SPRING 2002 RAPTOR MIGRATION STUDIES IN THE SANDIA MOUNTAINS OF CENTRAL NEW MEXICO

HawkWatch International, Inc.
Salt Lake City, Utah

June 2002

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June 2002

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INTRODUCTION

The Sandia Mountains raptor migration study in north-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. in press). HawkWatch International (HWI)—and its organizational precursors—initiated standardized counts of the spring raptor migration through this region in 1985, and began a trapping and banding program at the project site in 1990. To date, HWI observers have recorded 21 species of migratory raptors at the site, with counts typically ranging between 3,000 and 8,000 migrants per season. The 2002 season marked the 18th consecutive count and the 13th consecutive season of trapping and banding conducted at the site. This report summarizes the 2002 count and banding results.

The Sandia project was 1 of 16 long-term, annual migration counts (13 fall, 3 spring) and 1 of 7 migration banding studies (6 fall, 1 spring) conducted or co-sponsored by HWI in North America during 2002. 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 (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, 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, migratory behavior, population demographics, mortality factors and longevity, morphometric variation, molt sequences and timing, and health assessments. 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 Sandia 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 Sandia Mountains form a 41-km long ridge that runs north–south just east of Albuquerque in north–central New Mexico (35° 05′ N, 106° 26′ W; Figure 1). The study site is located at the southern end of the range within the Sandia Wilderness Area of the Cibola National Forest (Sandia Ranger District). The site is about 3 km north of Interstate 40 and Tijeras Canyon, and 18 km east of downtown Albuquerque. The site is reached by a steep, 2.5-km spur trail that originates at the U.S. Forest Service Tres Pistolas Canyon fence. The observation post, located at 2,196 m elevation, provides an expansive view of the Manzano Mountains to the south, the western plains, and northern Tres Pistolas Canyon. This season, one banding station (Upper Station) was situated 1.0 km east of the main observation post.

One–seeded juniper (*Juniperus monosperma*), mountain mahogany (*Cercocarpus montanus*), shrub live oak, (*Quercus turbinella*), tree cholla (*Opuntia imbricata*), and banana yucca (*Yucca baccata*) are the predominant plant species near the lookout, which is typical of the Upper Sonoran life zone. Ponderosa pine (*Pinus ponderosa*) and Gambel oak (*Quercus gambelii*) also occur at higher elevations.

METHODS

STANDARDIZED COUNTS

Two official or designated observers conducted standardized daily counts of migrating raptors from a single traditional observation site between 22 February and 3 May 2002. Before spring 2002, primary observers Craig Fosdick and Rigo Mendoza had six and two seasons, respectively, of previous experience counting migratory raptors (see Appendix A for a complete history of observer participation). Primary observer Geoff Evans, who filled in until Rigo arrived, had one previous full season of experience, plus had assisted with the Sandia count during several previous seasons. Visitors also frequently assisted with spotting migrants. Weather permitting, observations usually began between 0800 and 0900 hrs Mountain Standard Time (MST) and ended between 1700 and 1800 hrs.

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 assist in spotting and identifying birds. Clark and Wheeler (1987), Dunne et al. (1988), Wheeler and Clark (1995), and Clark 2001 served as primary identification references. Assessments of wind speed, cloud type, cloud cover, and flight altitude followed guidelines provided 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).

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. 1990), and both have varied in the Sandias 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. (1990). 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 1985–2002: 24 February – 5 May.

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 fall 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, 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 conducting 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 2002 annual statistics against means ± 95% confidence intervals (CI) for previous seasons, in which case I equate significance with a 2002 value falling outside of the CI for the associated mean. I also limit most comparisons of age and sex statistics to 2002 values versus means for 1992–2001, 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 1985–2002. 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

Two to four trappers operated a single traditional trapping station (Upper Station) from 10 March through 27 April, which is a typical period for the site. Weather permitting, the station was generally operated from approximately 0900–1700 hrs MST. Capture devices included mist nets, remotely triggered bow nets, and dho-gaza nets (Bloom 1987). Trappers lured migrating raptors into the capture station from a camouflaged blind 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. In 2002, Upper Station consisted of 4 standard bow nets, 1 mist net, and 1 dho-gaza, with 1–3 pigeon, 1 sparrow, and 1–2 dove lures standard. 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. All birds were released usually within 15 minutes, but within a maximum of 45 minutes from the time of capture.

RESULTS AND DISCUSSION

WEATHER SUMMARY

Compared to the last four seasons (the extent for which detailed comparisons are currently possible), 2002 featured a low proportion of days severely hampered by inclement weather, with only three days of observations entirely precluded (compared to the 1998–2001 average of 5 days) and only one other day reduced to less than four hours of observation (1998-2001 average of 4 days) because of the weather (see Appendix C for daily weather summaries). The weather during active observation days also tended to be fairer than during the previous years: 54% predominantly fair skies, 30% transitional weather [i.e., conditions changed from fair to mostly cloudy or overcast during the day, or vice versa], and 16% predominantly mostly cloudy to overcast skies, compared to 1998–2001 averages of 49%, 24% and 28%. The number of active days that included some rain or snow (15%) also was slightly lower than 1998–2001 average of 19%. However, 40% of the active observation days featured some visibility-reducing fog or especially haze, which is considerably higher than the previous four-year average of 22%. In 2002, 75% of the active observation days featured predominantly light winds (<12 kph), 25% moderate winds (12–28 kph), and none predominantly stronger winds, which compared to the previous four seasons is slightly skewed towards lighter winds (1998–2001 averages of 73%, 23%, and 4%). Compared to the last four seasons, 2002 also featured a unique array of predominant wind directions: 3% of days with primarily NW to NE winds, 25% W to NW, 34% SW to NW, 18% SW to W, 5% SE to SW, 2% E to SE, and 13% variable (1998–2001 averages of 22%, 19%, 13%, 7%, 8%, 11%, and 15%, plus 5% of days where the winds switched during the day from predominantly SW-NW to NE-SE). The temperature during active observation periods averaged 13.7°C (the average of daily values, which in turn were averages of hourly readings), ranging from 0.7–22.2°C, which is the warmest average recorded during the last five seasons (previous range 9.1–13.3°C). Thirteen percent of the active observation days received a median (of hourly ratings) thermal-lift rating of fair to poor and 87% good to excellent; compared to the 1998–2001 averages (47% and 53%), these values are highly skewed toward strong thermal conditions.

In summary, compared to the previous four seasons, 2001 featured less stormy weather, lighter winds, substantially fewer days with predominantly northerly or easterly winds and more with westerly winds, warmer temperatures, and substantially greater thermal lift.

OBSERVATION EFFORT

The observers worked on 67 of 71 possible days between 22 February and 3 May (Table 1). The number of observation days and hours (527.8) were 4% and 1% lower, respectively, than the 1985–2001 averages of 70 ± 95% CI of 3.4 days and 530.6 ± 95% CI of 27.45 hours. The 2001 average of 2.3 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 1985–2001 average of 2.0 ± 95% CI of 0.15 observers/hr.

FLIGHT SUMMARY

The observers counted 3,293 migrant raptors of 18 species during the 2002 season (see Appendix D for daily count records and Appendix E for annual summaries). The count of Ferruginous Hawks matched the previous record low set in 1999 (Appendix E).

The 2002 flight was composed of 37% vultures, 27% accipiters, 12% buteos, 11% eagles, 9% falcons, 1% Ospreys, 2% harriers, and 1% unidentified raptors. These values represent significantly lower than average proportions of accipiters and Ospreys, and significantly above average proportions of vultures, buteos, eagles, and falcons (Figure 2). The Turkey Vulture was the most abundant species, followed by Cooper's Hawk, Sharp-shinned Hawk, Golden Eagle, Red-tailed Hawk, and American Kestrel (Table 1).

Adjusted passage rates were significantly above average for only 3 of 18 species seen this season (Swainson's Hawk, Rough-legged Hawk, and Peregrine Falcon), significantly below average for 8 species (Osprey, Sharp-shinned Hawks, Cooper's Hawks, Northern Goshawks, Ferruginous Hawks, Bald Eagle, Merlin, and Prairie Falcon), and not significantly different from average for the remaining 7 species (Table 1, Figures 3–7).

The 1985–2002 regression analyses showed significant to highly significant linear increasing trends in adjusted passage rates for Turkey Vultures (Figure 3), Broad-winged Hawks, Swainson's Hawks (Figure 5), Merlins, and Peregrine Falcons (Figure 7); a marginally significant linear decreasing trend for Northern Goshawks overall, reflecting primarily a significant decline among adults (Figure 4); a highly significant quadratic trend for Ospreys tracking a strong increasing trend through 1998 but a pronounced decline thereafter (Figure 3); a marginally significant quadratic trend for Cooper's Hawks tracking an increasing pattern through 1993 but a gradual decline thereafter (Figure 4); and no significant long-term trends for all other species. It also is important to note that, although the pattern was statistically confirmed by quadratic trends only for Ospreys and Cooper's Hawks, most species have shown some degree of downturn since 1997/1998 when prolonged drought and extensive wildfires began to plague much of the interior West. This pattern is now apparent for most species at all of HWI's long-term monitoring sites in the interior West. Thus, although the greater prevalence of strong thermal lift during the 2002 season may have dispersed the flight more than usual and reduced the detectability of migrants, the generally low passage rates seen this season are consistent with evidence of widespread, drought-related population declines.

Eight of 10 species with sufficient data for comparison showed below average immature : adult ratios in 2002, with the differences significant for Northern Harriers, Sharp-shinned, Cooper's, and Red-tailed Hawks, and Peregrine Falcons (Table 2). Moreover, except for Broad-winged and Ferruginous Hawks, the lower ratios reflect substantial reductions in the abundances of young birds. Even for Bald Eagles and Northern Goshawks, which showed significantly above average age ratios, the higher ratios were due

primarily to fewer adults rather than more young birds. The generally low age ratios match the pattern documented during fall 2001 in the nearby Manzano Mountains (Smith 2002) and provide additional evidence of drought-related reductions in productivity and juvenile recruitment.

Twelve of 15 species common enough to allow for comparisons showed earlier than average median passage dates in 2002, with the differences significant for six species (Turkey Vulture, Northern Harrier, Ferruginous Hawk, Golden Eagle, Prairie Falcon, and Peregrine Falcon). Conversely, only Sharp-shinned Hawks showed late timing (Table 3). The combined-species median passage date of 2 April also was a significant 4 days earlier than average (Table 3) and plotting flight volume by five-day periods confirmed higher than average relative volume during all but one period prior to April and lower than average volume during all but one five-day period thereafter (Figure 8). Examination of age-specific median passage dates further suggested that the pattern of early timing applied most strongly to immature birds of all species except Peregrine Falcons (Table 4). Reasons for this pattern are unclear, but may include fair weather enabling faster travel speeds and /or warmer weather leading to earlier breeding and territoriality among resident birds on wintering grounds (thus increasing pressure on winter residents, especially late-departing immature birds, to avoid competition with territorial, resident breeders by departing earlier than usual).

NON-NORTHBOUND MIGRANTS

The observers recorded as migrants 1 eastbound American Kestrel, 1 southbound Golden Eagle, 1 southeast-bound Red-tailed Hawk, and 1 southwest-bound Ferruginous Hawk.

TRAPPING EFFORT

The trapping and banding crew operated Upper Station for 320.8 hours on 45 days between 10 March and 27 April (see Appendix F for daily effort and capture totals by species). This is an average amount of effort for the project (see Appendix G for annual summaries).

TRAPPING AND BANDING SUMMARY

The 2002 capture total of 254 birds included 7 species, 253 newly banded birds and 1 recapture of a bird previously banded by HWI during fall migration in the Manzano Mountains (Table 5, Appendix G). The 2002 effort raises the total number of birds captured since project inception to 3,161 of 12 species, including 24 Sandia recaptures and 27 foreign recaptures (i.e., birds originally banded elsewhere and subsequently recaptured in the Sandias; Appendix G). The most commonly captured species were the Cooper's Hawk (76% of all captures), Sharp-shinned Hawk (13%), American Kestrel (6%), and Red-tailed Hawk (3%). Each of the remaining five species accounted for less than 2% of the total. The most noteworthy capture was an after-hatch-year Zone-tailed Hawk; only the second individual of this species ever captured at the site.

The 2002 combined-species capture total and capture rate were slightly below average, whereas capture success was significantly above average (Table 5). Among commonly captured species, all measures of capture efficiency were equal to or above average for Cooper's Hawks, Northern Goshawks, Prairie Falcons, and American Kestrels, whereas the opposite was true for Northern Harriers, Sharp-shinned Hawks, Merlins, and Peregrine Falcons. For Red-tailed Hawks, the capture total and rate were slightly below average, whereas capture success was slightly above average. Thus, few consistent multi-species capture trends were evident. There also was little consistency in relation to the observed count trends.

Compared to the counts, banding at this site yields unique and substantial sex–age specific data only for Sharp-shinned and Cooper's Hawks, and to a lesser degree American Kestrels. For Sharp-shinned and

Cooper's Hawks, the 2002 and long-term average second-year (SY) : after-second-year (ASY) capture ratios showed the same patterns (Table 6; significantly below average in 2002 for both species) as the age ratios derived from the count data (Table 2). The capture statistics further indicated that all sex-age classes of Sharp-shinned Hawks were captured in below average numbers in 2002, whereas for Cooper's Hawks this was true only for SY females (Table 6). In terms of capture sex ratios, both Sharp-shinned and Cooper's Hawks showed near average values. Examination of condition indices (i.e., keel muscle mass, wing-pit fat load, and proportions of birds with food in their crops) indicated that the Sharp-shinned Hawks captured in 2002 averaged slightly emptier crops and slightly leaner than in previous years. The same was true for Cooper's Hawks, but to a lesser degree.

For American Kestrels, the capture statistics uniquely indicated that SY females and after-hatch-year (AHY) males were captured 5 and 2.5 times more frequently than average, whereas the capture totals for other sex-age classes were close to average (Table 6). This resulted in a significantly above average SY : ASY ratio and a slightly below average female : male ratio. Condition indices indicated a similar pattern as for the two accipiters.

ENCOUNTERS WITH PREVIOUSLY BANDED BIRDS

During the 2002 season, the trappers captured one previously banded adult female Cooper's Hawk. HWI trappers originally banded this bird in 1998 during fall migration in the nearby Manzano Mountains as an AHY bird. This brings the total number of Sandia–Manzano exchanges to 36, all involving Sharp-shinned and Cooper's Hawks.

To date, 7 Sandia-banded Cooper's Hawks, 3 Sharp-shinned Hawks, 1 Red-tailed Hawk, and 1 Prairie Falcon have subsequently been encountered elsewhere outside of the Manzano Mountains. Additions since our last annual report include two Cooper's Hawks and the Prairie Falcon. One of the new Cooper's Hawks was a female banded as an ASY adult in 1993 and recovered dead of unknown causes in May 2001 about 1300 km NW of the banding site near Challis, Idaho. The other new Cooper's Hawk was a female banded as an ASY adult in 1998 and recovered, most likely starved to death, in January 2002 about 890 km south of the banding site in Durango, Mexico. The Prairie Falcon was a male banded as an ASY adult in 1998 and recovered in January 2002 with a broken wing 11 km from the banding site near Corrales, New Mexico; this bird was subsequently euthanized at a local rehabilitation facility.

RESIDENT BIRDS

The 2002 resident raptor community included a typical assemblage for the site. A territorial pair of Golden Eagles was seen throughout the season, often escorting other migrant eagles out of the area. Frequent observations of apparent food deliveries to one nest site on the Sandia "shields" suggested that the pair produced at least one nestling this year. During early April, it appeared that a pair of Peregrine Falcons, also commonly seen in 2001, sought to establish a territory at a known, nearby Prairie Falcon eyrie. The Golden Eagle pair frequently harassed the falcons and after mid-April only single peregrines were infrequently seen. The decline in peregrine observations may have reflected the female attending a nest, but the observers wondered if the eagles might not have injured or killed one of the peregrines. In early March, a male Prairie Falcon also spent some time in the area, perhaps looking for a territory, but did not remain.

As is typical for the site, at least two light-morph, adult Red-tailed Hawks were frequently seen hunting below and to the east of the observation site in the Tijeras Canyon area. Beginning in early April and continuing through early May, Cooper's Hawks were occasionally seen performing courtship displays near the site, with an apparent pair seen together on three occasions. Single Sharp-shinned Hawks were seen twice hunting the area in late February and a single American Kestrel was seen hunting the area in

late March; however, these observations may have involved transient individuals using the area as a stopover site.

SITE VISITATION

In 2002, 447 individuals visited the project site and signed the visitor logs, which was about the same as last year. The visitors included 12 organized groups involving 140 individuals from eight elementary and high school classes, the College of Santa Fe, and three family/community groups. For most of the school groups, previous visits by HWI classroom educator Adam Behr translated to noticeable enthusiasm among the kids during the site visit.

In 2002 at the Sandias, 560 hourly assessments of visitor disturbance resulted in the following ratings: 79% none, 19% low, 2% moderate, and <1% high. We consider this proof positive that on-site educator, Amy Eberhart, did an excellent job of chaperoning visitors in a way that both provided them with a rich experience and largely precluded unnecessary distraction of the observers.

ACKNOWLEDGMENTS

Funding for the 2002 Sandia season was provided by the USDA Forest Service, Cibola National Forest and Southwestern Region; the New Mexico Department of Game and Fish, Share with Wildlife Program; the U. S. Fish and Wildlife Service, Region 2; Intel Corporation; New Belgium Brewing Company; the Central New Mexico Audubon Society; and HWI members. We are very grateful for the continued support of these agencies, organizations, and individuals. We thank Wild Oats Markets (Menaul, San Mateo, and Carlisle stores) and Albertsons for their generous donations of food and supplies, which helped sustained our field crews. We also extend our heartiest thanks to the following individuals for their assistance in setting up the trapping station, helping with observations, and generally helping to keep the crews happy and make the operation a success: Chris and John Acklen, Art Arenholz, Adam Behr, Pat Brady, Seamus Breslin, Devon Corbet, Steve de la Peña, John DeLong, Zane Dohner, Geoff Evans, Helen Haskell, Holly Hiser, Jim Keleman, Jeanette Kelly, Claire Lamos, Walt and Jennifer Lehman, Maurice Mackey, Lise Maggio, Tim Meehan, Annie, Pete and Tim Newsted, Bill Ostheimer, Robert Pasztor, Brenda Prosett, Bob Schwaller, Debby Serabia, Ruthie Smith, Beth Hurst-Waitz, and Richard Wood.

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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 Sandia Mountains, NM: 1985–2001 versus 2002.

	COUNTS			RAPTORS / 100 HOURS[1]		
SPECIES	1985–2001[2]	2002	% CHANGE	1985–2001[2]	2002	% CHANGE
Turkey Vulture	1424 ± 306.9	1227	-14	453.2 ± 96.48	445.0	-2
Osprey	65 ± 14.4	38	-41	22.2 ± 4.87	15.8	-29
Northern Harrier	59 ± 7.5	55	-7	13.2 ± 1.68	12.6	-4
White-tailed Kite	0.1 ± 0.12	0	-100	0.01 ± 0.03	0.0	-100
Mississippi Kite	0.2 ± 0.19	0	-100	0.04 ± 0.04	0.0	-100
TOTAL KITES	0.2 ± 0.27	0	-100	–	–	–
Sharp-shinned Hawk	537 ± 127.8	337	-37	128.3 ± 27.68	86.3	-33
Cooper's Hawk	820 ± 143.9	506	-38	235.7 ± 36.95	152.5	-35
Northern Goshawk	11 ± 3.1	7	-37	2.3 ± 0.65	1.4	-40
Unknown small accipiter[3]	0.0 ± 0.0	8	–	–	–	–
Unknown large accipiter[3]	0.1 ± 0.1	1	–	–	–	–
Unknown accipiter	78 ± 19.8	16	–	–	–	–
TOTAL ACCIPITERS	1446 ± 216.8	875	-39	–	–	–
Broad-winged Hawk	6 ± 3.1	4	-36	1.4 ± 0.69	0.9	-32
Swainson's Hawk	50 ± 8.9	54	+8	18.6 ± 2.92	24.8	33
Red-tailed Hawk	342 ± 55.2	321	-6	76.9 ± 10.42	70.2	-9
Ferruginous Hawk	13 ± 2.1	7	-46	2.8 ± 0.45	1.4	-49
Rough-legged Hawk	0.4 ± 0.29	1	+143	0.2 ± 0.16	0.4	105
Zone-tailed Hawk	2.3 ± 1.17	3	+31	0.5 ± 0.25	0.6	25
Unidentified buteo	12 ± 4.9	1	-92	–	–	–
TOTAL BUTEOS	424 ± 65.4	388	-8	–	–	–
Golden Eagle	351 ± 78.2	366	+4	70.4 ± 14.43	71.0	1
Bald Eagle	16 ± 3.9	12	-23	4.3 ± 1.01	3.1	-28
Unidentified eagle	0.8 ± 0.66	0.0	-100	–	–	–
TOTAL EAGLES	367 ± 80.5	378	+3	–	–	–
American Kestrel	207 ± 45.7	205	-1	54.4 ± 10.95	60.3	11
Merlin	9 ± 3.6	5	-45	2.1 ± 0.82	1.2	-43
Prairie Falcon	24 ± 5.0	16	-32	4.5 ± 0.94	3.1	-31
Peregrine Falcon	34 ± 12.2	52	51	6.7 ± 2.39	10.4	55
Aplomado Falcon	0.1 ± 0.12	0	-100	0.01 ± 0.02	0.0	-100
Unknown small falcon[3]	0.1 ± 0.12	0	–	–	–	–
Unknown large falcon[3]	0.0 ± 0.00	0	–	–	–	–
Unknown falcon	3 ± 1.1	2	–	–	–	–
TOTAL FALCONS	276 ± 58.6	280	+1	–	–	–
Unidentified raptor	45 ± 17.0	49	+8	–	–	–
GRAND TOTAL	4109 ± 646.7	3293	-20	–	–	–

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

[2] Mean ± 95% CI.

[3] Designations used regularly for the first time in 2002.

Table 2. Annual raptor migration counts by age classes and second-year (SY) : after-second-year (ASY) age ratios for selected species in the Sandia Mountains, NM: 1992–2001 versus 2002.

	Total and Age-classified Counts								SY : ASY Ratio	
	1992–2001 Average			2002			% Unknown Age			
	Total	SY	ASY	Total	SY	ASY	1992–2001[1]	2002	1992–2001[1]	2002
Northern Harrier	61	12	31	55	5	44	29 ± 4.8	11	0.41 ± 0.222	0.11
Sharp-shinned Hawk	601	66	318	337	17	215	36 ± 5.9	31	0.22 ± 0.057	0.08
Cooper's Hawk	914	80	587	506	11	334	28 ± 8.3	32	0.15 ± 0.037	0.03
Northern Goshawk	11	3	7	7	2	3	21 ± 13.1	29	0.39 ± 0.151	0.67
Broad-winged Hawk	9	<1	6	4	0	4	28 ± 14.7	0	0.03 ± 0.049	0.00
Red-tailed Hawk	393	68	265	321	20	271	15 ± 3.7	9	0.28 ± 0.098	0.07
Ferruginous Hawk	14	1	5	7	1	4	59 ± 10.5	29	0.61 ± 0.961	0.25
Golden Eagle	401	208	127	366	194	128	15 ± 3.6	12	1.80 ± 0.566	1.52
Bald Eagle	16	8	7	12	9	3	7 ± 7.4	0	1.35 ± 0.522	3.00
Peregrine Falcon	50	13	26	52	6	44	21 ± 10.2	4	0.50 ± 0.185	0.14

[1] Mean ± 95% confidence interval. For age ratios, note that the long-term mean SY : ASY ratio is an average of annual ratios and may differ from the value obtained by dividing long-term average numbers of SY and ASY birds. 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 Sandia Mountains, NM in 2002, with a comparison of 2002 and 1985–2001 average median passage dates.

	2002				1985–2001
Species	First Observed	Last Observed	Bulk Passage Dates[1]	Median Passage Date[2]	Median Passage Date[2, 3]
Turkey Vulture	14-Mar	29-Apr	26-Mar – 12-Apr	1-Apr	4-Apr ± 1.6
Osprey	29-Mar	3-May	1-Apr – 24-Apr	12-Apr	12-Apr ± 1.6
Northern Harrier	7-Mar	29-Apr	23-Mar – 17-Apr	2-Apr	6-Apr ± 1.8
Sharp-shinned Hawk	24-Feb	3-May	2-Apr – 28-Apr	20-Apr	16-Apr ± 2.1
Cooper's Hawk	23-Feb	1-May	27-Mar – 23-Apr	9-Apr	10-Apr ± 1.1
Northern Goshawk	27-Feb	28-Apr	27-Feb – 28-Apr	31-Mar	3-Apr ± 4.1
Broad-winged Hawk	14-Apr	23-Apr	–	–	22-Apr ± 2.9
Swainson's Hawk	29-Mar	24-Apr	10-Apr – 20-Apr	14-Apr	16-Apr ± 1.8
Red-tailed Hawk	23-Feb	3-May	9-Mar – 15-Apr	23-Mar	25-Mar ± 1.6
Ferruginous Hawk	28-Feb	10-Apr	28-Feb – 10-Apr	9-Mar	20-Mar ± 5.5
Rough-legged Hawk	15-Mar	15-Mar	–	–	–
Zone-tailed Hawk	21-Apr	24-Apr	–	–	–
Golden Eagle	22-Feb	3-May	26-Feb – 17-Apr	14-Mar	22-Mar ± 3.5
Bald Eagle	23-Feb	29-Mar	24-Feb – 23-Mar	5-Mar	9-Mar ± 4.8
American Kestrel	24-Feb	29-Apr	29-Mar – 20-Apr	9-Apr	11-Apr ± 1.8
Merlin	14-Mar	23-Apr	14-Mar – 23-Apr	9-Apr	9-Apr ± 5.4
Prairie Falcon	9-Mar	17-Apr	9-Mar – 4-Apr	11-Mar	17-Mar ± 4.7
Peregrine Falcon	5-Mar	1-May	22-Mar – 27-Apr	7-Apr	11-Apr ± 3.0
All species	22-Feb	3-May	14-Mar – 22-Apr	2-Apr	6-Apr ± 1.4

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

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

[3] Mean of annual values ± 95% confidence interval 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 Sandia Mountains, NM: 1992–2001 versus 2002.

	ASY ADULTS		SECOND-YEAR BIRDS	
SPECIES	1992–2001[1]	2002	1992–2001[1]	2002
Northern Harrier	4-Apr ± 3.5	1-Apr	12-Apr ± 10.0	2-Apr
Sharp-shinned Hawk	17-Apr ± 3.1	20-Apr	22-Apr ± 6.6	2-Apr
Cooper's Hawk	9-Apr ± 1.6	9-Apr	21-Apr ± 2.6	14-Apr
Red-tailed Hawk	22-Mar ± 1.8	23-Mar	16-Apr ± 3.3	11-Apr
Golden Eagle	9-Mar ± 1.9	5-Mar	5-Apr ± 3.5	29-Mar
Bald Eagle	7-Mar ± 5.2	–	12-Mar ± 5.7	4-Mar
Peregrine Falcon	8-Apr ± 3.4	5-Apr	11-Apr ± 6.6	12-Apr

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 Sandia Mountains, NM, excluding Lower Station capture results from 1998 and 1999: 1990–2001 versus 2002.

	Capture Totals		Capture Rate[1]		% Capture Success[2]	
Species	1990–2001[3]	2002	1990–2001[3]	2002	1990–2001[3]	2002
Northern Harrier	1 ± 0.7	0	0.2 ± 0.22	0.0	0.0 ± 0.05	0.0
Sharp-shinned Hawk	56 ± 25.2	32	16.8 ± 6.15	10.0	9.5 ± 1.48	9.2
Cooper's Hawk	176 ± 35.8	194	57.0 ± 12.66	60.5	20.7 ± 5.32	37.2
Northern Goshawk	1 ± 0.8	3	0.5 ± 0.26	0.9	13.0 ± 7.52	42.8
Broad-winged Hawk	0.1 ± 0.18	0	0.0 ± 0.08	0.0	2.3 ± 4.45	0.0
Swainson's Hawk	0.4 ± 0.30	0	0.1 ± 0.10	0.0	0.7 ± 0.59	0.0
Red-tailed Hawk	9 ± 3.8	8	2.9 ± 1.29	2.5	2.3 ± 0.95	2.5
Zone-tailed Hawk	0.1 ± 0.18	1	0.0 ± 0.05	0.3	6.3 ± 12.25	33.3
American Kestrel	8 ± 4.8	14	2.3 ± 1.28	4.4	3.0 ± 1.51	6.8
Merlin	1 ± 0.7	0	0.3 ± 0.21	0.0	7.1 ± 4.51	0.0
Prairie Falcon	2 ± 0.9	2	0.5 ± 0.28	0.6	8.5 ± 4.88	12.5
Peregrine Falcon	3 ± 1.4	0	0.8 ± 0.39	0.0	5.9 ± 2.87	0.0
Total	257 ± 60.4	254	81.5 ± 16.76	79.2	9.7 ± 1.97	12.9

[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 (SY = second year; AHY = after hatching year; ASY = after second year), female : male capture ratios, and SY : ASY capture ratios for selected species of migrating raptors in the Sandia Mountains, NM: 1990–2001 (mean ± 95% CI) versus 2002.

		Female			Male			Female : Male	SY : ASY
Species	Year	SY	ASY	AHY	SY	ASY	AHY	Ratio	Ratio
Sharp-shinned Hawk	1990–01	14	32	0	4	12	0	4.52 ± 0.705	0.39 ± 0.052
	2002	4	22	0	0	6	0	4.33	0.14
Cooper's Hawk	1990–01	21	87	0	3	81	0	1.33 ± 0.071	0.15 ± 0.026
	2002	11	100	0	3	80	0	1.34	0.08
American Kestrel	1990–01	1	1	3	0	2	2	1.45 ± 0.363	0.56 ± 0.150
	2002	5	0	3	0	1	5	1.33	5.00

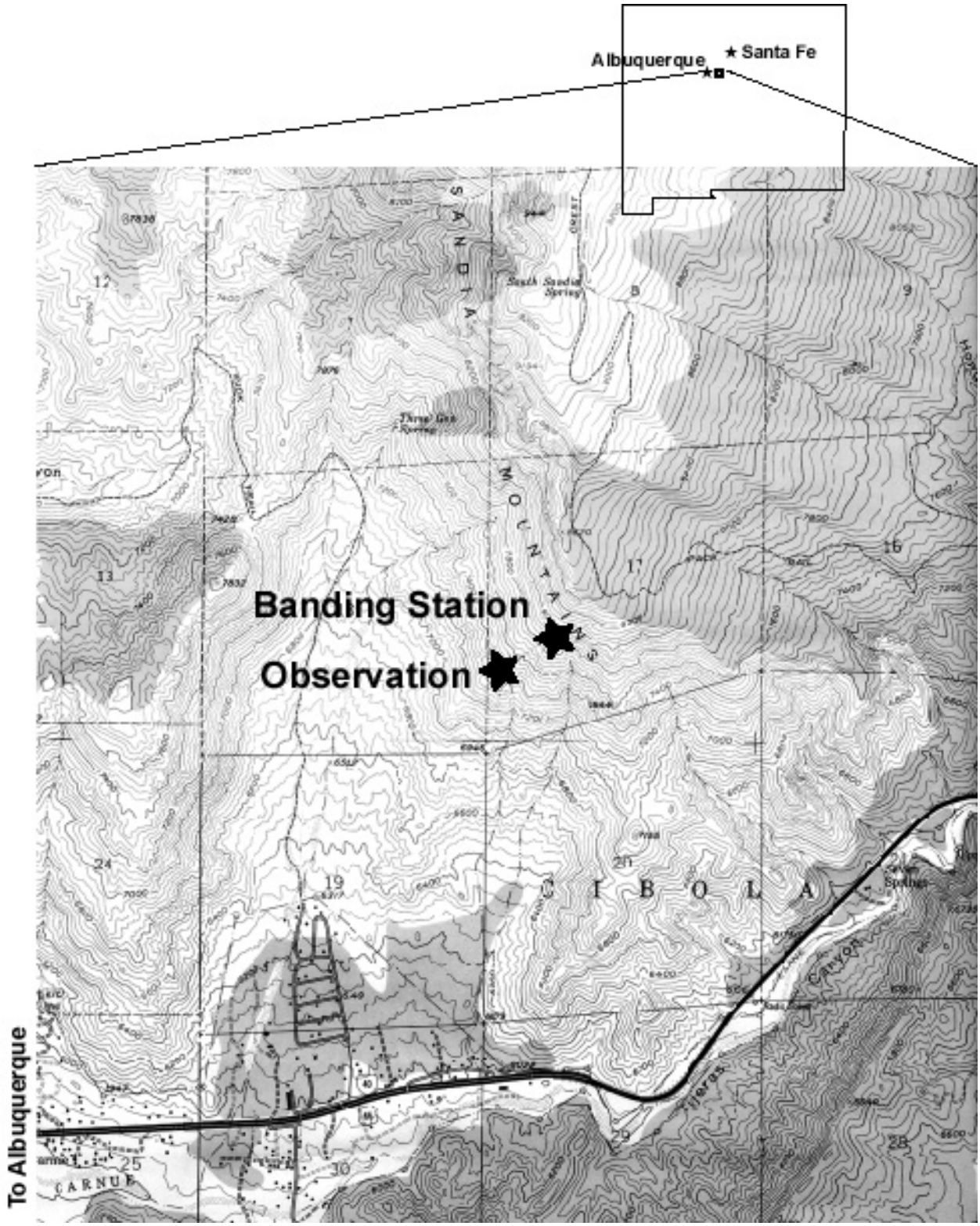

Figure 1. Map of Sandia Mountains Raptor Migration Project study site.

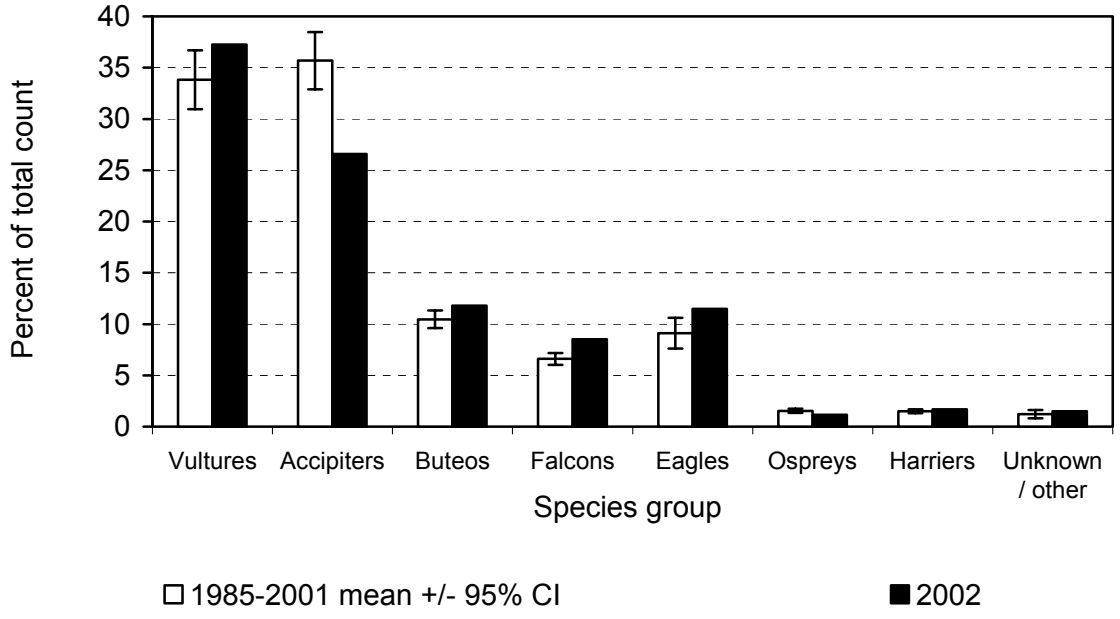

Figure 2. Spring raptor-migration flight composition by major species groups in the Sandia Mountains, NM: 1985–2001 versus 2002.

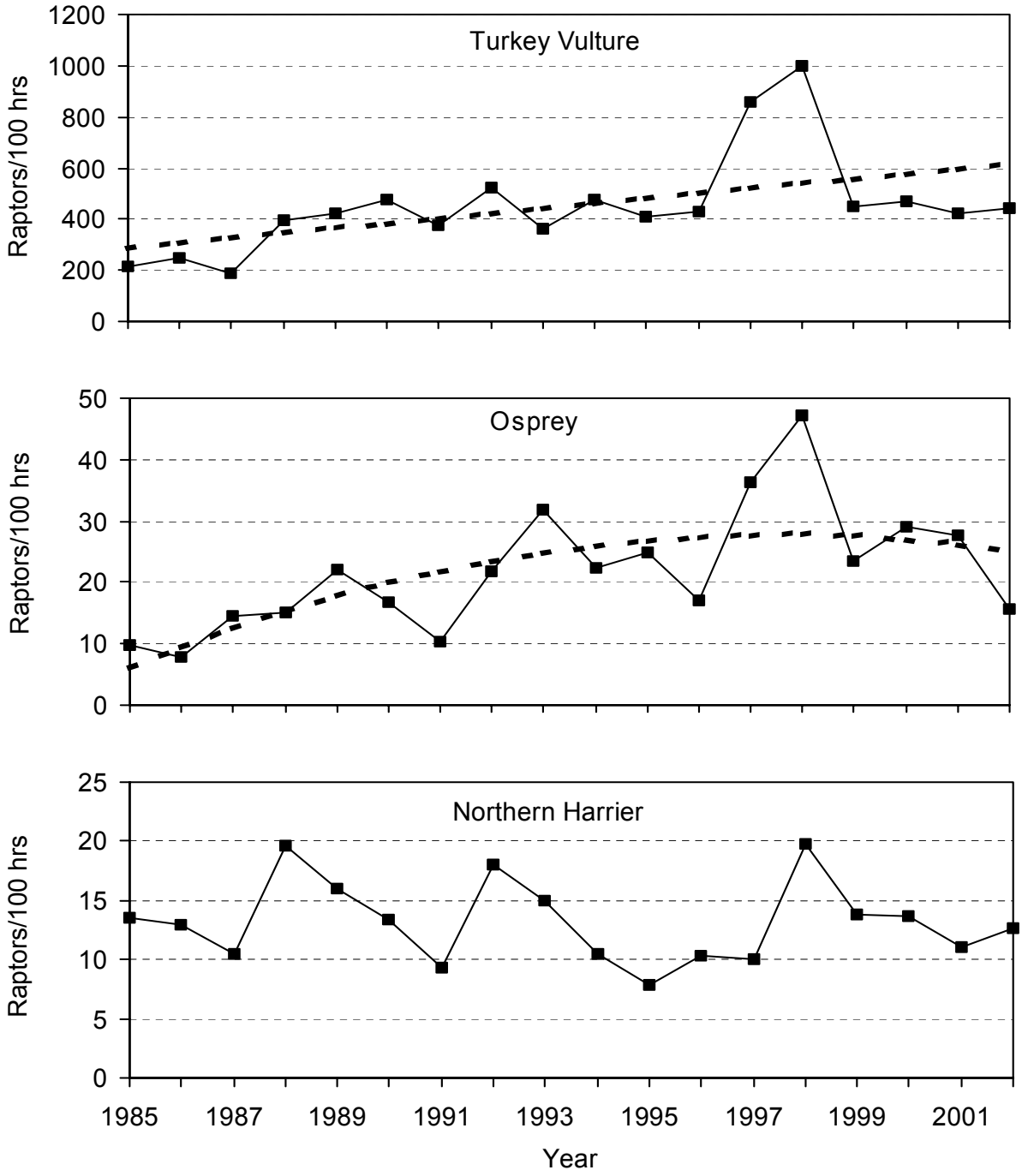

Figure 3. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) spring-migration passage rates for Turkey Vultures, Ospreys, and Northern Harriers in the Sandia Mountains, NM: 1985–2002. Dashed lines indicate significant ($P \leq 0.10$) regressions.

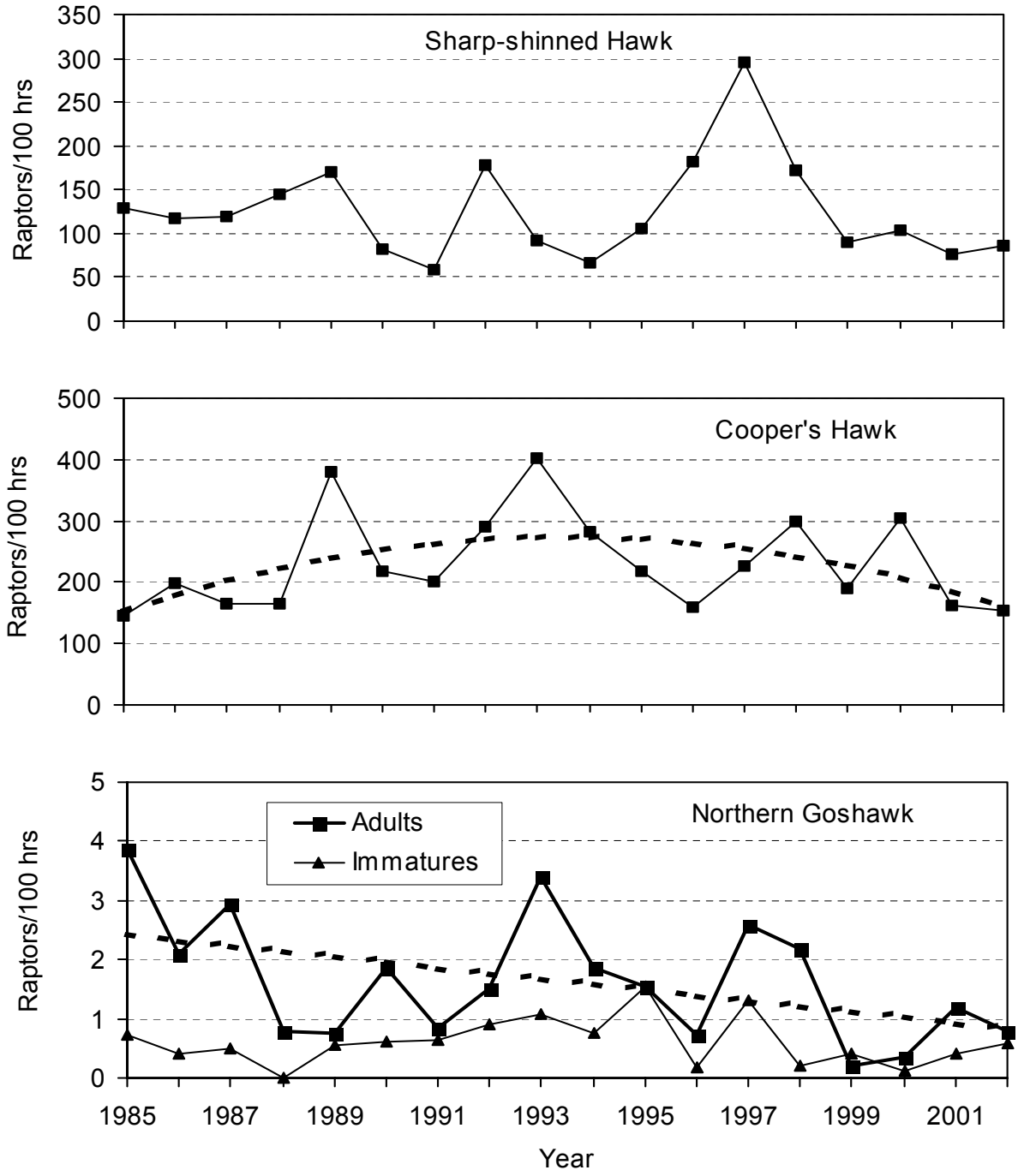

Figure 4. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) spring-migration passage rates for Sharp-shinned Hawks, Cooper's Hawks, and Northern Goshawks in the Sandia Mountains, NM: 1985–2002. Dashed lines indicate significant ($P \leq 0.10$) regressions.

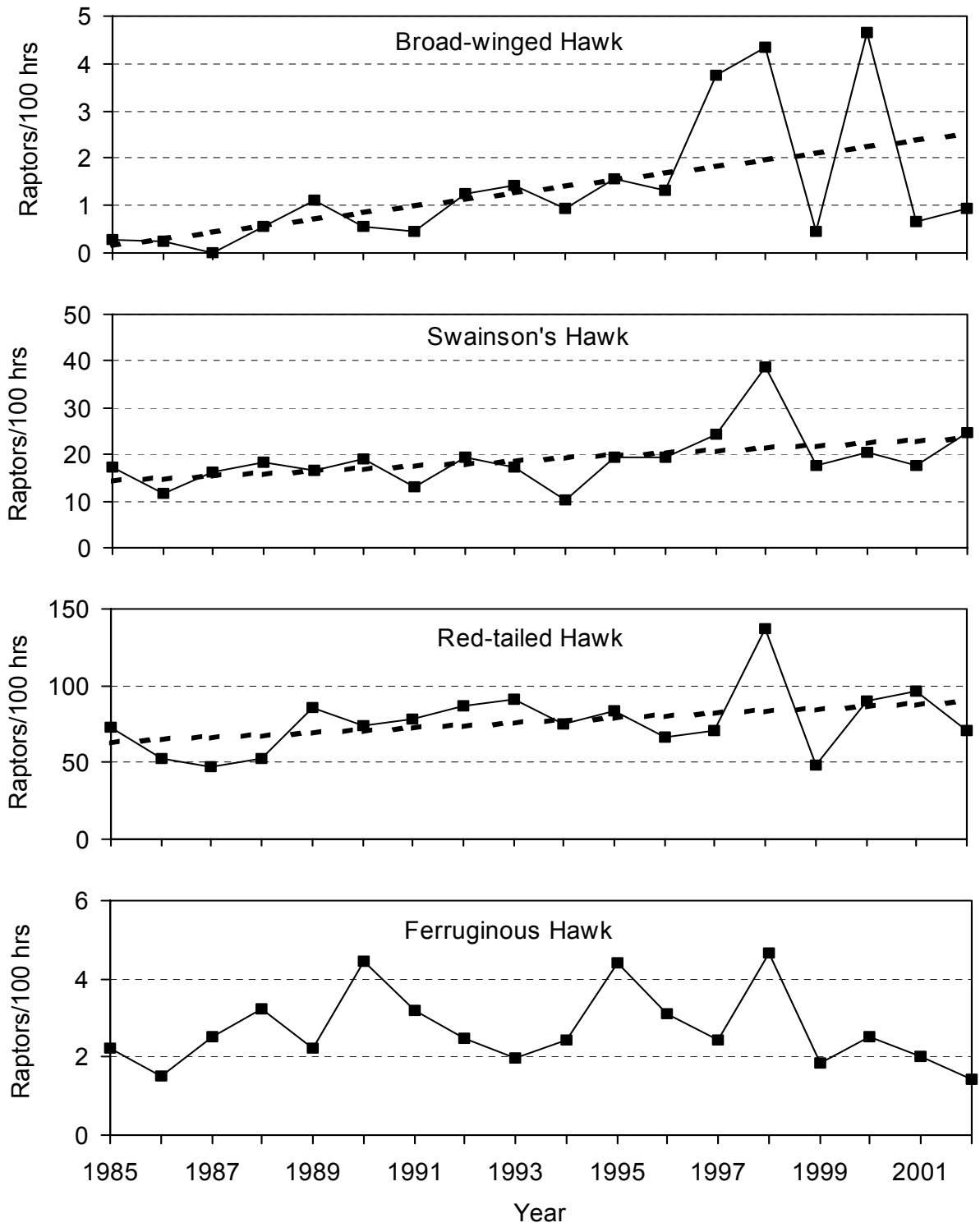

Figure 5. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) spring-migration passage rates for Broad-winged, Swainson's, Red-tailed, and Ferruginous Hawks in the Sandia Mountains, NM: 1985–2002. Dashed lines indicate significant ($P \leq 0.10$) regressions.

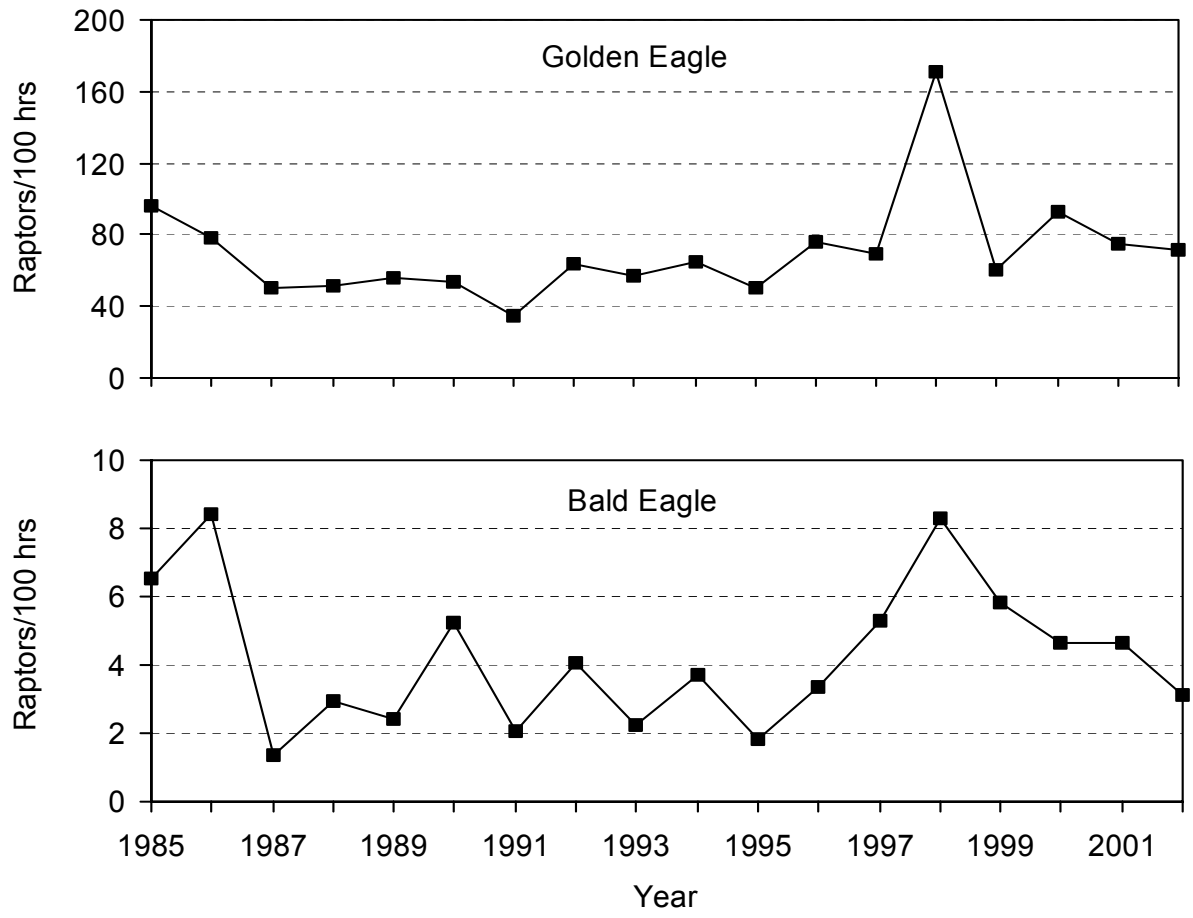

Figure 6. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) spring-migration passage rates for Golden and Bald Eagles in the Sandia Mountains, NM: 1985–2002. Dashed lines indicate significant ($P \leq 0.10$) regressions.

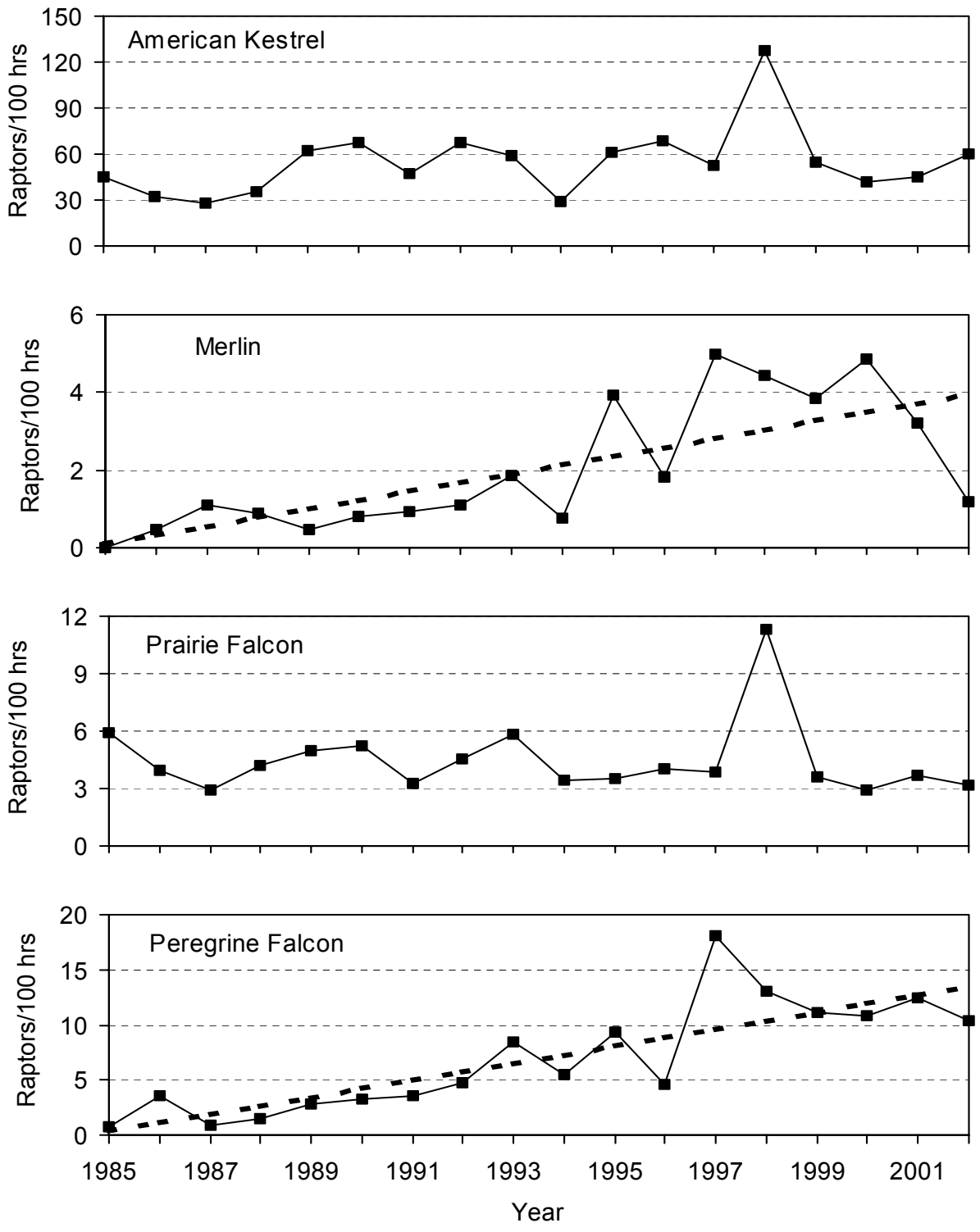

Figure 7. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) spring-migration passage rates for American Kestrels, Merlins, Prairie Falcons, and Peregrine Falcons in the Sandia Mountains, NM: 1985–2002. Dashed lines indicate significant ($P \leq 0.10$) regressions.

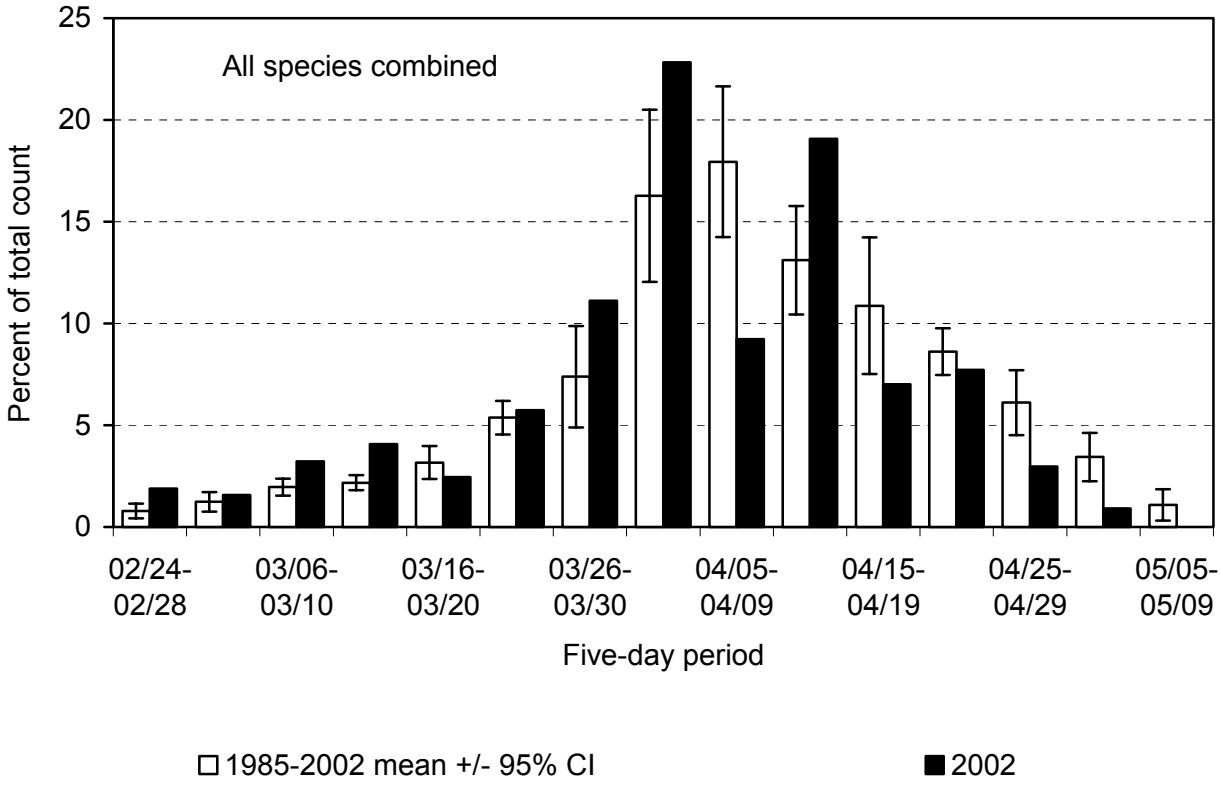

Figure 8. Combined-species, spring-migration passage volume by five-day periods for raptors in the Sandia Mountains, NM: 1985–2001 versus 2002.

Appendix A. History of official observer participation in the Sandia Mountains Raptor Migration Project: 1985–2002.

1985 Single observer throughout: Jim Daly–primary (1), Penny Rodefer (0)[1]

1986 Single observer throughout: Jim Daly (3)

1987 Single observer throughout, rotating crew: LisaBeth Daly (2), Tom Davis (0), Bill Howe (0), Gordon Vickrey (0), Ann Cole (0)

1988 Single observer throughout: Gordon Vickrey (1)

1989 Single observer throughout, two observers during 30-day peak period: Rick Watson–primary (0), Rich Besser (0), Ann Cole (1), LisaBeth Daly (2), Gordon Vickrey (3)

1990 Single observer throughout, two observers during 30-day peak period: LisaBeth Daly–primary (3), Joe Kelly (0)

1991 Single observer throughout, two observers during 30-day peak period: LisaBeth Daly–primary (4), Eric Meyer (0)

1992 Two observers throughout: LisaBeth Daly (5), Mark Cantrell (1), Eric Meyer (2)

1993 Two observers throughout: LisaBeth Daly (6), Jessie Jewell (1), Daniel Perry (1)

1994 Two observers throughout: Jessie Jewell (3), Daniel Perry (3)

1995 Two observers throughout: Jessie Jewell (5), Tim Meehan (0), Sherry Swanson (0)

1996 Two observers throughout: Jessie Jewell (7), Sherry Swanson (1), Aaron Barna (0)

1997 Two observers throughout: Aaron Barna (2), Sean O'Connor (3)

1998 Two observers throughout: Jerry Liguori (11), Brian Sullivan (10)

1999 Two observers throughout: Jason Beason (3), Nikos Vulgares (2)

2000 Two observers throughout: Nikos Vulgares (3), Sue Vulgares (1)

2001 Two observers throughout: Craig Fosdick (4), Allison Cebula Benedict (0)

2002 Two observers throughout: Craig Fosdick (6; full season), Geoff Evans (1; first two weeks and later substitute), Rigo Mendoza-Rebolledo (2; full-time after first two weeks)

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[1] Numbers in parentheses indicate previous full seasons of raptor migration 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 spring migration in the Sandia 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
White-tailed Kite	*Elanus caeruleus*	WK	U	U	NA
Mississippi Kite	*Ictinia mississippiensis*	MK	A I U	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
Aplomado Falcon	*Falco femoralis*	AF	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 or older immature: 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 Sandia Mountains Raptor Migration Project: 2002.

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
22-Feb	7.50	1.0	0	pc	11.9	sw-wnw	8.6	30.74	2	100.0	100.0	1	0.1
23-Feb	8.50	1.9	0	clr-ovc	4.0	nw, sw	11.6	29.79	2	100.0	100.0	2	0.6
24-Feb	9.00	2.0	0	clr-pc	10.7	nw-n, se	10.2	29.67	2	100.0	100.0	2	1.2
25-Feb	9.00	1.0	0	clr	17.6	wsw-nw	6.8	29.85	3	40.0	80.8	2	1.0
26-Feb	8.50	2.7	0	clr	10.6	w-nw	3.5	30.00	2	40.0	87.0	3	2.5
27-Feb	9.00	1.0	0	clr-pc	11.0	w-nw	6.7	29.73	3	38.0	73.0	2	1.1
28-Feb	9.00	1.0	0	clr-pc	7.8	sw-wnw	11.2	29.50	2	80.0	83.6	2	1.2
1-Mar	7.00	2.0	0	pc-mc/rain	14.1	var	8.4	29.28	3	40.0	65.0	2	1.1
2-Mar	5.25	2.0	1	mc-ovc, rain/snow	6.3	var, sw-wnw	0.7	29.60	2	40.0	85.7	3	0.8
3-Mar	9.00	2.2	0	clr	12.5	w-wnw	2.5	29.83	3	40.0	94.0	2	1.4
4-Mar	8.00	2.0	0	clr	14.6	wsw-nw	5.1	29.92	3	40.0	90.0	2	0.4
5-Mar	9.50	1.4	1.5	clr/haze	7.3	sw-wnw	6.2	29.81	1	40.0	89.0	2	2.5
6-Mar	9.00	2.0	0	clr-mc, haze	11.7	sw-wnw	10.0	29.77	2	40.0	94.0	2	2.1
7-Mar	8.00	2.8	0	clr-ovc	9.6	sw-w	11.6	29.62	2	61.1	71.1	2	1.5
8-Mar	4.25	2.0	0	ovc, blowing snow/haze	20.2	wsw-w	7.8	29.40	4	3.8	5.8	2	1.6
9-Mar	8.50	3.2	0	clr	3.0	var	7.9	30.09	1	40.0	88.0	2	4.2
10-Mar	8.00	2.9	0	clr-pc	0.7	var	13.7	29.95	1	32.8	52.2	2	4.0
11-Mar	9.25	4.2	0	clr	18.7	w-wnw	8.0	29.79	3	40.0	93.0	2	2.7
12-Mar	8.50	2.7	0	pc	10.1	wnw	11.8	29.81	2	40.0	100.0	2	2.9
13-Mar	8.50	2.0	0	clr, PM haze	7.0	wsw-wnw	15.8	29.53	1	40.0	93.3	2	3.1
14-Mar	8.50	2.8	0	clr/haze	16.7	wsw-w	9.3	29.35	2	11.4	12.2	2	3.9
15-Mar	9.50	3.1	0	clr	0.9	var	5.9	29.52	2	33.0	63.0	2	2.6
16-Mar	8.50	2.7	1	clr-pc, haze	9.2	var	5.3	29.48	2	31.6	57.8	2	1.4
17-Mar	8.50	2.7	1	clr-pc, haze	3.1	var, wsw-wnw	5.6	29.60	2	40.0	66.7	3	2.0
18-Mar	8.00	1.9	0	clr-pc, haze	4.8	sw-wnw	9.2	29.55	1	40.0	85.6	2	1.3
19-Mar	7.25	3.5	0	pc-mc, AM snow, haze	10.5	w-wnw	10.0	29.68	2	32.5	65.0	3	1.4
20-Mar	9.00	2.0	0	clr, scat haze	6.7	wnw-nw	12.4	30.00	1	40.0	94.4	2	3.6
21-Mar	8.00	2.9	0	clr	4.1	se/var	16.0	30.13	1	40.0	64.4	2	3.0
22-Mar	9.50	2.7	0	ovc-clr, haze	4.1	w	12.3	29.94	2	27.0	27.5	2	2.5
23-Mar	8.50	2.8	1	clr-ovc, PM dust	8.8	sw	17.4	29.55	2	35.0	63.0	2	5.5
24-Mar	8.25	3.8	0	pc-mc, dust	14.1	sw-wnw	10.1	29.45	3	40.0	98.9	2	8.0
25-Mar	7.50	1.4	1	mc	8.0	sw-w	8.3	29.68	2	38.8	97.5	1	3.7
26-Mar	8.67	3.5	0	clr-ovc	1.9	var	13.7	29.90	1	43.3	82.2	2	16.4
27-Mar	8.50	1.9	0	clr-ovc	8.0	sw-w/var	17.3	29.79	1	36.7	72.2	2	6.7
28-Mar	8.50	3.3	0	clr	7.0	w	17.3	29.76	1	28.2	70.0	2	6.1
29-Mar	7.33	2.7	1	clr-ovc, haze, PM rain	7.1	se-s/var	16.6	29.65	2	33.8	73.8	2	9.3
30-Mar	8.25	2.7	1	clr/haze	10.7	w-wnw	15.0	29.70	1	37.8	84.4	2	5.7
31-Mar	0.00			<personnel emergency>									
1-Apr	8.25	1.7	0	clr/haze	9.5	sw-wnw	18.7	29.71	1	37.8	80.0	2	20.2
2-Apr	8.00	3.1	0	clr-ovc, haze	3.8	var	19.3	29.73	1	30.0	85.6	2	48.8
3-Apr	9.00	1.8	0	pc-mc, haze	2.6	var	14.3	29.86	2	33.3	40.0	2	15.8
4-Apr	8.00	2.9	0	clr	5.3	var, nw	19.9	29.87	1	37.8	67.8	2	6.6

Appendix C. continued

Date	Obs. Hours	Obsrvr / Hour[1]	Median Visitor Disturb[2]	Predominant Weather[3]	Wind Speed (kph)[1]	Wind Direction	Temp (°C)[1]	Barom. Press. (in Hg)[1]	Median Thermal Lift[4]	Visib. West (km)[1]	Visib. East (km)[1]	Median Flight Distance[5]	Birds / Hour
5-Apr	7.50	2.3	1	mc, haze/rain	0.6	sw-w	20.3	29.96	2	40.0	77.5	2	6.3
6-Apr	7.50	2.0	1.5	mc-ovc, haze/rain	1.9	var, sw	19.3	29.67	1	37.5	81.3	2	10.9
7-Apr	0.00			rain/snow									
8-Apr	9.25	2.7	0	clr/haze	7.6	sw-nw	13.7	29.72	2	34.0	68.0	2	7.7
9-Apr	8.50	2.7	0	clr-mc, haze, scat rain	1.0	sw-nw/var	17.7	30.06	1	37.8	84.4	2	12.2
10-Apr	8.50	2.6	0	mc-ovc, PM rain	6.2	sw-wnw	20.0	29.92	1	36.7	82.2	2	22.0
11-Apr	8.75	2.9	0	clr-mc	17.3	w	17.6	29.91	1	40.0	82.2	2	15.9
12-Apr	7.75	2.6	0	pc/haze-PM ovc/rain	1.6	var, sw-w	20.0	29.95	1	40.0	92.2	2	14.2
13-Apr	9.00	2.8	0	clr-pc, haze	7.1	w	19.3	29.93	1	40.0	90.0	2	13.1
14-Apr	9.00	2.5	1.5	clr-pc	6.8	sw-wnw	21.2	29.81	1	40.0	92.2	2	8.2
15-Apr	8.25	2.4	0	clr-mc, haze/rain	8.0	sw-w	19.7	29.57	2	36.7	84.4	2	7.5
16-Apr	4.75	2.0	0	ovc/haze	17.8	w	13.2	29.68	3	28.3	61.7	2	2.9
17-Apr	8.00	2.0	0	mc	8.9	sw-w	18.3	29.79	2	37.8	90.0	2	6.3
18-Apr	7.00	2.7	0	clr	11.1	sw-w	18.5	29.80	1	40.0	90.0	2	3.7
19-Apr	8.25	2.4	1	clr	4.5	calm/var	20.3	29.71	1	40.0	90.0	2	9.6
20-Apr	4.50	2.0	0	clr, dust/haze	13.7	se-sw	17.5	29.61	2	40.0	90.0	1	2.2
21-Apr	7.75	2.9	0	clr-pc	9.4	sw-wnw	12.9	29.84	1	40.0	92.2	2	2.7
22-Apr	9.00	2.0	0	clr	11.6	sw-wnw	18.8	29.86	1	40.0	90.0	2	7.2
23-Apr	9.25	2.0	0	clr-pc	12.8	sw-wnw	21.1	29.89	1	40.0	90.0	2	6.1
24-Apr	8.75	1.8	0	mc-ovc, haze	14.7	w	21.7	30.00	1	40.0	70.0	2	11.7
25-Apr	0.00			rain/snow									
26-Apr	4.00	1.0	0	mc/haze	6.0	sse	18.6	29.73	2	32.0	54.0	2	3.5
27-Apr	7.25	2.0	1.5	pc-mc, haze	14.9	sw-nw	12.5	29.64	3	40.0	76.3	2	3.2
28-Apr	7.25	1.1	0	pc-mc, haze	8.5	w-nw	18.3	29.93	2	38.8	91.3	2	3.4
29-Apr	5.00	1.0	0	mc-ovc	5.7	w-nw	22.2	29.93	2	40.0	90.0	2	7.2
30-Apr	6.25	2.0	0	clr-pc	6.6	sw-nw	21.1	29.75	1	40.0	90.0	3	2.1
1-May	5.00	1.8	0	pc-ovc	12.8	sw-wnw	17.7	29.60	2	38.3	90.0	2	2.0
2-May	0.00			rain/wind/low clouds									
3-May	3.00	2.0	0	clr	8.8	w-wnw	15.8	29.81	2	35.0	95.0	2	2.3

[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 spring raptor migration counts by species in the Sandia Mountains, NM: 2002.

	Obs.	Species[1]																										Birds
Date	Hours	TV	OS	NH	SS	CH	NG	SA	LA	UA	BW	SW	RT	FH	RL	ZT	UB	GE	BE	AK	ML	PR	PG	SF	LF	UF	UU	Total	/ hour
22-Feb	7.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0.1
23-Feb	8.50	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	2	1	0	0	0	0	0	0	0	0	5	0.6
24-Feb	9.00	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	6	2	1	0	0	0	0	0	0	0	11	1.2
25-Feb	9.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	1	0	9	1.0
26-Feb	8.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	1	21	2.5
27-Feb	9.00	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	10	1.1
28-Feb	9.00	0	0	0	0	0	1	0	0	0	0	0	3	1	0	0	0	5	1	0	0	0	0	0	0	0	0	11	1.2
01-Mar	7.00	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	6	0	0	0	0	0	0	0	0	0	8	1.1
02-Mar	5.25	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	3	0	0	0	0	0	0	0	0	0	4	0.8
03-Mar	9.00	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	11	0	0	0	0	0	0	0	0	0	13	1.4
04-Mar	8.00	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	3	0.4
05-Mar	9.50	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	18	1	0	0	0	1	0	0	0	0	24	2.5
06-Mar	9.00	0	0	0	0	3	0	0	0	0	0	0	2	0	0	0	0	13	1	0	0	0	0	0	0	0	0	19	2.1
07-Mar	8.00	0	0	1	0	1	0	0	0	0	0	0	5	0	0	0	0	5	0	0	0	0	0	0	0	0	0	12	1.5
08-Mar	4.25	0	0	0	0	1	0	0	0	0	0	0	3	0	0	0	0	1	1	0	0	0	1	0	0	0	0	7	1.6
09-Mar	8.50	0	0	0	1	2	0	0	0	0	0	0	14	2	0	0	0	12	0	0	0	2	1	0	0	0	2	36	4.2
10-Mar	8.00	0	0	0	0	1	0	1	0	0	0	0	11	2	0	0	0	11	0	1	0	3	1	0	0	0	1	32	4.0
11-Mar	9.25	0	0	1	0	2	0	0	0	0	0	0	4	0	0	0	0	13	2	0	0	1	1	0	0	0	1	25	2.7
12-Mar	8.50	0	0	0	1	1	0	1	0	0	0	0	8	1	0	0	0	11	0	0	0	2	0	0	0	0	0	25	2.9
13-Mar	8.50	0	0	0	1	2	1	0	0	1	0	0	7	0	0	0	0	12	0	0	0	2	0	0	0	0	0	26	3.1
14-Mar	8.50	1	0	1	0	1	0	0	0	0	0	0	17	0	0	0	0	12	0	0	1	0	0	0	0	0	0	33	3.9
15-Mar	9.50	0	0	1	0	0	0	0	0	0	0	0	4	0	1	0	0	15	0	1	0	1	0	0	0	0	2	25	2.6
16-Mar	8.50	0	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	7	0	1	0	0	0	0	0	0	1	12	1.4
17-Mar	8.50	3	0	0	1	3	0	0	0	0	0	0	5	0	0	0	0	3	0	0	0	0	0	0	0	0	2	17	2.0
18-Mar	8.00	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	3	0	0	0	0	0	0	0	0	0	10	1.3
19-Mar	7.25	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	4	0	0	0	0	0	0	0	0	0	10	1.4
20-Mar	9.00	2	0	0	4	3	0	0	0	1	0	0	12	0	0	0	0	8	0	1	0	0	0	0	0	0	1	32	3.6
21-Mar	8.00	0	0	0	6	2	0	0	0	0	0	0	8	0	0	0	0	2	0	2	1	1	0	0	0	0	2	24	3.0
22-Mar	9.50	4	0	0	0	3	0	0	0	0	0	0	9	0	0	0	0	5	0	1	0	0	1	0	0	0	1	24	2.5
23-Mar	8.50	21	0	2	1	4	0	0	0	0	0	0	11	0	0	0	0	3	2	1	0	0	2	0	0	0	0	47	5.5
24-Mar	8.25	30	0	1	1	6	0	0	0	0	0	0	17	0	0	0	0	6	0	0	0	0	2	0	0	0	3	66	8.0
25-Mar	7.50	6	0	1	2	3	0	0	0	0	0	0	8	0	0	0	0	7	0	0	0	0	1	0	0	0	0	28	3.7
26-Mar	8.67	116	0	5	2	4	0	0	0	0	0	0	5	0	0	0	0	6	0	2	0	0	2	0	0	0	0	142	16.4
27-Mar	8.50	26	0	0	2	10	0	0	0	0	0	0	7	0	0	0	0	4	0	5	0	1	2	0	0	0	0	57	6.7
28-Mar	8.50	29	0	1	1	8	0	0	0	0	0	0	5	0	0	0	0	3	0	2	0	0	1	0	0	0	2	52	6.1
29-Mar	7.33	30	1	3	1	10	0	0	0	0	0	1	9	0	0	0	0	2	1	10	0	0	0	0	0	0	0	68	9.3
30-Mar	8.25	19	1	1	3	5	0	0	0	0	0	0	5	0	0	0	0	6	0	4	0	1	1	0	0	0	1	47	5.7
31-Mar	0.00																												
01-Apr	8.25	121	3	3	5	19	1	0	0	0	0	0	4	0	0	0	1	7	0	0	0	0	1	0	0	0	2	167	20.2
02-Apr	8.00	304	1	6	4	26	1	2	0	0	0	1	20	0	0	0	0	5	0	15	0	0	2	0	0	0	3	390	48.8
03-Apr	9.00	96	3	1	9	13	0	1	0	0	0	0	6	0	0	0	0	5	0	5	0	0	2	0	0	0	1	142	15.8
04-Apr	8.00	29	1	1	3	10	0	0	0	1	0	1	3	0	0	0	0	1	0	1	0	1	1	0	0	0	0	53	6.6

Appendix D. continued

Date	Obs. Hours	Species[1]																										Total	Birds / hour
		TV	OS	NH	SS	CH	NG	SA	LA	UA	BW	SW	RT	FH	RL	ZT	UB	GE	BE	AK	ML	PR	PG	SF	LF	UF	UU		
05-Apr	7.50	23	2	2	0	11	0	0	0	0	0	1	5	0	0	0	0	0	0	1	0	0	0	0	0	0	2	47	6.3
06-Apr	7.50	30	0	3	1	20	0	0	0	0	0	0	6	0	0	0	0	2	0	15	0	0	2	0	0	0	3	82	10.9
07-Apr	0.00																												
08-Apr	9.25	8	0	1	2	42	0	0	0	0	0	1	1	0	0	0	0	12	0	1	0	0	1	0	0	0	2	71	7.7
09-Apr	8.50	33	2	4	5	20	1	0	0	0	0	0	7	0	0	0	0	2	0	26	0	0	1	0	0	0	3	104	12.2
10-Apr	8.50	114	1	1	6	37	0	0	0	0	0	10	8	1	0	0	0	0	0	7	1	0	0	0	0	0	1	187	22.0
11-Apr	8.75	57	1	0	17	44	0	0	0	0	0	1	8	0	0	0	0	3	0	2	0	0	2	0	0	0	4	139	15.9
12-Apr	7.75	43	2	4	1	14	0	1	0	2	0	3	8	0	0	0	0	3	0	29	0	0	0	0	0	0	0	110	14.2
13-Apr	9.00	27	7	3	7	39	0	0	0	2	0	3	4	0	0	0	0	14	0	6	1	0	2	0	0	0	3	118	13.1
14-Apr	9.00	5	4	0	17	21	0	0	0	0	1	3	3	0	0	0	0	10	0	6	0	0	4	0	0	0	0	74	8.2
15-Apr	8.25	5	1	2	12	24	0	0	0	0	0	3	5	0	0	0	0	0	0	4	0	0	4	0	0	1	1	62	7.5
16-Apr	4.75	3	1	0	5	3	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	14	2.9
17-Apr	8.00	1	1	1	24	9	0	0	0	0	0	3	4	0	0	0	0	1	0	2	0	1	3	0	0	0	0	50	6.3
18-Apr	7.00	13	0	1	5	4	0	0	0	1	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	26	3.7
19-Apr	8.25	12	0	0	9	4	0	0	0	0	0	16	4	0	0	0	0	4	0	29	0	0	1	0	0	0	0	79	9.6
20-Apr	4.50	0	0	0	3	0	0	0	0	0	0	4	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	10	2.2
21-Apr	7.75	0	1	0	8	6	0	0	0	0	0	0	4	0	0	1	0	0	0	1	0	0	0	0	0	0	0	21	2.7
22-Apr	9.00	9	1	0	22	10	0	1	0	0	2	0	3	0	0	0	0	10	0	6	0	0	0	0	0	0	1	65	7.2
23-Apr	9.25	0	0	1	23	10	0	0	0	0	1	1	3	0	0	0	0	9	0	6	1	0	1	0	0	0	0	56	6.1
24-Apr	8.75	0	3	1	60	16	0	0	0	4	0	2	4	0	0	2	0	3	0	4	0	0	2	0	0	0	1	102	11.7
25-Apr	0.00																												
26-Apr	4.00	0	0	0	10	3	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	14	3.5
27-Apr	7.25	0	0	1	4	9	0	0	0	3	0	0	2	0	0	0	0	1	0	0	0	0	2	0	0	0	1	23	3.2
28-Apr	7.25	0	0	0	14	2	1	0	0	1	0	0	0	0	0	0	0	4	0	1	0	0	2	0	0	0	0	25	3.4
29-Apr	5.00	7	0	1	14	10	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	1	36	7.2
30-Apr	6.25	0	0	0	10	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	13	2.1
01-May	5.00	0	0	0	6	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	10	2.0
02-May	0.00																												
03-May	3.00	0	1	0	3	0	0	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	7	2.3
Total	527.75	1227	38	55	337	506	7	8	1	16	4	54	321	7	1	3	1	366	12	205	5	16	52	0	0	2	49	3293	6.2

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

Appendix E. Annual observation effort and spring raptor migration counts by species (unadjusted data) in the Sandia Mountains, NM: 1985–2002.

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	Mean
Start date	17-Feb	11-Feb	15-Feb	16-Feb	2-Mar	24-Feb	14-Feb	11-Feb	7-Feb	19-Feb	22-Feb	25-Feb	10-Feb	24-Feb	24-Feb	23-Feb	22-Feb	22-Feb	18-Feb
End date	13-May	9-May	10-May	9-May	30-Apr	6-May	10-May	11-May	5-May	5-May	5-May	5-May	7-May	5-May	3-May	5-May	5-May	3-May	5-May
Days of observation	73	78	69	65	56	61	83	84	75	69	67	68	70	68	66	67	67	67	70
Hours of observation	540.28	581.47	501.40	452.57	459.92	411.33	614.00	601.08	582.50	511.17	524.17	604.75	551.33	547.00	516.92	476.50	543.17	527.75	530.41
Raptors / 100 hours	518.2	535.2	467.9	642.1	1011.7	799.4	542.5	889.7	829.2	736.0	707.8	762.5	1103.5	1430.7	688.9	832.7	685.1	624.0	767.1
SPECIES	RAPTOR COUNTS																		
Turkey Vulture	641	814	559	1070	1380	1322	1246	1785	1327	1463	1217	1552	2531	3245	1427	1305	1328	1227	1413
Osprey	27	24	39	38	64	38	34	70	100	67	71	62	103	138	67	76	81	38	63
Northern Harrier	55	59	42	71	72	50	46	85	75	46	35	55	47	94	62	56	52	55	59
White-tailed Kite	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mississippi Kite	0	0	1	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
TOTAL KITES	0	0	2	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
Sharp-shinned Hawk	473	476	435	498	664	283	294	807	428	280	448	905	1280	772	386	391	311	337	526
Cooper's Hawk	454	709	521	498	1277	620	718	1050	1562	956	771	655	836	1157	670	922	556	506	802
Northern Goshawk	22	14	14	4	6	10	7	12	24	12	16	5	18	12	3	2	9	7	11
Unknown small accipiter[1]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	8	–
Unknown large accipiter[1]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1	–
Unknown accipiter	90	56	88	70	123	65	59	201	95	55	61	73	70	5	30	96	90	16	–
TOTAL ACCIPITERS	1039	1255	1058	1070	2070	978	1078	2070	2109	1303	1296	1638	2204	1946	1089	1411	967	875	1414
Broad-winged Hawk	1	1	0	2	5	2	2	6	7	4	7	7	19	20	2	19	3	4	6
Swainson's Hawk	47	32	41	43	38	40	42	60	52	30	50	61	59	114	45	50	43	54	50
Red-tailed Hawk	280	241	183	182	357	289	353	390	461	325	377	356	338	662	220	353	451	321	341
Ferruginous Hawk	11	8	11	13	9	18	16	12	11	12	20	17	11	23	7	11	12	7	13
Rough-legged Hawk	0	2	0	1	1	0	0	0	1	0	0	0	0	1	0	1	0	1	0
Zone-tailed Hawk	1	2	0	3	5	4	2	3	1	0	0	0	3	2	2	10	1	3	2
Unidentified buteo	6	4	10	9	40	3	15	32	5	5	14	9	6	2	15	21	10	1	12
TOTAL BUTEOS	346	290	245	253	455	356	430	503	538	376	468	450	436	824	291	465	520	391	424
Golden Eagle	441	432	213	205	255	218	198	338	300	310	255	441	352	897	304	417	391	366	352
Bald Eagle	20	37	5	7	7	13	18	17	9	12	7	14	22	27	18	13	18	12	15
Unidentified Eagle	4	0	0	1	0	0	4	2	0	0	0	0	0	0	2	0	1	0	1
TOTAL EAGLES	465	469	218	213	262	231	220	357	309	322	262	455	374	924	324	430	410	378	368
American Kestrel	147	127	96	118	225	209	182	275	250	112	226	308	233	497	198	143	165	205	206
Merlin	0	2	5	3	2	3	4	5	9	3	18	10	24	19	15	19	14	5	9
Prairie Falcon	29	27	17	16	23	21	21	28	33	16	17	23	19	59	18	13	20	16	23
Peregrine Falcon	5	18	6	7	13	13	20	25	47	26	47	27	91	72	56	49	64	52	35
Aplomado Falcon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Unknown small falcon[1]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	–
Unknown large falcon[1]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	–
Unknown falcon	2	0	5	2	5	2	5	3	3	0	0	1	7	1	4	0	6	2	3
TOTAL FALCONS	183	174	129	146	268	248	232	336	342	157	308	369	374	648	291	225	269	280	277
Unidentified raptor	44	27	54	45	82	65	45	142	29	28	53	30	14	7	10	0	94	49	45
ALL SPECIES	2800	3112	2346	2906	4653	3288	3331	5348	4830	3762	3710	4611	6084	7826	3561	3968	3721	3293	4064

[1] Designations used regularly for the first time in 2002.

Appendix F. Daily trapping effort and capture totals of migrating raptors by species in the Sandia Mountains, NM: 2002.

DATE	HOURS	SS[1]	CH	NG	RT	ZT	AK	PR	TOTAL	CAPTURES/HR
10-Mar	4.83	0	1	0	0	0	0	0	1	0.2
11-Mar	6.41	0	0	0	0	0	0	0	0	0.0
12-Mar	6.50	0	0	0	0	0	0	0	0	0.0
13-Mar	0.00									
14-Mar	7.50	0	0	0	0	0	0	0	0	0.0
15-Mar	5.50	0	0	0	0	0	0	0	0	0.0
16-Mar	6.75	0	1	0	0	0	0	0	1	0.1
17-Mar	7.75	0	1	0	0	0	0	0	1	0.1
18-Mar	7.00	0	0	0	0	0	0	0	0	0.0
19-Mar	6.00	0	0	0	0	0	0	0	0	0.0
20-Mar	7.58	0	2	0	0	0	2	0	4	0.5
21-Mar	6.25	0	1	1	0	0	0	0	2	0.3
22-Mar	7.50	0	1	0	0	0	0	0	1	0.1
23-Mar	7.33	0	1	0	2	0	0	0	3	0.4
24-Mar	7.41	0	3	0	1	0	0	0	4	0.5
25-Mar	0.00									
26-Mar	7.00	0	1	0	0	0	0	0	1	0.1
27-Mar	7.58	0	2	0	2	0	0	0	4	0.5
28-Mar	7.67	0	3	0	1	0	0	0	4	0.5
29-Mar	5.75	0	2	0	0	0	1	0	3	0.5
30-Mar	7.83	0	2	0	0	0	0	0	2	0.3
31-Mar	8.00	0	5	0	0	0	0	0	5	0.6
1-Apr	7.50	0	5	1	0	0	0	0	6	0.8
2-Apr	7.00	0	8	0	0	0	0	0	8	1.1
3-Apr	8.30	1	3	1	0	0	0	1	6	0.7
4-Apr	7.50	0	7	0	0	0	0	0	7	0.9
5-Apr	4.67	0	0	0	0	0	0	0	0	0.0
6-Apr	7.08	0	10	0	0	0	2	1	13	1.8
7-Apr	0.00									
8-Apr	8.25	0	13	0	0	0	0	0	13	1.6
9-Apr	8.33	1	9	0	0	0	2	0	12	1.4
10-Apr	8.25	1	9	0	0	0	0	0	10	1.2
11-Apr	8.41	0	20	0	0	0	0	0	20	2.4
12-Apr	7.25	1	5	0	0	0	2	0	8	1.1
13-Apr	9.25	2	9	0	0	0	1	0	12	1.3
14-Apr	9.25	1	16	0	0	0	0	0	17	1.8
15-Apr	8.58	0	13	0	0	0	0	0	13	1.5

Appendix F. continued

DATE	HOURS	SS[1]	CH	NG	RT	ZT	AK	PR	TOTAL	CAPTURES/HR
16-Apr	4.50	0	4	0	0	0	1	0	5	1.1
17-Apr	7.67	0	4	0	1	0	0	0	5	0.7
18-Apr	6.33	0	2	0	0	0	0	0	2	0.3
19-Apr	7.50	1	1	0	0	0	1	0	3	0.4
20-Apr	4.58	0	1	0	0	0	0	0	1	0.2
21-Apr	8.67	3	7	0	0	0	1	0	11	1.3
22-Apr	8.50	1	6	0	0	0	1	0	8	0.9
23-Apr	8.58	10	5	0	0	0	0	0	15	1.7
24-Apr	8.67	8	6	0	0	1	0	0	15	1.7
25-Apr	0.00									
26-Apr	3.25	1	2	0	0	0	0	0	3	0.9
27-Apr	4.75	1	3	0	1	0	0	0	5	1.1
Total	320.76	32	194	3	8	1	14	2	254	0.8

[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 Sandia Mountains, NM: 1990–2002.

	1990	1991	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	TOTAL	MEAN
First day	21-Mar	17-Mar	14-Mar	10-Mar	10-Mar	10-Mar	10-Mar	10-Mar	10-Mar	12-Mar	10-Mar	10-Mar		11-Mar
Last day	8-May	7-May	3-May	26-Apr	28-Apr	29-Apr	5-May	3-May	2-May	28-Apr	27-Apr	27-Apr		30-Apr
Number of stations	1	1	1	1	1	1	1	2	2	1	1	1		
Trapping days	36	45	43	34	40	46	48	46	47	41	53	41	511	43
Station days	36	45	43	34	40	46	48	65	63	41	44	45	550	46
Station hours	249.42	269.05	300.03	235.60	319.83	372.58	377.58	486.28	453.33	278.65	314.92	320.76	3978.03	331.50
Northern Harrier	0	0	0	0	3	0	1	3	2	0	0	0	9	1
Sharp-shinned Hawk	21	22	33	32	44	132	139	100	56	30	28	32	668	56
Cooper's Hawk	83	66	211	243	197	259	195	200	165	164	206	194	2184	182
Northern Goshawk	2	0	1	3	2	2	4	1	0	0	1	3	19	2
Broad-winged Hawk	0	0	0	1	0	0	0	0	0	0	0	0	1	0.1
Swainson's Hawk	1	0	0	0	0	0	1	1	0	0	1	0	4	0.3
Red-tailed Hawk	3	3	9	16	13	16	5	9	2	3	20	8	107	9
Zone-tailed Hawk	0	0	0	0	0	0	0	1	0	0	0	1	2	0.2
American Kestrel	2	0	3	2	2	26	14	22	10	5	4	14	104	9
Merlin	0	0	0	0	2	2	3	3	2	1	0	0	13	1
Prairie Falcon	0	0	1	1	2	3	3	2	0	2	5	2	21	2
Peregrine Falcon	1	0	0	2	6	4	7	2	2	1	4	0	29	2
All species	113	91	258	300	271	444	372	344	239	206	269	254	3161	263
Captures / 100 stn hrs	45.3	33.8	86.0	127.3	84.7	119.2	98.5	70.7	52.7	73.9	85.4	79.2	79.5	79.7
Recaptures[1]	0	1	1	2	3	4	2	3	3	2	4	0	24	2
Foreign recaptures[2]	0	0	2	3	0	4	2	6	5	1	3	1	27	2
Foreign encounters[3]	2	1	0	2	0	5	2	3	3	0	1	2	25	2

[1] Birds banded and later recaptured in the Sandias—totals included in capture tally above.

[2] Birds banded elsewhere and later recaptured in the Sandias—totals included in capture tally above.

[3] Birds banded in the Sandias and later recaptured or otherwise recovered elsewhere.