

**SPRING 2008 RAPTOR MIGRATION STUDY IN THE  
SANDIA MOUNTAINS OF CENTRAL NEW MEXICO**



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

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# **SPRING 2008 RAPTOR MIGRATION STUDY IN THE SANDIA MOUNTAINS OF CENTRAL NEW MEXICO**

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## INTRODUCTION

The Sandia Mountains Raptor Migration Project 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. 2002, Hoffman and Smith 2003). HawkWatch International (HWI) 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 22 species of migratory raptors at the site, with counts typically ranging between 3,000 and 5,000 migrants per season. The 2008 season marked the 24<sup>th</sup> consecutive migration count and the 17<sup>th</sup> season of trapping and banding conducted at the site. This report summarizes the 2008 count and banding results.

## 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°05'12" N, 106°25'57" 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 northeast of the 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

Two official or designated observers conducted standardized daily counts of migrating raptors from a single traditional observation site between 24 February and 5 May 2008. Official observers Kevin Payne and Carissa Turner worked the majority of the season. This was their first full season of migration counting experience, but they received initial on-site training from HWI's SW Monitoring Coordinator, Mike Neal, and veteran HWI and Sandias observer Ken Babcock provided further training and supplemented their efforts throughout the season. On-site Environmental Interpreter, Lora Fasolino, also routinely assisted with the count when not engaged in public outreach efforts. Mike Neal and long-time HWI volunteer Jason Bjork conducted the last 8 days of counts. Other local volunteers and visitors also occasionally assisted with the counts. Weather permitting, observations usually began between 0800 and 0900 H Mountain Standard Time (MST) and ended between 1700 and 1800 H.

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

1. Species, age, sex, and color morph of each migrant raptor, whenever possible and applicable (Appendix 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 H 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.

Calculation of “adjusted” (to standardize sampling periods and adjust for incompletely identified birds) passage rates (migrants counted per 100 hours of observation) and analysis of trends follows Hoffman and Smith (2003). In comparing 2008 annual statistics against means and 95% confidence intervals (CI) for previous seasons, we equate significance with a 2008 value falling outside the bounds of the confidence interval for the associated mean.

## **RESULTS AND DISCUSSION**

### **WEATHER SUMMARY**

Similar to the last few seasons, the weather was relatively mild in 2008 (see Appendix C for daily weather summaries), with no days entirely precluded or severely hampered (i.e., reduced to less than 4 hours of observation) by inclement weather (1998–2007 averages of 4.1 and 3.0 days, respectively, with 2008 the only season in the past decade to have experienced no weather days). The proportion of active observation days that featured predominately fair skies also was above average in 2008 (56% vs. 1998–2007 average of 44%), whereas the proportion of active days that featured mostly cloudy to overcast skies was significantly below average (10% vs. average of 25%), and the proportion that featured transitional skies (i.e., conditions changed from fair to mostly cloudy or overcast during the day, or vice versa) was slightly above average (35 vs. 30%). The number of days featuring some rain or snow (10%) also was nearly half the 1998–2007 average (19%), which undoubtedly contributed to the dryer conditions and early fire season. Even with the late-season Trigo Fire in the nearby Manzano Mountains, the proportion of active observation days that featured substantial visibility reducing fog/haze was only slightly above average (39% vs. average of 34%) and resulted in only slightly lower than average visibility to the east (76 vs. average of 78 km) and moderately low visibility to the west (46 vs. 53 km).

Similar to 2007, moderate wind speeds (12–28 kph) were more prevalent than usual in 2008, predominating on 44% of the active observation days (average 30%), and stronger winds also were significantly more common than usual (8% vs. average of 3% of the active days), whereas lighter winds were significantly less common than usual (47% vs. average of 63%). In the Sandias, W–NW and more variable SW–NW winds are the most common wind-direction patterns, with the prevalence of W–NW winds averaging 26% of the active observation days across the last decade, and the prevalence of SW–NW winds averaging 20% of the active days. In 2008, the prevalence of W–NW winds matched the 1998–2007 average, whereas SW–NW winds prevailed on an above-average 26% of the active days. In addition, days that featured these winds for a significant portion of the day in combination with either periods of calm/variable winds or winds with a more southerly or easterly component were more prevalent than usual (i.e., mixes of SW–NW or W–NW and calm/variable winds, 8% vs. averages of 2%; mix of SW–NW and NE–SE winds, 4% vs. average of 3%; and mix of W–NW and SE–SW winds, 7% vs. average of 3% of the active days). Most other, typically uncommon (i.e., generally averaging <5% of the active days), wind patterns occurred less often than usual in 2008.

The temperature during active observation periods averaged 12.5°C (the average of daily values, which in turn were averages of hourly readings), with hourly readings ranging from -1.5 to 23.1°C. The overall mean matched the 1985–2007 average and the minimum and maximum fell well within the previously observed range of variation. The barometric pressure during active observations averaged 30.04 in Hg (the average of daily values, which in turn were averages of hourly readings), with hourly readings ranging from 29.40 to 30.33 in Hg. The overall mean was only slightly lower than the 2001–2007 (the period of record for these data) average of 30.11 in Hg and the minimum fell within the range of previously observed values; however, the maximum was the lowest recorded to date.

Good to excellent thermal-lift conditions prevailed on a moderately high 54% of the active observation days (1998–2007 average of 47%).

In summary, compared to the last 10 seasons, 2008 featured overall milder than usual weather, but above-average winds speeds and higher than usual prevalences of SW–NW winds and to a lesser degree W–NW winds; mostly average temperature and barometric pressure regimes; slightly more than average visibility reducing fog/haze and, as a result, slight reductions in average visibility; and slightly above-average thermal-lift conditions.

## **OBSERVATION EFFORT**

The observers worked on all 72 possible days between 24 February and 5 May, the standard count period for the project. The number of observation days was a marginally significant 4% above the 1985–2007 average of  $69 \pm 95\%$  CI of 2.6 days, and the number of observation hours (615.75) was a significant 14% above average ( $540.55 \pm 23.11$  hrs). The 2008 average of 2.64 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 26% above average ( $2.1 \pm 0.13$  observers/hr).

## **FLIGHT SUMMARY**

The observers counted 3,963 migrant raptors of 17 species during the 2008 season, with the total count essentially matching the 1985–2007 average of 3,955 (Table 1; and see Appendix D for daily count records and Appendix E for annual summaries). No record low or high counts occurred for commonly encountered species.

The 2008 flight consisted of 37% accipiters, 35% vultures, 12% buteos, 7% falcons, 4% eagles, 2% Ospreys, 1% harriers, and 2% unidentified raptors. These values represent a significantly below average proportion of eagles, but near-average proportions of all other species groups (Figure 2). The Turkey Vulture was the most commonly encountered species, followed by the Cooper's Hawk, Sharp-shinned Hawk, Red-tailed Hawk, American Kestrel, and Golden Eagle; all other species comprised <3% each of the total count (Table 1).

## **Passage Rates and Long-term Trends**

Among 17 species seen in most years, adjusted passage rates were significantly above average only for Peregrine Falcons, whereas passage rates were significantly below average for 8 of the 16 remaining species (Table 1, Figures 3–7). Regression analyses of adjusted passage rates through 2008 indicated a significant ( $P \leq 0.05$ ) linear increasing for Swainson's Hawks (Figure 5), a highly significant ( $P \leq 0.01$ ) linear increasing trend for Peregrine Falcons (Figure 7), a marginally significant declining trend for Bald Eagles (Figure 6; recent drop only), and marginally ( $P \leq 0.10$ ) to highly significant quadratic (i.e., second-order polynomial) trends for Turkey Vultures and Ospreys (Figure 3), Cooper's Hawks (Figure 4), Broad-winged, Red-tailed and Ferruginous Hawks (Figure 5), and American Kestrels and Merlins (Figure 7). In most cases, these quadratic trends track increasing patterns through the mid-to-late 1990s



followed by recent stabilization or more commonly declines. The increasing patterns from the late 1980s through mid-1990s correlate with a wet El Niño period, with the subsequent declines correlating with the onset of widespread drought throughout much of the interior West after 1998 (Hoffman and Smith 2003). The Cooper's Hawk is the only species that previously showed a similar quadratic trend but has rebounded enough in the past three years to again reduce the pattern to no significant long-term trend (Figure 4); however, for several other species the 2008 passage rates represented noticeable upswings (e.g., for Turkey Vultures and Ospreys [Figure 3], and Red-tailed and Ferruginous Hawks [Figure 5]), and for Broad-winged Hawks continued a three-year upswing similar to Cooper's Hawks (Figure 5). In contrast, the newly significant quadratic trend for Swainson's Hawks tracks an increasing trend through 2003, but a relatively sharp and continuing decline since then (Figure 5). Age-specific analyses further revealed a significant ( $P \leq 0.05$ ) linear decline for adult Northern Goshawks, but no long-term trend for immature goshawks (Figure 4).

### **Age Ratios**

Immature : adult ratios were below average in 2008 for 7 of 9 species with data suited to comparisons, but significantly so only for the Northern Harrier, Bald Eagle, and Peregrine Falcon (Table 2). For all three of these species, counts of immature birds were well below average, suggesting that low productivity in 2007 and/or low overwinter survival of juveniles may have contributed to the results. That said, these results must be considered highly speculative because for all three species the proportions of unaged birds were well above average (Table 2). In particular, it is likely that the complete lack of confirmed second-year Northern Harriers and the very low number of confirmed immature Peregrine Falcons reflects, at least partly, limitations of observer identification skill. In fact, the only species for which variation in the proportions of unaged birds was not significant were the Northern Goshawk, Broad-winged Hawk, and Red-tailed Hawk. Moreover, counts of identified immature birds were below average for all species except the Northern Goshawk and Ferruginous Hawk, which were the only two species that showed above-average immature : adult ratios.

### **Seasonal Timing**

Similar to the past two seasons, the overall combined-species median passage date of 4 April was a marginally significant two days earlier than average (Table 3). At the species level, 10 of 17 species for which a comparison was possible showed significantly earlier than average timing in 2008, with only the Golden Eagle, Bald Eagle, and American Kestrel showing significantly later than average median passage dates. The combined-species distribution of seasonal activity illustrates the general pattern that applied to most species, with no obvious, overall early or late shifts in the activity pattern, but substantial variation from the average pattern for several five-day periods, especially from late-March through early April when several minor weather events intervened (Figure 8). Limited (due to low proportions of aged birds) age-specific comparisons revealed no further insight other than pointing to significantly early passage of juvenile Red-tailed Hawks (2008 median passage date of 5 April was 11 days earlier than average), whereas the timing of adult passage matched the long-term average (median passage date 23 March).

### **TRAPPING EFFORT**

The trapping crew operated Upper Station on 53 days (376.3 hrs) between 10 March and 2 May (see Appendix F for daily effort and capture totals by species). The number of station days was a significant 17% above the 1990–2007 average ( $44 \pm 95\%$  CI of 5.2 days) and the number of station hours was a significant 16% above average ( $317.1 \pm 42.4$  hrs; see Appendix G for annual summaries).

## **TRAPPING AND BANDING SUMMARY**

The 2008 capture total of 233 birds included eight species and two previously banded birds (Table 5, Appendix G). The 2008 effort raises the capture total since project inception to 3,966 birds of 12 species, including 26 recaptures of Sandia-banded birds and 32 foreign recaptures (i.e., birds originally banded elsewhere and subsequently recaptured in the Sandias; Appendix G). Captured species included the Cooper's Hawk (84% of all captures), Sharp-shinned Hawk (8%), Peregrine Falcon (3%), Red-tailed Hawk (3%), and four other species that each comprised <1% of the total. No Golden Eagles have ever been captured at this site, but one immature bird came close this season, having broken the lure line at the last second to escape.

Among the 12 species captured at the site thus far, the 2008 capture totals, rates, and estimates of capture success were all below average for eight species, with the differences generally significant except for Broad-winged and Red-tailed Hawks and Prairie Falcons (Table 5). Exceptions included Cooper's Hawk, for which the capture total was significantly above average but both the capture rate and success were non-significantly below average; Northern Goshawk, for which the capture total and rate were non-significantly below average but capture success was significantly above average; and Zone-tailed Hawk and Peregrine Falcon, for which all three measures were significantly above average. These statistics generally are consistent with changes in relative passage totals, but indicate that trapping efficiency also was low for most species except Cooper's Hawks and Peregrine Falcons.

Sharp-shinned and Cooper's Hawks captured in 2008 averaged slightly poorer condition than usual, with proportionately more birds having emptier crops, less wing-pit fat, and less robust keel muscles compared to long-term averages (Table 5). In contrast, other than empty crops, the few goshawks and falcons caught this season all were at least moderately healthy in terms of fat storage and keel-muscle health, and the seven Red-tailed Hawks captured in 2008 averaged healthier than usual based on these measure (Table 5).

## **ENCOUNTERS WITH PREVIOUSLY BANDED BIRDS**

The 2008 tally of captured birds included two previously banded, female Cooper's Hawks, one originally banded in the Sandias as an after-second-year (ASY) adult in 2006, and the other originally banded at HWI's nearby fall monitoring site in the Manzano Mountains in 2002 as a HY bird (Table 6). To date, 26 same-site recaptures have occurred at the Sandias site, all involving Cooper's Hawks (Appendix G), and 45 exchanges of banded birds have occurred between the Sandias and Manzanos sites, all involving Sharp-shinned and Cooper's Hawks.

Besides birds recaptured in the Manzano Mountains, to date 20 Sandia-banded Cooper's Hawks, 5 Sharp-shinned Hawks, 1 Red-tailed Hawk, and 1 Prairie Falcon have subsequently been encountered elsewhere. Seven new recoveries occurred in 2007 and up through May 2008, involving 6 Cooper's Hawks and 1 Sharp-shinned Hawk (Table 6). Five of the new recoveries occurred in New Mexico in close proximity (<100 km) to the project site, two during the same season as banding, one a year later, and two 10 years later (Table 6). Four of these birds were recovered dead, with two having died due to collisions with manmade objects (car and window). The other bird, one of the 11-year olds, was captured in a building and successfully released unharmed. The other two new "foreign encounters" involved adult, female Cooper's Hawks that were found dead of unknown causes 1 year later and 309 km north in southwestern Colorado and 2 years later and 883 km northwest near Jackson, Wyoming. All of the new recovery locations fell well within the expected bounds of the Rocky Mountain Flyway as described in Hoffman et al. (2002).

## **RESIDENT BIRDS**

The 2008 resident raptor community included a typical assemblage for the site.

Three resident Golden Eagles were present the entire season, including two adults and one subadult still with limited white patches in its wings. All three individuals were seen in the sky together on 1 April and during the last three days of the season, whereas between 1 April and 2 May, only one adult and the subadult were ever seen in the sky at the same time. We suspect this may indicate that the remaining adult was incubating.

Two light-morph, adult Red-tailed Hawks were first noted in the area on 9 March and thereafter were observed periodically through the remainder of the season. They were often spotted foraging low on the main ridge to the southeast of the observation point.

One or more apparently resident Sharp-shinned Hawks were observed early in the season, mostly seen perched during the observers' daily hikes up to the site.

Two adult Peregrine Falcons with light gray backs were present from 8 April until the end of the season. These birds often were spotted near the rocky "shields" above the count site (see cover photo) diving on the resident Golden Eagles and interacting with other migrating Peregrine Falcons. Prairie Falcons have not been regular, or at least not readily apparent, members of the resident community for the past several years; possibly due to the presence of resident peregrines.

The first sightings of resident Turkey Vultures occurred when three birds that were acting unlike previous migrants were observed on 11 April. Typically they flew east to west over the observation site and descended on the far side of the western ridge. On a few occasions, up to five birds were seen together.

## **SITE VISITATION AND PUBLIC OUTREACH**

A total of 415 individuals were recorded on our site visitor logs in 2008, with repeat visitors common. This year's visitors hailed from eight states (NM, IA, CA, FL, TX, VA, UT, and WA) and the United Kingdom. Visitors included 104 individuals as part of eight organized groups, including students from Bosque Prep School (5 classes), Cedar Crest School, and two local scout troops.

In 2008, 641 hourly assessments of visitor disturbance resulted in the following ratings: 81% none, 13% low, 6% moderate, and <1% high. Although higher than the last two years, as rated by our primary observers, this is a fairly typical level of disturbance for this busy site. The goal of having a dedicated Site Interpreter as part of the field crew is to provide visitors with a rich, educational experience while helping to minimize unnecessary distraction of the observers.

## **ACKNOWLEDGMENTS**

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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: 1985–2007 versus 2008.**

SPECIES	COUNTS			RAPTORS / 100 HOURS <sup>1</sup>		
	1985–2007 <sup>2</sup>	2008	% CHANGE	1985–2007 <sup>2</sup>	2008	% CHANGE
Turkey Vulture	1,367.2 ± 251.4	1,395	+2	430.6 ± 78.6	369.9	-14
Osprey	64.0 ± 11.1	85	+33	21.2 ± 3.6	24.4	15
Northern Harrier	58.4 ± 5.8	50	-14	13.2 ± 1.4	10.2	-23
White-tailed Kite	0.04 ± 0.09	0	-100	0.01 ± 0.02	0.0	-100
Mississippi Kite	0.17 ± 0.16	0	-100	0.03 ± 0.03	0.0	-100
TOTAL KITES	0.22 ± 0.21	0	-100	–	–	–
Sharp-shinned Hawk	496.3 ± 100.6	436	-12	115.7 ± 21.4	93.1	-20
Cooper's Hawk	759.7 ± 115.7	824	+8	212.7 ± 29.8	223.2	5
Northern Goshawk	11.3 ± 3.0	4	-64	2.3 ± 0.6	0.7	-69
Unknown small accipiter <sup>3</sup>	38.0 ± 47.0	32	-16	–	–	–
Unknown large accipiter <sup>3</sup>	4.1 ± 2.4	6	+45	–	–	–
Unknown accipiter	67.3 ± 17.8	171	+154	–	–	–
TOTAL ACCIPITERS	1,347.3 ± 177.1	1,473	+9	–	–	–
Common Black Hawk	0.04 ± 0.09	0	-100	0.01 ± 0.01	0.0	-100
Broad-winged Hawk	5.9 ± 2.4	7	+19	1.3 ± 0.5	1.5	+20
Swainson's Hawk	54.1 ± 8.7	31	-43	20.0 ± 2.6	11.4	-43
Zone-tailed Hawk	2.3 ± 0.9	2	-12	0.45 ± 0.2	0.3	-28
Red-tailed Hawk	340.4 ± 51.8	398	+17	74.3 ± 9.8	78.5	+6
Ferruginous Hawk	11.6 ± 2.0	8	-31	2.4 ± 0.4	1.6	-34
Rough-legged Hawk	0.52 ± 0.27	0	-100	0.19 ± 0.11	0.0	-100
Unidentified buteo	12.5 ± 4.1	40	+221	–	–	–
TOTAL BUTEOS	427.3 ± 60.9	486	+14	–	–	–
Golden Eagle	354.2 ± 67.6	132	-63	69.3 ± 12.3	23.1	-67
Bald Eagle	13.7 ± 3.5	6	-56	3.8 ± 0.9	1.8	-52
Unidentified eagle	0.61 ± 0.50	3	+393	–	–	–
TOTAL EAGLES	368.5 ± 69.8	141	-62	–	–	–
American Kestrel	198.4 ± 37.1	147	-26	50.4 ± 8.8	32.5	-35
Merlin	9.9 ± 3.1	8	-19	2.1 ± 0.6	1.6	-27
Prairie Falcon	25.0 ± 4.4	23	-8	5.0 ± 0.9	4.6	-7
Peregrine Falcon	45.1 ± 12.4	69	+53	9.1 ± 2.4	13.4	+47
Aplomado Falcon	0.04 ± 0.09	0	-100	0.01 ± 0.02	0.0	-100
Unknown small falcon <sup>3</sup>	1.4 ± 1.9	1	-30	–	–	–
Unknown large falcon <sup>3</sup>	2.9 ± 2.7	6	+110	–	–	–
Unknown falcon	2.6 ± 1.1	9	+245	–	–	–
TOTAL FALCONS	282.3 ± 46.3	263	-7	–	–	–
Unidentified raptor	40.2 ± 13.7	70	+74	–	–	–
GRAND TOTAL	3,955.3 ± 530.6	3,963	0	–	–	–

<sup>1</sup> Based on data truncated to standardized, species-specific sampling periods and adjusted for incompletely identified birds.

<sup>2</sup> Mean ± 95% CI.

<sup>3</sup> Designations used regularly for the first time in 2002.

**Table 2. Annual raptor migration counts by age classes and immature (second-year birds for most species, all non-adults for eagles) : adult age ratios for selected species in the Sandia Mountains, NM: 1990–2007 versus 2008.**

	TOTAL AND AGE-CLASSIFIED COUNTS						IMM. : ADULT			
	1990–2007 AVERAGE			2008			% UNKNOWN AGE		RATIO	
	TOTAL	IMM.	AD.	TOTAL	IMM.	AD.	1990–2007 <sup>1</sup>	2008	1990–2007 <sup>1</sup>	2008
Northern Harrier	58	11	30	50	0	22	31 ± 5.6	56	0.43 ± 0.194	0.00
Sharp-shinned Hawk	493	55	263	436	37	201	36 ± 5.1	45	0.24 ± 0.067	0.18
Cooper's Hawk	779	74	478	824	65	354	31 ± 6.7	49	0.19 ± 0.078	0.18
Northern Goshawk	11	3	6	4	3	0	24 ± 9.1	25	0.92 ± 0.658	~3.00
Broad-winged Hawk	7	0.4	4	7	0	5	29 ± 13.3	29	0.21 ± 0.250	0.00
Red-tailed Hawk	366	58	246	398	68	266	17 ± 3.6	16	0.26 ± 0.061	0.26
Ferruginous Hawk	12	2	5	8	4	2	44 ± 11.3	25	0.81 ± 0.667	2.00
Golden Eagle	367	169	123	132	71	51	21 ± 7.9	8	1.57 ± 0.481	1.39
Bald Eagle	13	6	6	6	0	3	8 ± 6.4	50	1.32 ± 0.453	0.00
Peregrine Falcon	55	12	29	69	4	27	23 ± 7.7	55	0.45 ± 0.113	0.15

<sup>1</sup> Mean ± 95% confidence interval. 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 long-term average numbers of immature and adult 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 2008 with a comparison of 2008 and 1985–2007 average median passage dates.**

SPECIES	2008				1985–2007
	FIRST OBSERVED	LAST OBSERVED	BULK PASSAGE DATES <sup>1</sup>	MEDIAN PASSAGE DATE <sup>2</sup>	MEDIAN PASSAGE DATE <sup>2,3</sup>
Turkey Vulture	11-Mar	5-May	22-Mar – 18-Apr	31-Mar	03-Apr ± 1.2
Osprey	7-Mar	3-May	31-Mar – 26-Apr	11-Apr	13-Apr ± 1.5
Northern Harrier	10-Mar	25-Apr	29-Mar – 22-Apr	7-Apr	06-Apr ± 1.8
Sharp-shinned Hawk	24-Feb	5-May	22-Mar – 26-Apr	13-Apr	18-Apr ± 2.0
Cooper's Hawk	24-Feb	5-May	24-Mar – 22-Apr	7-Apr	11-Apr ± 1.0
Northern Goshawk	12-Apr	26-Apr	–	–	05-Apr ± 5.2
Broad-winged Hawk	19-Apr	26-Apr	19-Apr – 26-Apr	22-Apr	23-Apr ± 2.8
Swainson's Hawk	2-Apr	29-Apr	6-Apr – 21-Apr	12-Apr	17-Apr ± 1.5
Zone-tailed Hawk	31-Mar	18-Apr	–	–	11-Apr ± 0.0
Red-tailed Hawk	24-Feb	4-May	8-Mar – 16-Apr	26-Mar	25-Mar ± 1.2
Ferruginous Hawk	24-Feb	5-Apr	24-Feb – 5-Apr	8-Mar	18-Mar ± 5.3
Golden Eagle	24-Feb	4-May	28-Feb – 24-Apr	27-Mar	20-Mar ± 3.3
Bald Eagle	28-Feb	26-Mar	28-Feb – 26-Mar	13-Mar	08-Mar ± 3.9
American Kestrel	29-Feb	5-May	22-Mar – 23-Apr	14-Apr	11-Apr ± 1.7
Merlin	12-Mar	5-May	12-Mar – 5-May	15-Mar	09-Apr ± 3.9
Prairie Falcon	27-Feb	22-Apr	28-Feb – 13-Apr	20-Mar	20-Mar ± 3.4
Peregrine Falcon	25-Feb	1-May	15-Mar – 23-Apr	5-Apr	12-Apr ± 2.7
All species	24-Feb	5-May	19-Mar – 21-Apr	4-Apr	06-Apr ± 1.3

<sup>1</sup> Dates between which the central 80% of the flight passed the lookout; calculated only for species with counts ≥5 birds.

<sup>2</sup> Date by which 50% of the flight passed the lookout; calculated only for species with counts ≥5 birds.

<sup>3</sup> Mean of annual values ± 95% confidence interval in days; calculated using only data for years with counts ≥5 birds.

**Table 4. Capture totals, rates, and successes for migrating raptors in the Sandia Mountains, NM, excluding Lower Station capture results from 1998 and 1999: 1990–2007 versus 2008.**

SPECIES	CAPTURE TOTALS		CAPTURE RATE <sup>1</sup>		% CAPTURE SUCCESS <sup>2</sup>	
	1990–2007 <sup>3</sup>	2008	1990–2007 <sup>3</sup>	2008	1990–2007 <sup>3</sup>	2008
Northern Harrier	1 ± 0.5	0	0.2 ± 0.2	0.0	1.1 ± 1.1	0.0
Sharp-shinned Hawk	44 ± 18.1	19	13.9 ± 4.7	5.0	8.5 ± 1.6	3.8
Cooper's Hawk	163 ± 28.4	196	53.3 ± 9.4	52.1	20.7 ± 4.5	20.4
Northern Goshawk	1 ± 0.6	1	0.5 ± 0.3	0.3	12.7 ± 6.9	24.8
Broad-winged Hawk	0.1 ± 0.12	0	0.0 ± 0.1	0.0	1.6 ± 3.1	0.0
Swainson's Hawk	0.2 ± 0.21	0	0.1 ± 0.1	0.0	0.4 ± 0.4	0.0
Red-tailed Hawk	8 ± 2.6	7	2.6 ± 0.9	1.9	2.1 ± 0.7	1.6
Zone-tailed Hawk	0.2 ± 0.19	1	0.0 ± 0.1	0.3	7.6 ± 10.2	50.0
American Kestrel	6 ± 3.5	2	2.0 ± 1.0	0.5	2.7 ± 1.3	1.3
Merlin	1 ± 0.5	0	0.3 ± 0.2	0.0	6.4 ± 4.2	0.0
Prairie Falcon	1 ± 0.7	1	0.4 ± 0.2	0.3	6.8 ± 3.8	4.0
Peregrine Falcon	3 ± 1.1	6	0.8 ± 0.3	1.6	4.9 ± 2.2	7.9
Total	228 ± 46.5	233	74.1 ± 13.1	61.9	10.8 ± 2.1	10.3

<sup>1</sup> Captures / 100 station hours.

<sup>2</sup> 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.

<sup>3</sup> Mean of annual values ± 95% confidence interval.



**Table 5. Comparisons of crop-fullness, wing-pit fat storage, and keel-muscle thickness ratings for three species of migrating raptors trapped in the Sandia Mountains, NM: 1991–2007 versus 2008.**

SPECIES	PERIOD	CROP <sup>1,2</sup>					KEEL MUSCLE <sup>1,3</sup>			WING-PIT FAT <sup>1,4</sup>			
		EMPTY	1/4	1/2	3/4	FULL	0	1	2	0	1	2	3
Sharp-shinned Hawk	1991–07 avg	74	8	5	4	8	2	54	44	5	24	39	32
Hawk	2008 ( <i>n</i> = 19)	74	16	5	0	5	0	68	32	5	32	42	21
Cooper’s Hawk	1991–07 avg	88	4	3	2	3	4	67	29	7	32	31	30
Hawk	2008 ( <i>n</i> = 195)	90	3	5	1	2	11	73	15	15	27	34	25
Northern Goshawk	1991–07 avg	92	5	0	0	3	3	63	33	8	59	23	10
Goshawk	2008 ( <i>n</i> = 1)	100	0	0	0	0	0	100	0	0	100	0	0
Red-tailed Hawk	1991–07 avg	93	1	5	0	0	22	69	9	54	40	4	1
Hawk	2008 ( <i>n</i> = 7)	86	14	0	0	0	14	71	14	29	29	43	0
American Kestrel	1991–07 avg	95	5	0	0	0	3	67	29	6	27	28	39
Kestrel	2008 ( <i>n</i> = 2)	100	0	0	0	0	0	100	0	0	0	100	0
Prairie Falcon	1991–07 avg	84	0	16	0	0	7	86	7	58	18	24	0
Falcon	2008 ( <i>n</i> = 1)	100	0	0	0	0	0	100	0	0	0	100	0
Peregrine Falcon	1991–07 avg	86	9	2	1	2	9	52	39	39	37	17	7
Falcon	2008 ( <i>n</i> = 6)	100	0	0	0	0	0	83	17	0	0	100	0

<sup>1</sup> Values are percentages of birds trapped.

<sup>2</sup> Subjective visual and tactile assessment of relative crop fullness.

<sup>3</sup> Subjective visual and tactile assessment of the relative thickness of the keel muscle, with 0 = skinny – “sharp” keel bone; 1 = average – moderately padded keel bone; and 2 = robust – keel bone solidly padded with muscle.

<sup>4</sup> Subjective visual assessment of the relative volume of fat deposited in the “wing-pit” area, with 0 = none; 1 = light deposit; 2 = moderate deposit – wing pit approaching or more than half full; and 3 = heavy deposit – bulging from wing-pit area.

**Table 6. Recaptures of previously banded raptors in the Sandia Mountains, New Mexico during the 2008 migration season and other encounters of Sandia-banded raptors between January 2007 and May 2008.**

BAND NUMBER	SPECIES <sup>1</sup>	SEX	BANDING SITE	BANDING DATE	BANDING AGE	RECOVERY LOCATION	RECOVERY DATE	RECOVERY AGE	DISTANCE (km)	DISPOSITION
1005 – 23806	CH	F	Sandia Mts., NM	16-Mar-07	ASY	Cuba, NM	14-Feb-08	ATY	94	Car kill
1005 – 23820	CH	F	Sandia Mts., NM	26-Mar-07	ASY	Cortez, CO	22-Apr-08	ATY	309	Found dead - cause unknown
1005 – 24900	CH	F	Sandia Mts., NM	07-Apr-06	TY	Jackson, WY	1-May-08	5 <sup>th</sup> yr	883	Found dead - cause unknown
1005 – 24949	CH	F	Sandia Mts., NM	13-Apr-06	ASY	Sandia Mts., NM	23-Apr-08	ATY	--	Research recapture
0745 – 96379	CH	F	Sandia Mts., NM	25-Mar-98	SY	Tijeras, NM	1-Jan-07	11 <sup>th</sup> yr	14	Caught in building - released
0804 – 31921	CH	M	Sandia Mts., NM	27-Mar-07	ASY	Albuquerque, NM	6-May-07	ASY	11	Found dead - cause unknown
1593 – 61518	SS	F	Sandia Mts., NM	15-Apr-07	SY	Albuquerque, NM	25-Apr-07	SY	11	Found dead - cause unknown
0745 – 96365	CH	F	Sandia Mts., NM	12-Mar-98	SY	Albuquerque, NM	20-Oct-07	11 <sup>th</sup> yr	11	Window kill
1005 – 01619	CH	F	Manzano Mts., NM	15-Sep-02	HY	Sandia Mts., NM	6-Apr-08	7 <sup>th</sup> yr	34	Research recapture

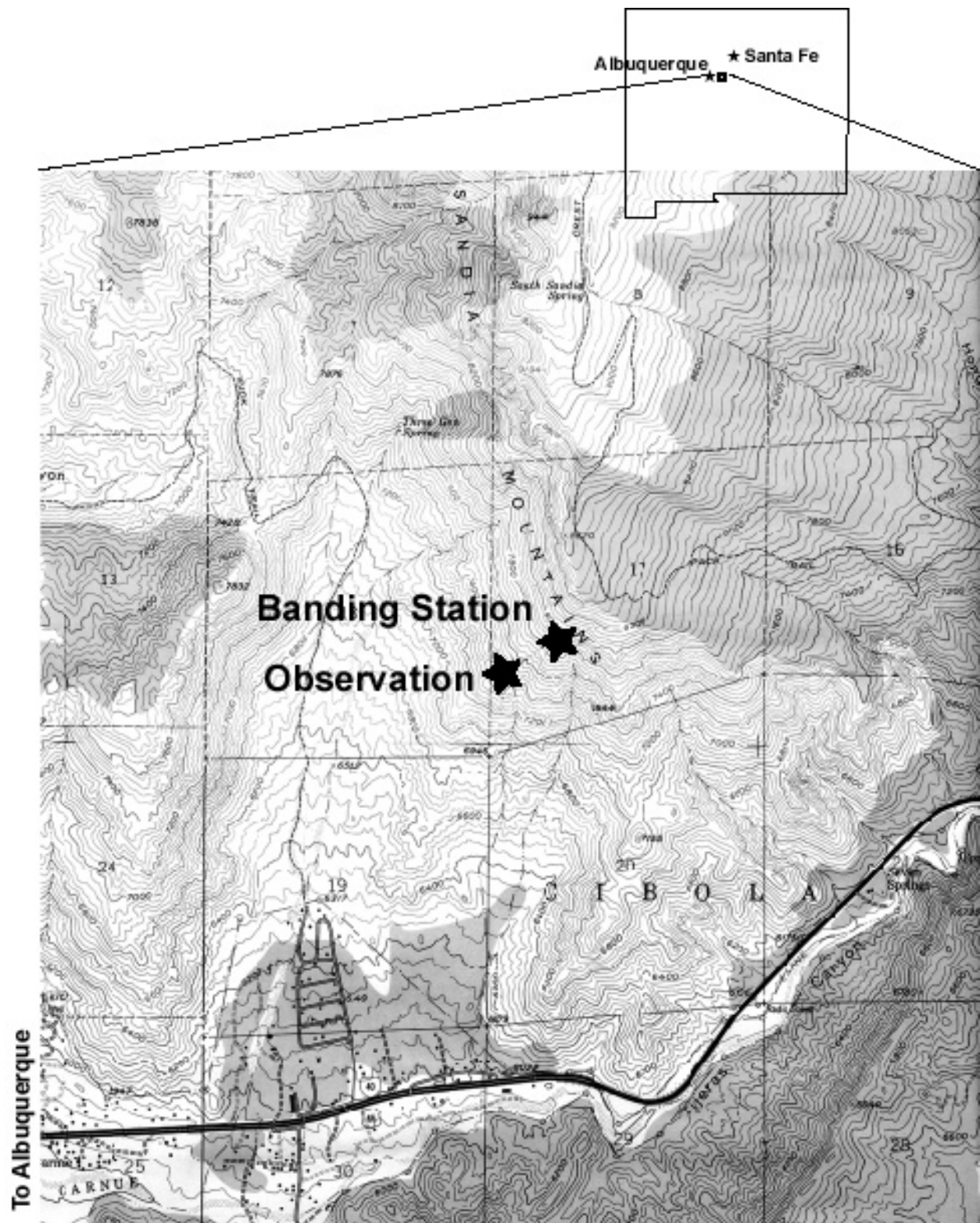
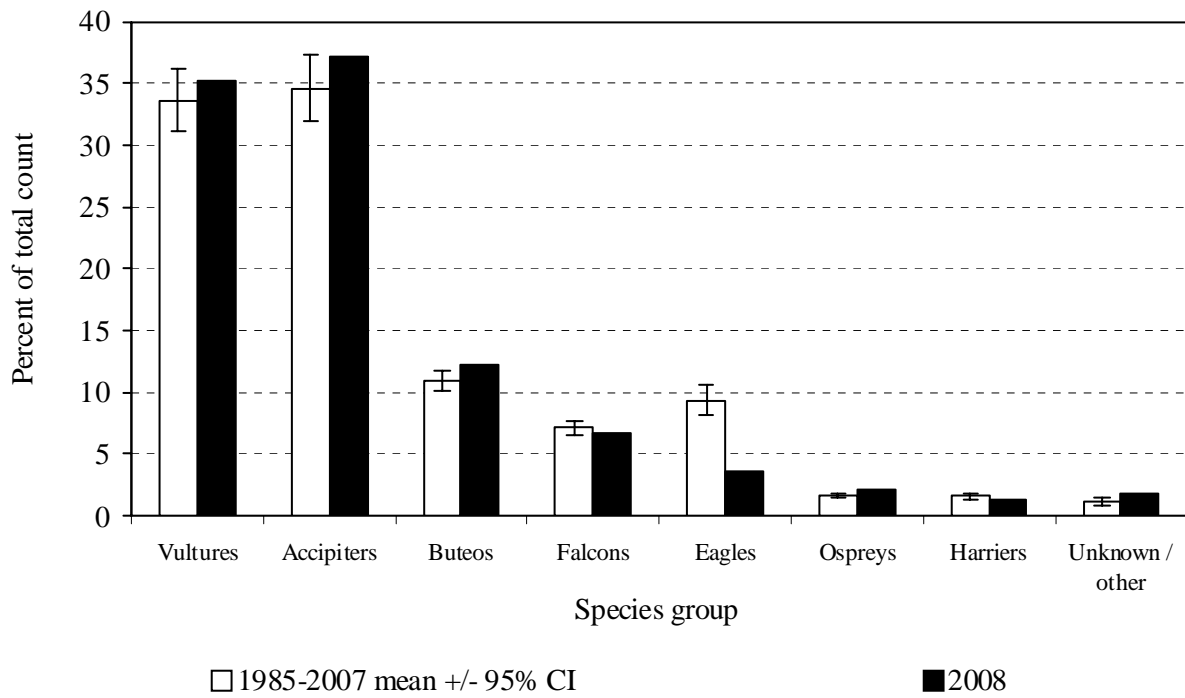
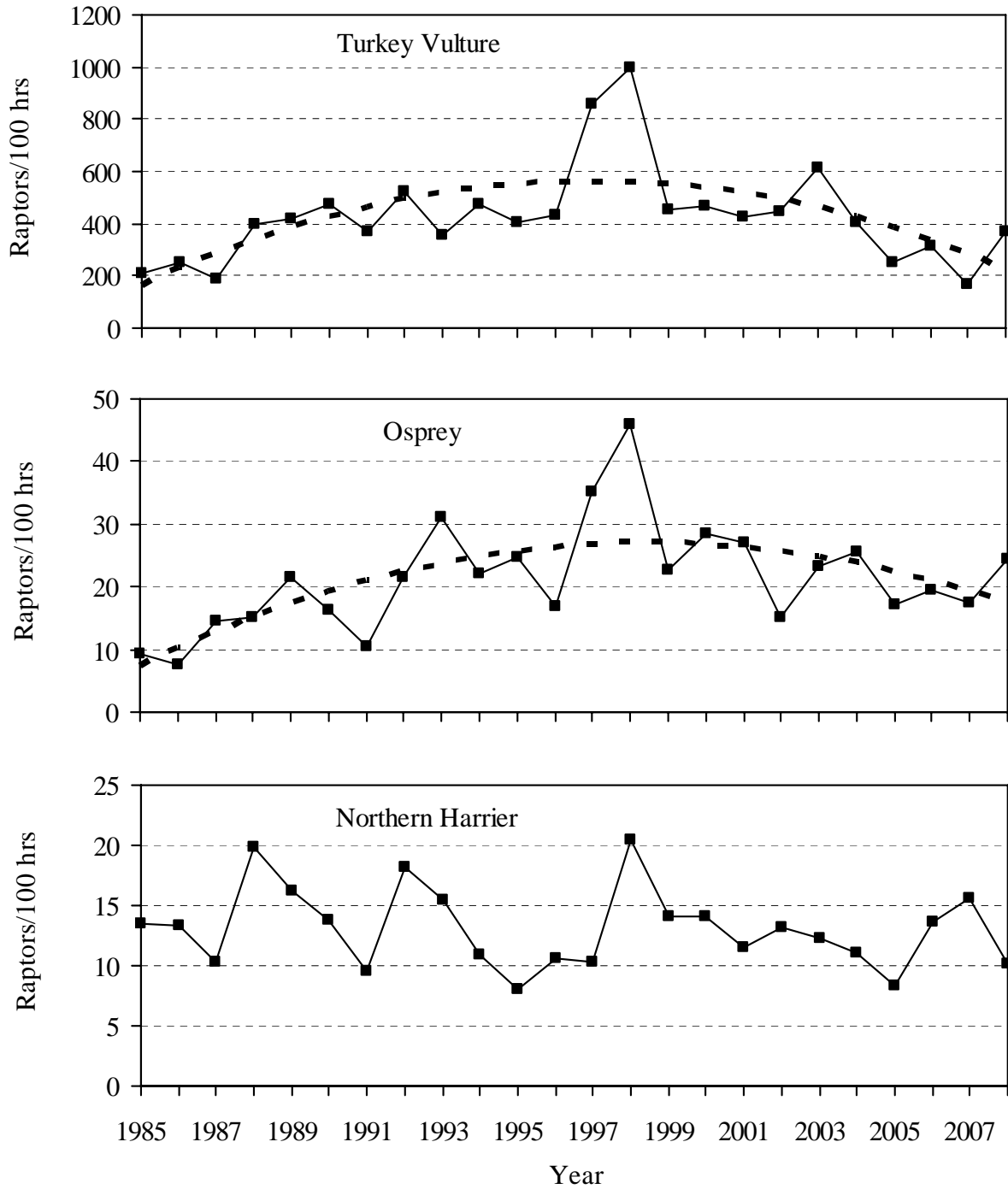


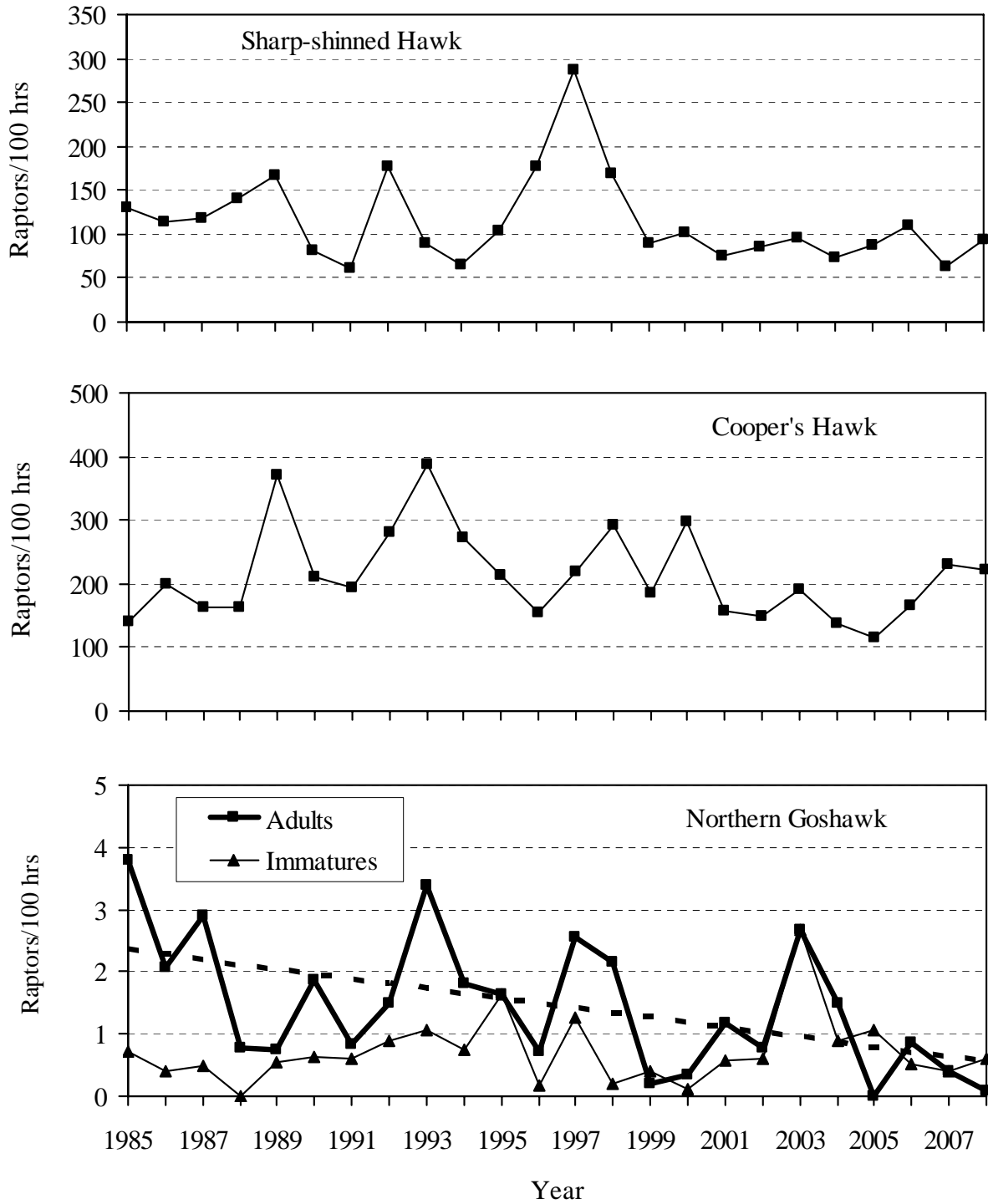
Figure 1. Map of Sandia Mountains Raptor Migration Project study site.



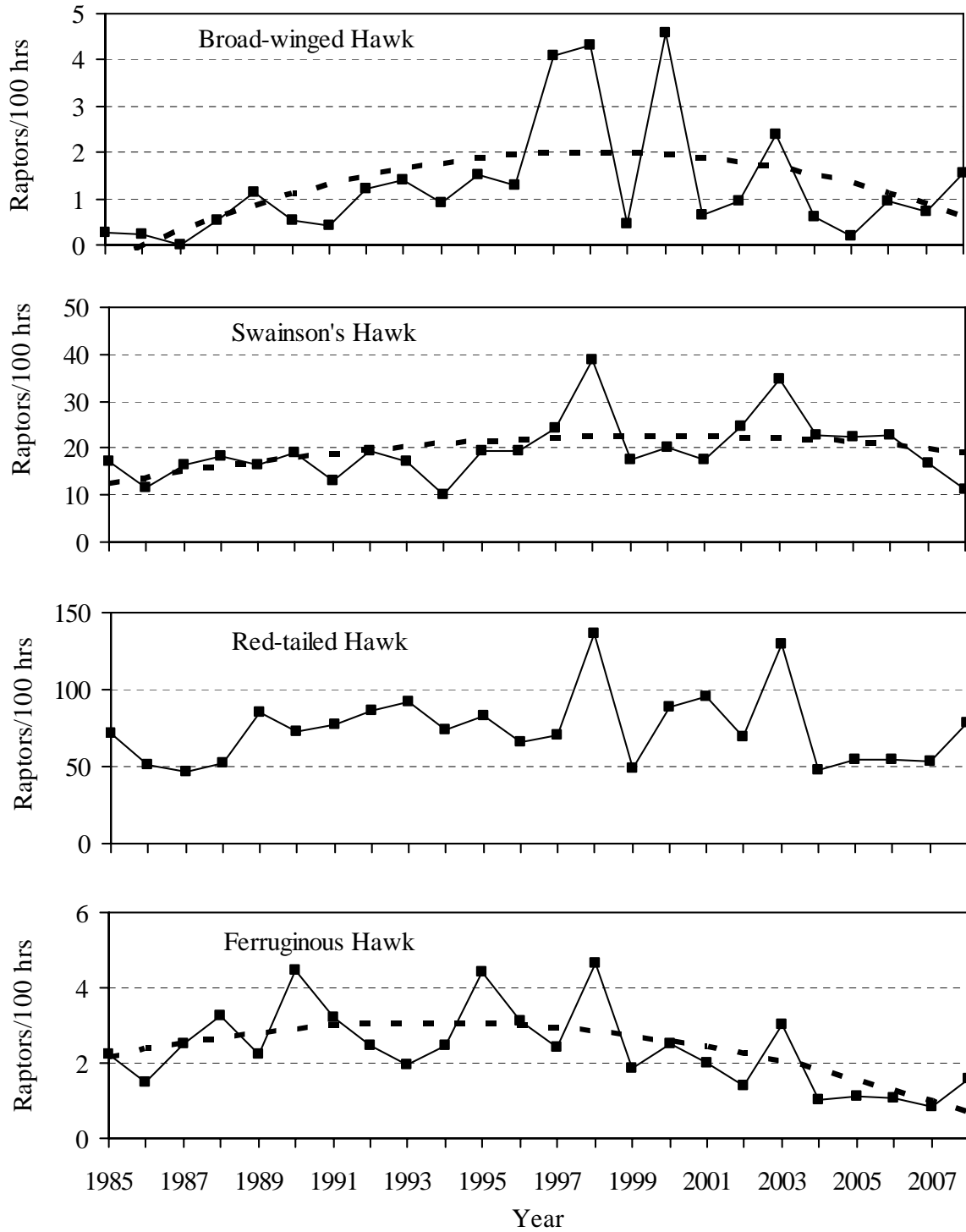
**Figure 2. Spring raptor-migration flight composition by major species groups in the Sandia Mountains, NM: 1985–2007 versus 2008.**



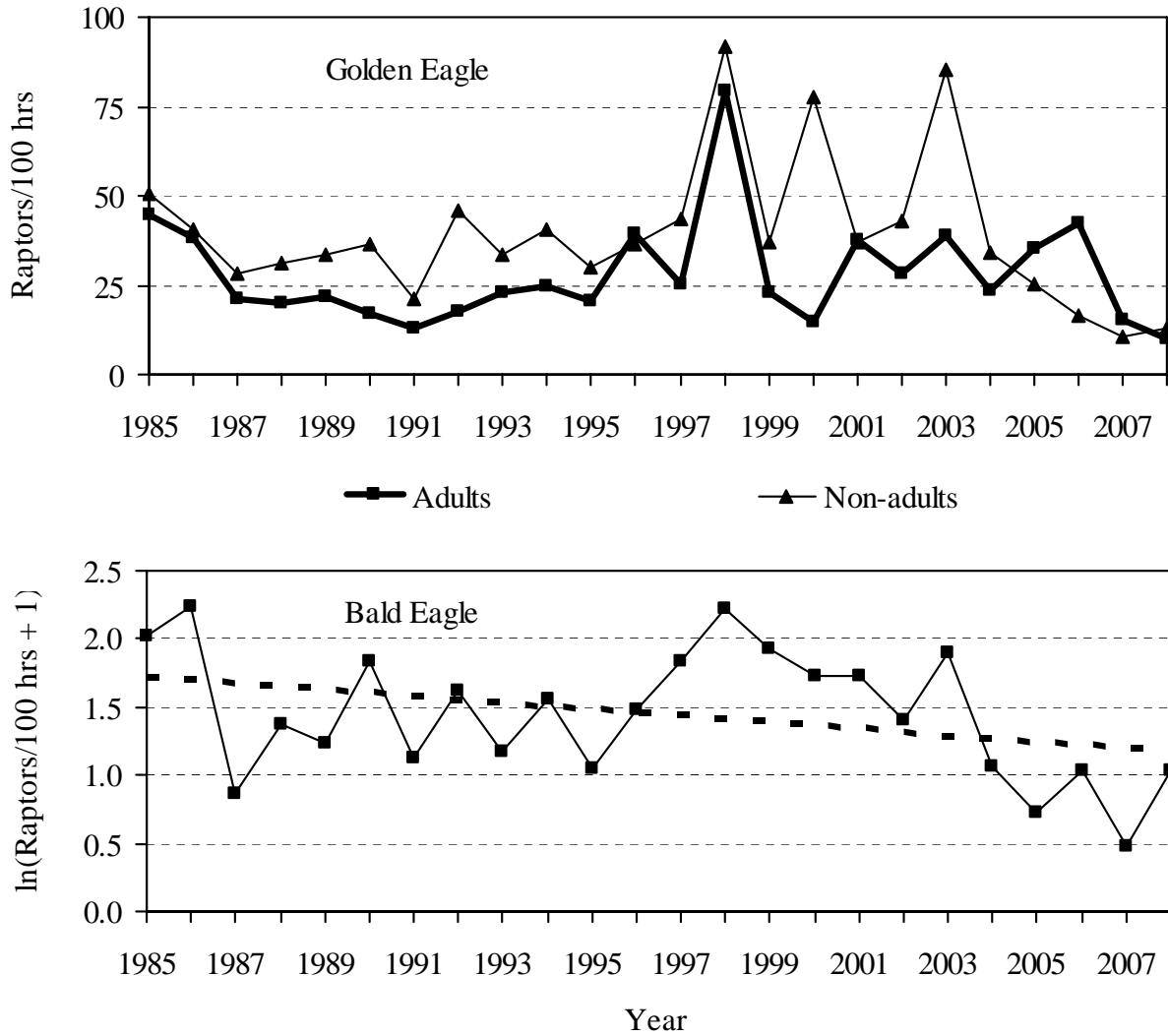
**Figure 3. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) spring-migration passage rates for Turkey Vultures, Ospreys, and Northern Harriers in the Sandia Mountains, NM: 1985–2008. Dashed lines indicate significant ( $P \leq 0.10$ ) linear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

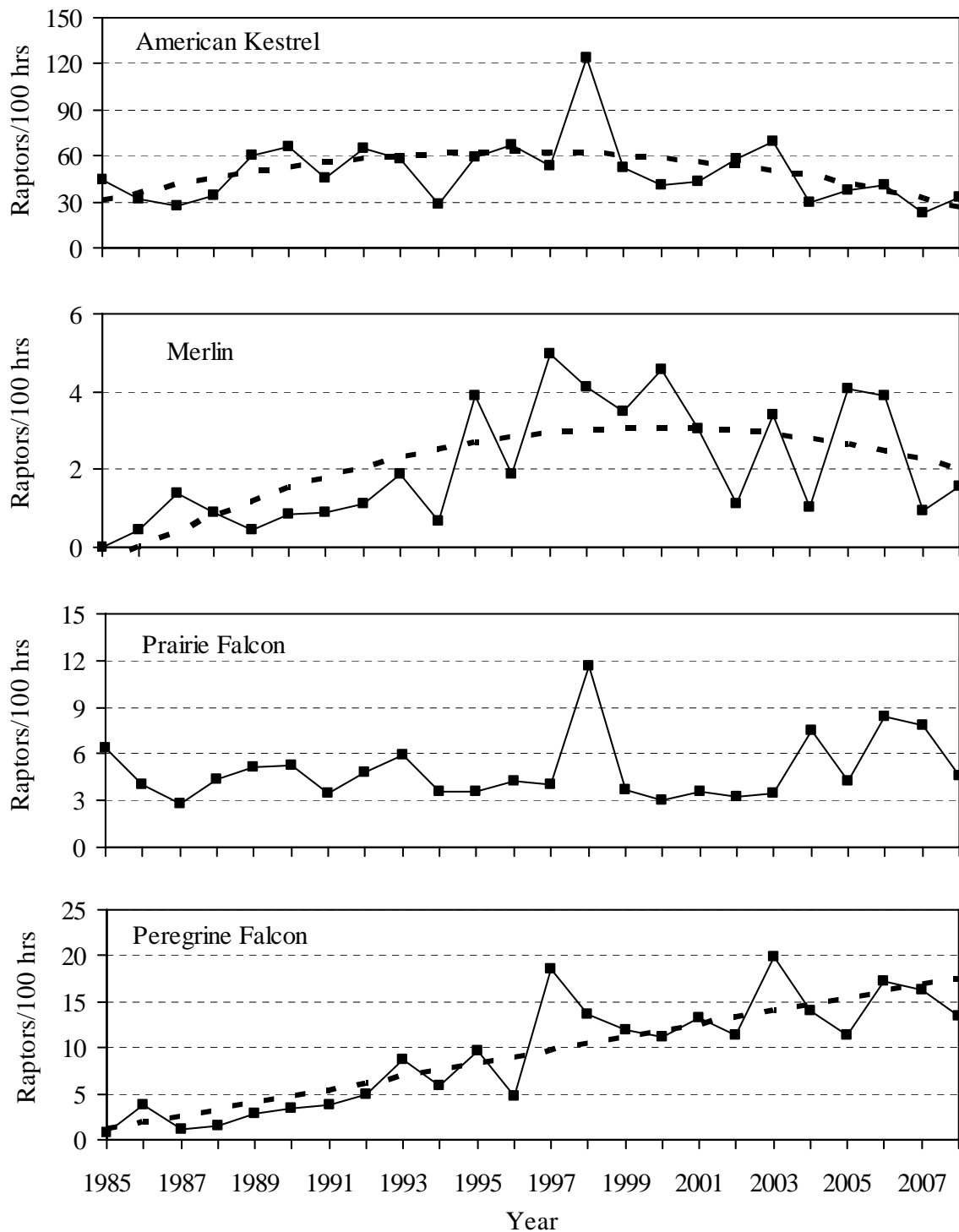


**Figure 5.** Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) spring-migration passage rates for Broad-winged, Swainson's, Red-tailed, and Ferruginous Hawks in the Sandia Mountains, NM: 1985–2008. Dashed lines indicate significant ( $P \leq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

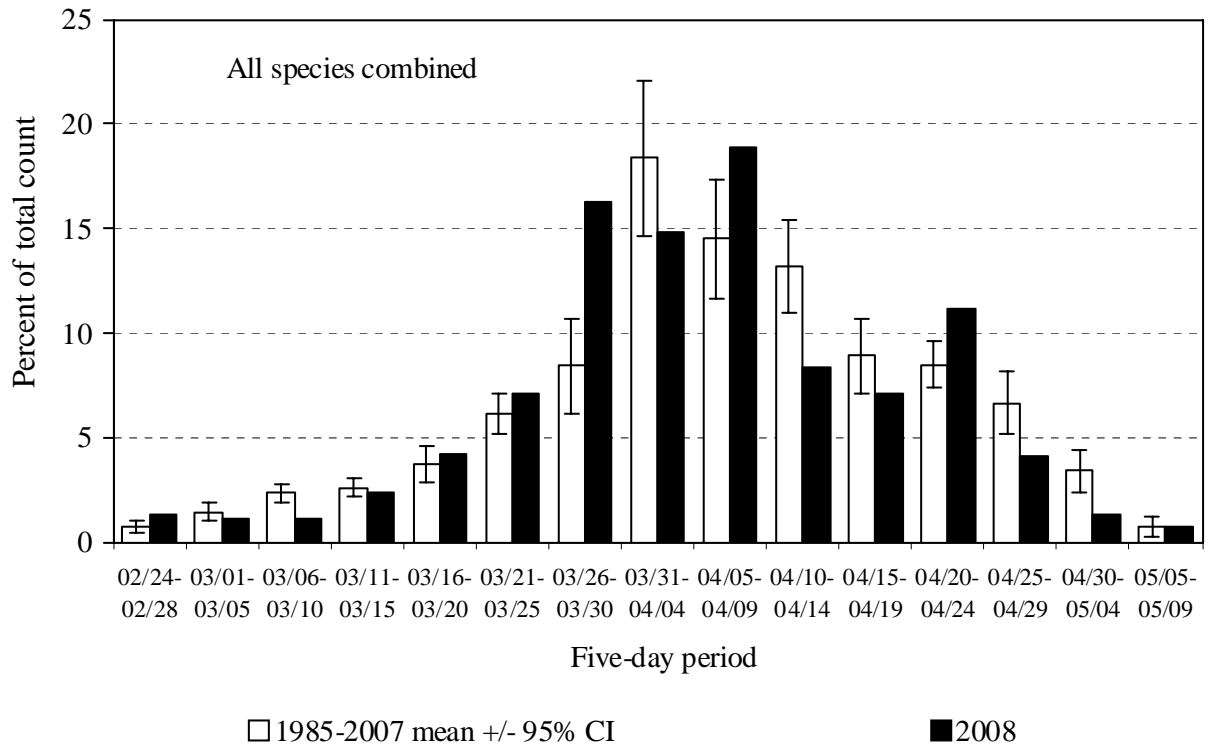


**Figure 6.** Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) spring-migration passage rates for Golden and Bald Eagles in the Sandia Mountains, NM: 1985–2008. Dashed lines indicate significant ( $P \leq 0.10$ ) linear or quadratic regressions.





**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: 1985–2008. Dashed lines indicate significant ( $P \leq 0.10$ ) linear or quadratic regressions.**



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

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

- 1985 Single observer throughout: Jim Daly–primary (1), Penny Rodefer (0)<sup>1</sup>
- 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)
- 2003 Two observers throughout: Bob Diebold (4), Teresa Lorenz (1)
- 2004 Two observers throughout: Ken Babcock (1), Dane Ferrell (1)
- 2005 Two observers throughout: Ken Babcock (3), Eileen Müller (1), Octavio Cruz (2)
- 2006 Two observers throughout: Alberto Martinez (3), Ingrid Verhoeckx (0), and Ken Babcock (4; support/substitute throughout)
- 2007 Two observers throughout: Graeme Davis (0), Shawn Thietten (0), and Ken Babcock (4+; support/substitute throughout)
- 2008 Two observers throughout: Kevin Payne (0), Carissa Turner (0), Ken Babcock (4+; support/substitute throughout), Mike Neal (6+; training + last 8 days), Jason Bjork (+; last 8 days)

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

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

<sup>2</sup> Sex codes: M = male, F = female, U = unknown.

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

<sup>4</sup> 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.

<sup>5</sup> 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: 2008.**

DATE	OBS. HOURS	OBSRVR / HOUR <sup>1</sup>	MEDIAN	PREDOMINANT WEATHER <sup>3</sup>	WIND	TEMP (°C) <sup>1</sup>	BAROM.	MEDIAN	VISIB.	VISIB.	MEDIAN	BIRDS / HOUR	
			VISITOR DISTURB <sup>2</sup>		SPEED (KPH) <sup>1</sup>		PRESS. (IN HG) <sup>1</sup>	THERMAL LIFT <sup>4</sup>	WEST (KM) <sup>1</sup>	EAST (KM) <sup>1</sup>	FLIGHT DISTANCE <sup>5</sup> / HOUR		
24-Feb	8.00	5.6	0	pc-ovc	4.9	w-nw/var	14.4	29.54	3	94	93	1	1.4
25-Feb	8.00	4.0	0	ovc-pc	24.6	wnw-nw	9.3	29.40	3	97	96	2	0.6
26-Feb	8.00	4.9	0	clr	7.1	se, w-nw	8.5	30.25	2	93	93	2	1.5
27-Feb	8.25	3.0	0	clr-pc	10.6	w-nw	9.8	30.19	2	95	95	1	0.8
28-Feb	8.50	2.9	0	clr-pc	16.4	w-nw	11.8	30.06	2	98	89	1	2.1
29-Feb	8.25	3.0	0	clr	5.3	se, ene	14.9	30.27	2	93	89	2	1.1
1-Mar	8.00	3.6	1	clr	4.5	w-nw/var	15.6	30.15	2	88	88	2	1.5
2-Mar	8.25	3.0	0	mc-ovc, snow	36.0	wnw-nw	2.4	29.79	4	42	41	3	0.4
3-Mar	8.00	2.6	0	clr-ovc	14.2	w-nw	1.5	30.16	3	92	92	1	0.6
4-Mar	8.00	2.9	0	clr-pc	10.8	sw-nw	9.4	29.95	2	92	90	2	1.9
5-Mar	8.00	2.0	1	clr-ovc	9.4	se, wnw-nw	7.6	29.92	3	86	86	2	1.4
6-Mar	6.00	3.0	0	mc-ovc, AM snow	9.4	ws-w-nw	0.5	30.03	4	39	39	2	0.5
7-Mar	8.25	3.3	0	clr	17.4	sw-wnw	5.5	30.16	3	98	98	1	0.8
8-Mar	8.33	3.6	0	mc-ovc	4.5	sw-wnw	7.0	29.98	3	85	85	2	2.4
9-Mar	8.25	2.6	1	pc-mc	27.2	se	5.2	30.12	3	90	90	3	0.4
10-Mar	8.42	2.0	0	clr-mc	2.9	calm, sw-nw/var	10.9	30.28	2	84	83	2	2.3
11-Mar	8.33	3.0	0	clr	15.5	w-nw	12.2	30.21	2	95	88	2	1.1
12-Mar	8.42	2.2	0	clr-pc	20.7	w-nw	12.7	30.06	2	90	90	2	2.4
13-Mar	8.75	1.5	0	clr-ovc	18.6	w-nw	12.5	29.97	2	77	67	2	2.6
14-Mar	8.00	2.1	0	clr-pc, dust	33.5	sw-nw	10.8	29.79	3	70	63	1	2.6
15-Mar	8.25	3.0	0	clr-ovc	12.5	sw-nw/var	11.5	29.86	3	82	79	1	3.9
16-Mar	8.00	2.4	1.5	pc-mc, dust	29.0	se-s	12.6	29.71	3	81	67	2	2.1
17-Mar	8.00	2.0	0	pc-mc	8.3	wnw-nw	6.5	29.90	3	90	90	2	2.3
18-Mar	8.42	2.0	0	clr	11.6	se-ssw, wnw-nw	10.5	30.04	2	93	95	2	1.4
19-Mar	8.50	2.8	0	clr	8.3	calm/var, wsw-wnw	12.6	30.19	2	83	76	1	10.5
20-Mar	8.50	2.9	0	clr-mc	10.4	sw-nw/var	16.7	30.11	2	88	87	1	7.3
21-Mar	8.67	2.0	0	clr	8.7	w-nw	14.4	30.21	2	88	81	1	5.5
22-Mar	8.25	2.9	0	clr/haze	15.3	se-sw, w-nw	15.5	30.19	2	83	76	2	13.7
23-Mar	8.33	2.8	0	AM ovc/snow/fog, PM clr/haze	13.6	ese-se, sw	5.8	30.29	3	74	73	1	2.8
24-Mar	8.50	2.7	0	clr/haze	8.2	w-nw/var	14.2	30.20	2	75	67	1	4.4
25-Mar	8.25	2.8	0	clr/haze	11.0	sw-nw, var	15.3	30.13	2	84	77	2	12.6
26-Mar	9.33	2.6	0	ovc-clr, haze	16.8	sw-wnw	14.7	30.10	2	81	69	2	14.7
27-Mar	10.00	2.6	0	clr/haze	19.9	wnw-nw/var	15.8	29.98	3	89	86	2	10.5
28-Mar	10.00	2.0	0	ovc-pc, haze	29.9	e-se	9.2	30.02	3	62	66	2	7.8
29-Mar	9.50	3.0	0	clr/haze	5.4	sw-nw, var	16.3	29.99	2	84	76	1	23.3
30-Mar	9.00	2.7	2	pc-mc, haze	9.9	var	16.3	29.98	3	89	79	1	15.3
31-Mar	9.25	1.9	0	clr, AM haze	6.3	nw, ne-se	12.7	30.02	2	90	88	2	7.8
1-Apr	9.00	2.0	0	clr/haze	24.4	ene-e, se	6.6	30.14	3	76	74	2	5.2
2-Apr	9.75	2.6	0	pc-ovc, haze	8.3	sw-w	15.6	30.06	3	84	79	2	28.7
3-Apr	9.00	2.9	0	clr-ovc, AM haze	13.5	sw-nw	10.4	30.01	3	84	80	1	5.4
4-Apr	10.00	3.5	0	clr	12.2	calm, wnw-nw	11.7	30.11	3	87	85	2	8.3
5-Apr	9.50	3.8	1.5	mc-clr	27.8	sw-nw	14.0	29.90	3	86	80	2	24.1
6-Apr	10.00	3.5	1	clr/haze	16.3	sw-nw	15.4	30.01	3	84	75	2	14.4
7-Apr	10.00	2.6	0	clr-pc	14.0	sw-w	14.6	29.95	2	88	85	2	13.7
8-Apr	9.50	1.9	0	clr-mc	9.1	sw-nw, e-se	13.0	29.98	2	82	70	2	16.3
9-Apr	7.00	2.0	0	ovc, PM snow	12.8	sw-nw	8.1	29.80	4	63	66	2	10.6
10-Apr	4.50	2.4	0	pc-ovc, PM snow	44.3	sw-nw	-1.5	29.73	4	72	64	1	0.2

Appendix C. continued

DATE	OBS. HOURS	OBSRVR / HOUR <sup>1</sup>	MEDIAN	PREDOMINANT WEATHER <sup>3</sup>	WIND	WIND DIRECTION	TEMP (°C) <sup>1</sup>	BAROM.	MEDIAN	VISIB.	VISIB.	MEDIAN	BIRDS / HOUR
			VISITOR DISTURB <sup>2</sup>		SPEED (KPH) <sup>1</sup>			PRESS. (IN HG) <sup>1</sup>	THERMAL LIFT <sup>4</sup>	WEST (KM) <sup>1</sup>	EAST (KM) <sup>1</sup>	FLIGHT DISTANCE <sup>5</sup>	
11-Apr	9.50	2.7	0	clr-mc	36.2	wnw-nw	3.7	30.07	3	88	81	2	3.4
12-Apr	9.50	4.7	0	clr-ovc	12.6	sw-nw	8.7	30.27	2	67	80	2	11.5
13-Apr	9.50	3.8	1	clr	7.4	ene-se/var	12.4	30.33	2	88	77	2	12.0
14-Apr	9.50	3.8	0	clr	6.6	wsw-nw, calm/var	17.1	30.23	2	84	85	2	7.9
15-Apr	9.50	2.7	0	clr, dust/haze	14.6	sw-wnw	19.5	30.01	2	88	86	2	9.7
16-Apr	9.50	2.6	0	clr-pc, PM haze	25.0	sw	16.4	29.88	3	82	76	2	4.7
17-Apr	7.25	2.0	0	mc-ovc, AM haze, scat snow	14.7	wnw, se	6.4	30.05	3	66	72	2	1.1
18-Apr	9.75	1.9	0	clr/haze	16.5	wsw-nw	14.3	30.15	2	77	69	2	6.3
19-Apr	9.50	4.0	0	mc-ovc	5.1	sw-nw, se	18.1	30.07	3	74	69	2	14.8
20-Apr	9.50	4.1	1	clr	18.8	sw-wnw	17.6	29.96	2	86	77	2	10.1
21-Apr	9.50	1.9	0	clr	21.3	sw-wnw	14.7	30.00	2	87	78	2	5.9
22-Apr	9.00	2.6	0	clr/haze	4.8	se-sse/calm-var	18.8	30.12	2	84	78	2	9.7
23-Apr	9.50	2.6	0	clr	9.6	sw-wnw	21.1	30.02	1	89	81	2	6.6
24-Apr	9.50	2.4	0	clr/haze	21.6	sw-wnw	16.6	29.99	3	79	71	2	5.7
25-Apr	9.00	2.7	0	clr/haze	23.6	w-nw	10.6	30.15	3	87	85	2	2.4
26-Apr	9.00	2.0	0	clr/haze	27.7	wsw-nw	14.2	30.14	3	70	66	1	5.6
27-Apr	9.00	1.2	1.5	clr/haze	9.4	se, sw-w	11.4	30.31	1	80	60	3	2.0
28-Apr	8.25	1.9	0	clr-mc, haze	3.3	wnw	18.1	30.25	1	72	55	2	2.4
29-Apr	8.00	1.9	1	pc-mc	3.3	wnw	23.1	30.10	1	63	68	2	2.5
30-Apr	8.00	1.0	0	clr-mc, PM haze	8.5	wnw	22.3	29.84	1	63	54	2	1.4
1-May	6.00	1.5	0	pc, haze	22.7	w-wnw	14.0	29.83	4	51	26	3	1.0
2-May	7.00	1.3	0	clr	17.0	w-wnw	10.9	29.99	3	69	58	2	0.7
3-May	8.00	1.0	0	clr	3.3	w-wnw	15.0	30.13	1	68	56	2	1.5
4-May	8.00	1.1	2	pc	2.3	w	21.4	30.10	2	73	60	2	1.5
5-May	6.00	1.9	0	mc-ovc, PM rain	9.6	w, se	22.3	30.10	2	56	44	2	2.7

<sup>1</sup> Average of hourly records.

<sup>2</sup> Median hourly visitor-disturbance rating (subjective assessment by observers): 0 = none, 1 = low, 2 = moderate, 3 = high.

<sup>3</sup> 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.

<sup>4</sup> 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.

<sup>5</sup> 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: 2008.**

OBSERV.		SPECIES <sup>1</sup>																										BIRDS							
DATE	HOURS	TV	OS	NH	WK	MK	SS	CH	NG	SA	LA	UA	CB	BW	SW	ZT	RT	FH	RL	UB	GE	BE	UE	AK	ML	PR	PG	AF	SF	LF	UF	UU	TOTAL	/HOUR	
24-Feb	8.00	0	0	0	0	0	4	1	0	0	0	0	0	0	0	3	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	11	1.4
25-Feb	8.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	1	0	0	0	0	0	0	5	0.6	
26-Feb	8.00	0	0	0	0	0	5	0	0	1	0	0	0	0	0	2	0	0	0	3	0	0	0	0	0	1	0	0	0	0	0	0	12	1.5	
27-Feb	8.25	0	0	0	0	0	2	0	0	0	0	1	0	0	0	2	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	7	0.8	
28-Feb	8.50	0	0	0	0	0	2	0	0	0	0	0	0	0	0	8	0	0	0	4	2	0	0	0	2	0	0	0	0	0	0	0	18	2.1	
29-Feb	8.25	0	0	0	0	0	3	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	9	1.1		
01-Mar	8.00	0	0	0	0	0	2	0	0	1	0	1	0	0	0	5	0	0	1	0	0	0	1	0	1	0	0	0	0	0	0	12	1.5		
02-Mar	8.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	0.4	
03-Mar	8.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	1	0	0	0	0	0	0	1	5	0.6	
04-Mar	8.00	0	0	0	0	0	3	0	0	0	0	0	0	0	0	5	1	0	0	4	0	0	1	0	0	0	0	0	0	0	0	1	15	1.9	
05-Mar	8.00	0	0	0	0	0	0	3	0	0	0	1	0	0	0	3	1	0	0	0	0	0	0	0	2	0	0	0	1	0	0	11	1.4		
06-Mar	6.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	3	0.5	
07-Mar	8.25	0	1	0	0	0	1	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	7	0.8	
08-Mar	8.33	0	0	0	0	0	2	2	0	0	0	0	0	0	0	4	1	0	1	8	0	0	1	0	0	0	0	0	0	0	0	1	20	2.4	
09-Mar	8.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	3	0.4	
10-Mar	8.42	0	0	1	0	0	3	2	0	1	0	1	0	0	0	5	0	0	0	3	0	0	1	0	1	0	0	0	1	0	0	19	2.3		
11-Mar	8.33	1	0	0	0	0	1	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	2	1	9	1.1		
12-Mar	8.42	0	0	0	0	0	0	4	0	0	0	3	0	0	0	8	0	0	0	2	0	0	0	1	0	2	0	0	0	0	0	20	2.4		
13-Mar	8.75	5	0	0	0	0	0	2	0	0	0	0	0	0	0	10	0	0	0	2	1	0	0	1	0	1	0	0	0	0	1	23	2.6		
14-Mar	8.00	0	0	0	0	0	0	2	0	1	0	1	0	0	0	12	0	0	0	3	0	0	0	1	1	0	0	0	0	0	0	21	2.6		
15-Mar	8.25	2	1	0	0	0	0	4	0	0	0	1	0	0	0	14	1	0	0	3	0	0	0	1	0	2	0	0	0	2	1	32	3.9		
16-Mar	8.00	1	0	0	0	0	0	0	0	0	0	0	0	0	0	7	1	0	2	4	0	1	1	0	0	0	0	0	0	0	0	17	2.1		
17-Mar	8.00	6	0	1	0	0	1	2	0	0	0	1	0	0	0	5	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	18	2.3		
18-Mar	8.42	1	0	0	0	0	2	2	0	0	0	1	0	0	0	0	0	0	2	1	0	0	2	0	1	0	0	0	0	0	0	12	1.4		
19-Mar	8.50	55	0	1	0	0	3	12	0	1	0	2	0	0	0	7	0	0	0	5	0	0	1	0	0	1	0	0	0	0	1	89	10.5		
20-Mar	8.50	23	0	0	0	0	1	7	0	0	0	2	0	0	0	20	0	0	0	0	0	0	0	1	1	4	0	0	0	0	3	62	7.3		
21-Mar	8.67	9	0	0	0	0	1	13	0	1	0	3	0	0	0	14	0	0	3	0	0	1	2	0	0	0	0	0	0	0	1	48	5.5		
22-Mar	8.25	38	2	1	0	0	16	15	0	0	0	9	0	0	0	17	0	0	5	1	1	0	3	0	0	1	0	0	0	0	4	113	13.7		
23-Mar	8.33	6	0	0	0	0	1	4	0	0	0	3	0	0	0	6	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	23	2.8		
24-Mar	8.50	10	0	0	0	0	5	10	0	1	0	4	0	0	0	5	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	37	4.4		
25-Mar	8.25	57	0	0	0	0	7	12	0	0	0	6	0	0	0	15	0	0	0	1	0	0	2	0	0	2	0	0	0	1	1	104	12.6		
26-Mar	9.33	73	1	0	0	0	5	20	0	0	0	5	0	0	0	16	1	0	3	5	1	1	2	0	0	2	0	0	0	2	137	14.7			
27-Mar	10.00	53	1	0	0	0	6	17	0	1	0	1	0	0	0	14	0	0	2	1	0	0	2	0	0	4	0	0	0	1	2	105	10.5		
28-Mar	10.00	62	0	0	0	0	0	1	0	0	0	2	0	0	0	8	0	0	0	0	0	0	1	0	0	1	0	0	0	0	3	78	7.8		
29-Mar	9.50	162	0	2	0	0	9	18	0	0	0	5	0	0	0	16	0	0	0	2	0	0	2	0	1	1	0	0	0	0	3	221	23.3		
30-Mar	9.00	96	1	1	0	0	3	17	0	0	0	2	0	0	0	16	0	0	0	0	0	0	0	0	1	0	0	0	0	1	138	15.3			
31-Mar	9.25	38	4	0	0	0	3	5	0	1	0	3	0	0	0	1	10	0	0	0	6	0	0	0	1	0	0	0	0	0	72	7.8			
01-Apr	9.00	26	0	1	0	0	0	4	0	0	0	2	0	0	0	6	0	0	0	2	0	0	0	0	0	0	0	1	0	0	5	47	5.2		

Appendix D. continued

DATE	OBSERV.		SPECIES <sup>1</sup>																								BIRDS								
	HOURS	TV	OS	NH	WK	MK	SS	CH	NG	SA	LA	UA	CB	BW	SW	ZT	RT	FH	RL	UB	GE	BE	UE	AK	ML	PR	PG	AF	SF	LF	UF	UU	TOTAL	/HOUR	
02-Apr	9.75	193	1	5	0	0	13	40	0	2	0	7	0	0	1	0	8	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	6	280	28.7
03-Apr	9.00	30	2	0	0	0	2	5	0	1	0	0	0	0	0	0	5	0	0	0	2	0	0	0	0	0	1	0	0	1	0	0	49	5.4	
04-Apr	10.00	24	3	6	0	0	8	14	0	1	1	5	0	0	2	0	6	0	0	1	5	0	0	1	0	0	3	0	0	0	0	3	83	8.3	
05-Apr	9.50	81	4	3	0	0	26	76	0	4	0	12	0	0	0	0	13	1	0	0	1	0	0	1	0	1	6	0	0	0	0	0	229	24.1	
06-Apr	10.00	30	9	2	0	0	16	59	0	1	2	5	0	0	1	0	8	0	0	2	6	0	0	0	0	0	3	0	0	0	0	0	144	14.4	
07-Apr	10.00	35	4	3	0	0	16	45	0	3	0	6	0	0	1	0	14	0	0	1	1	0	0	1	0	0	2	0	0	0	0	5	137	13.7	
08-Apr	9.50	52	1	2	0	0	9	40	0	0	1	9	0	0	4	0	5	0	0	1	5	0	0	19	0	1	2	0	0	0	0	4	155	16.3	
09-Apr	7.00	2	5	5	0	0	8	36	0	1	0	2	0	0	5	0	2	0	0	2	0	0	0	1	0	0	1	0	0	1	1	2	74	10.6	
10-Apr	4.50	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.2	
11-Apr	9.50	7	5	0	0	0	7	6	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	2	32	3.4	
12-Apr	9.50	15	11	1	0	0	14	42	1	2	0	3	0	0	3	0	5	0	0	0	2	0	0	6	1	1	2	0	0	0	0	0	109	11.5	
13-Apr	9.50	29	0	0	0	0	12	32	0	1	1	8	0	0	1	0	7	0	0	0	4	0	0	16	0	1	1	0	0	0	0	1	114	12.0	
14-Apr	9.50	17	1	2	0	0	11	31	1	1	0	3	0	0	0	0	2	0	0	1	0	0	0	3	0	0	1	0	0	0	0	1	75	7.9	
15-Apr	9.50	6	1	0	0	0	16	29	0	1	1	8	0	0	1	0	6	0	0	4	0	0	0	10	0	1	4	0	0	0	1	3	92	9.7	
16-Apr	9.50	10	2	0	0	0	8	9	0	0	0	3	0	0	1	0	4	0	0	0	2	0	0	3	0	0	2	0	0	0	0	1	45	4.7	
17-Apr	7.25	0	2	0	0	0	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	8	1.1	
18-Apr	9.75	10	2	1	0	0	14	15	0	0	0	4	0	0	0	1	5	0	0	1	2	0	0	3	0	0	2	0	0	0	0	1	61	6.3	
19-Apr	9.50	38	2	0	0	0	20	37	0	0	0	17	0	1	7	0	6	0	0	2	2	0	0	6	0	0	1	0	0	0	0	2	141	14.8	
20-Apr	9.50	24	3	1	0	0	26	23	1	0	0	1	0	1	0	0	6	0	0	2	3	0	0	2	0	0	3	0	0	0	0	0	96	10.1	
21-Apr	9.50	10	1	0	0	0	10	18	0	0	0	5	0	0	1	0	6	0	0	0	2	0	0	2	0	0	1	0	0	0	0	0	56	5.9	
22-Apr	9.00	3	3	6	0	0	14	17	0	0	0	1	0	2	2	0	4	0	0	0	4	0	0	30	0	1	0	0	0	0	0	0	87	9.7	
23-Apr	9.50	11	0	3	0	0	17	15	0	1	0	2	0	0	0	0	4	0	0	1	1	0	0	3	0	0	2	0	0	0	0	3	63	6.6	
24-Apr	9.50	12	1	1	0	0	15	10	0	0	0	5	0	0	0	0	3	0	0	0	5	0	0	1	0	0	0	0	0	0	1	0	54	5.7	
25-Apr	9.00	1	1	1	0	0	9	3	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	1	0	0	3	0	0	0	0	0	22	2.4	
26-Apr	9.00	4	9	0	0	0	19	11	1	2	0	1	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	50	5.6	
27-Apr	9.00	4	0	0	0	0	3	8	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0	0	0	0	0	0	0	0	18	2.0	
28-Apr	8.25	5	0	0	0	0	7	2	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	3	0	0	1	0	0	0	0	0	20	2.4	
29-Apr	8.00	2	0	0	0	0	6	3	0	0	0	2	0	0	1	0	0	0	0	0	4	0	0	1	0	0	0	0	0	0	0	1	20	2.5	
30-Apr	8.00	1	0	0	0	0	2	5	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	11	1.4	
01-May	6.00	0	0	0	0	0	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	6	1.0		
02-May	7.00	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	5	0.7	
03-May	8.00	1	1	0	0	0	2	5	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	12	1.5	
04-May	8.00	6	0	0	0	0	1	1	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	12	1.5	
05-May	6.00	8	0	0	0	0	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	16	2.7	
Total	615.75	1395	85	50	0	0	436	824	4	32	6	171	0	7	31	2	398	8	0	40	132	6	3	147	8	23	69	0	1	6	9	70	3963	6.4	

<sup>1</sup> See Appendix B for explanations of species codes.



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

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
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
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
Days of observation	73	78	69	65	56	61	83	84	75	69	67	68	70	68	66
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
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
SPECIES	RAPTOR COUNTS														
Turkey Vulture	641	814	559	1070	1380	1322	1246	1785	1327	1463	1217	1552	2531	3245	1427
Osprey	27	24	39	38	64	38	34	70	100	67	71	62	103	138	67
Northern Harrier	55	59	42	71	72	50	46	85	75	46	35	55	47	94	62
White-tailed Kite	0	0	1	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
TOTAL KITES	0	0	2	0	0	0	0	0	1	0	0	0	1	0	0
Sharp-shinned Hawk	473	476	435	498	664	283	294	807	428	280	448	905	1280	772	386
Cooper's Hawk	454	709	521	498	1277	620	718	1050	1562	956	771	655	836	1157	670
Northern Goshawk	22	14	14	4	6	10	7	12	24	12	16	5	18	12	3
Unknown small accipiter <sup>1</sup>	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Unknown large accipiter <sup>1</sup>	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Unknown accipiter	90	56	88	70	123	65	59	201	95	55	61	73	70	5	30
TOTAL ACCIPIERS	1039	1255	1058	1070	2070	978	1078	2070	2109	1303	1296	1638	2204	1946	1089
Common Black-Hawk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Broad-winged Hawk	1	1	0	2	5	2	2	6	7	4	7	7	19	20	2
Swainson's Hawk	47	32	41	43	38	40	42	60	52	30	50	61	59	114	45
Zone-tailed Hawk	1	2	0	3	5	4	2	3	1	0	0	0	3	2	2
Red-tailed Hawk	280	241	183	182	357	289	353	390	461	325	377	356	338	662	220
Ferruginous Hawk	11	8	11	13	9	18	16	12	11	12	20	17	11	23	7
Rough-legged Hawk	0	2	0	1	1	0	0	0	1	0	0	0	0	1	0
Unidentified buteo	6	4	10	9	40	3	15	32	5	5	14	9	6	2	15
TOTAL BUTEOS	346	290	245	253	455	356	430	503	538	376	468	450	436	824	291
Golden Eagle	441	432	213	205	255	218	198	338	300	310	255	441	352	897	304
Bald Eagle	20	37	5	7	7	13	18	17	9	12	7	14	22	27	18
Unidentified Eagle	4	0	0	1	0	0	4	2	0	0	0	0	0	0	2
TOTAL EAGLES	465	469	218	213	262	231	220	357	309	322	262	455	374	924	324
American Kestrel	147	127	96	118	225	209	182	275	250	112	226	308	233	497	198
Merlin	0	2	5	3	2	3	4	5	9	3	18	10	24	19	15
Prairie Falcon	29	27	17	16	23	21	21	28	33	16	17	23	19	59	18
Peregrine Falcon	5	18	6	7	13	13	20	25	47	26	47	27	91	72	56
Aplomado Falcon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unknown small falcon <sup>1</sup>	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Unknown large falcon <sup>1</sup>	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Unknown falcon	2	0	5	2	5	2	5	3	3	0	0	1	7	1	4
TOTAL FALCONS	183	174	129	146	268	248	232	336	342	157	308	369	374	648	291
Unidentified raptor	44	27	54	45	82	65	45	142	29	28	53	30	14	7	10
ALL SPECIES	2800	3112	2346	2906	4653	3288	3331	5348	4830	3762	3710	4611	6084	7826	3561

## Appendix E. continued

	2000	2001	2002	2003	2004	2005	2006	2007	2008	Mean
Start date	23-Feb	22-Feb	22-Feb	22-Feb	26-Feb	24-Feb	24-Feb	24-Feb	24-Feb	19-Feb
End date	5-May	5-May	3-May	5-May	5-May	8-May	5-May	5-May	5-May	5-May
Days of observation	67	67	67	69	65	73	70	65	72	69
Hours of observation	476.50	543.17	527.75	590.00	552.92	611.51	621.42	509.42	615.75	540.55
Raptors / 100 hours	832.7	685.1	624.0	937.8	586.2	508.7	596.9	449.9	643.6	733.6
SPECIES	RAPTOR COUNTS									
Turkey Vulture	1305	1328	1227	2128	1285	921	1151	496	1395	1367
Osprey	76	81	38	79	77	64	70	44	85	64
Northern Harrier	56	52	55	59	55	44	69	61	50	58
White-tailed Kite	0	0	0	0	0	0	0	0	0	0
Mississippi Kite	0	0	0	0	0	1	0	0	0	0
TOTAL KITES	0	0	0	0	0	1	0	0	0	0
Sharp-shinned Hawk	391	311	337	459	372	390	540	209	436	496
Cooper's Hawk	922	556	506	797	561	486	677	574	824	760
Northern Goshawk	2	9	7	31	12	8	8	4	4	11
Unknown small accipiter <sup>1</sup>	-	0	8	6	2	44	29	177	32	38
Unknown large accipiter <sup>1</sup>	-	1	1	1	5	7	9	5	6	4
Unknown accipiter	96	90	16	3	6	82	35	74	171	67
TOTAL ACCIPITERS	1411	967	875	1297	958	1017	1298	1043	1473	1347
Common Black-Hawk	0	0	0	0	0	1	0	0	0	0
Broad-winged Hawk	19	3	4	12	4	2	5	2	7	6
Swainson's Hawk	50	43	54	111	62	66	68	33	31	54
Zone-tailed Hawk	10	1	3	3	0	4	4	0	2	2
Red-tailed Hawk	353	451	321	663	224	282	296	223	398	340
Ferruginous Hawk	11	12	7	17	5	6	6	4	8	12
Rough-legged Hawk	1	0	1	2	0	1	0	1	0	1
Unidentified buteo	21	10	1	3	14	16	20	25	40	12
TOTAL BUTEOS	465	520	391	811	309	378	399	288	486	427
Golden Eagle	417	391	366	689	307	348	351	124	132	354
Bald Eagle	13	18	12	23	6	4	7	2	6	14
Unidentified Eagle	0	1	0	0	0	0	0	0	3	1
TOTAL EAGLES	430	410	378	712	313	352	358	126	141	369
American Kestrel	143	165	205	299	128	163	181	75	147	198
Merlin	19	14	5	17	5	20	22	4	8	10
Prairie Falcon	13	20	16	20	35	21	47	33	23	25
Peregrine Falcon	49	64	52	105	73	62	97	62	69	45
Aplomado Falcon	1	0	0	0	0	0	0	0	0	0
Unknown small falcon <sup>1</sup>	-	-	0	0	0	7	1	2	1	1
Unknown large falcon <sup>1</sup>	-	-	0	0	3	3	4	10	6	3
Unknown falcon	0	6	2	0	0	0	3	9	9	3
TOTAL FALCONS	225	269	280	441	244	276	355	195	263	282
Unidentified raptor	0	94	49	6	0	58	9	39	70	40
ALL SPECIES	3968	3721	3293	5533	3241	3111	3709	2292	3963	3955

<sup>1</sup> 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: 2008.**

DATE	HOURS	NH <sup>1</sup>	SS	CH	NG	BW	SW	RT	ML	AK	ML	PR	PG	TOTAL	CAPTURES/HR
10-Mar	5.33	0	0	1	0	0	0	0	0	0	0	0	0	1	0.2
11-Mar	3.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
12-Mar	6.25	0	0	1	0	0	0	0	1	0	0	0	0	2	0.3
13-Mar	5.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
14-Mar	5.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
15-Mar	6.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
16-Mar	5.42	0	0	0	0	0	0	0	1	0	0	0	0	1	0.2
17-Mar	6.50	0	0	1	0	0	0	0	0	0	0	0	0	1	0.2
18-Mar	7.00	0	0	2	0	0	0	0	0	0	0	0	0	2	0.3
19-Mar	7.25	0	0	4	0	0	0	0	0	0	0	0	0	4	0.6
20-Mar	6.50	0	0	4	0	0	0	0	1	0	0	0	0	5	0.8
21-Mar	7.00	0	0	4	0	0	0	0	1	0	0	0	0	5	0.7
22-Mar	7.50	0	0	3	0	0	0	0	0	0	0	0	0	3	0.4
23-Mar	3.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
24-Mar	7.75	0	0	5	0	0	0	0	0	0	0	0	0	5	0.6
25-Mar	7.50	0	1	3	0	0	0	0	0	0	0	0	0	4	0.5
26-Mar	7.75	0	0	5	0	0	0	0	0	0	0	0	1	6	0.8
27-Mar	8.00	0	0	7	0	0	0	0	0	0	0	0	0	7	0.9
28-Mar	4.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
29-Mar	8.50	0	2	10	0	0	0	0	0	0	0	0	0	12	1.4
30-Mar	8.50	0	0	4	0	0	0	0	0	0	0	0	1	5	0.6
31-Mar	8.00	0	0	1	0	0	0	0	1	0	0	0	0	2	0.3
1-Apr	6.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
2-Apr	9.00	0	1	10	0	0	0	0	0	0	0	0	0	11	1.2
3-Apr	8.00	0	1	3	0	0	0	0	0	0	0	0	0	4	0.5
4-Apr	9.00	0	0	8	0	0	0	0	0	0	0	0	1	9	1.0
5-Apr	8.50	0	1	14	0	0	0	0	0	0	0	0	1	16	1.9
6-Apr	8.00	0	0	13	0	0	0	0	0	0	0	0	0	13	1.6
7-Apr	8.92	0	1	14	0	0	0	0	2	0	0	0	0	17	1.9
8-Apr	8.50	0	0	6	0	0	0	0	0	0	0	1	0	7	0.8
9-Apr	5.17	0	0	4	0	0	0	0	0	0	0	0	0	4	0.8
10-Apr	0.00														
11-Apr	7.00	0	1	1	0	0	0	0	0	0	0	0	0	2	0.3
12-Apr	8.25	0	0	12	1	0	0	0	0	0	0	0	0	13	1.6
13-Apr	8.00	0	0	8	0	0	0	0	0	0	0	0	0	8	1.0
14-Apr	8.25	0	1	10	0	0	0	0	0	0	0	0	0	11	1.3
15-Apr	8.00	0	1	9	0	0	0	1	0	0	0	0	0	11	1.4
16-Apr	7.50	0	1	1	0	0	0	0	0	0	0	0	0	2	0.3
17-Apr	3.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
18-Apr	7.50	0	0	5	0	0	0	0	0	0	0	0	0	5	0.7
19-Apr	8.50	0	0	2	0	0	0	0	0	0	0	0	0	2	0.2
20-Apr	9.50	0	2	1	0	0	0	0	0	0	0	0	1	4	0.4
21-Apr	8.75	0	1	2	0	0	0	0	0	1	0	0	0	4	0.5
22-Apr	9.50	0	3	2	0	0	0	0	0	0	0	0	0	5	0.5
23-Apr	9.50	0	1	3	0	0	0	0	0	0	0	0	0	4	0.4
24-Apr	8.00	0	0	1	0	0	0	0	0	1	0	0	0	2	0.3
25-Apr	9.00	0	0	2	0	0	0	0	0	0	0	0	1	3	0.3
26-Apr	9.00	0	1	6	0	0	0	0	0	0	0	0	0	7	0.8
27-Apr	2.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
28-Apr	6.75	0	0	1	0	0	0	0	0	0	0	0	0	1	0.1
29-Apr	6.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
30-Apr	6.50	0	0	1	0	0	0	0	0	0	0	0	0	1	0.2
1-May	4.75	0	0	2	0	0	0	0	0	0	0	0	0	2	0.4
2-May	5.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Total	376.26	0	19	196	1	0	0	1	7	2	0	1	6	233	0.6

<sup>1</sup> 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: 1990–2008.**

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
First day	21-Mar	17-Mar	–	14-Mar	10-Mar	10-Mar	10-Mar	10-Mar	10-Mar	10-Mar
Last day	8-May	7-May	–	3-May	26-Apr	28-Apr	29-Apr	5-May	3-May	2-May
Number of stations	1	1	0	1	1	1	1	1	2	2
Trapping days	36	45	0	43	34	40	46	48	46	47
Station days	36	45	0	43	34	40	46	48	65	63
Station hours	249.42	269.05	0	300.03	235.60	319.83	372.58	377.58	486.28	453.33
<b>SPECIES</b>	<b>RAPTOR CAPTURES</b>									
Northern Harrier	0	0	–	0	0	3	0	1	3	2
Sharp-shinned Hawk	21	22	–	33	32	44	132	139	100	56
Cooper’s Hawk	83	66	–	211	243	197	259	195	200	165
Northern Goshawk	2	0	–	1	3	2	2	4	1	0
Broad-winged Hawk	0	0	–	0	1	0	0	0	0	0
Swainson’s Hawk	1	0	–	0	0	0	0	1	1	0
Red-tailed Hawk	3	3	–	9	16	13	16	5	9	2
Zone-tailed Hawk	0	0	–	0	0	0	0	0	1	0
American Kestrel	2	0	–	3	2	2	26	14	22	10
Merlin	0	0	–	0	0	2	2	3	3	2
Prairie Falcon	0	0	–	1	1	2	3	3	2	0
Peregrine Falcon	1	0	–	0	2	6	4	7	2	2
All species	113	91	–	258	300	271	444	372	344	239
Captures / 100 stn hrs	45.3	33.8	–	86.0	127.3	84.7	119.2	98.5	70.7	52.7
Recaptures <sup>1</sup>	0	1	–	1	2	3	4	2	3	3
Foreign recaptures <sup>2</sup>	0	0	–	2	3	0	4	2	6	5
Foreign encounters <sup>3</sup>	2	1	0	0	2	0	5	2	3	3

Appendix G. continued

	2000	2001	2002	2003	2004	2005	2006 <sup>4</sup>	2007	2008	TOTAL	MEAN
First day	12-Mar	10-Mar	10-Mar	16-Mar	13-Mar	–	12-Mar	9-Mar	10-Mar		11-Mar
Last day	28-Apr	27-Apr	27-Apr	21-Apr	28-Apr	–	2-May	1-May	2-May		29-Apr
Number of stations	1	1	1	1	1	0	1	1	1		1
Trapping days	41	53	41	19	41	0	50	44	53	722	42
Station days	41	44	45	19	41	0	50	44	53	757	45
Station hours	278.65	314.92	320.76	115.54	309.57	0	366.05	304.50	376.26	5450.34	320.61
SPECIES	RAPTOR CAPTURES										
Northern Harrier	0	0	0	0	0	–	0	0	0	9	1
Sharp-shinned Hawk	30	28	32	4	20	–	31	28	19	770	45
Cooper's Hawk	164	206	194	48	114	–	141	146	196	2830	166
Northern Goshawk	0	1	3	2	1	–	0	0	1	23	1
Broad-winged Hawk	0	0	0	0	0	–	0	0	0	1	0
Swainson's Hawk	0	1	0	0	0	–	0	0	0	4	0
Red-tailed Hawk	3	20	8	4	7	–	4	2	7	131	8
Zone-tailed Hawk	0	0	1	0	0	–	0	0	1	3	0
American Kestrel	5	4	14	1	1	–	4	0	2	112	7
Merlin	1	0	0	0	0	–	0	1	0	14	1
Prairie Falcon	2	5	2	0	1	–	0	0	1	23	1
Peregrine Falcon	1	4	0	2	0	–	5	4	6	46	3
All species	206	269	254	61	144	–	185	181	233	3966	233
Captures / 100 stn hrs	73.9	85.4	79.2	52.8	46.5	–	50.5	59.4	61.9	72.8	72.3
Recaptures <sup>1</sup>	2	4	0	0	1	–	0	0	1	26	2
Foreign recaptures <sup>2</sup>	1	3	1	1	2	–	1	0	1	32	2
Foreign encounters <sup>3</sup>	1	3	5	4	3	0	3	4	1 <sup>4</sup>	43	2

<sup>1</sup> Birds banded and later recaptured in the Sandias; totals included in capture tally above.

<sup>2</sup> Birds banded elsewhere and later recaptured in the Sandias; totals included in capture tally above.

<sup>3</sup> Birds banded in the Sandias and later recaptured or recovered elsewhere.

<sup>4</sup> As of 31 May 2008.