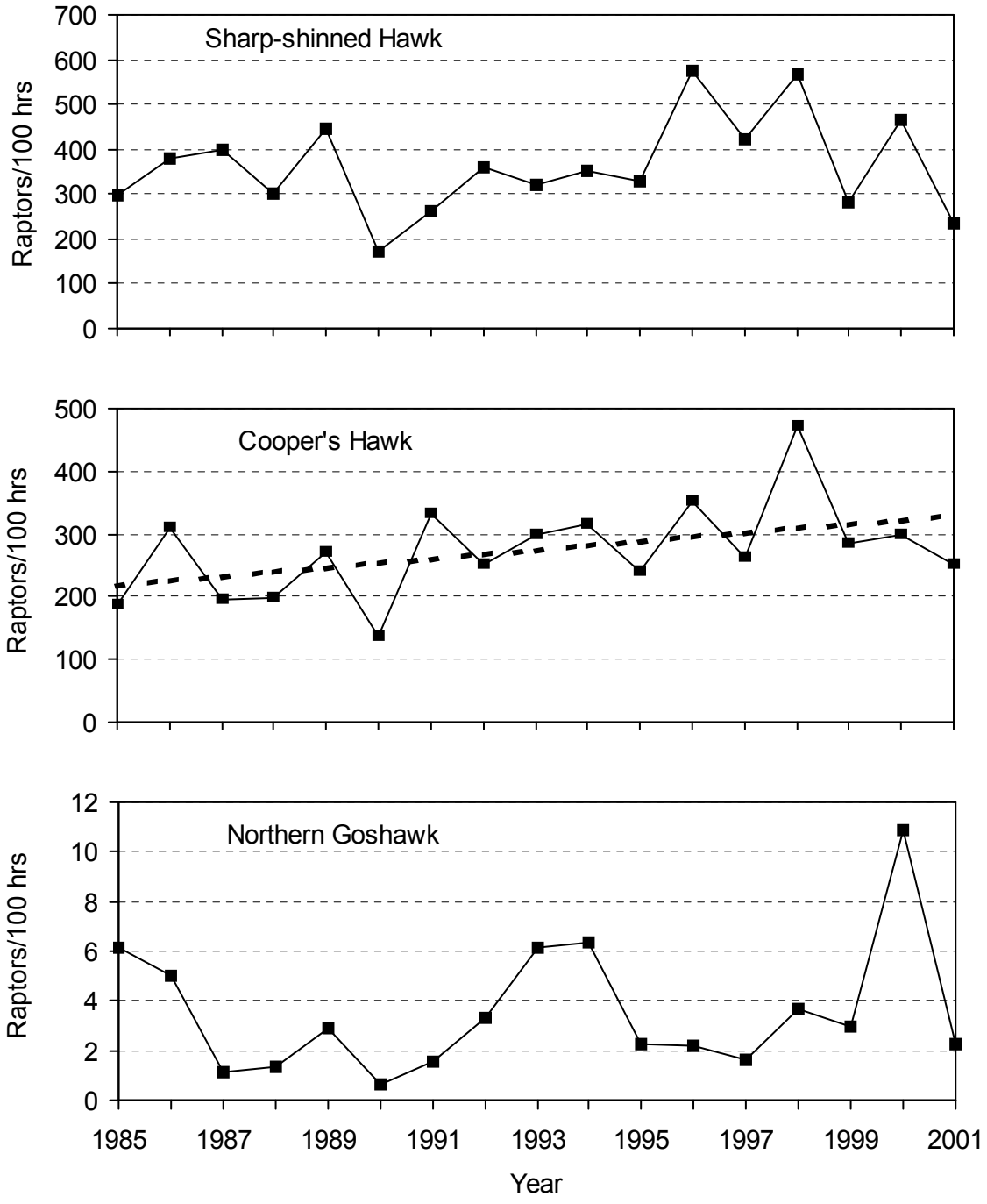

Figure 4. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) fall-migration passage rates for Sharp-shinned Hawks, Cooper's Hawks, and Northern Goshawks in the Manzano Mountains, NM: 1985–2001. Dashed lines indicate significant ($P \leq 0.10$) regressions.

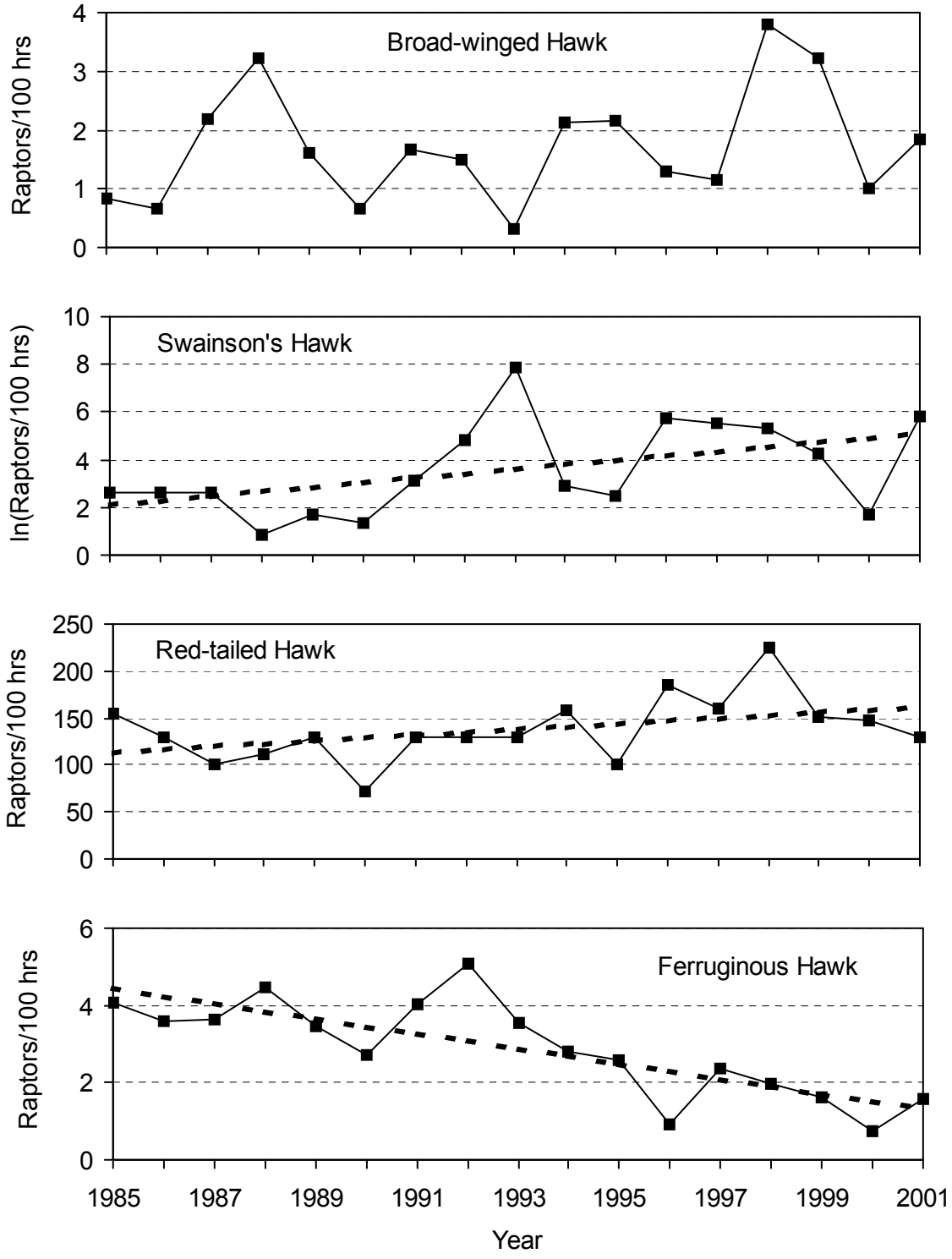

Figure 5. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) fall-migration passage rates for Broad-winged, Swainson's, Red-tailed and Ferruginous Hawks in the Manzano Mountains, NM: 1985–2001. Dashed lines indicate significant ($P \leq 0.10$) regressions.

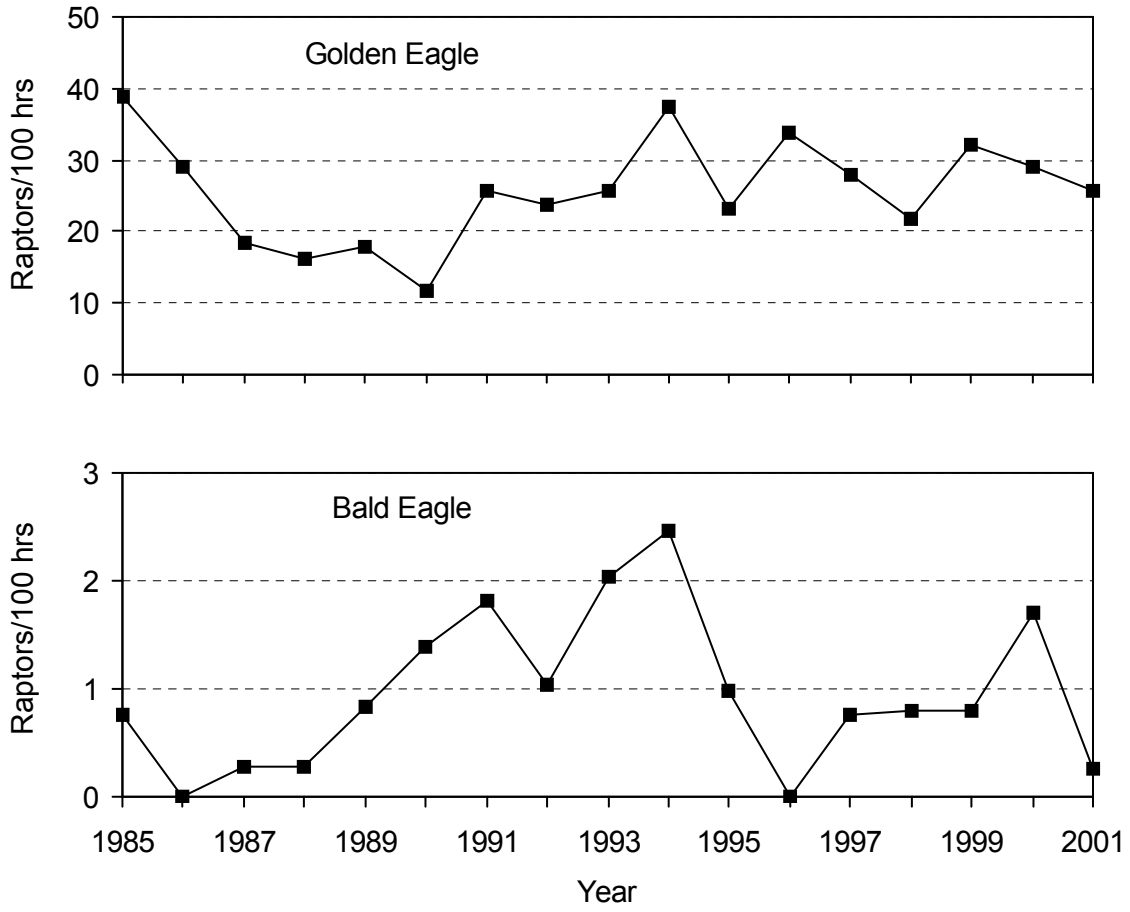

Figure 6. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) fall-migration passage rates for Golden and Bald Eagles in the Manzano Mountains, NM: 1985–2001. Dashed lines indicate significant ($P \leq 0.10$) regressions.

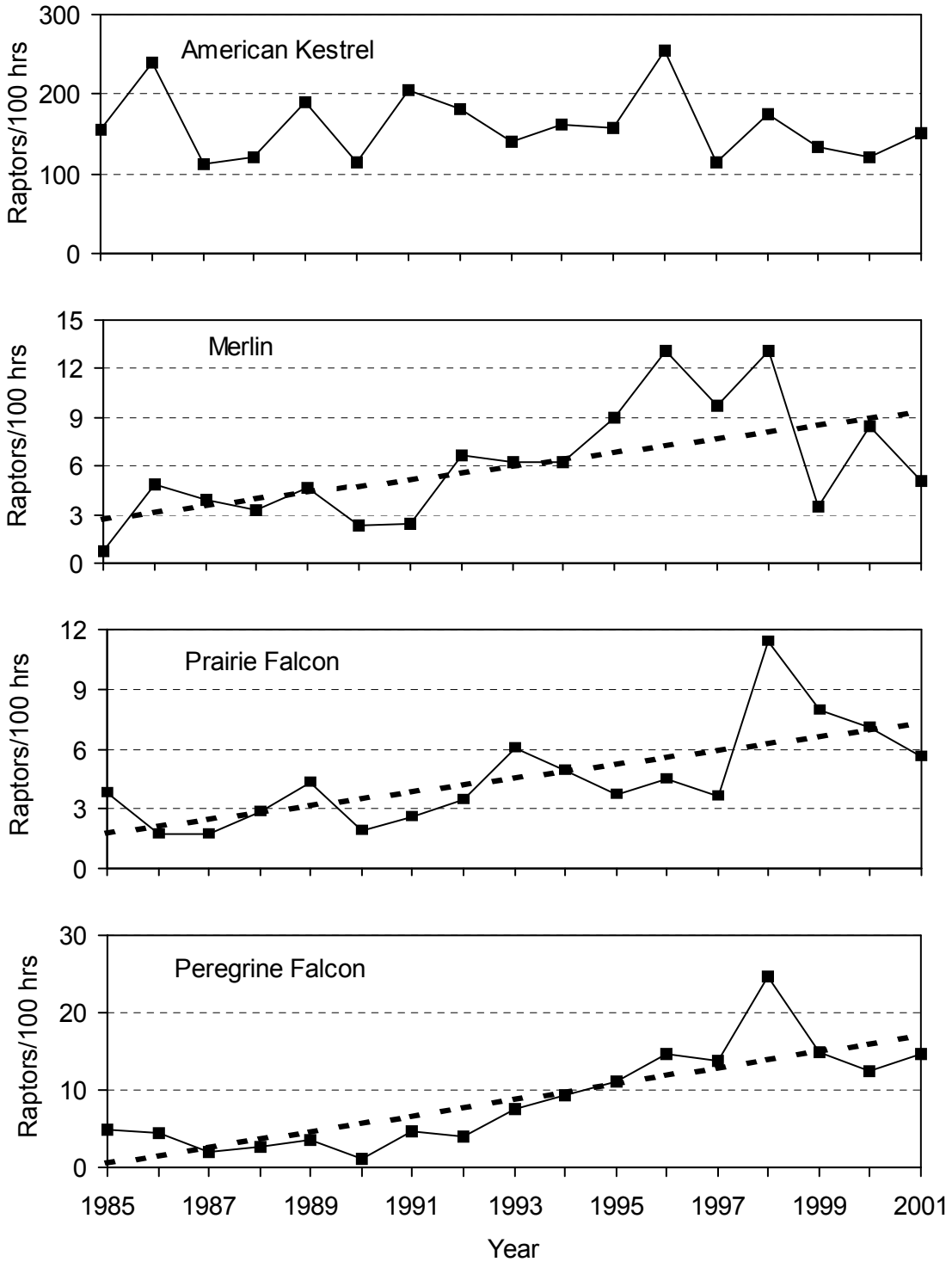

Figure 7. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) fall-migration passage rates for American Kestrels, Merlins, Prairie Falcons, and Peregrine Falcons: 1985–2001. Dashed lines indicate significant ($P \leq 0.10$) regressions.

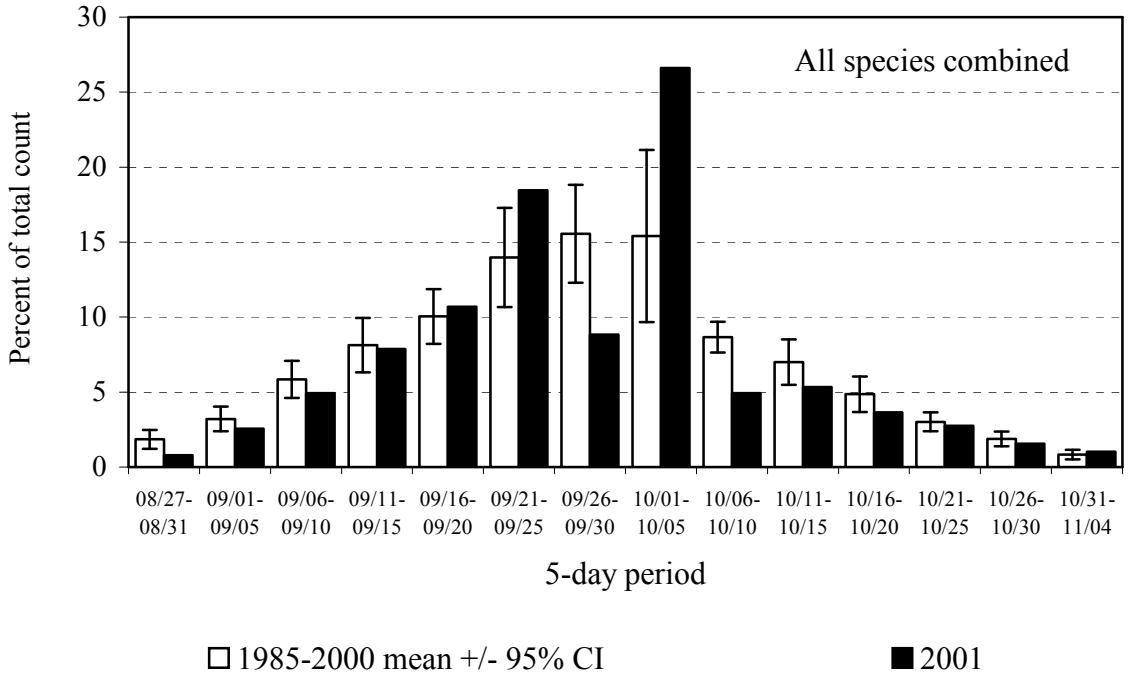

Figure 8. Combined-species, fall-migration passage volume by five-day periods for raptors in the Manzano Mountains, NM: 1985–1999 versus 2001.

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)

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[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: 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	6.17	2.0	0	clr-pc, PM ts	1.4	wsw-wnw	25.4	29.72	1	100	100	2	1.9
28-Aug	4.00	2.0	0	mc, PM ts	1.7	calm-wnw, se	23.7	29.65	1	100	100	2	1.0
29-Aug	9.00	2.2	0	clr-mc	5.4	w-wnw	20.6	29.54	2	96	90	1.5	2.0
30-Aug	5.50	4.9	1	pc-mc, PM ts	2.3	calm/var	18.8	29.60	2	90	82	2.5	0.5
31-Aug	4.00	1.5	0	mc, scat ts	0.6	calm/var	20.2	29.65	3	84	84	-	0.0
1-Sep	9.00	4.1	0	clr-pc	10.4	w	20.9	29.64	2	100	98	1	2.9
2-Sep	9.00	3.9	0	ovc-pc	5.9	sw-nw	21.4	29.64	3	100	94	2	3.3
3-Sep	5.50	4.5	0	clr-pc, PM ts-rain	1.0	calm/sw-w	24.0	29.68	1	84	94	2	1.6
4-Sep	8.00	1.7	0	clr-pc	6.6	ene	21.0	29.71	2	77	72	2	4.8
5-Sep	9.00	2.4	0	clr-pc	5.9	sw-wsw	21.4	29.59	3	80	75	2	1.9
6-Sep	8.25	2.9	0	clr-mc	20.1	sw-w	19.5	29.46	4	100	99	2	9.5
7-Sep	9.00	2.0	0	clr-pc	28.7	w	16.6	29.31	4	100	100	1	2.7
8-Sep	9.00	2.5	0	clr	12.3	w-nw	17.4	29.38	3	100	99	2	5.8
9-Sep	9.00	2.6	0	clr	2.2	wnw-calm/sw	19.9	29.64	1	100	100	2	3.2
10-Sep	9.25	2.4	0	clr/haze	3.1	sw-w	19.5	29.73	1	90	88	2	5.1
11-Sep	9.50	2.0	0	clr-pc	0.9	wsw	18.4	29.76	2	90	90	2	5.5
12-Sep	8.50	2.2	0	clr-ovc, haze, PM rain	7.6	ne	21.0	29.69	3	90	85	2	12.5
13-Sep	0.00			rain									
14-Sep	5.10	3.8	1	mc-ovc	4.5	w-nw	16.4	29.60	4	78	67	2	12.2
15-Sep	9.25	5.4	1	mc-ovc	5.5	sw	19.9	29.61	3	79	86	2	16.0
16-Sep	7.50	3.1	1	clr-ovc, PM ts	4.8	sw-w	17.8	29.58	2	92	84	2	10.7
17-Sep	9.00	1.9	0	clr-pc	6.3	w	15.7	29.59	4	100	99	1	13.1
18-Sep	8.50	2.5	0	clr	9.3	w-wnw	18.1	29.54	3	90	90	2	9.2
19-Sep	9.00	2.4	0	clr-pc	4.8	w	18.8	29.62	3	100	100	2	11.6
20-Sep	9.25	2.6	0	clr-pc	4.3	w-nw	18.4	29.71	2	90	100	2	12.9
21-Sep	9.00	1.9	0	pc-mc	3.6	wsw	20.2	29.68	2	80	100	2	11.9
22-Sep	10.10	3.5	1	clr-mc	5.7	sw-w	19.5	29.64	2	94	100	2	20.0
23-Sep	8.50	3.8	1	clr-pc	5.6	e	18.4	29.76	3	76	89	2	25.8
24-Sep	9.25	2.7	0	clr-pc	1.6	sw-wsw	18.4	29.77	1	78	83	2	24.0
25-Sep	9.10	1.7	0	clr-pc, PM ts	5.7	w	19.7	29.68	2	82	90	2	12.3
26-Sep	9.00	2.4	0	clr	5.2	w	20.0	29.68	2	100	100	1	10.2
27-Sep	8.50	3.3	1.5	clr-pc	1.6	wsw-w	21.1	29.67	1	85	97	2	10.7
28-Sep	9.00	1.8	0	clr	4.5	wnw	20.9	29.67	2	90	92	1	5.9
29-Sep	9.75	3.6	0	clr-pc, haze	3.7	sw-w	19.5	29.71	1	78	80	2	8.7
30-Sep	9.50	5.1	1	clr-ovc, haze	8.0	e-ese	16.6	29.79	4	78	78	2	9.6
1-Oct	9.00	2.8	0	pc-ovc, haze	4.8	e, sw-w	16.9	29.72	3	85	80	3	95.0
2-Oct	8.50	2.0	0	pc-ovc, haze	5.9	sw-w	15.4	29.59	3	79	81	2	11.5
3-Oct	9.00	2.7	0	pc-ovc, scat ts	2.6	sw	18.9	29.60	2	74	85	2	20.0
4-Oct	9.00	2.9	0	clr	10.3	wnw, sw	17.6	29.49	3	94	98	2	6.7
5-Oct	8.50	2.4	0	clr, fog/haze	6.0	wsw, ene	13.2	29.54	4	32	69	2	5.8
6-Oct	8.50	1.9	1	clr-mc, AM haze	6.4	sw	15.0	29.64	2	79	73	2	7.5
7-Oct	9.00	2.5	1	pc-mc	6.9	sw-wsw	14.4	29.63	3	94	95	2	12.0
8-Oct	7.25	2.0	2.5	clr-mc, PM ts	11.2	sw	14.6	29.52	3	100	100	1	5.5
9-Oct	0.00			fog/rain									
10-Oct	6.00	1.4	0	pc-ovc, scat fog/rain	4.6	calm, ene, w	8.0	29.50	4	68	75	2	3.0
11-Oct	9.00	2.2	0	clr-pc	15.4	sw-w	8.5	29.44	3	100	100	2	7.0
12-Oct	7.75	2.0	0	pc-ovc, fog/haze/snow	14.9	nw	4.1	29.23	4	67	67	1	5.9
13-Oct	8.50	2.0	0	clr	20.8	w-nw	9.3	29.27	4	98	98	1	3.6
14-Oct	8.50	2.0	1	clr	19.0	w-wnw	13.5	29.48	4	100	100	1	4.4

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	8.75	2.6	0	clr, PM haze	8.5	nw, ne-se	12.2	29.73	2	100	100	2	8.2
16-Oct	9.00	2.7	0	pc/haze	12.9	sw-w	12.7	29.80	3	75	59	2	5.7
17-Oct	8.50	1.6	0	clr-ovc, haze	13.2	sw-w	14.3	29.66	3	81	74	1	3.2
18-Oct	8.25	2.0	1	clr-pc, haze	9.9	wsw	14.6	29.58	3	81	76	2	5.2
19-Oct	8.50	2.8	0	clr	10.0	wsw-nw	14.6	29.58	3	100	100	1	2.4
20-Oct	9.00	3.0	0	clr-pc	5.6	sw	16.0	29.82	3	100	100	1	3.2
21-Oct	8.75	2.5	1	pc-ovc	3.9	sw	16.9	29.91	2	84	84	2	3.4
22-Oct	4.00	2.4	0	ovc	14.4	nw	10.2	29.77	4	76	72	1	1.8
23-Oct	8.25	2.4	0	clr	26.0	sw-w	12.0	29.62	4	100	100	1	3.9
24-Oct	8.00	1.9	0	clr	19.9	wnw-nw	9.3	29.80	4	100	100	1	4.1
25-Oct	7.75	1.0	0	pc-ovc	4.4	wsw-wnw	12.7	30.08	2	100	100	1	3.4
26-Oct	8.00	1.0	0	pc	0.6	calm, ne	-	-	2	100	100	1.5	4.4
27-Oct	7.75	1.0	0	pc/haze	13.6	ssw-sw	14.3	30.16	3	73	71	1.5	0.9
28-Oct	4.00	1.6	0	pc-mc, haze/scat ts	7.2	sw	18.7	30.10	1	75	70	1	1.8
29-Oct	7.50	2.0	0	pc-mc	8.5	ssw	15.9	30.20	2	80	66	1	2.1
30-Oct	7.50	2.0	0	pc-ovc, haze	15.4	sse-ssw	16.1	30.09	4	71	63	1	1.1
31-Oct	7.00	2.0	0	pc-ovc	21.9	ssw-sw	14.4	29.78	4	91	98	1	3.4
1-Nov	7.25	2.0	0	mc-ovc	14.5	se	9.1	29.79	4	91	91	2	1.4
2-Nov	7.50	2.0	0	clr	3.2	sw-nw	10.4	29.98	1	100	100	1	0.8
3-Nov	7.50	2.0	0	clr-pc	2.2	calm, sw	12.9	30.16	1	100	100	2	0.7
4-Nov	3.25	1.0	0	ovc/fog	2.8	ese	12.8	30.15	4	63	55	2	0.9
5-Nov	0.00			rain/snow									

[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: 2001.

		Species[1]																							Birds
Date	Hours	TV	OS	NH	SS	CH	NG	SA	UA	BW	SW	RT	FH	ZT	UB	GE	BE	UE	AK	ML	PR	PG	UF	UU	Total	/ Hour
27-Aug	6.17	1	0	0	0	4	0	1	0	0	0	4	1	0	0	0	0	0	0	1	0	0	0	0	0	12
28-Aug	4.00	0	0	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	4
29-Aug	9.00	1	0	0	3	5	0	0	0	0	4	3	1	0	0	0	0	0	0	1	0	0	0	0	0	18
30-Aug	5.50	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	3
31-Aug	4.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1-Sep	9.00	1	0	0	3	4	0	0	0	0	3	3	1	0	0	1	0	0	0	6	0	0	2	0	2	26
2-Sep	9.00	5	0	0	6	6	0	0	0	0	2	1	0	0	0	0	0	0	0	10	0	0	0	0	0	30
3-Sep	5.50	1	0	0	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	5	0	0	0	0	0	9
4-Sep	8.00	15	0	0	5	5	0	1	0	0	2	3	0	0	0	0	0	0	0	4	0	0	2	0	1	38
5-Sep	9.00	1	1	0	4	2	0	0	0	0	0	4	0	0	0	0	0	0	0	4	0	0	0	1	0	17
6-Sep	8.25	11	0	1	10	11	0	0	0	0	0	7	0	0	1	0	0	0	0	36	0	0	0	0	1	78
7-Sep	9.00	0	0	0	1	6	0	1	0	0	0	6	0	0	0	0	0	0	0	9	0	0	1	0	0	24
8-Sep	9.00	4	1	0	8	5	0	1	0	0	0	4	0	0	0	0	1	0	0	23	0	3	2	0	0	52
9-Sep	9.00	0	0	0	19	5	0	0	0	0	1	1	0	0	0	0	0	0	0	2	0	0	1	0	0	29
10-Sep	9.25	4	0	1	16	9	0	0	0	0	2	8	0	0	0	0	0	0	0	5	0	1	1	0	0	47
11-Sep	9.50	7	0	0	32	6	0	1	0	0	0	5	0	0	0	0	0	0	0	0	0	0	1	0	0	52
12-Sep	8.50	5	1	2	45	37	0	2	0	0	0	8	0	0	0	0	2	0	0	2	0	0	0	0	2	106
13-Sep	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14-Sep	5.10	4	4	0	9	10	0	3	0	0	3	8	0	0	0	0	0	0	0	17	0	1	3	0	0	62
15-Sep	9.25	2	1	0	53	31	0	3	0	0	1	22	1	0	0	0	0	0	0	29	0	1	3	0	1	148
16-Sep	7.50	2	1	0	19	34	0	0	0	0	0	9	0	0	0	0	0	0	0	13	1	0	1	0	0	80
17-Sep	9.00	6	1	3	24	16	0	0	0	0	0	11	0	0	0	0	1	0	0	49	3	1	3	0	0	118
18-Sep	8.50	2	2	0	13	23	0	0	0	0	0	20	0	0	0	0	1	0	0	16	0	0	1	0	0	78
19-Sep	9.00	1	1	0	28	27	0	2	0	0	0	14	0	0	0	0	1	0	0	27	0	0	3	0	0	104
20-Sep	9.25	4	0	1	30	35	0	5	0	0	2	11	1	0	0	0	1	0	0	25	2	0	1	0	1	119
21-Sep	9.00	9	1	2	29	33	0	1	0	1	1	7	0	0	0	0	3	0	0	19	0	1	0	0	0	107
22-Sep	10.10	29	0	2	37	32	0	3	0	1	13	14	0	0	0	0	1	0	0	64	0	2	4	0	0	202
23-Sep	8.50	5	1	3	49	97	0	15	0	0	4	36	0	0	0	1	2	0	0	2	0	0	3	0	1	219
24-Sep	9.25	0	0	1	27	45	0	0	0	0	59	23	0	0	0	33	0	0	0	32	1	0	0	0	1	222
25-Sep	9.10	0	1	0	39	35	0	14	0	0	1	11	0	0	0	0	1	0	0	8	0	1	1	0	0	112
26-Sep	9.00	8	1	1	18	23	0	2	0	0	4	9	1	0	0	0	3	0	0	18	0	3	0	0	1	92
27-Sep	8.50	0	0	2	16	38	0	3	0	0	0	9	1	0	0	0	1	0	0	17	2	0	0	1	1	91
28-Sep	9.00	8	0	0	9	14	0	1	0	0	0	8	0	0	0	0	1	0	0	7	1	0	4	0	0	53
29-Sep	9.75	6	0	1	27	35	0	0	0	0	0	4	0	0	0	0	5	0	0	7	0	0	0	0	0	85
30-Sep	9.50	0	1	0	30	20	0	5	0	1	0	19	0	0	0	4	3	0	0	1	0	0	6	0	1	91
1-Oct	9.00	5	2	0	22	71	0	7	0	0	648	15	0	0	0	66	1	0	0	9	0	0	7	1	1	855
2-Oct	8.50	4	1	5	14	17	0	2	0	0	0	6	0	0	0	0	1	0	0	40	2	1	4	0	1	98

Appendix D. continued

		Species[1]																								Birds
Date	Hours	TV	OS	NH	SS	CH	NG	SA	UA	BW	SW	RT	FH	ZT	UB	GE	BE	UE	AK	ML	PR	PG	UF	UU	Total	/ Hour
3-Oct	9.00	2	1	2	36	41	0	4	0	2	64	18	0	0	0	0	2	0	0	6	0	0	2	0	0	180
4-Oct	9.00	2	0	0	16	11	0	2	0	0	0	8	0	0	0	0	3	0	0	16	1	0	0	0	1	60
5-Oct	8.50	4	1	2	8	14	0	1	0	0	0	9	0	0	0	1	4	0	0	4	0	0	0	0	1	49
6-Oct	8.50	1	1	0	20	20	0	1	0	1	0	13	0	0	0	0	2	0	0	5	0	0	0	0	0	64
7-Oct	9.00	1	1	1	39	26	2	3	0	0	0	23	0	0	0	0	6	0	0	3	0	0	1	1	1	108
8-Oct	7.25	1	0	1	20	5	0	0	0	0	0	5	0	0	0	0	2	0	0	2	1	2	1	0	0	40
9-Oct	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10-Oct	6.00	0	0	0	9	2	0	0	0	0	0	5	0	0	0	0	0	0	0	1	0	1	0	0	0	18
11-Oct	9.00	0	0	0	30	14	0	0	0	0	0	10	2	0	0	0	5	0	0	0	0	0	2	0	0	63
12-Oct	7.75	0	0	1	12	7	0	2	0	0	0	13	0	0	0	0	7	1	0	0	0	0	1	0	2	46
13-Oct	8.50	0	0	0	11	2	0	0	0	0	0	12	0	0	0	0	5	0	0	1	0	0	0	0	0	31
14-Oct	8.50	0	0	1	13	1	1	0	0	0	0	17	0	0	0	0	3	0	0	0	1	0	0	0	0	37
15-Oct	8.75	0	0	1	12	3	1	0	0	0	0	49	0	0	0	0	3	0	0	1	0	1	1	0	0	72
16-Oct	9.00	0	0	0	15	2	0	0	0	0	0	22	0	0	0	0	8	0	0	0	3	1	0	0	0	51
17-Oct	8.50	0	0	0	16	2	1	0	0	0	0	3	0	0	0	0	3	0	0	1	0	1	0	0	0	27
18-Oct	8.25	0	0	0	19	2	0	0	0	0	0	11	0	0	0	0	7	0	0	2	0	2	0	0	0	43
19-Oct	8.50	0	0	1	8	3	0	0	0	0	0	6	0	0	0	0	1	0	0	0	0	1	0	0	0	20
20-Oct	9.00	0	0	0	9	5	1	0	0	0	0	5	0	0	0	0	4	0	0	4	0	1	0	0	0	29
21-Oct	8.75	0	0	2	13	1	1	0	0	0	0	6	0	0	0	0	4	0	0	2	0	1	0	0	0	30
22-Oct	4.00	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	7
23-Oct	8.25	0	0	0	9	0	0	0	0	0	0	16	0	1	0	0	4	0	0	1	1	0	0	0	0	32
24-Oct	8.00	0	0	0	13	2	0	0	0	0	0	9	0	0	0	0	7	0	0	0	1	1	0	0	0	33
25-Oct	7.75	0	0	0	13	0	0	0	0	0	0	4	0	0	0	0	7	0	0	1	1	0	0	0	0	26
26-Oct	8.00	0	0	0	9	7	2	0	0	0	0	15	1	0	0	0	1	0	0	0	0	0	0	0	0	35
27-Oct	7.75	0	0	0	3	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0	7
28-Oct	4.00	0	0	0	4	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	7
29-Oct	7.50	0	0	0	6	0	0	0	0	0	0	7	0	0	0	0	2	0	0	0	0	1	0	0	0	16
30-Oct	7.50	0	0	0	4	0	0	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0	1	0	0	8
31-Oct	7.00	0	1	0	5	0	1	0	0	0	0	16	0	0	0	0	1	0	0	0	0	0	0	0	0	24
1-Nov	7.25	0	0	0	6	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	10
2-Nov	7.50	0	0	0	1	0	1	0	0	0	0	3	0	0	0	0	1	0	0	0	0	0	0	0	0	6
3-Nov	7.50	0	0	0	1	0	2	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	5
4-Nov	3.25	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	3
Total	545.47	164	26	37	1032	913	13	86	0	6	815	632	10	1	1	106	128	1	0	560	21	28	63	5	20	4668

[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: 1985–2001.

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	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	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	2-Nov
Days of observation	50	63	65	60	63	62	67	70	68	66	70	59	68	65	70	57	68	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	501.15
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	1034.9
SPECIES										COUNTS								
Turkey Vulture	74	118	283	466	178	295	176	268	601	430	636	640	563	1116	637	241	164	405
Osprey	10	14	19	13	22	12	24	26	31	38	53	33	47	44	14	25	26	27
Northern Harrier	28	36	78	78	59	27	66	69	48	97	72	64	69	133	69	38	37	63
Sharp-shinned Hawk	956	1300	1622	1118	1834	688	1080	1540	1193	1415	1519	2174	1872	2585	1212	1698	1032	1461
Cooper's Hawk	531	881	679	604	929	471	1105	961	944	1054	907	1205	1018	2025	1069	984	913	958
Northern Goshawk	21	20	7	6	14	3	8	16	27	30	11	9	9	19	14	42	13	16
Unknown small accipiter[1]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	86	-
Unknown large accipiter[1]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	-
Unknown accipiter	78	104	119	111	121	120	156	117	266	118	44	147	76	107	51	29	0	-
TOTAL ACCIPITERS	1586	2305	2427	1839	2898	1282	2349	2634	2430	2617	2481	3535	2975	4736	2346	2753	2044	2543
Broad-winged Hawk	2	2	7	10	5	2	5	5	1	7	7	4	5	14	12	3	6	5.7
Swainson's Hawk	27	33	44	3	16	9	58	344	7301	67	32	867	679	572	194	19	815	652
Red-tailed Hawk	513	527	457	486	604	329	577	667	566	707	519	771	803	1151	733	591	632	625
Ferruginous Hawk	14	15	17	20	16	13	19	25	17	13	13	4	13	10	8	3	10	14
Rough-legged Hawk	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	0	1	0.3
Zone-tailed Hawk	0	0	0	0	0	0	0	2	0	1	1	0	1	2	0	3	1	1
Unknown buteo	21	12	11	16	4	19	30	11	31	22	9	11	3	28	5	2	106	20
TOTAL BUTEOS	577	589	536	536	646	372	689	1054	7916	817	581	1657	1504	1778	953	621	1571	1317
Golden Eagle	133	123	86	67	85	52	124	119	120	172	136	151	145	115	159	115	128	119
Bald Eagle	2	0	1	1	3	4	7	4	7	9	4	0	3	4	3	5	1	3
Unknown Eagle	0	0	0	4	0	4	0	0	0	0	0	0	0	0	0	1	0	0.5
TOTAL EAGLES	135	123	87	72	88	60	131	123	127	181	140	151	148	119	162	121	129	123
American Kestrel	421	755	426	385	677	409	728	704	520	582	584	905	455	742	525	397	560	575
Merlin	2	16	17	12	18	9	10	28	24	24	42	48	42	56	14	27	21	24
Prairie Falcon	13	7	8	12	19	9	14	17	27	22	18	19	19	58	38	30	28	21
Peregrine Falcon	14	15	7	10	15	5	21	18	31	37	49	60	67	116	64	49	63	38
Unknown small falcon[1]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	-
Unknown large falcon[1]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	-
Unknown falcon	4	0	1	0	3	5	3	1	0	1	0	1	0	12	2	1	5	-
TOTAL FALCONS	454	793	459	419	732	437	776	768	602	666	693	1033	583	984	643	504	677	660
Unknown raptor	31	35	40	76	56	41	120	142	140	71	8	24	15	11	11	4	20	50
TOTAL	2895	4013	3929	3499	4679	2526	4331	5084	11895	4917	4664	7137	5904	8921	4835	4307	4668	5188

[1] New designations in 2001.

Appendix F. Daily trapping effort and capture totals of migrating raptors by species in the Manzano Mountains, NM: 2001.

Date	Station Hours	Species[1]											Total	Captures / stn hr
		NH	SS	CH	NG	SW	RT	GE	AK	ML	PR	PG		
1-Sep	6.50	0	2	1	0	0	0	0	0	0	0	0	3	0.5
2-Sep	14.50	0	3	0	0	0	0	0	0	0	1	0	4	0.3
3-Sep	12.00	0	0	1	0	0	0	0	0	0	0	0	1	0.1
4-Sep	7.00	0	3	2	0	1	0	0	1	0	0	1	8	1.1
5-Sep	17.00	0	1	1	0	0	1	0	1	0	0	0	4	0.2
6-Sep	14.00	0	1	1	0	0	0	0	4	0	0	0	6	0.4
7-Sep	19.00	0	2	2	0	0	1	0	0	0	0	0	5	0.3
8-Sep	14.20	0	5	2	0	0	0	0	0	0	0	2	9	0.6
9-Sep	24.00	0	16	4	0	0	0	0	1	0	0	0	21	0.9
10-Sep	22.10	0	10	5	0	0	1	0	3	0	1	0	20	0.9
11-Sep	22.75	0	19	9	0	0	1	0	0	0	1	2	32	1.4
12-Sep	20.50	0	8	11	0	0	0	0	0	0	0	0	19	0.9
13-Sep	17.50	0	1	0	0	0	0	0	0	0	0	0	1	0.1
14-Sep	6.75	0	5	2	0	0	0	0	2	0	1	0	10	1.5
15-Sep	8.00	0	24	11	0	0	1	0	3	0	0	0	39	4.9
16-Sep	21.00	0	18	13	0	0	0	0	3	0	0	0	34	1.6
17-Sep	24.90	1	17	7	0	0	1	0	5	0	1	2	34	1.4
18-Sep	22.50	0	8	7	0	0	2	0	0	0	0	0	17	0.8
19-Sep	19.45	0	16	17	0	0	2	0	4	0	1	0	40	2.1
20-Sep	23.25	0	11	13	0	0	0	0	4	1	0	1	30	1.3
21-Sep	22.00	1	18	13	0	0	1	0	4	0	0	1	38	1.7
22-Sep	23.00	1	6	10	0	0	1	0	7	0	0	0	25	1.1
23-Sep	20.50	1	12	28	0	0	1	0	0	0	0	1	43	2.1
24-Sep	23.25	0	17	24	0	0	3	0	2	0	0	0	46	2.0
25-Sep	20.25	0	14	17	0	0	0	0	0	0	0	0	31	1.5
26-Sep	24.00	0	11	11	0	0	4	0	4	0	0	0	30	1.3
27-Sep	24.50	0	6	12	0	0	1	0	0	0	0	0	19	0.8
28-Sep	24.50	0	4	11	0	0	2	0	0	0	0	0	17	0.7
29-Sep	24.75	1	14	13	0	0	0	0	0	0	0	0	28	1.1
30-Sep	23.25	0	9	9	0	0	0	0	0	0	0	0	18	0.8
1-Oct	22.25	0	7	17	0	0	1	0	0	0	0	0	25	1.1
2-Oct	24.50	0	7	6	0	0	1	0	4	1	0	0	19	0.8
3-Oct	25.00	1	16	7	0	0	1	0	1	0	0	0	26	1.0
4-Oct	25.00	0	6	6	0	0	0	2	0	0	0	0	14	0.6
5-Oct	17.00	0	4	2	0	0	0	0	0	0	0	0	6	0.4
6-Oct	22.50	0	10	12	0	0	0	0	0	0	0	0	22	1.0
7-Oct	24.25	0	16	9	0	0	0	1	1	0	0	0	27	1.1
8-Oct	22.75	0	6	4	0	0	0	0	1	0	0	0	11	0.5
9-Oct	4.25	0	1	0	0	0	0	0	0	0	0	0	1	0.2
10-Oct	11.50	0	4	1	0	0	0	0	0	0	0	0	5	0.4
11-Oct	22.50	0	10	7	0	0	1	1	1	0	0	0	20	0.9
12-Oct	20.50	0	5	1	0	0	0	0	0	0	0	0	6	0.3
13-Oct	20.25	0	2	0	0	0	1	0	0	0	0	0	3	0.1
14-Oct	15.50	0	5	0	0	0	1	0	0	0	0	0	6	0.4
15-Oct	22.50	0	6	0	0	0	3	1	0	0	0	0	10	0.4
16-Oct	22.00	0	9	0	0	0	2	0	0	0	0	0	11	0.5
17-Oct	17.00	0	6	2	0	0	0	0	0	0	0	0	8	0.5
18-Oct	21.50	0	8	0	0	0	0	0	0	0	0	0	8	0.4
19-Oct	20.75	0	2	1	0	0	0	0	0	0	0	0	3	0.1
20-Oct	20.50	0	2	3	0	0	1	0	0	0	0	0	6	0.3
21-Oct	20.25	1	4	1	1	0	1	0	0	0	1	0	9	0.4
22-Oct	18.25	0	2	0	0	0	0	0	0	0	0	0	2	0.1
23-Oct	14.00	0	1	1	0	0	2	0	0	0	0	0	4	0.3
24-Oct	7.75	0	2	0	0	0	0	0	0	0	0	0	2	0.3
25-Oct	7.50	0	4	0	0	0	1	0	0	0	0	0	5	0.7
Total	1036.65	7	426	337	1	1	39	5	56	2	7	10	891	0.9

[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: 1990–2001.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	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		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		24-Oct
Blinds in operation	1	3	3	3	3	4	4	4	3	3	3	3		3.1
Trapping days	47	54	57	50	48	53	45	54	58	46	50	55		51.4
Station days	47	95	131	120	121	136	132	151	165	94	119	145		121.3
Station hours	511	693	967	889	926	1041	1030	1211	1352.58	663.75	791.42	1036.65		926.0
SPECIES	RAPTOR CAPTURE TOTALS													
Northern Harrier	1	2	2	3	9	2	1	8	14	0	5	7	54	4.5
Sharp-shinned Hawk	124	262	589	430	502	493	778	612	987	321	495	426	6019	501.6
Cooper's Hawk	95	195	335	374	353	310	460	427	772	323	330	337	4311	359.3
Northern Goshawk	1	7	6	6	7	1	5	3	6	6	16	1	65	5.4
Broad-winged Hawk	0	0	0	0	0	0	0	0	1	0	0	0	1	0.1
Swainson's Hawk	0	0	0	0	0	0	0	0	0	0	0	1	1	0.1
Red-tailed Hawk	8	18	61	55	83	50	50	46	112	56	76	39	654	54.5
Zone-tailed Hawk	0	0	0	0	0	0	0	0	1	0	0	0	1	0.1
Golden Eagle	1	3	4	4	4	4	6	4	5	2	4	5	46	3.8
American Kestrel	10	13	42	14	59	28	92	32	75	44	25	56	490	40.8
Merlin	1	0	2	4	1	1	11	6	7	2	8	2	45	3.8
Prairie Falcon	1	1	3	5	3	1	3	5	13	6	3	7	51	4.3
Peregrine Falcon	2	1	2	1	4	2	5	7	12	8	1	10	55	4.6
All Species	244	502	1046	896	1025	892	1411	1150	2005	768	963	891	11793	982.8
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	1229.0	102.4
Recaptures[1]	0	0	1	1	2	2	1	2	4	4	3	2	22	1.8
Foreign recaptures[2]	2	1	1	1	2	0	5	1	2	2	0	0	17	1.4
Foreign encounters[3]	0	2	2	3	6	6	7	8	13	12	6	7	72	6.0

[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.