

**FALL 2004 RAPTOR MIGRATION STUDY IN THE  
WELLSVILLE MOUNTAINS OF NORTHERN UTAH**



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

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## INTRODUCTION

The Wellsville Mountains Raptor Migration Project in northern Utah is an ongoing effort to monitor long-term population trends of raptors that migrate through the Wasatch Mountains along the western margin of the Rocky Mountain Flyway (Hoffman and Smith 2003). Steve Hoffman and Wayne Potts discovered the Wellsville fall site in 1976 and conducted season-long counts from 1977 through 1979 (Hoffman and Potts 1985). The migration count was suspended from 1980 to 1986, and then reestablished by HawkWatch International (HWI) in 1987. Annual counts have occurred at the site since then, except during 2002. To date, 17 species of raptors have been observed migrating along the Wellsville Mountains, with annual counts typically ranging between 2,500 and 5,000 migrants. This report summarizes count results from the 2004 season, which marked the 20<sup>th</sup> full-season autumn count of migratory raptors at the site.

## STUDY SITE

The Wellsville Mountains are situated northeast of the Great Salt Lake, 16 km west of Logan, Utah (41°41'18" N, 112°02'54" W; Figure 1). The single, traditional observation point is located at 2,617 m (8,585 ft) near the northern end of the Wellsville range (Figure 1) and provides a panoramic view in all directions. The lookout is reached by a 5.6 km (3.5 mi) hike up Deep Canyon Trail and then another 1 km (0.6 mi) hike to the north along the ridgetop. The trailhead begins just west of Mendon.

The Wellsvilles are an exceptionally steep, isolated ridge oriented in a north-south direction. Agriculture is the dominant land use in the expansive valleys below. The Great Salt Lake lies 31 km to the southwest. The predominant vegetation types on the slopes of the ridge are subalpine fir (*Abies lasiocarpa*), quaking aspen (*Populus tremuloides*), Douglas fir (*Pseudotsuga menziesii*), bigtooth maple (*Acer grandidentatum*), Rocky Mountain maple (*Acer glabrum*), and Sitka Mountain-ash (*Sorbus sitchensis*). The ridgetop supports few trees, with primary vegetation along the ridgetop consisting of grasses and sagebrush (*Artemisia tridentata*). Consequently, the lookout affords exceptional unobstructed views in all directions.

Many factors make the Wellsville lookout ideal for observing consistent fall flights of migrating raptors. Several ridges to the north serve as "leading lines" (Geyr von Schweppenburg 1963) funneling migrating raptors into the Wellsvilles. In addition, the Great Salt Lake and Great Salt Desert to the west probably serve as barriers to migration. Most species of raptors prefer not to fly over large expanses of water and inhospitable habitat (Kerlinger 1989). If this holds true for raptors navigating the Great Salt Lake, they would most likely divert their migratory flight around either side of the Bonneville Basin (Hoffman 1985), and the Wellsville range is the first ridge northeast of the lake. Migrating raptors find consistent updrafts along steep slopes such as those in the Wellsvilles because ridges deflect winds upward. These updrafts, combined with rising thermals from the plains below, provide lift that the raptors use to reduce the need for powered flight. By reducing the amount of flapping flight, birds may migrate great distances while minimizing energetic output (Haugh 1972).

## METHODS

Weather permitting, a single official or designated observer conducted standardized daily counts of migrating raptors during late August, with two official observers continuing the count through late October. Observations typically began between 0830 and 0930 hrs Mountain Standard Time (MST) and ended between 1630 and 1730 hrs MST. Official observer Mark Fogg assisted with the Wellsville count in 2003 and attended preseason training in 2004. This was official observer Rob Spaul's first season of

migration counting; he received on-site training. Visitors and other HWI staff occasionally assisted with spotting and identifying migrants.

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-hour, always using Mountain Standard Time.
3. Wind speed and direction, air temperature, barometric pressure, percent cloud cover, predominant cloud type(s), presence of precipitation, visibility estimates, 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 for each hour, recorded on the hour.
7. Daily start and end times for each official or experienced observer.

I generally limited data comparisons to the years 1991–2004, because 1991 was the first year that a standardized two-observer system was instituted at the site. In the case of age and sex statistics, comparisons are limited to 1992–2004, because previous age-specific data are not computerized. In comparing 2004 annual statistics against means and 95% confidence intervals for previous seasons, I equate significance with a 2004 value falling outside the bounds of the confidence interval for the associated mean. For analysis of long-term count trends, calculation of “adjusted” passage rates (i.e., migrants counted per 100 hours of observation, adjusted to standardize sampling periods and account for incompletely identified birds) and the trend analyses follow Hoffman and Smith (2003) and utilize data from the mostly contiguous period 1987–2004. I commonly refer to marginally significant ( $P \leq 0.10$ ), significant ( $P \leq 0.05$ ), and highly significant ( $P \leq 0.01$ ) results.

## **RESULTS AND DISCUSSION**

### **WEATHER**

Heavy snowfall precluded efficient access to the count site after 17 October in 2004, which is eight days earlier than average. Up until this point, inclement weather had fully precluded eight other full days of potential observations and reduced observation time to  $\leq 4$  hours on two other days (see Appendix C for daily weather records). The 1997–2003 averages, calculated across variable but generally longer annual observation periods, are eight full and four partial days (see Appendix D for annual effort and count summaries). Thus, stormy weather, frequent ridge hugging fog and low clouds, and heavy snowfall that hindered access to the count site had a marked impact on observation effort during the 2004 season.

Based on hourly weather records collected during actual observation periods, the array of sky conditions documented in 2004 was similar to the 1997–2003 average pattern, with fair skies prevailing on 55% of the active observation days (average 55%), transitional skies (i.e., skies changed from primarily fair to

mostly cloudy or overcast during the day, or vice versa) on 30% (average 26%), and mostly cloudy to overcast skies on 14% (average 18%). The only noteworthy difference was that a higher than average proportion of days that featured otherwise fair skies included some visibility reducing fog and/or haze (35% of all active observation days versus 1997–2003 average of 26%). Average visibility ratings recorded by HWI observers at this site since 1997 have varied considerably, with ratings for 2004 (average 21 km west and 30 km east) near the bottom with 1998, and values ranging as high as 93–94 km in 1997. Some of this extreme variation may be due to inconsistent observer evaluations; nevertheless, the low 2004 rating is consistent with the indication that visibility reducing fog and especially haze hampered days with otherwise fair skies more than usual.

Light winds (<12 kph) prevailed on 39% and moderate winds (12–28 kph) on 61% of the active observation days. The comparative averages for the previous six seasons are 46% light, 45% moderate, and 10% strong winds (>28 kph). In terms of wind directions, S-SW winds prevailed on 61% of the active observation days (1997–2003 average of 54%), with SW-W winds prevailing on 14% (average 12%), and more variable S-W winds on 10% of the active days (average 7%). There were no active observation days during the 2004 season that featured winds too variable to classify, whereas the 1997–2003 average is five such days. Days that featured variable SW-NW winds also were less common than usual in 2004 (2% vs. average of 8% of active days), whereas days with northeasterly winds were slightly more common than usual (10% vs. average of 6%).

The daily-average (mean of hourly readings) temperature averaged 14.8°C, ranging from 7.9 to 22.9°C. The average is only slightly higher than the 1997–2003 mean of 14.7°C, whereas the minimum is the highest and the maximum the lowest recorded since 1997. The daily-average (mean of hourly readings) barometric pressure averaged 30.21 in Hg, ranging from 29.68 to 30.48 in Hg. The proportion of days rated as good to excellent for thermal lift in 2004 (44%) was the second lowest since 1997 (average 55%).

In summary, heavy rain and snowfall hampered observations during the 2004 season more than usual, effectively precluding a minimum of 17 days worth of potential observations over the course of the season. Otherwise, the array of sky conditions during active observation periods was typical for the site, except that scattered fog and especially haze were more of a problem than usual on days with otherwise fair skies. The latter contributed to lower than average visibility for the observers. The overall average daily temperature during periods of active observation was near average compared to the past six seasons; however, the range of temperatures was much narrower than usual and constricted at both ends of the spectrum. Southwesterly winds, typically the dominant pattern at the site, were even more common than usual, as were relatively uncommon northeasterly winds, while days with highly variable winds and predominantly northwesterly winds were less common than usual. Moderate winds were more common than usual in 2004, while strong winds were noticeably absent and light winds were less common than usual. The higher prevalence of moderate and steadier than usual winds likely limited thermal production more than usual in 2004.

## **OBSERVATION EFFORT**

The observers worked on 49 of 56 possible observation days between 22 August and 17 October. The ultimate ending date for the project was 31 October, but heavy snowfall forced an early shut down. The long-term average ending date for the project is 25 October. The number of observation days was a significant 11% lower than the 1977–2003 average of  $55 \pm 95\%$  CI of 3.2 days, whereas the number of observation hours (391.59) was only 1% less than the 1977–2003 average of  $388.09 \pm 95\%$  CI of 26.78 hours.

The 2004 average of 1.7 observers per hour (includes official and guest observers; value is mean of daily values, which are in turn means of hourly values) is a non-significant 11% lower than the 1977–2003 average of  $1.9 \pm 95\%$  CI of 0.24 observers/hr. This occurred because only a single official observer was available to conduct the count during August.

## FLIGHT SUMMARY

The observers tallied 2,925 migrant raptors of 17 species during the 2004 season (Table 1, and see Appendix E for daily count records). The flight was composed of 42% accipiters, 23% buteos, 22% falcons, 6% harriers, 4% eagles, and <2% each of Ospreys, vultures, and unidentified raptors (Figure 2). The proportional representation of accipiters and vultures was significantly above average, and the proportional representation of harriers and eagles was significantly below average. The most numerous species were the Sharp-shinned Hawk (31% of the total count), American Kestrel (21%), Red-tailed Hawk (18%), Cooper's Hawk (8%), Northern Harrier (6%), and Golden Eagle (4%). All other species each comprised  $\leq 2\%$  of the total count.

The total combined-species count was a significant 28% below the 1991–2003 average. Below-average counts occurred for 11 of 17 species usually seen at the site, with the differences significant for nine species (Table 1). Most notably, the count of Cooper's Hawks (241) fell to a record low and the count of Golden Eagles (104) was the second lowest recorded to date (Appendix D). In contrast, the Broad-winged Hawk count (9) was the third highest for that species since 1977. Other species that showed above-average (1991–2003) counts include Turkey Vulture, Bald Eagle, and Prairie and Peregrine Falcons, though the difference was significant only for Bald Eagles. Comparisons of adjusted passage rates revealed similar results, with the same five species showing significantly above average (1991–2003) rates and eight species showing significantly below average rates (Northern Harrier, Cooper's Hawk, Northern Goshawk, Swainson's Hawk, Ferruginous Hawk, Golden Eagle, American Kestrel, and Merlin; Table 1).

Regression analyses of adjusted passage rates since 1987 indicated marginally to highly significant quadratic trends for five species (Osprey, Cooper's Hawk, Swainson's Hawk, Ferruginous Hawk, Golden Eagle, and American Kestrel), in all cases tracking hill-shaped patterns with increases through the early to mid-1990s followed by recent declines (Figures 3–7). Turkey Vultures also showed the same basic pattern except that a high 2004 passage rate moderated the recent decline (Figure 3). It is also important to note that the quadratic pattern in Golden Eagles is reflected only in data for adults; passage rates for non-adults have been relatively stable since 1987. Similarly, passage rates for adult Northern Goshawks show a significant increasing trend, whereas passage rates for immature goshawks show no significant trend since 1987. The only other significant, species-level regression was a highly significant increasing trend for Peregrine Falcons, which is a common pattern across much of North America (Hoffman and Smith 2003).

Six of 10 species with data suited to such comparisons showed below average immature : adult ratios in 2004, with significant differences indicted for Northern Harriers, Northern Goshawks, and Red-tailed Hawks (Table 2). For the latter three species and Ferruginous Hawks, the low age ratios were due to below average numbers of immature birds, suggesting that low productivity may have been a factor. For Broad-winged Hawks and Peregrine Falcons, however, counts of both adults and immatures were above average in 2004, with the relative abundance of adults particularly high. Golden and Bald Eagles were the only species that showed significantly above-average age ratios in 2004, but for very different reasons. For Bald Eagles, the high age ratio was due to a three-fold higher than average count of non-adults. For Golden Eagles, counts of both adults and non-adults were well below average in 2004, with a proportionately greater reduction in the adult count.

The combined-species median passage date of 26 September was a marginally significant two days later than the 1991–2003 average (Table 3). Reasons for this difference are evident in the seasonal distribution pattern, with significantly below average overall flight volume during the 16–20 September 5-day period and much higher than average activity during the first five days of October (Figure 8). The former low activity period corresponded to occurrence of the first truly cold (and snowy) storm front of the season, which precluded observations for two full days on 19–20 September. The latter high activity period followed immediately after the next major storm front, which again precluded observations for two full



days on March 30–31. Most species showed a spike in activity during the four days following this storm. At the species level, however, only 8 of 16 species for which a comparison was possible showed later than average median passage dates in 2004, with the difference significant for only five species (Turkey Vulture, Osprey, Sharp-shinned Hawk, Broad-winged Hawk, and Ferruginous Hawk; Table 3). Swainson's Hawks, Golden and Bald Eagles, and Merlins showed significantly earlier than average median passage dates. Age- and sex-specific data illustrated additional complexity in the distributional patterns of some species, but no other consistent patterns (Table 4).

Premature truncation of the season by heavy snowfall after 17 October (eight days earlier than the long-term average ending date of 25 October) undoubtedly resulted in our missing a portion of the migration that would otherwise have been tallied. Over the entire history of the project, 97% of all birds counted after 21 August passed through before 18 October. For 2004, this average translates to an estimated 88 uncounted birds. The species most likely to have been undercounted are the latest-season migrants, the Bald Eagle and uncommon Rough-legged Hawk. Thirty-two percent of the Rough-legged Hawks and 27% of the Bald Eagles counted at the site since 1977 passed through after 17 October. The Northern Goshawk, whose seasonal migration is typically protracted, is the only other species for which more than 10% (14%) of the total number of birds counted since project inception passed through after 17 October. Between 5 and 10% of the Golden Eagle, Northern Harrier, and Merlin migrations passed through after that date, with the value dropping to  $\leq 5\%$  for all other species. Five species have never been counted past 17 October: Turkey Vulture, Osprey, Broad-winged Hawk, Swainson's Hawk, and American Kestrel.

Earlier than average median passage dates for Northern Goshawks, Golden and Bald Eagles, and Merlins reflected the early closure, whereas in most cases late median passage dates resulted from delayed spikes in activity in late September and especially after the storm during the first several days of October. At HWI's newest migration site ~150 km to the east-northeast of the Wellsvilles at Commissary Ridge in southwest Wyoming, significant numbers of Northern Harriers, Northern Goshawks, Red-tailed Hawks, Rough-legged Hawks, and Golden and Bald Eagles passed through during the first three days of November (Smith 2005).

## **RESIDENT RAPTORS**

This season's resident community included one family of light-morph Red-tailed Hawks comprised of two adults and two immature birds. In the past, a mixed-morph pair (1 light, 1 dark) and mixed offspring were often apparent. This year a local-acting dark-morph adult was not seen until early October and then only one other time in mid-October, suggesting that it either moved its territory elsewhere or had its mate and territory usurped by a new light-morph bird. Both adult and immature local red-tails were observed regularly through 12 October, but no resident sightings were recorded during the last five days of the season.

A family of Golden Eagles, including two adults, one subadult, and at least one first-year bird, was seen regularly throughout the season. A family group of Northern Harriers, consisting of two adult and two first-year birds, hunted along the ridge frequently, with the last sighting of the adult female on 14 October and the last sighting of an immature bird on 8 October. Apparently local Sharp-shinned Hawks were recorded on four occasions, including two sightings of immature birds in September, and unknown age bird in early October, and an adult bird on 15 October. No resident Cooper's Hawks were recorded this season, and only a single record of an apparently local immature Northern Goshawk was recorded on 15 September. Regular sightings of a resident pair of American Kestrels were recorded through 7 September. A family group of two adult and at least one immature Peregrine Falcons frequented the site throughout much of the season, with the last confirmed sighting of an immature bird on 2 October and the last sighting of an adult on 14 October.

This is a fairly typical local assemblage except that two obvious family groups of Red-tailed Hawks was often the rule in years past, the absence of local Cooper's Hawks was atypical, and for the second year in

a row the absence of obvious immature American Kestrels was noticeable. In the later case, it is possible that the young kestrels simply dispersed away before the new observers had sufficient time to orient to the local population.

## VISITATION

Difficult, stormy weather significantly constrained visitation to the project site in 2004, limiting visitor days to 14 and total visitation to about 50 individuals. Organized groups included 23 members of the Bridgerland Audubon Society and a local high school class. In 2004, 399 hourly assessments of visitor disturbance resulted in the following ratings: 94% none, 6% low, 1% moderate, and 0% high. Unlike at some other HWI sites where on-site educators facilitate visitor interactions, the Wellsville observers must themselves deal with all aspects of visitor coordination. Achieving positive public outreach is an important aspect of all HWI migration projects; accordingly, a modest level of observer distraction, especially at observer-only sites like the Wellsvilles, is expected.

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**Table 1. Unadjusted fall-migration counts and adjusted passage rates by raptor species in the Wellsville Mountains, UT: 1987–2003 versus 2004.**

SPECIES	COUNTS			BIRDS / 100 HRS		
	1991–2003 <sup>1</sup>	2004	% CHANGE	1991–2003 <sup>1</sup>	2004	% CHANGE
Turkey Vulture	28 ± 6.2	40	+45	8.1 ± 1.65	12.5	+54
Osprey	31 ± 5.0	24	-23	12.6 ± 2.63	9.3	-26
Northern Harrier	332 ± 61.4	183	-45	87.0 ± 17.08	48.7	-44
Sharp-shinned Hawk	918 ± 81.6	918	0	296.0 ± 35.25	289.4	-2
Cooper's Hawk	599 ± 77.4	241	-60	187.6 ± 29.85	75.1	-60
Northern Goshawk	25 ± 9.3	17	-33	6.7 ± 2.14	4.8	-29
Unknown small accipiter <sup>2</sup>	76 ± 22.5	44	-42	–	–	–
Unknown large accipiter <sup>2</sup>	2 ± 1.0	8	+433	–	–	–
Unidentified accipiter	48 ± 19.6	8	-83	–	–	–
TOTAL ACCIPITERS	1603 ± 157.8	1236	-23	–	–	–
Broad-winged Hawk	5 ± 2.3	9	+100	1.8 ± 0.89	4.5	+155
Swainson's Hawk	204 ± 95.0	63	-69	83.8 ± 41.94	25.3	-70
Red-tailed Hawk	719 ± 130.9	538	-25	195.2 ± 37.49	149.8	-23
Ferruginous Hawk	13 ± 3.1	6	-54	3.5 ± 1.00	1.4	-61
Rough-legged Hawk	2 ± 0.9	1	-48	0.8 ± 0.42	0.5	-37
Unidentified buteo	22 ± 5.8	36	+66	–	–	–
TOTAL BUTEOS	964 ± 203.5	653	-32	–	–	–
Golden Eagle	198 ± 50.4	104	-48	52.5 ± 12.90	26.0	-50
Bald Eagle	4 ± 2.5	10	+126	1.0 ± 0.62	2.2	+114
TOTAL EAGLES	203 ± 52.0	114	-44	–	–	–
American Kestrel	853 ± 167.0	616	-28	266.0 ± 50.88	181.3	-32
Merlin	13 ± 2.6	6	-55	3.8 ± 0.73	1.7	-54
Prairie Falcon	19 ± 3.6	20	+5	5.1 ± 1.13	5.9	+17
Peregrine Falcon	12 ± 3.2	14	+14	3.5 ± 0.98	4.3	+22
Unknown small falcon <sup>2</sup>	4 ± 4.9	0	-100	–	–	–
Unknown large falcon <sup>2</sup>	4 ± 4.9	2	-43	–	–	–
Unidentified falcon	3 ± 1.5	1	-65	–	–	–
TOTAL FALCONS	901 ± 164.8	659	-27	–	–	–
Unidentified raptor	16 ± 5.8	16	0	–	–	–
GRAND TOTAL	4077 ± 514.3	2925	-28	–	–	–

<sup>1</sup> Mean ± 95% confidence interval.

<sup>2</sup> Designations used for the first time in 2001.

**Table 2. Annual counts by age classes and immature : adult ratios for selected species: 1992–2003 versus 2004.**

	TOTAL AND AGE-CLASSIFIED COUNTS							IMMATURE : ADULT			
	1992–2003 AVERAGE			2004			% UNKNOWN AGE		RATIO		
	TOTAL	IMM.	ADULT	TOTAL	IMM.	ADULT	1992–2003 <sup>1</sup>	2004	1992–2003 <sup>1</sup>	2004	
Northern Harrier	323	178	82	183	54	92	20 ± 4.4	20	2.51 ± 0.924	0.59	
Sharp-shinned Hawk	911	350	369	918	331	309	21 ± 5.5	30	1.05 ± 0.343	1.07	
Cooper's Hawk	597	234	212	241	103	72	26 ± 8.3	27	1.37 ± 0.433	1.43	
Northern Goshawk	26	13	7	17	7	7	27 ± 11.8	18	2.83 ± 1.141	1.00	
Broad-winged Hawk	4	1	1	9	4	5	36 ± 70.0	0	0.88 ± 0.879	0.80	
Red-tailed Hawk	701	295	329	538	168	343	11 ± 3.0	5	0.93 ± 0.348	0.49	
Ferruginous Hawk	13	3	3	6	1	3	58 ± 18.1	33	2.32 ± 2.374	0.33	
Golden Eagle	190	89	86	104	64	32	7 ± 2.2	8	1.10 ± 0.217	2.00	
Bald Eagle	4	3	1	10	9	1	9 ± 11.1	0	2.25 ± 2.397	9.00	
Peregrine Falcon	12	2	3	14	5	7	63 ± 9.4	14	1.12 ± 0.486	0.71	

<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 immatures and adults. Discrepancies in the two values reflect high annual variability in the observed age ratio.

**Table 3. First and last observed, bulk passage, and median passage dates by species for 2004, with a comparison of 2004 and 1991–2003 average median passage dates.**

SPECIES	2004				1991–2003
	FIRST DATE OBSERVED	LAST DATE OBSERVED	BULK PASSAGE DATES <sup>1</sup>	MEDIAN PASSAGE DATE <sup>2</sup>	MEDIAN PASSAGE DATE <sup>3</sup>
Turkey Vulture	29-Aug	13-Oct	30-Aug – 25-Sep	25-Sep	07-Sep ± 6.3
Osprey	29-Aug	3-Oct	5-Sep – 1-Oct	18-Sep	13-Sep ± 2.1
Northern Harrier	24-Aug	16-Oct	31-Aug – 8-Oct	25-Sep	25-Sep ± 2.1
Sharp-shinned Hawk	22-Aug	16-Oct	11-Sep – 8-Oct	1-Oct	26-Sep ± 1.9
Cooper's Hawk	27-Aug	12-Oct	6-Sep – 3-Oct	24-Sep	25-Sep ± 2.1
Northern Goshawk	28-Aug	6-Oct	28-Aug – 5-Oct	24-Sep	26-Sep ± 5.3
Broad-winged Hawk	24-Sep	3-Oct	24-Sep – 3-Oct	1-Oct	22-Sep ± 1.6
Swainson's Hawk	22-Aug	6-Oct	28-Aug – 27-Sep	10-Sep	18-Sep ± 4.9
Red-tailed Hawk	22-Aug	16-Oct	30-Aug – 11-Oct	23-Sep	21-Sep ± 1.6
Ferruginous Hawk	25-Aug	5-Oct	25-Aug – 5-Oct	28-Aug	17-Sep ± 4.6
Rough-legged Hawk	14-Oct	14-Oct	–	–	19-Oct <sup>4</sup>
Golden Eagle	22-Aug	17-Oct	28-Aug – 12-Oct	24-Sep	02-Oct ± 1.9
Bald Eagles	25-Aug	6-Oct	25-Aug – 3-Oct	22-Sep	09-Oct ± 12.2
American Kestrel	22-Aug	16-Oct	4-Sep – 3-Oct	21-Sep	19-Sep ± 2.3
Merlin	22-Sep	15-Oct	22-Sep – 15-Oct	24-Sep	30-Sep ± 2.6
Prairie Falcon	28-Aug	13-Oct	30-Aug – 2-Oct	16-Sep	13-Sep ± 3.7
Peregrine Falcon	30-Aug	17-Oct	5-Sep – 13-Oct	10-Sep	12-Sep ± 3.4
Total	22-Aug	17-Oct	6-Sep – 7-Oct	25-Sep	23-Sep ± 1.1

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

<sup>2</sup> Date by which 50% of the flight had passed; values are given only for species with annual counts ≥ 5 birds.

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

<sup>4</sup> Value for 1997 only.

**Table 4. Median passage dates by age and sex classes for selected species: 1992–2003 versus 2004.**

	2004	1992–2003 MEAN ± 95% CI (DAYS)	2004	1992–2003 MEAN ± 95% CI (DAYS)
	ADULT		IMMATURE / SUBADULT	
Northern Harrier	26-Sep	30-Sep ± 2.6	3-Oct	25-Sep ± 2.8
Sharp-shinned Hawk	2-Oct	02-Oct ± 2.3	26-Sep	18-Sep ± 2.5
Cooper’s Hawk	26-Sep	30-Sep ± 2.4	22-Sep	19-Sep ± 2.4
Northern Goshawk	1-Oct	28-Sep ± 9.3	24-Sep	25-Sep ± 6.4
Broad-winged Hawk	26-Sep	22-Sep ± 5.9	–	22-Sep ± 0.0
Red-tailed Hawk	26-Sep	28-Sep ± 2.0	13-Sep	15-Sep ± 2.2
Ferruginous Hawk	–	22-Sep ± 7.2	–	16-Sep ± 19.1
Golden Eagle	17-Sep	03-Oct ± 2.8	24-Sep	03-Oct ± 3.8
Bald Eagle	–	–	25-Sep	06-Oct ± 12.8
Peregrine Falcon	10-Sep	14-Sep ± 8.3	25-Sep	17-Sep ± 15.7
	MALE		FEMALE	
Northern Harrier adult	2-Oct	02-Oct ± 2.4	25-Sep	25-Sep ± 6.4
American Kestrel	24-Sep	24-Sep ± 2.1	12-Sep	15-Sep ± 2.3

Note: Median passage date is the date by which 50% of the flight had passed; values are based only on annual counts ≥ 5 birds.

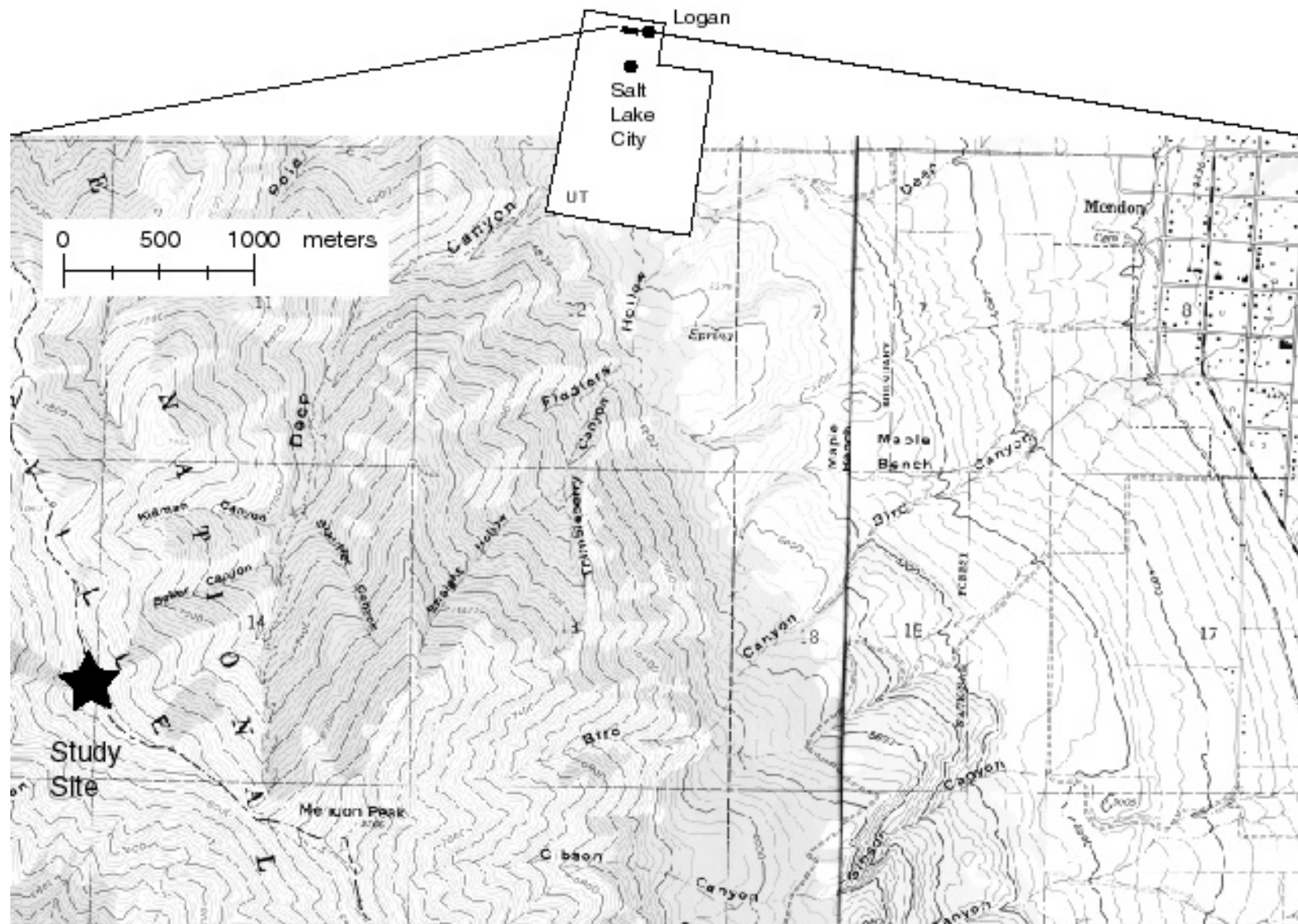
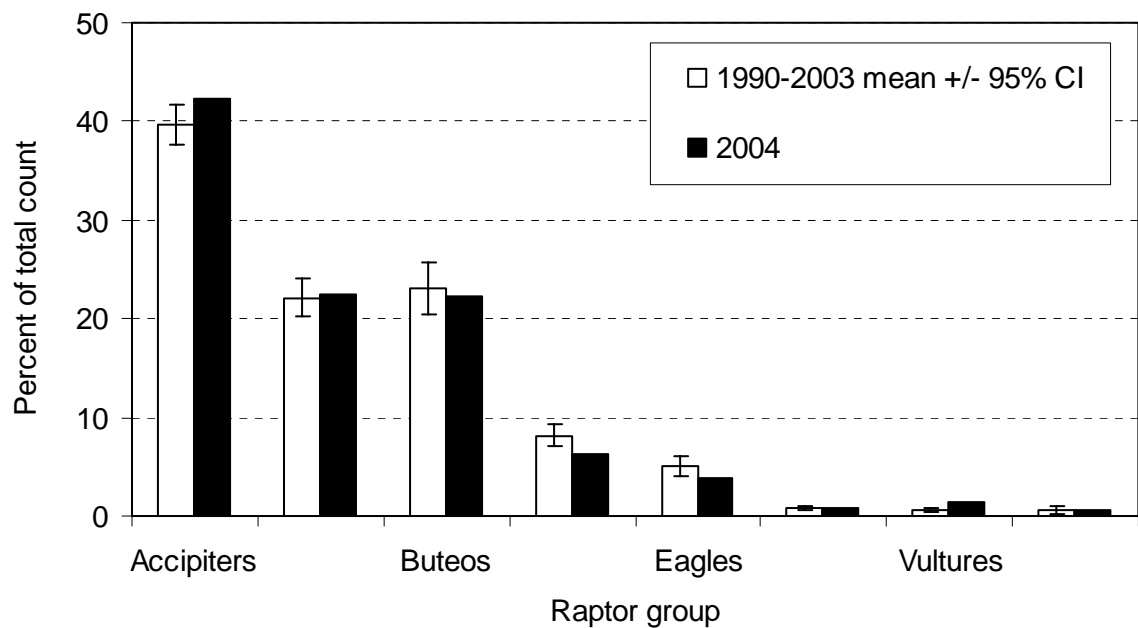
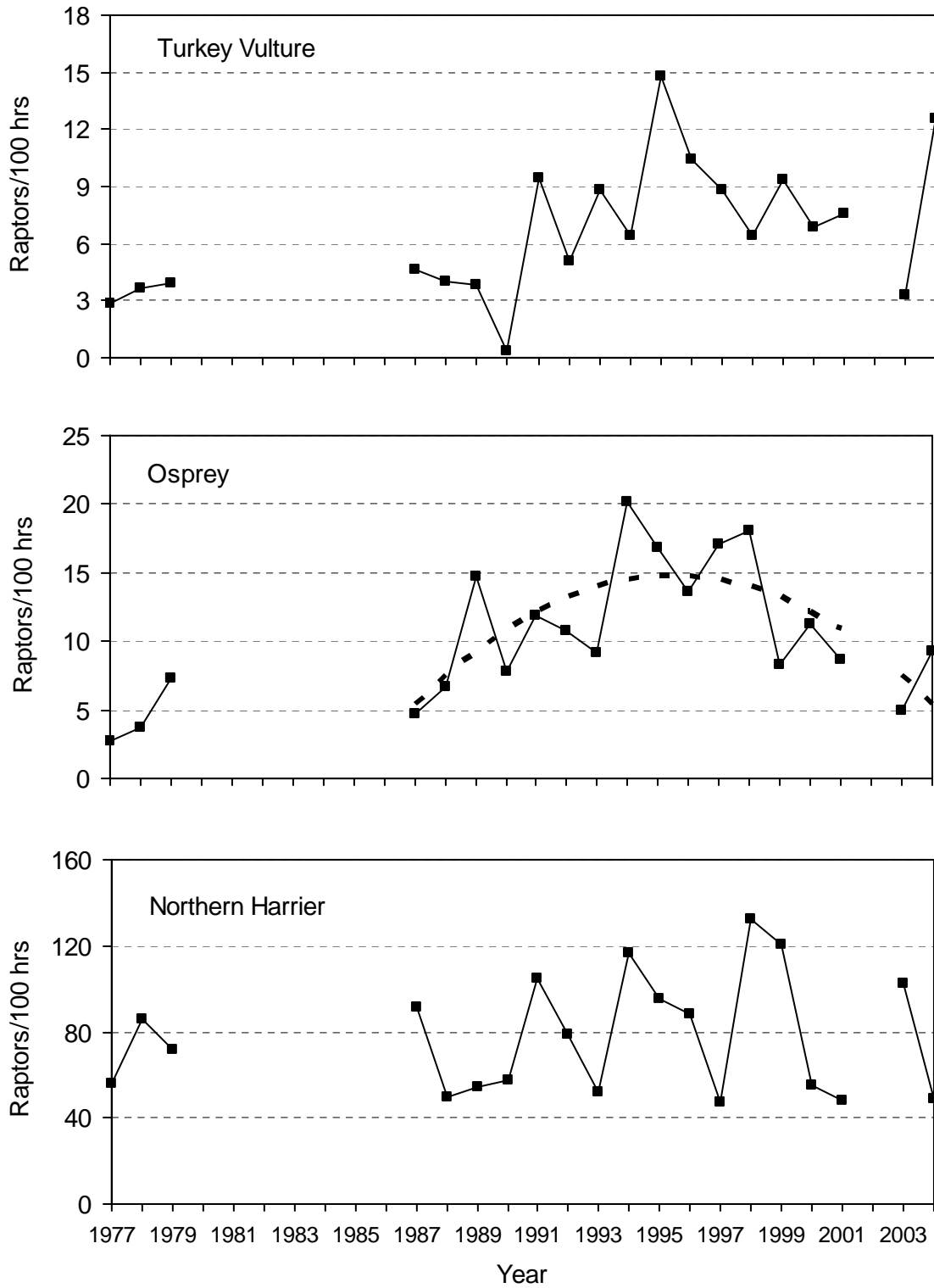


Figure 1. Location of the Wellsville Mountains Raptor Migration Project site in northern Utah.

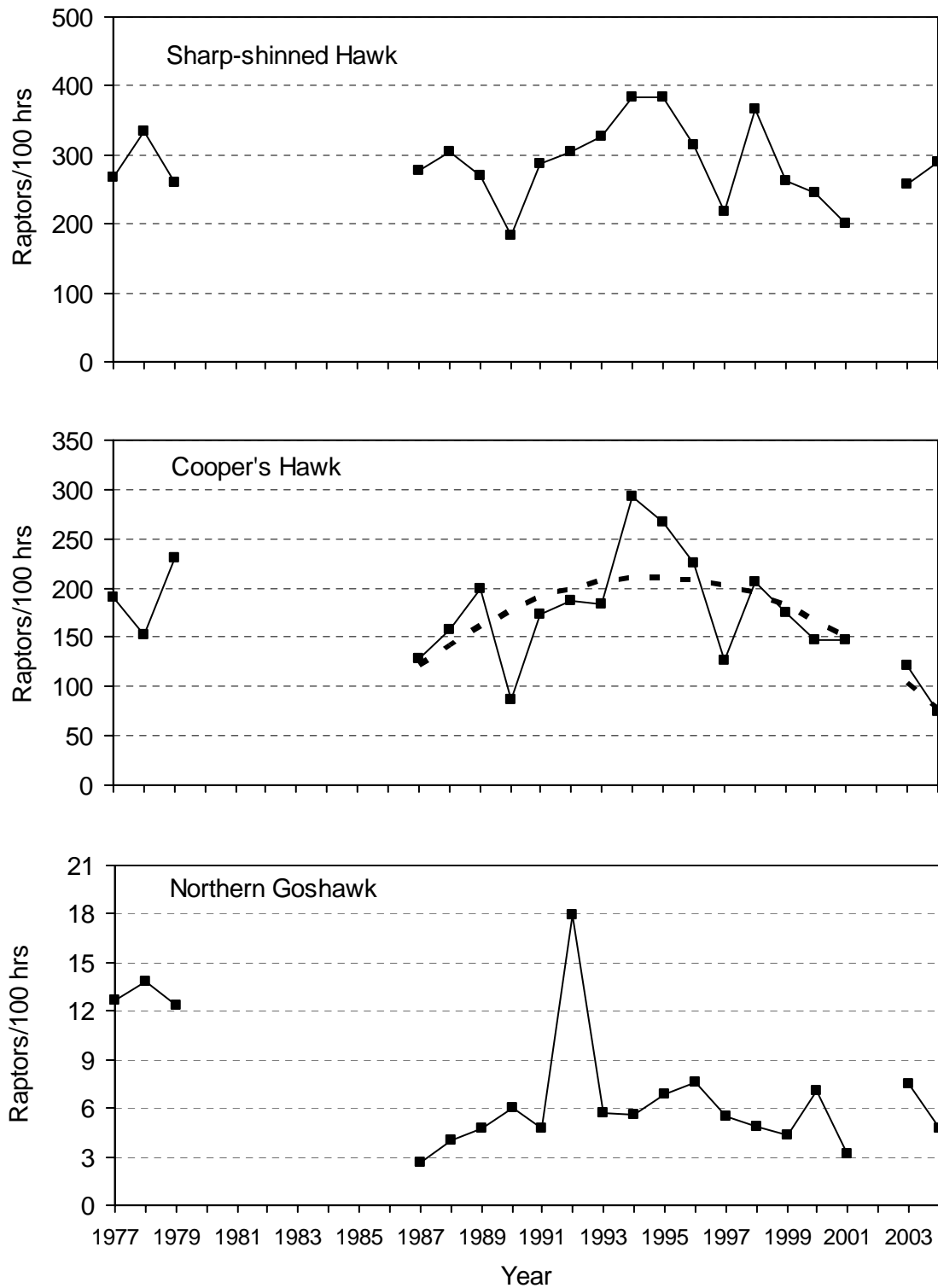


**Figure 2. Fall-migration flight composition by major raptor species groups: 1990–2003 versus 2004.**

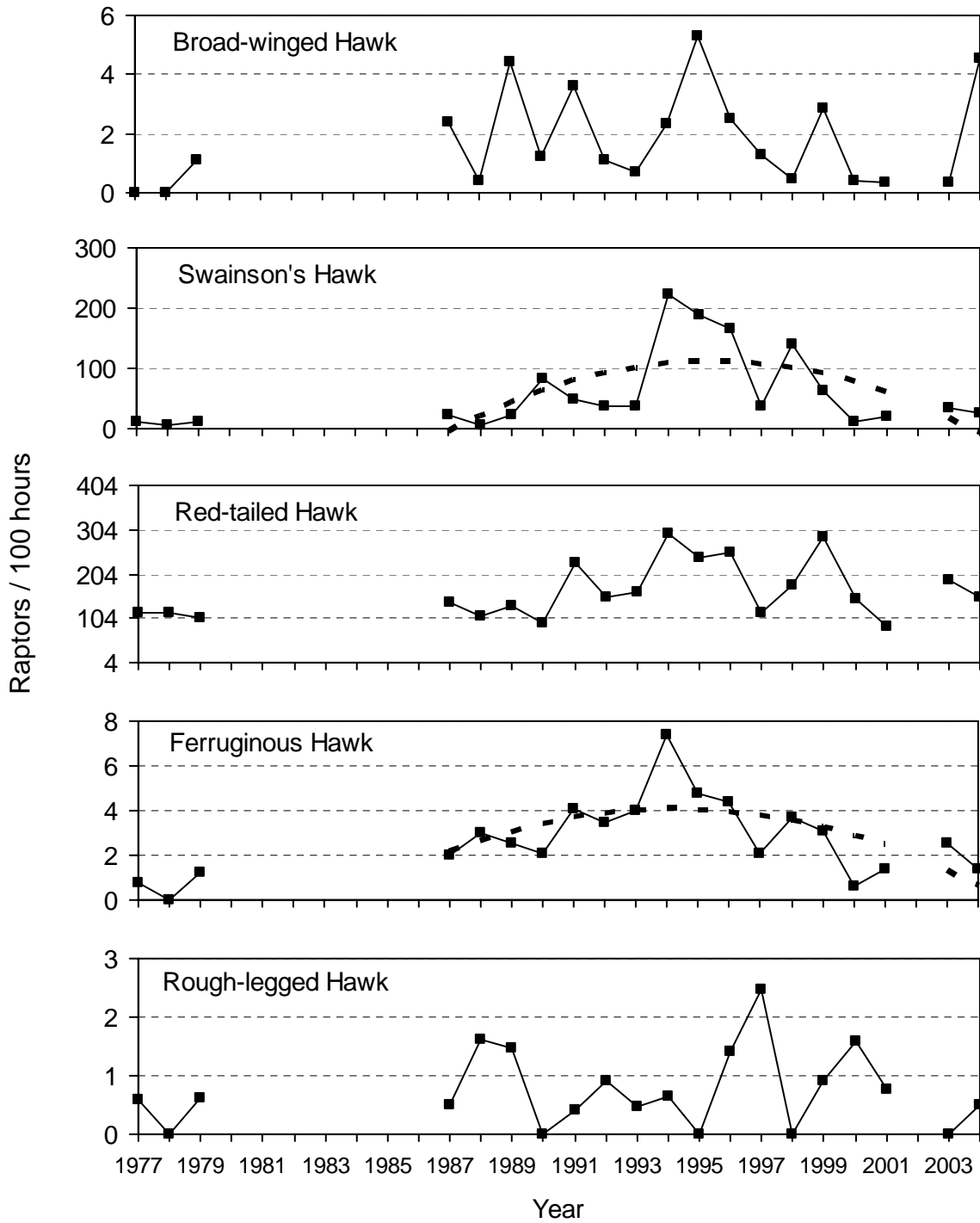




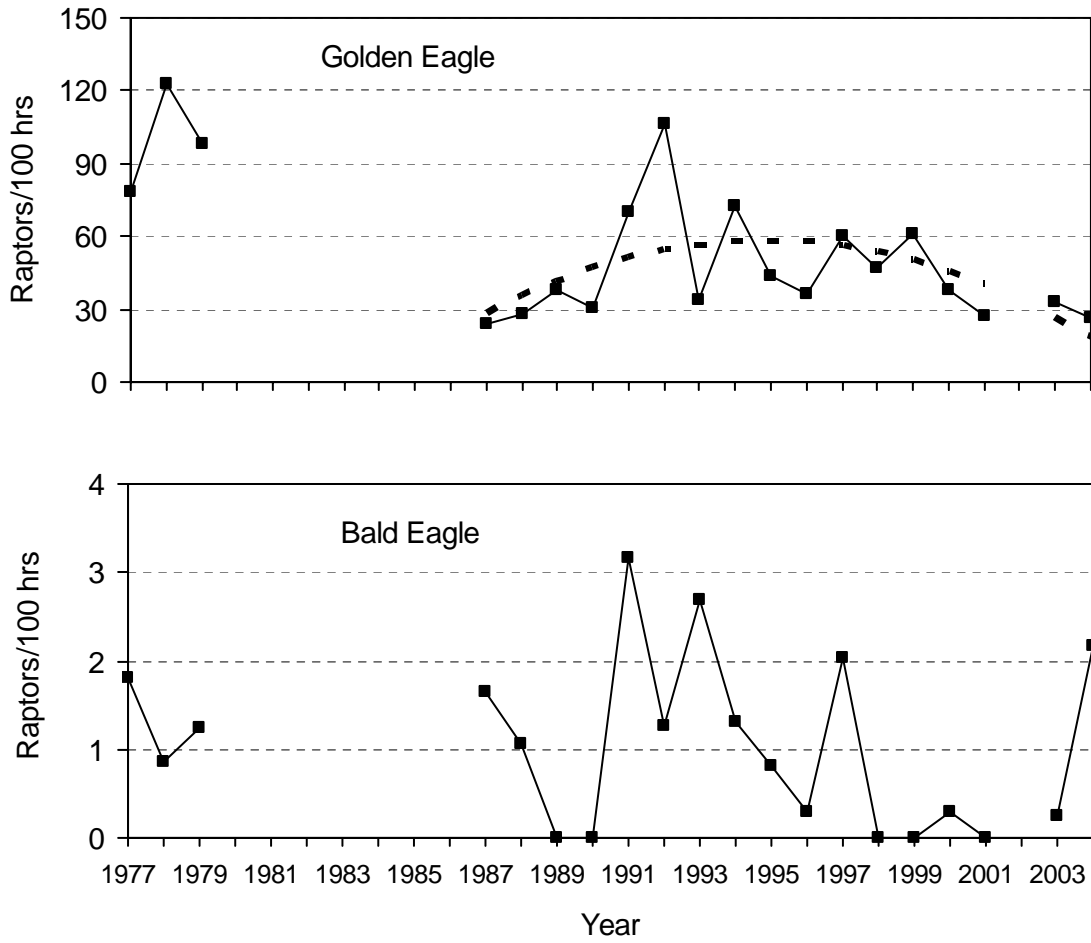
**Figure 3. Adjusted fall-migration passage rates for Turkey Vultures, Ospreys, and Northern Harriers: 1977–2004. Dotted lines indicate significant ( $P \leq 0.10$ ) linear or quadratic regressions.**



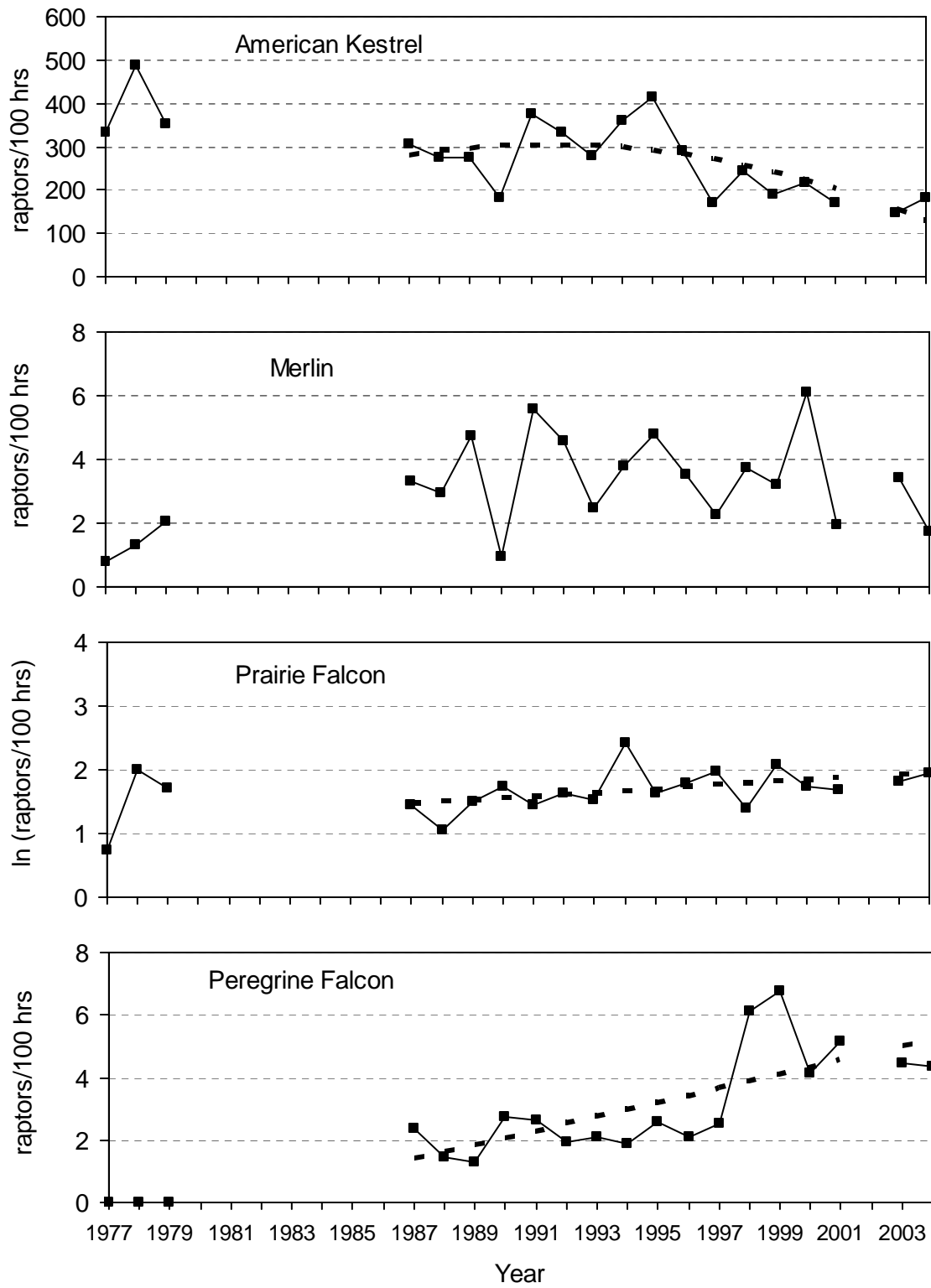
**Figure 4. Adjusted fall-migration passage rates for Sharp-shinned Hawks, Cooper's Hawks, and Northern Goshawks: 1977–2004. Dotted lines indicate significant ( $P \leq 0.10$ ) linear or quadratic regressions.**



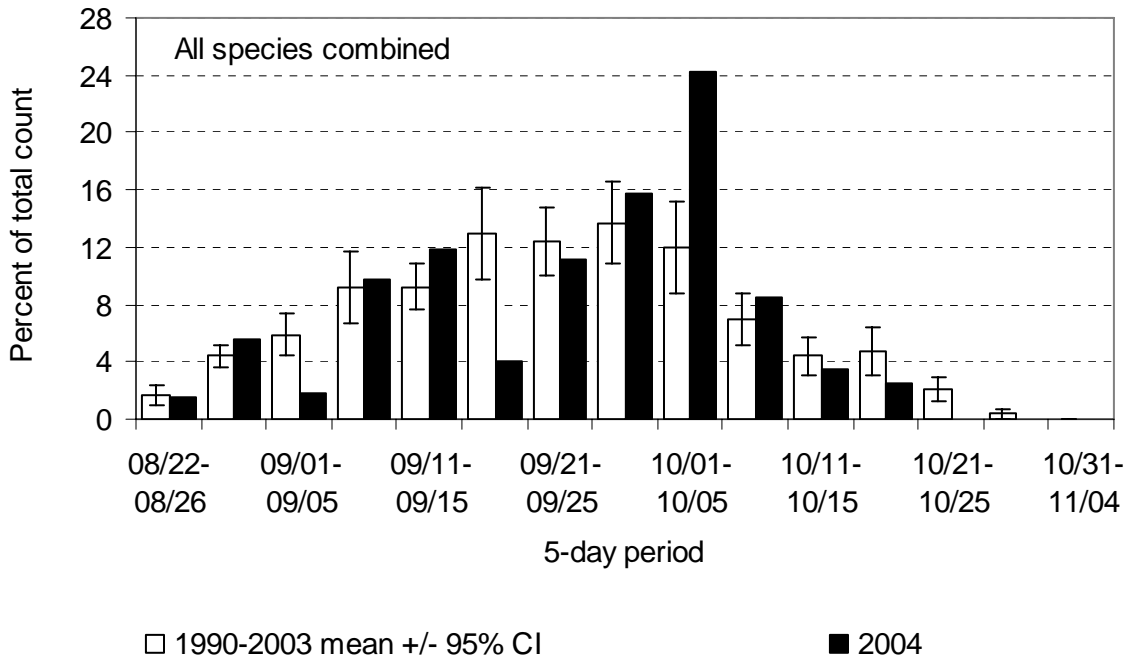
**Figure 5. Adjusted fall-migration passage rates for Broad-winged, Swainson's, Red-tailed, Ferruginous, and Rough-legged Hawks: 1977–2004. Dotted lines indicate significant ( $P \leq 0.10$ ) linear or quadratic regressions.**



**Figure 6. Adjusted fall-migration passage rates for Golden and Bald Eagles: 1977–2004. Dotted lines indicate significant ( $P \leq 0.10$ ) linear or quadratic regressions.**



**Figure 7. Adjusted fall-migration passage rates for American Kestrels, Merlins, Prairie Falcons, and Peregrine Falcons in the Wellsville Mountains, UT: 1977–2004. Dotted lines indicate significant ( $P \leq 0.10$ ) linear or quadratic regressions.**



**Figure 8. Combined-species, fall-migration passage volume by five-day periods in the Wellsville Mountains, UT: 1990–2003 versus 2004.**

## **Appendix A. History of official observer participation in the Wellsville Mountains Raptor Migration Project.**

- 1977:** Single observer throughout: Wayne Potts (0)<sup>1</sup>
- 1978:** Single observer throughout: 5–6 rotating observers (0)
- 1979:** Single observer throughout: 5–6 rotating observers (0)
- 1987:** Single observer throughout: Joe DiDonato (1), Fred Tilly (16), and Allen Hale (2)
- 1988:** Single observer throughout: Scott Stoleson (0)
- 1989:** Single observer throughout: LisaBeth Daly (1)
- 1990:** Single observer throughout: Jane Kidd (0)
- 1991:** Two observers throughout: Jim Daly (4) and Bernd Rindermann (0)
- 1992:** Two observers throughout: Shawn Farry (0) and Frank A. LaSorte (0)
- 1993:** Two observers throughout: Rob Clemens (1), Chris Berger—1st half (0), Andy Day—2nd half (0)
- 1994:** Two observers throughout: Susan Salafsky (1) and Mari Remsberg (0)
- 1995:** Two observers throughout: Sean O'Connor (1) and Paul Archibald (0)
- 1996:** Two observers throughout: Susan Thomas (1) Scott Harris (1)
- 1997:** Two observers throughout: Julie Heath (0), Doug Cooper (0), and Rob Wilson (1)
- 1998:** Two observers throughout: David Tidhar (0) and Wendy Peacock (0)
- 1999:** Two observers throughout: Jorge Canaca (0) and Laura Lutz (0)
- 2000:** Two observers throughout: Darlene Kilpatrick (0) and Paula Shannon (0)
- 2001:** Two observers throughout: Peter Cole (0) and Lisa Sheffield (0)
- 2003:** Two observers throughout: David Tidhar (1), Jason Ferrell (0), Anthony Sandoval (0)
- 2004:** Two observers throughout: Mark Fogg (1 partial), Rob Spaul (0)

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<sup>1</sup> Numbers in parentheses indicate the number of previous full-seasons of experience conducting migratory raptor counts.

**Appendix B. Common and scientific names, species codes, and regularly applied age, sex, and color-morph classifications for migrating raptors observed in the Wellsville Mountains, UT.**

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
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
Red-shouldered Hawk	<i>Buteo lineatus</i>	RS	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
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
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: 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 fall-migration flight summaries for raptors in the Wellsville Mountains, UT: 2004.**

DATE	OBS. HOURS	OBSRVR / HOUR <sup>1</sup>	MEDIAN VISITOR DISTURB <sup>2</sup>	PREDOMINANT WEATHER <sup>3</sup>	WIND SPEED (KPH) <sup>1</sup>	WIND DIRECTION	TEMP (°C) <sup>1</sup>	BAROM. PRESS. (IN HG) <sup>1</sup>	MEDIAN THERMAL LIFT <sup>4</sup>	VISIB. WEST (KM) <sup>1</sup>	VISIB. EAST (KM) <sup>1</sup>	MEDIAN FLIGHT DISTANCE <sup>5</sup> / HOUR	BIRDS / HOUR
22-Aug	6.67	1.00	0	pc-ovc, haze PM ts	18.8	calm, s-sw	21.2	30.11	4	14	21	2	3.3
23-Aug	0.00			rain									
24-Aug	7.50	1.00	0	pc-mc, fog, AM rain	9.1	ssw-sw	15.8	30.06	4	13	19	2	1.2
25-Aug	7.50	1.00	0	mc-ovc	24.8	ssw-wsw	15.4	30.02	4	14	25	2	1.6
26-Aug	0.00			rain									
27-Aug	8.50	1.00	0	mc-clr, AM fog	5.5	calm, w	14.3	30.37	3	15	25	2	2.5
28-Aug	9.00	1.00	0	clr	11.3	sw-wsw	15.1	30.35	2	15	25	2	5.7
29-Aug	9.00	1.00	0	clr	10.8	ssw	17.8	30.35	2	15	25	2	5.9
30-Aug	6.67	1.00	0	clr	10.0	sw	22.1	30.40	2	25	15	1	5.7
31-Aug	7.00	1.47	0	clr/haze	7.2	s-wsw	21.8	30.48	1	15	25	2	3.9
1-Sep	7.00	1.00	0	mc-clr, haze	13.4	ssw	22.9	30.36	1	15	25	1	0.7
2-Sep	0.00			weather day									
3-Sep	0.00			weather day									
4-Sep	9.00	2.00	0	pc-mc, fog	3.3	ssw-sw	10.5	30.06	3	14	22	2	2.2
5-Sep	9.00	2.00	0	clr, AM haze	19.3	s-ssw	11.4	30.25	3	16	24	2	1.3
6-Sep	9.00	2.64	0	clr/haze	11.1	ssw-wsw	15.2	30.47	2	25	39	2	7.9
7-Sep	9.00	1.89	0	clr-pc, haze	12.4	s-ssw	18.3	30.30	1	25	32	2	4.7
8-Sep	9.00	2.00	0	clr-pc	12.1	ssw	19.5	30.28	1.5	28	36	2	8.1
9-Sep	9.00	1.33	0	clr-pc, haze	14.0	ssw	20.4	30.26	1	32	33	2	9.6
10-Sep	8.50	1.00	0	clr, PM haze	17.0	ssw	18.3	30.30	1	22	33	1	16.0
11-Sep	9.00	2.00	0	clr/haze	15.9	ssw-sw	21.3	30.35	3	26	35	2	9.8
12-Sep	7.50	1.50	0	mc-ovc, PM rain	20.1	ssw	20.7	30.05	3	26	35	1	3.7
13-Sep	9.00	2.00	0	pc	18.0	ssw-sw	15.2	29.99	3	27	34	2	9.8
14-Sep	3.00	2.00	0	mc-ovc	9.7	wnw	8.3	29.99	3	20	30	-	2.0
15-Sep	8.50	1.89	0	clr	16.6	ssw-sw	12.8	30.15	2	24	34	2	2.6
16-Sep	9.00	1.00	0	pc, PM haze	23.2	sw	16.9	30.12	3	25	35	2	7.1
17-Sep	9.00	1.00	0	clr, AM haze	16.1	sw-wsw	18.6	30.08	2	19	29	1.5	2.2
18-Sep	8.00	2.00	0	clr-mc, haze	27.8	ssw	18.3	29.84	4	10	17	2	1.8
19-Sep	0.00			snow									
20-Sep	0.00			snow									
21-Sep	7.00	2.00	0	pc-mc, scat snow	13.1	ene-e	7.9	30.21	3	19	27	2	6.3
22-Sep	9.00	2.00	0	mc-ovc, haze	16.8	sw	8.4	30.20	4	22	30	2	7.1
23-Sep	9.00	2.00	0	pc-mc, haze	17.1	sw-wsw	11.2	30.32	3	24	27	1	5.0
24-Sep	9.00	2.00	0	clr/haze	10.3	s-sw	14.1	30.36	1	24	37	2	19.1
25-Sep	9.25	3.23	0	clr/haze	7.6	s, sw	14.7	30.35	2	25	38	2	21.6
26-Sep	8.00	2.96	0	pc-mc	6.8	s-sw	17.0	30.31	3	25	31	1.5	16.4
27-Sep	8.00	1.00	0	pc-mc	12.1	sw, var	19.4	30.33	2	21	37	2	1.5
28-Sep	8.25	1.00	0	pc-mc	19.6	s-sw	17.6	30.20	3	25	34	2	14.2
29-Sep	0.00			rain									

Appendix C. continued

DATE	OBS. HOURS	OBSRVR / HOUR <sup>1</sup>	MEDIAN VISITOR DISTURB <sup>2</sup>	PREDOMINANT WEATHER <sup>3</sup>	WIND SPEED (KPH) <sup>1</sup>	WIND DIRECTION	TEMP (°C) <sup>1</sup>	BAROM. PRESS. (IN HG) <sup>1</sup>	MEDIAN THERMAL LIFT <sup>4</sup>	VISIB. WEST (KM) <sup>1</sup>	VISIB. EAST (KM) <sup>1</sup>	MEDIAN FLIGHT DISTANCE <sup>5</sup>	BIRDS / HOUR
30-Sep	0.00			rain									
1-Oct	8.50	1.89	0	pc, haze, AM fog	9.8	var, sw	13.1	30.20	2	19	27	2	31.6
2-Oct	9.00	2.24	0	clr-pc	12.9	ssw-sw	12.8	30.36	2	27	33	2	22.8
3-Oct	8.00	2.06	0	clr-pc	8.0	s-w/calm	13.5	30.39	1.5	25	38	2.5	15.0
4-Oct	7.75	2.06	0	clr-pc	9.8	s-w	13.5	30.32	2	20	31	2	15.1
5-Oct	6.00	2.00	0	clr-pc	7.5	var, n-e	13.3	30.22	3	25	35	3	3.8
6-Oct	7.50	1.94	1	clr/haze	11.7	ssw-sw	10.1	30.24	3	23	32	2	13.1
7-Oct	8.50	0.94	0	clr-mc, haze	18.0	ssw-sw	13.6	30.29	2.5	24	26	2	6.9
8-Oct	8.00	1.84	0	clr/haze	13.1	s, sw	14.9	30.36	3	25	37	1	5.3
9-Oct	9.00	4.02	0	mc-ovc, haze	16.8	s-sw	17.4	30.04	4	23	25	1	2.8
10-Oct	5.75	2.25	0	mc-ovc	20.6	nne	8.0	30.10	4	25	39	2	1.2
11-Oct	7.75	1.78	0	clr/haze	11.9	nne-e	9.9	30.22	2	25	34	1.5	2.6
12-Oct	7.75	1.81	0	pc-mc	6.6	calm/sw, w	10.4	30.28	3	23	34	2	4.1
13-Oct	7.75	1.00	0	clr/haze	7.0	nne/var	7.9	30.36	2	24	37	1.5	1.9
14-Oct	8.50	1.78	0	clr, PM haze	13.1	sw-nw	9.9	30.24	3	23	33	2	3.2
15-Oct	8.00	1.00	0	pc-ovc, haze	17.8	ssw-wsw	11.4	30.03	3	25	28	2	4.0
16-Oct	8.75	1.89	0	clr-mc	26.0	ssw-sw	12.2	29.82	4	19	24	1	4.5
17-Oct	3.25	1.88	0	ovc, PM rain	25.0	s-ssw	10.5	29.68	4	14	21	2	0.6
18-Oct	0.00			heavy snow									
19-Oct	0.00			heavy snow									
20-Oct	0.00			heavy snow									

<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. Annual observation effort and unadjusted fall-migration counts by raptor species in the Wellsville Mountains, UT: 1977–2004.**

	1977	1978	1979	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2003	2004	MEAN
Start date	6-Aug	6-Sep	6-Sep	7-Sep	2-Sep	3-Sep	28-Aug	25-Aug	23-Aug	24-Aug	26-Aug	22-Aug	23-Aug	22-Aug	23-Aug	25-Aug	23-Aug	28-Aug	22-Aug	22-Aug	25-Aug
End date	26-Nov	1-Nov	17-Oct	20-Oct	20-Oct	20-Oct	20-Oct	24-Oct	25-Oct	26-Oct	26-Oct	25-Oct	23-Oct	25-Oct	25-Oct	31-Oct	26-Oct	30-Oct	29-Oct	17-Oct	25-Oct
Observation days	67	41	41	43	47	47	52	59	63	55	49	62	55	58	54	59	49	59	65	49	54
Observation hours	317.17	234.83	242.25	303.50	373.92	315.92	339.00	417.75	428.00	414.25	333.25	407.75	374.25	377.92	358.75	407.83	373.84	488.00	495.53	391.59	369.76
Raptors / 100 hours	885.0	1257.5	1160.4	968.7	893.8	981.6	699.7	1189.9	1048.1	908.6	1461.7	1389.8	1222.4	712.3	1134.2	1044.8	796.1	605.7	733.0	747.0	992.4
SPECIES	RAPTOR COUNTS																				
Turkey Vulture	6	7	8	11	11	9	1	39	15	28	16	43	33	47	17	28	20	26	18	40	21
Osprey	5	8	13	11	17	30	19	34	29	25	44	41	35	39	39	21	28	27	14	24	25
Northern Harrier	159	200	173	278	185	172	195	430	330	208	363	362	315	171	443	487	198	230	441	183	276
Sharp-shinned Hawk	618	737	570	793	1093	832	546	997	989	1000	901	1217	928	652	1005	901	790	764	869	918	856
Cooper's Hawk	457	333	495	362	561	603	260	621	601	596	778	874	701	388	587	577	482	545	440	241	525
Northern Goshawk	35	32	30	8	15	15	20	18	74	26	16	23	27	17	14	16	24	15	33	17	24
Unknown small accipiter <sup>1</sup>	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	87	64	44	65
Unknown large accipiter <sup>1</sup>	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	1	8	4
Unidentified accipiter	86	53	122	64	26	43	47	59	124	44	70	66	73	22	55	20	31	0	6	8	51
TOTAL ACCIPITERS	1196	1155	1217	1227	1695	1493	873	1695	1788	1666	1765	2180	1729	1079	1661	1514	1327	1413	1413	1236	1466
Broad-winged Hawk	0	0	2	5	1	9	4	10	3	2	5	13	7	3	1	7	1	1	1	9	4
Swainson's Hawk	19	5	21	44	12	47	188	129	97	91	487	468	419	106	309	155	29	61	102	63	143
Red-tailed Hawk	311	258	238	409	403	413	286	908	566	621	891	926	876	430	609	1089	509	357	841	538	575
Ferruginous Hawk	2	0	3	6	11	8	6	16	13	15	23	18	15	8	14	13	2	6	12	6	10
Rough-legged Hawk	2	0	1	1	4	3	0	1	2	1	2	0	3	6	1	2	3	2	0	1	2
Unidentified buteo	10	13	21	12	5	5	34	17	38	26	14	24	33	9	19	23	4	19	35	36	20
TOTAL BUTEOS	344	276	286	477	436	485	518	1081	719	756	1422	1449	1353	562	953	1289	548	446	991	653	753
Golden Eagle	236	285	237	73	106	119	101	292	423	133	224	163	127	212	154	245	130	122	154	104	182
Bald Eagle	5	3	3	5	4	0	0	13	10	10	4	3	2	7	0	2	1	0	1	10	4
TOTAL EAGLES	241	288	240	78	110	119	101	305	433	143	228	166	129	219	154	247	131	122	155	114	187
American Kestrel	808	970	799	817	862	744	557	1307	1118	888	975	1371	922	524	727	600	660	623	515	616	820
Merlin	2	3	5	10	11	15	3	21	17	8	11	17	12	8	11	13	20	8	13	6	11
Prairie Falcon	4	15	11	10	7	11	16	13	17	14	33	18	17	23	13	28	14	16	23	20	16
Peregrine Falcon	0	0	0	7	5	5	9	10	7	7	6	11	8	9	19	24	13	16	17	14	9
Unknown small falcon <sup>1</sup>	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	6	1	0	2
Unknown large falcon <sup>1</sup>	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	6	1	2	3
Unidentified falcon	0	0	2	2	1	2	4	2	3	3	0	1	1	3	2	6	10	2	1	1	2
TOTAL FALCONS	814	988	817	846	886	777	589	1353	1162	920	1025	1418	960	567	772	671	717	677	571	659	859
Unidentified raptors	42	31	57	12	2	16	76	34	10	18	8	8	21	8	30	4	7	15	29	16	22
GRAND TOTAL	2807	2953	2811	2940	3342	3101	2372	4971	4486	3764	4871	5667	4575	2692	4069	4261	2976	2956	3632	2925	3610

<sup>1</sup> Designations used for the first time in 2001.

**Appendix E. Daily observation hours and unadjusted fall-migration counts by raptor species in the Wellsville Mountains, UT: 2004.**

DATE	HOURS	SPECIES <sup>1</sup>																								BIRDS			
		TV	OS	NH	SS	CH	NG	SA	LA	UA	BW	SW	RT	FH	RL	UB	GE	BE	UE	AK	ML	PR	PG	SF	LF	UF	UU	TOTAL	/ HOUR
22-Aug	6.67	0	0	0	5	0	0	1	0	0	0	1	11	0	0	0	1	0	0	3	0	0	0	0	0	0	0	22	3.3
23-Aug	0.00																												
24-Aug	7.50	0	0	2	1	0	0	0	0	0	0	1	0	0	1	3	0	0	1	0	0	0	0	0	0	0	9	1.2	
25-Aug	7.50	0	0	1	0	0	0	0	0	0	0	3	1	0	0	4	2	0	0	0	0	0	0	0	0	1	12	1.6	
26-Aug	0.00																												
27-Aug	8.50	0	0	0	1	2	0	0	0	0	0	11	0	0	0	2	0	0	5	0	0	0	0	0	0	0	21	2.5	
28-Aug	9.00	0	0	8	3	1	2	0	1	1	0	7	12	2	0	0	6	0	0	7	0	1	0	0	0	0	51	5.7	
29-Aug	9.00	1	1	4	5	0	0	1	0	0	0	2	10	0	0	3	4	0	0	22	0	0	0	0	0	0	53	5.9	
30-Aug	6.67	3	0	3	3	1	0	0	0	0	0	10	0	0	0	2	0	0	12	0	1	1	0	0	0	2	38	5.7	
31-Aug	7.00	0	0	4	2	3	0	1	0	0	0	4	2	0	0	0	0	0	11	0	0	0	0	0	0	0	27	3.9	
01-Sep	7.00	0	0	0	1	1	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0.7	
02-Sep	0.00																												
03-Sep	0.00																												
04-Sep	9.00	0	1	1	3	3	0	0	0	0	0	3	4	0	0	0	1	0	0	1	0	1	0	0	0	2	20	2.2	
05-Sep	9.00	0	1	0	2	0	0	0	0	0	0	2	4	0	0	0	0	0	2	0	0	1	0	0	0	0	12	1.3	
06-Sep	9.00	1	0	3	12	17	0	1	0	0	0	3	9	0	0	0	0	2	0	22	0	0	0	0	0	1	71	7.9	
07-Sep	9.00	0	1	4	5	7	0	2	1	0	0	2	16	0	0	0	1	0	0	2	0	0	1	0	0	0	42	4.7	
08-Sep	9.00	1	0	5	12	9	1	3	0	0	0	3	21	0	0	1	1	0	0	14	0	0	1	0	0	1	73	8.1	
09-Sep	9.00	0	3	4	20	6	0	4	0	0	0	2	19	0	0	1	1	0	0	23	0	1	2	0	0	0	86	9.6	
10-Sep	8.50	0	1	0	13	11	0	1	0	0	0	3	27	1	0	1	3	0	0	73	0	1	1	0	0	0	136	16.0	
11-Sep	9.00	0	0	0	15	8	0	2	0	0	0	2	9	0	0	0	0	0	51	0	0	1	0	0	0	0	88	9.8	
12-Sep	7.50	0	2	0	4	3	0	0	0	0	0	1	8	0	0	0	0	0	7	0	1	1	0	1	0	0	28	3.7	
13-Sep	9.00	0	0	7	16	8	0	1	0	0	0	1	24	0	0	0	4	0	0	26	0	0	1	0	0	0	88	9.8	
14-Sep	3.00	0	0	0	0	1	0	0	0	0	0	1	2	0	0	0	0	0	1	0	1	0	0	0	0	0	6	2.0	
15-Sep	8.50	0	0	1	3	2	1	0	0	0	0	0	10	0	0	0	0	0	3	0	2	0	0	0	0	0	22	2.6	
16-Sep	9.00	0	0	4	12	12	0	3	0	0	0	2	15	0	0	0	3	0	0	12	0	1	0	0	0	0	64	7.1	
17-Sep	9.00	0	0	0	8	1	0	1	1	0	0	1	3	0	0	0	1	0	0	4	0	0	0	0	0	0	20	2.2	
18-Sep	8.00	0	2	2	1	1	0	0	0	0	0	2	3	0	0	0	2	0	0	1	0	0	0	0	0	0	14	1.8	
19-Sep	0.00																												
20-Sep	0.00																												
21-Sep	7.00	0	1	3	6	5	1	2	1	0	0	2	8	0	0	2	5	0	0	7	0	0	0	0	1	0	44	6.3	
22-Sep	9.00	0	0	4	18	6	2	0	0	1	0	0	19	0	0	0	4	1	0	7	2	0	0	0	0	0	64	7.1	
23-Sep	9.00	0	1	2	18	4	1	2	0	0	0	0	9	0	0	0	2	0	0	5	0	1	0	0	0	0	45	5.0	
24-Sep	9.00	0	1	18	48	21	1	3	1	0	2	1	14	0	0	0	9	0	0	49	1	2	0	0	0	1	172	19.1	
25-Sep	9.25	30	2	14	79	10	1	5	0	1	0	5	22	0	0	2	1	1	0	26	0	0	1	0	0	0	200	21.6	
26-Sep	8.00	0	1	2	74	9	0	1	0	0	2	1	14	0	0	1	1	1	0	23	0	1	0	0	0	0	131	16.4	
27-Sep	8.00	0	0	0	3	0	0	0	0	0	0	5	3	0	0	1	0	0	0	0	0	0	0	0	0	0	12	1.5	
28-Sep	8.25	0	1	9	36	9	0	1	0	0	0	2	18	0	0	0	4	0	0	35	0	1	1	0	0	0	117	14.2	

Appendix E. continued

DATE	HOURS	SPECIES <sup>1</sup>																								BIRDS			
		TV	OS	NH	SS	CH	NG	SA	LA	UA	BW	SW	RT	FH	RL	UB	GE	BE	UE	AK	ML	PR	PG	SF	LF	UF	UU	TOTAL	/ HOUR
29-Sep	0.00																												
30-Sep	0.00																												
01-Oct	8.50	0	3	11	112	20	2	0	1	0	1	3	37	0	0	2	4	0	0	70	0	0	0	0	0	0	3	269	31.6
02-Oct	9.00	0	1	14	95	26	1	1	1	0	2	0	32	1	0	0	2	0	0	23	1	3	0	0	0	1	1	205	22.8
03-Oct	8.00	0	1	4	43	10	1	1	0	2	2	0	12	0	0	20	4	2	0	16	1	0	0	0	0	0	1	120	15.0
04-Oct	7.75	0	0	11	56	8	1	5	0	1	0	0	13	0	0	0	3	0	0	17	0	1	0	0	0	0	1	117	15.1
05-Oct	6.00	0	0	3	5	0	1	0	0	0	0	0	6	1	0	0	3	0	0	2	0	0	0	0	0	0	2	23	3.8
06-Oct	7.50	0	0	8	53	6	1	0	0	0	0	1	20	0	0	0	2	1	0	6	0	0	0	0	0	0	0	98	13.1
07-Oct	8.50	1	0	5	31	5	0	0	0	0	0	0	7	0	0	0	3	0	0	7	0	0	0	0	0	0	0	59	6.9
08-Oct	8.00	0	0	4	19	0	0	2	0	0	0	0	8	0	0	0	4	0	0	5	0	0	0	0	0	0	0	42	5.3
09-Oct	9.00	1	0	0	17	1	0	0	0	0	0	0	1	0	0	0	1	0	0	4	0	0	0	0	0	0	0	25	2.8
10-Oct	5.75	0	0	1	4	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	1.2
11-Oct	7.75	0	0	4	9	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	2.6
12-Oct	7.75	0	0	4	12	1	0	0	0	1	0	0	8	0	0	0	3	0	0	3	0	0	0	0	0	0	0	32	4.1
13-Oct	7.75	2	0	1	0	0	0	0	1	0	0	0	7	0	0	0	2	0	0	0	0	1	1	0	0	0	0	15	1.9
14-Oct	8.50	0	0	2	14	0	0	0	0	0	0	0	7	0	1	0	2	0	0	1	0	0	0	0	0	0	0	27	3.2
15-Oct	8.00	0	0	4	11	0	0	0	0	1	0	0	11	0	0	0	1	0	0	3	1	0	0	0	0	0	0	32	4.0
16-Oct	8.75	0	0	2	11	0	0	0	0	0	0	0	17	0	0	1	4	0	0	4	0	0	0	0	0	0	0	39	4.5
17-Oct	3.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	2	0.6	
Total	391.59	40	24	183	918	241	17	44	8	8	9	63	538	6	1	36	104	10	0	616	6	20	14	0	2	1	16	2925	7.5

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