FALL 2006 RAPTOR MIGRATION STUDY IN THE WELLSVILLE MOUNTAINS OF NORTHERN UTAH

HawkWatch International, Inc.
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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 and 2005. 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 2006 season, which marked the 21st 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. This was the first season of migration counting for official observers Adam Remus and Adam Schmidt. Both attended pre-season protocol and field training, and

received additional on-site training. Experienced visitors, previous official observers, 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.

We limited some data comparisons to the years 1991–2006; 1991 was the first year that a standardized two-observer system was instituted at the site. In comparing 2006 annual statistics against means and 95% confidence intervals for previous seasons, we equate significance with a 2006 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 1987–2006. We 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

Frequent rain and snow hampered access to the count site throughout the season in 2006. Inclement weather fully precluded a record-high 15 full days of potential observations and reduced observation time to ≤4 hours on three other days (see Appendix C for daily weather records). The 1997–2004 averages, calculated across variable annual observation periods, are 8 full and 3 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 2006 season.

Based on hourly weather records collected during actual observation periods, the array of sky conditions documented in 2006 was significantly different than the 1997–2004 average pattern. Fair skies prevailed on a record 71% of the active observation days (average 58%), transitional skies (i.e., skies changed from primarily fair to mostly cloudy or overcast during the day, or vice versa) on only14% (average 25%), and

mostly cloudy to overcast skies on 16% (average 17%). Additionally, a record low proportion of the active observation days featured rain, snow, or visibility reducing fog or haze (28% vs. 1997–2004 average of 49%). Average visibility ratings recorded by HWI observers at this site since 1997 have varied considerably, with record high ratings for 2006 (average 95 km west and 96 km east) surpassing 1997, and values ranging as low as 23–24 km in 1998. Some of this extreme variation may be due to inconsistent observer evaluations; nevertheless, the record high 2006 rating is consistent with the indication that the observers were not present at the count site during severely inclement weather when fog and snow would have hampered visibility.

Light winds (<12 kph) prevailed on 52% and moderate winds (12–28 kph) on 48% of the active observation days. The comparative averages for the previous seven seasons are 46% light, 45% moderate, and 8% strong (>28 kph) winds. Consistent S-SW winds prevailed on a slightly below average 45% of the active observation days (1997–2004 average of 50%), and days with consistent SW-W winds were absent (average 8% of days). Instead, a record high 31% of the active days featured more variable mixes of S-W winds (average 10%). In addition, days that featured only SW-NW winds were less common than usual in 2006 (0% vs. average of 5% of active days), but the prevalence of days where the winds shifted markedly during the day from the SW-NW quadrant to the N-E quadrant, or vice versa, rose to a record high of 8% of the active days (average 2%).

The daily-average (mean of hourly readings) temperature averaged 14.1°C, ranging from -0.1 to 26.5°C. The average is only slightly lower than the 1997–2004 mean of 14.6°C, whereas the minimum and the maximum temperatures are in the range of normal variability. The daily-average (mean of hourly readings) barometric pressure averaged 30.15 in Hg, ranging from 29.07 to 30.60 in Hg. The proportion of days rated as good to excellent for thermal lift in 2006 (18%) was a record low since 1997 (average 51%), possibly indicating some discrepancy in the subjective rating system.

In summary, heavy rain and snowfall hampered observations during the 2006 season more than usual, effectively precluding 15 days of potential observations over the course of the season. When observations did occur, however, fair skies and light-to-moderate (as opposed to strong) winds predominated more than usual, the temperature regime was about average for the site, and visibility was at an all time high. In other words, this season was one of contrasts: when the weather was bad it was consistently bad enough to keep the observers off the ridge for full days at a time, but when that was not the case, the weather and viewing conditions were optimal. In addition, as usual S-SW winds were the most common pattern, but days featuring a more variable mix of S-W winds were atypically common.

OBSERVATION EFFORT

The observers worked on 50 of 65 possible observation days between 28 August and 31 October. The official start date was scheduled to be 27 August, but logistic issues postponed the start by one day. The long-term average ending date for the project is 25 October. The number of observation days was a significant 8% lower than the 1977–2004 average of 54 ± 95% CI of 3.0 days, whereas the number of observation hours (370.25) was a non-significant 5% lower than the 1977–2004 average of 388.30 ± 95% CI of 25.16 hours. The 2006 average of 1.9 observers per hour (includes official and guest observers; value is mean of daily values, which are in turn means of hourly values) matches the 1977–2004 average of 1.9 ± 95% CI of 0.23 observers/hr.

FLIGHT SUMMARY

The observers tallied 1,952 migrant raptors of 16 species during the 2006 season (Table 1, and see Appendix E for daily count records). The flight was composed of 55% accipiters, 19% falcons, 18% buteos, 5% harriers, 1% eagles, 1% Ospreys, and <1% vultures and unidentified raptors (Figure 2). The proportional representation of accipiters and Ospreys was significantly above average, while the proportional representation of all other species groups was significantly below average. The most

numerous species were the Sharp-shinned Hawk (38% of the total count), American Kestrel (17%), Cooper's Hawk (16%), Red-tailed Hawk (15%), Northern Harrier (5%), Swainson's Hawk (3%), and Golden Eagle (1%). All other species each comprised ≤1% of the total count.

The total combined-species count was a significant 48% below the 1991–2004 average. Below-average counts occurred for 15 of 17 species usually seen at the site, with the differences significant for all species (Table 1). Most notably, the counts of Northern Harriers (97), Golden Eagles (20), and American Kestrels (328) all fell to a record lows and the count of Turkey Vultures (3), Cooper's Hawks (312), and Northern Goshawks (8) were the second lowest recorded to date (Appendix D). In contrast, the Merlin count (18) was the third highest for that species since 1977. Comparisons of adjusted passage rates revealed similar results, with 14of the 15 species showing significantly below average (1991–2004) rates and only Merlins showing a significantly above average rate (Table 1). In fact, for most species, especially the two smaller accipiters, low counts were generally the rule in 2006 across fall migration count sites in the interior West (see relevant technical reports at http://www.hawkwatch.org).

Regression analyses of adjusted passage rates since 1987 indicated marginally to highly significant quadratic trends for 10 species (Turkey Vulture, Osprey, Cooper's Hawk, Red-tailed Hawk, Swainson's Hawk, Ferruginous Hawk, Golden Eagle, Northern Goshawk, American Kestrel, and Prairie Falcon), generally tracking hill-shaped patterns with increases through the early to mid-1990s followed by recent declines (Figures 3–7). Turkey Vultures showed the same basic pattern as the others except that a high 2004 passage rate appears anomalous (Figure 3). This common, recent pattern appears to correlate with rising regional moisture levels during the early to mid-1990s due to an *El Nino* weather pattern, followed by the onset of severe and widespread drought throughout much of the interior West between 1999 and at least 2004. The pattern of variation in passage rates is also common to other regional datasets, such as in the Goshute Mountains of northeastern Nevada (Smith and Hoffman 2003, Smith and Neal 2007). 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).

Three of 8 species with data suited to such comparisons showed below average immature : adult ratios in 2006, with significant differences indicated for Northern Harriers and Red-tailed Hawks (Table 2). For these two species, the low age ratios were due to below average numbers of immature birds, suggesting that low productivity may have been a factor. Sharp-shinned Hawks, Cooper's Hawks, and Golden Eagles all showed significantly above-average age ratios in 2006, but for very different reasons. For Sharp-shinned Hawks, the high age ratio was primarily due to a significantly higher than average count of immature birds. In contrast, the Cooper's Hawk adult count was significantly below average, suggesting low adult survival. For Golden Eagles, counts of both adults and non-adults were substantially below average in 2006, with a proportionately greater reduction in the adult count.

The combined-species median passage date of 26 September was a marginally significant 3 days later than the 1991–2004 average (Table 3). Reasons for this difference are evident in the seasonal distribution pattern, with significantly below average overall flight volume during 16–25 September, and much higher than average activity during the last five days of September and 11–15 October (Figure 8). The former low activity period corresponded to occurrence of the first truly cold (and snowy) storm fronts of the season, which precluded observations for five full days from 15–17 and 20–22 September. The first high activity period followed and featured sunny and breezy weather, making for great flight conditions. Most species showed a spike in activity during this period. The second peak of flight activity was sandwiched between two storm fronts that precluded observations on 11 October and 16–17 October. At the species level, however, only 5 of 16 species for which a comparison was possible showed later than average median passage dates in 2006, with the difference significant for three species (Osprey, Red-tailed Hawk, and American Kestrel; Table 3). Swainson's Hawks, Golden and Bald Eagles, and Peregrine Falcons showed significantly earlier than average median passage dates. Age and sex-specific data illustrated additional complexity in the distributional patterns for Sharp-shinned Hawks and Northern Harriers, with immature birds of both species later than average but adults at least slightly earlier than average (Table 4).

In contrast, age-specific passage dates for Cooper's Hawks and Golden Eagles matched the species-level pattern.

Early truncation of the season (begun 7 days later than the recent standard of 22 August), caused by shifting the official start date to 27 August (consistent with most other HWI fall projects) and an additional, unanticipated 1-day delay, undoubtedly resulted in our missing a portion of the migration that would otherwise have been tallied. Over the entire history of the project, only about 2% of all birds counted passed through before 28 August. For 2006, this average translates to an estimated 39 uncounted birds. The only species for which a sizeable portion of total flight volume has passed through before 28 August is the Turkey Vulture (20% of all birds since 1977). Other species for which 5–9% of total flight volume passed before 28 August include Red-tailed Hawk, Ferruginous Hawk, Prairie Falcon, and Peregrine Falcon. For all remaining species, this period accounts for <5% of total historic flight volume, with the value falling to ≤1% for all three accipiters and Rough-legged Hawks.

RESIDENT RAPTORS

This season's resident community included at least two light-morph Red-tailed Hawks, one adult and one immature. In the past, a mixed-morph pair (1 light, 1 dark) and mixed offspring were often apparent, but not in 2006. As is typical, the 2006 birds often kited in front of the observation post or south along the ridge near the saddle. They were most active during morning hours. The adult also liked to perch in a tree below and east of observation. A family of Golden Eagles, including at least one adult, one subadult, and two first-year birds, was seen regularly throughout the season. The adult liked to perch in a tree north of observation. An adult female and an immature Northern Harrier also were observed all season. In early October, an adult male harrier appeared and remained in the area for a couple of weeks. Two immature Sharp-shinned Hawks were spotted on a regular basis until mid-October. They often scuffled with American Kestrels and chased migrating buteos. No resident Cooper's Hawks or Northern Goshawk's were recorded this season. Regular sightings of a resident pair of American Kestrels were recorded through early October.

This assemblage differs from those of the recent past in several ways. The lack of two obvious family groups of Red-tailed Hawks was atypical. The absence of local Cooper's Hawks and Northern Goshawks was atypical. For the third year in a row, the absence of obvious immature American Kestrels was noticeable, but it is possible that the young kestrels simply dispersed away before the new observers had sufficient time to orient to the local population. The absence of obvious local Peregrine Falcons also is atypical compared to several seasons in the recent past.

VISITATION

Frequent, stormy weather did not dissuade visitation to the project site in 2006, with a total of 21 visitor days recorded, involving 123 individuals. The total number of visitors was above average for the past several years (e.g., compared to only 50 in 2004, also a year of difficult weather), though a visit by 41 students from Mountain View High School greatly augmented the total tally. Other organized groups included ~15 members of the Bridgerland Audubon Society and 14 members of the Utah State University Hiking Club.

In 2006, 372 hourly assessments of visitor disturbance resulted in the following ratings: 97% none and 3% low. 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.

ACKNOWLEDGMENTS

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Table 1. Unadjusted fall-migration counts and adjusted passage rates by raptor species in the Wellsville Mountains, UT: 1987–2004 versus 2006.

	COUNTS			BIRDS / 100 HRS		
SPECIES	1991–2004[1]	2006	% CHANGE	1991–2004[1]	2006	% CHANGE
Turkey Vulture	23 ± 6.2	3	-87	8.5 ± 1.66	1.2	-86
Osprey	28 ± 4.7	18	-36	11.8 ± 2.38	7.1	-40
Northern Harrier	294 ± 53.1	97	-67	84.1 ± 16.74	29.7	-65
Sharp-shinned Hawk	892 ± 77.4	750	-16	295.5 ± 32.44	287.1	-3
Cooper's Hawk	542 ± 80.2	312	-42	183.9 ± 33.25	115.5	-37
Northern Goshawk	22 ± 7.0	8	-64	6.6 ± 1.99	2.0	-69
Unknown small accipiter2	65 ± 24.3	11	-83	–	–	–
Unknown large accipiter2	4 ± 4.9	1	-75	–	–	–
Unidentified accipiter	44 ± 14.7	1	-98	–	–	–
TOTAL ACCIPITERS	1512 ± 150.0	1083	-28	–	–	–
Broad-winged Hawk	5 ± 1.8	2	-59	2.0 ± 0.92	0.8	-58
Swainson's Hawk	165 ± 74.4	58	-65	79.3 ± 39.57	25.2	-68
Red-tailed Hawk	627 ± 116.2	296	-53	191.7 ± 35.16	95.1	-50
Ferruginous Hawk	11 ± 2.6	3	-73	3.3 ± 0.97	1.0	-70
Rough-legged Hawk	2 ± 0.7	0	-100	0.8 ± 0.39	0.0	-100
Unidentified buteo	20 ± 5.5	2	-90	–	–	–
TOTAL BUTEOS	830 ± 174.7	361	-57	–	–	–
Golden Eagle	170 ± 41.3	20	-88	49.9 ± 12.26	5.8	-88
Bald Eagle	4 ± 2.0	1	-77	1.1 ± 0.60	0.3	-72
TOTAL EAGLES	175 ± 42.3	21	-88	–	–	–
American Kestrel	812 ± 124.2	328	-60	259.5 ± 48.51	117.6	-55
Merlin	12 ± 2.3	18	50	3.5 ± 0.71	5.5	54
Prairie Falcon	17 ± 3.2	13	-24	5.1 ± 1.04	4.0	-21
Peregrine Falcon	11 ± 2.6	7	-38	3.6 ± 0.92	2.3	-35
Unknown small falcon[2]	3 ± 3.0	0	-100	–	–	–
Unknown large falcon[2]	3 ± 2.8	1	-70	–	–	–
Unidentified falcon	3 ± 1.2	1	-65	–	–	–
TOTAL FALCONS	856 ± 123.2	368	-57	–	–	–
Unidentified raptor	19 ± 8.5	1	-95	–	–	–
GRAND TOTAL	3738 ± 448.9	1952	-48	–	–	–

[1] Mean ± 95% confidence interval.

[2] Designations used for the first time in 2001.

Table 2. Annual counts by age classes and immature : adult ratios for selected species: 1991–2004 versus 2006.

	Total and Age-classified Counts						% Unknown Age		Immature : Adult Ratio	
	1991–2004 Average			2006						
	Total	Imm.	Adult	Total	Imm.	Adult	1991–2004[1]	2006	1991–2004[1]	2006
Northern Harrier	321	181	80	97	39	49	19 ± 4.0	9	2.7 ± 1.04	0.8
Sharp-shinned Hawk	917	354	369	750	419	293	21 ± 4.9	5	1.1 ± 0.29	1.4
Cooper's Hawk	572	226	201	312	200	95	26 ± 7.0	5	1.4 ± 0.37	2.1
Northern Goshawk	25	12	7	8	2	1	24 ± 10.5	63	2.8 ± 1.04	2.0
Broad-winged Hawk	5	1	2	2	0	0	32 ± 67.3	100	0.8 ± 0.72	–
Red-tailed Hawk	704	294	339	296	71	210	10 ± 2.9	5	0.9 ± 0.30	0.3
Ferruginous Hawk	12	3	3	3	1	0	53 ± 16.3	67	2.2 ± 1.72	~1
Golden Eagle	191	89	83	20	13	7	9 ± 3.4	0	1.2 ± 0.23	1.9
Bald Eagle	5	4	1	1	1	0	7 ± 9.2	0	4.1 ± 2.43	~1
Peregrine Falcon	12	2	3	7	0	3	55 ± 13.2	57	1.1 ± 0.41	0.0

[1] 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 2006, with a comparison of 2006 and 1991–2004 average median passage dates.

Species	2006 First Date Observed	2006 Last Date Observed	2006 Bulk Passage Dates[1]	2006 Median Passage Date[2]	1991–2004 Median Passage Date[3]
Turkey Vulture	3-Sep	30-Sep	–	–	09-Sep ± 6.4
Osprey	31-Aug	24-Oct	4-Sep – 8-Oct	17-Sep	14-Sep ± 2.0
Northern Harrier	28-Aug	23-Oct	6-Sep – 14-Oct	27-Sep	25-Sep ± 2.0
Sharp-shinned Hawk	28-Aug	30-Oct	9-Sep – 13-Oct	28-Sep	26-Sep ± 2.0
Cooper's Hawk	30-Aug	18-Oct	5-Sep – 8-Oct	23-Sep	25-Sep ± 1.9
Northern Goshawk	4-Sep	30-Oct	4-Sep – 30-Oct	23-Sep	26-Sep ± 4.9
Broad-winged Hawk	26-Sep	28-Sep	–	–	23-Sep ± 3.4
Swainson's Hawk	28-Aug	8-Oct	30-Aug – 29-Sep	6-Sep	17-Sep ± 4.7
Red-tailed Hawk	28-Aug	24-Oct	4-Sep – 12-Oct	29-Sep	21-Sep ± 1.6
Ferruginous Hawk	28-Aug	3-Oct	–	–	15-Sep ± 5.2
Golden Eagle	28-Aug	24-Oct	29-Aug – 23-Oct	17-Sep	01-Oct ± 2.0
Bald Eagles	4-Sep	4-Sep	–	–	05-Oct ± 11.3
American Kestrel	28-Aug	15-Oct	6-Sep – 30-Sep	26-Sep	20-Sep ± 2.1
Merlin	28-Aug	22-Oct	5-Sep – 22-Oct	29-Sep	30-Sep ± 2.5
Prairie Falcon	28-Aug	23-Oct	30-Aug – 29-Sep	11-Sep	14-Sep ± 3.5
Peregrine Falcon	29-Aug	18-Sep	29-Aug – 18-Sep	29-Aug	12-Sep ± 3.3
Total	28-Aug	30-Oct	6-Sep – 12-Oct	26-Sep	23-Sep ± 1.1

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

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

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

Table 4. Median passage dates by age and sex classes for selected species: 1991–2004 versus 2006.

SPECIES	2006	1991–2004 MEAN ± 95% CI (days)	2006	1991–2004 MEAN ± 95% CI (days)
	ADULT		IMMATURE / SUBADULT	
Northern Harrier	27-Sep	30-Sep ± 2.5	28-Sep	24-Sep ± 2.4
Sharp-shinned Hawk	1-Oct	02-Oct ± 2.1	26-Sep	18-Sep ± 2.6
Cooper's Hawk	27-Sep	30-Sep ± 2.3	13-Sep	19-Sep ± 2.3
Red-tailed Hawk	1-Oct	28-Sep ± 1.9	17-Sep	15-Sep ± 2.1
Golden Eagle	17-Sep	02-Oct ± 3.3	8-Oct	01-Oct ± 2.6
	MALE		FEMALE	
Adult Northern Harrier	28-Sep	02-Oct ± 2.2	9-Sep	25-Sep ± 5.9
American Kestrel	26-Sep	24-Sep ± 1.9	25-Sep	15-Sep ± 2.2

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

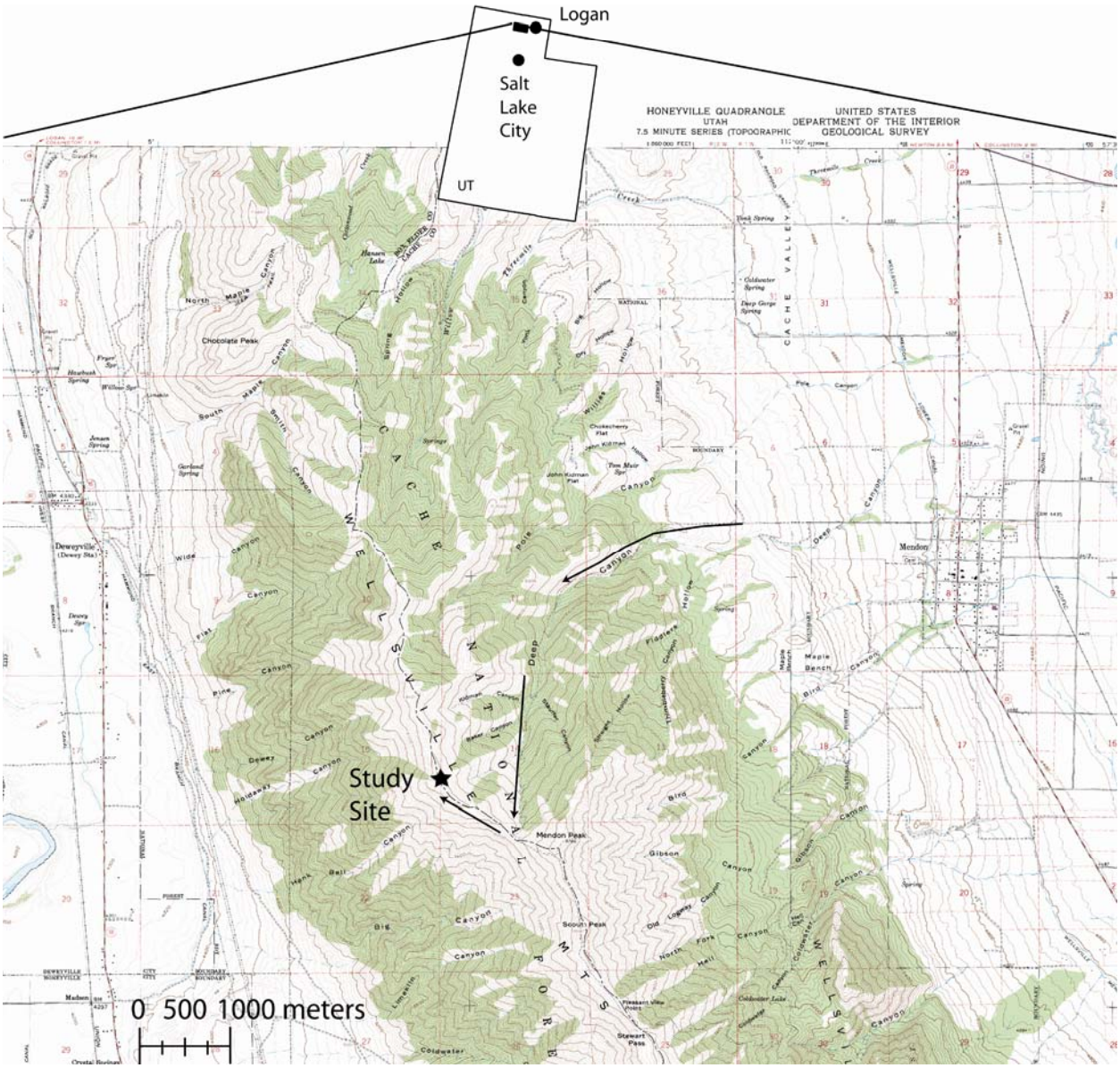

Figure 1. Location of the Wellsville Mountains Raptor Migration Project site in northern Utah.

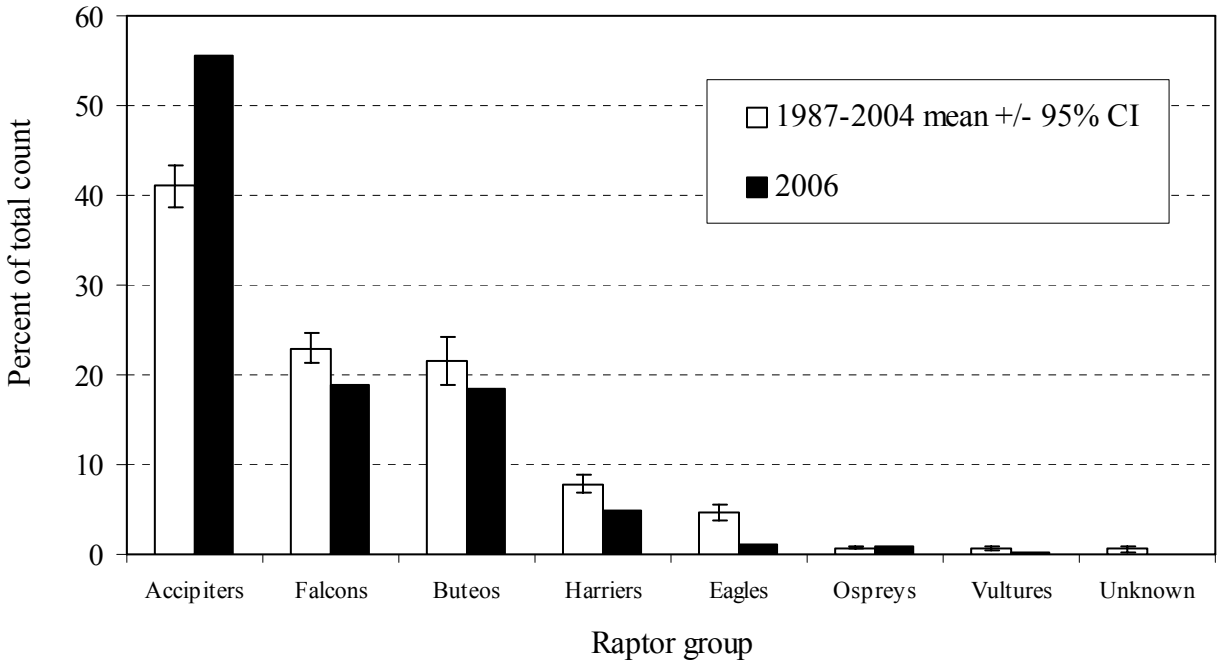

Figure 2. Fall-migration flight composition by major raptor species groups: 1987–2004 versus 2006.

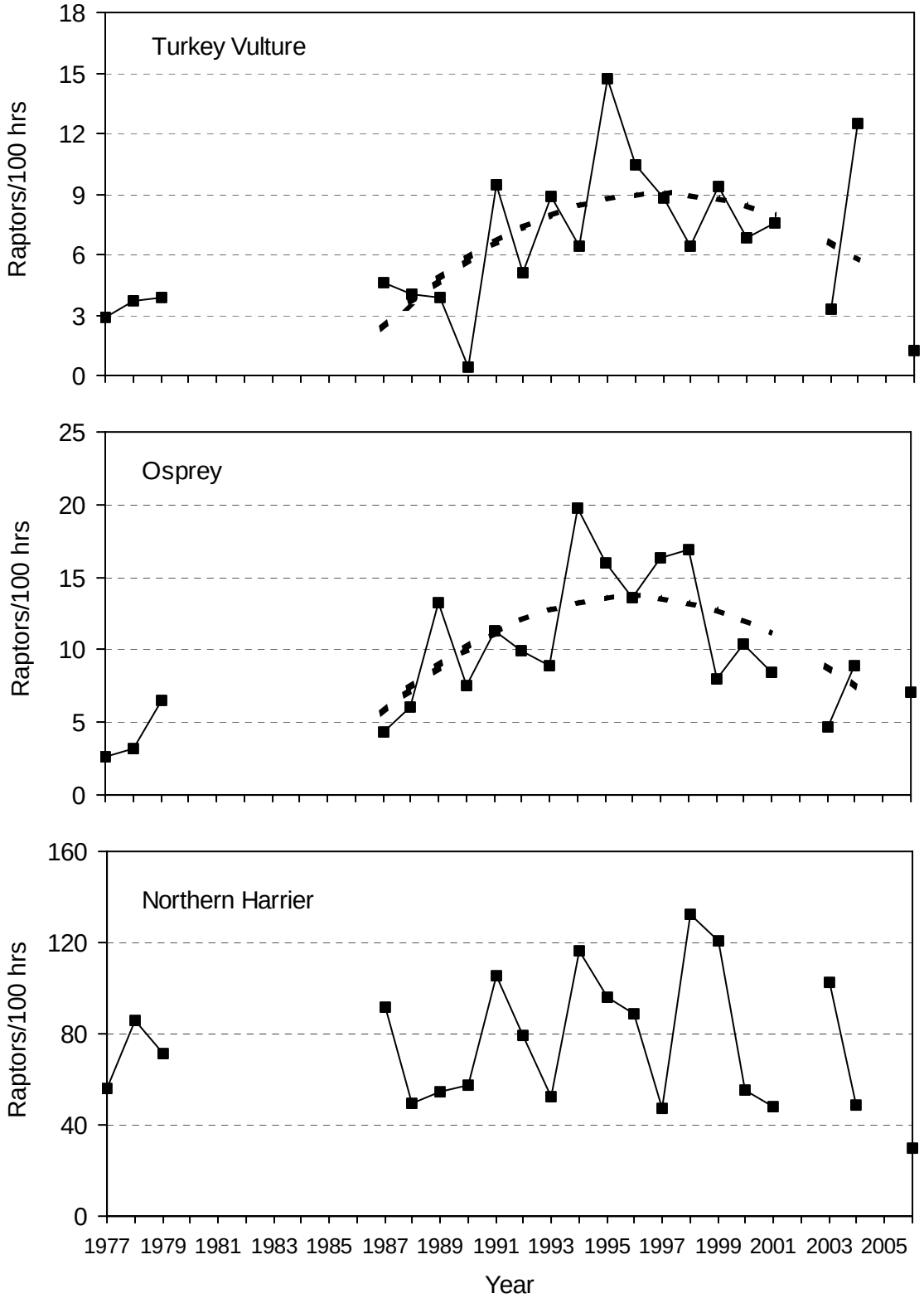

Figure 3. Adjusted fall-migration passage rates for Turkey Vultures, Ospreys, and Northern Harriers: 1977–2006. Dotted lines indicate significant ($P \leq 0.10$) linear or quadratic regressions.

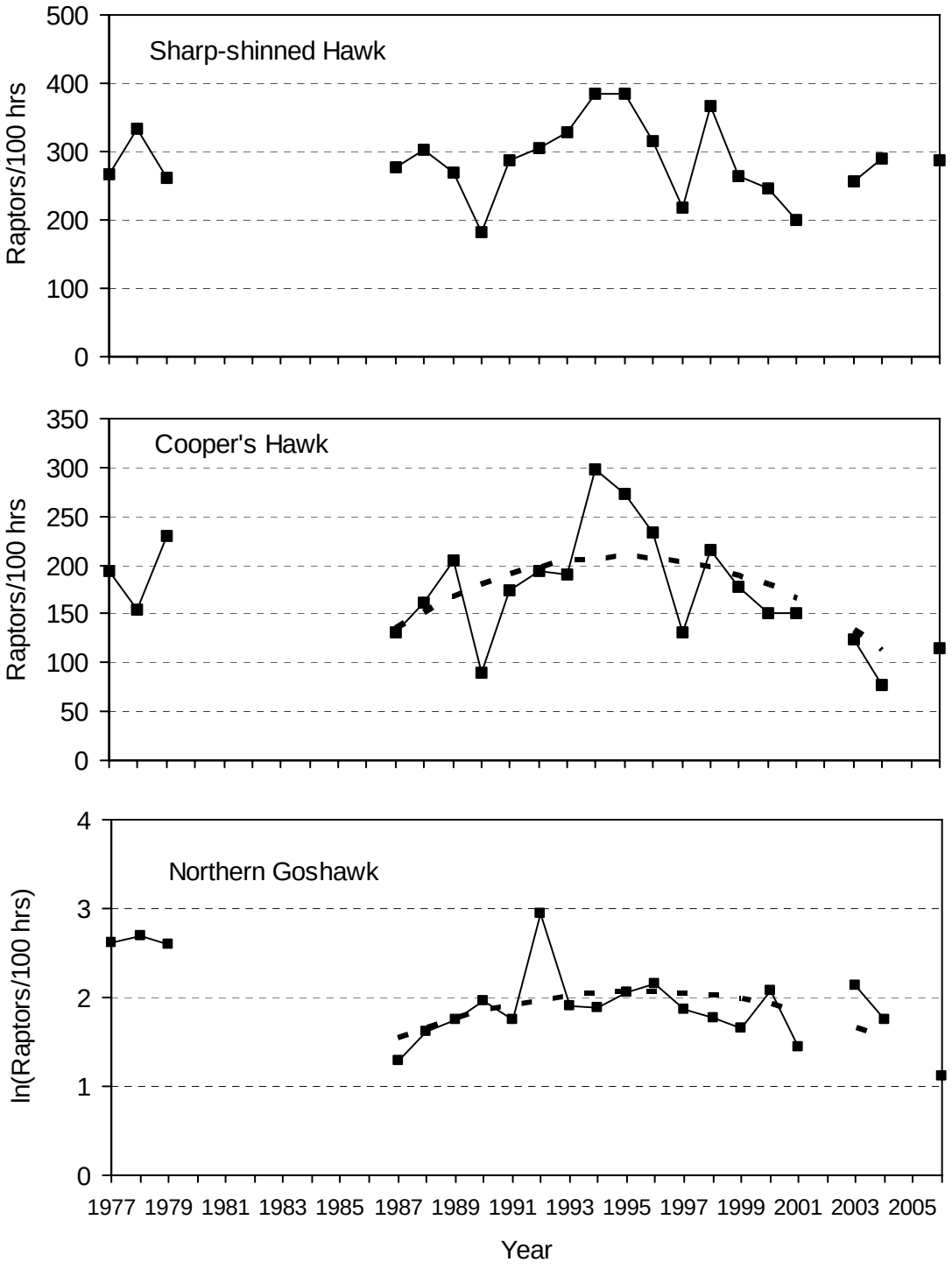

Figure 4. Adjusted fall-migration passage rates for Sharp-shinned Hawks, Cooper's Hawks, and Northern Goshawks: 1977–2006. Dotted lines indicate significant ($P \leq 0.10$) linear or quadratic regressions.

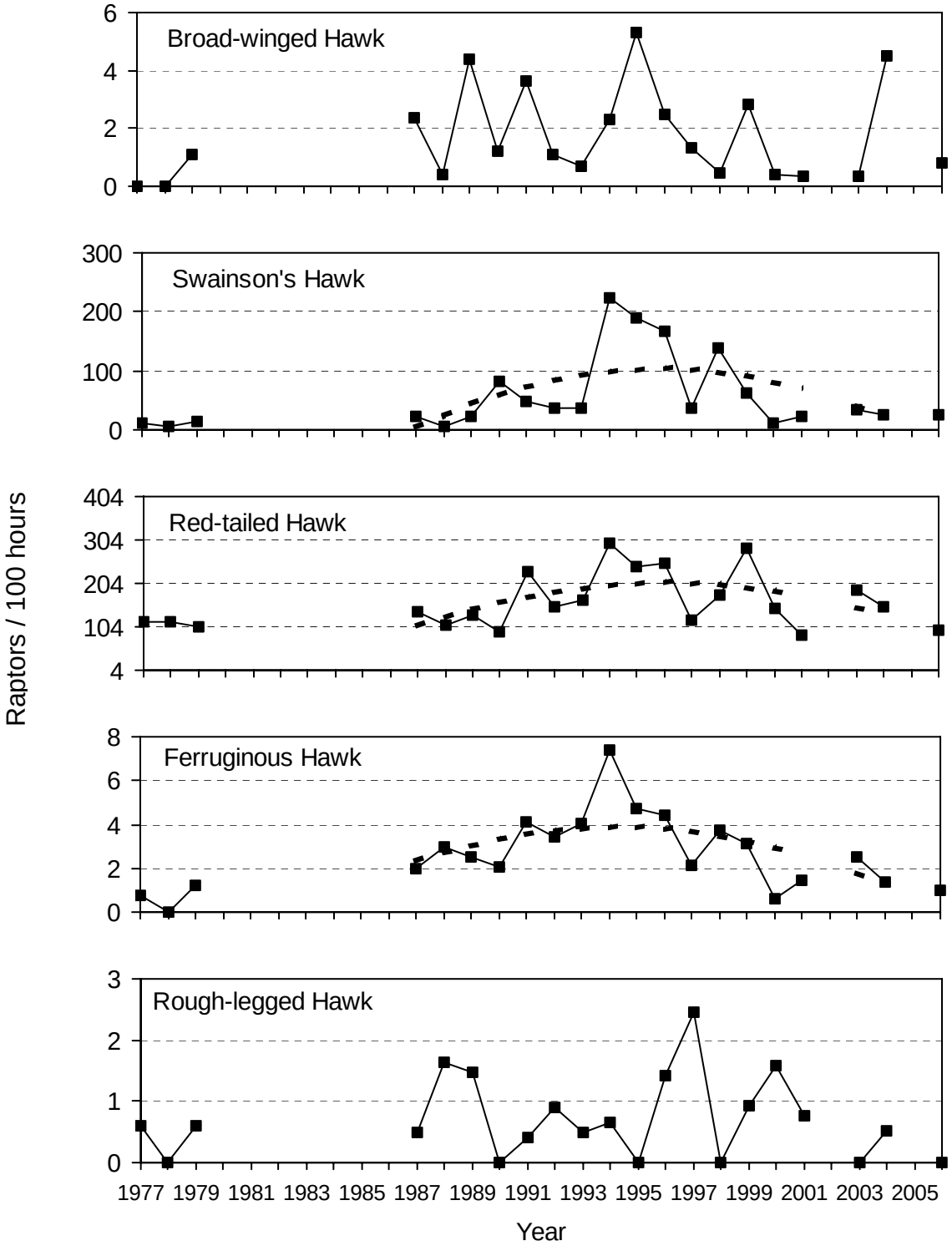

Figure 5. Adjusted fall-migration passage rates for Broad-winged, Swainson's, Red-tailed, Ferruginous, and Rough-legged Hawks: 1977–2006. Dotted lines indicate significant ($P \leq 0.10$) linear or quadratic regressions.

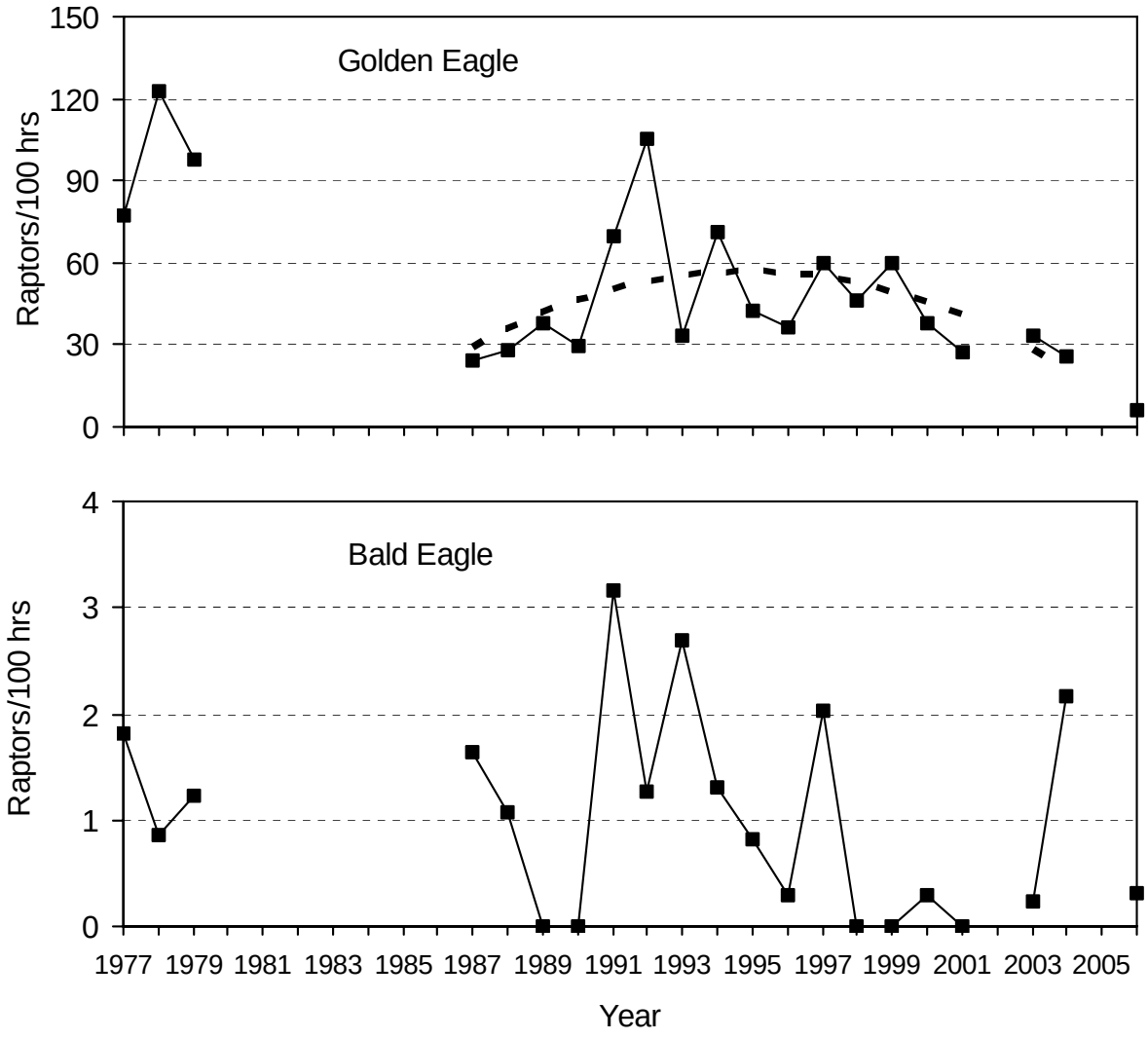

Figure 6. Adjusted fall-migration passage rates for Golden and Bald Eagles: 1977–2006. Dotted lines indicate significant ($P \leq 0.10$) linear or quadratic regressions.

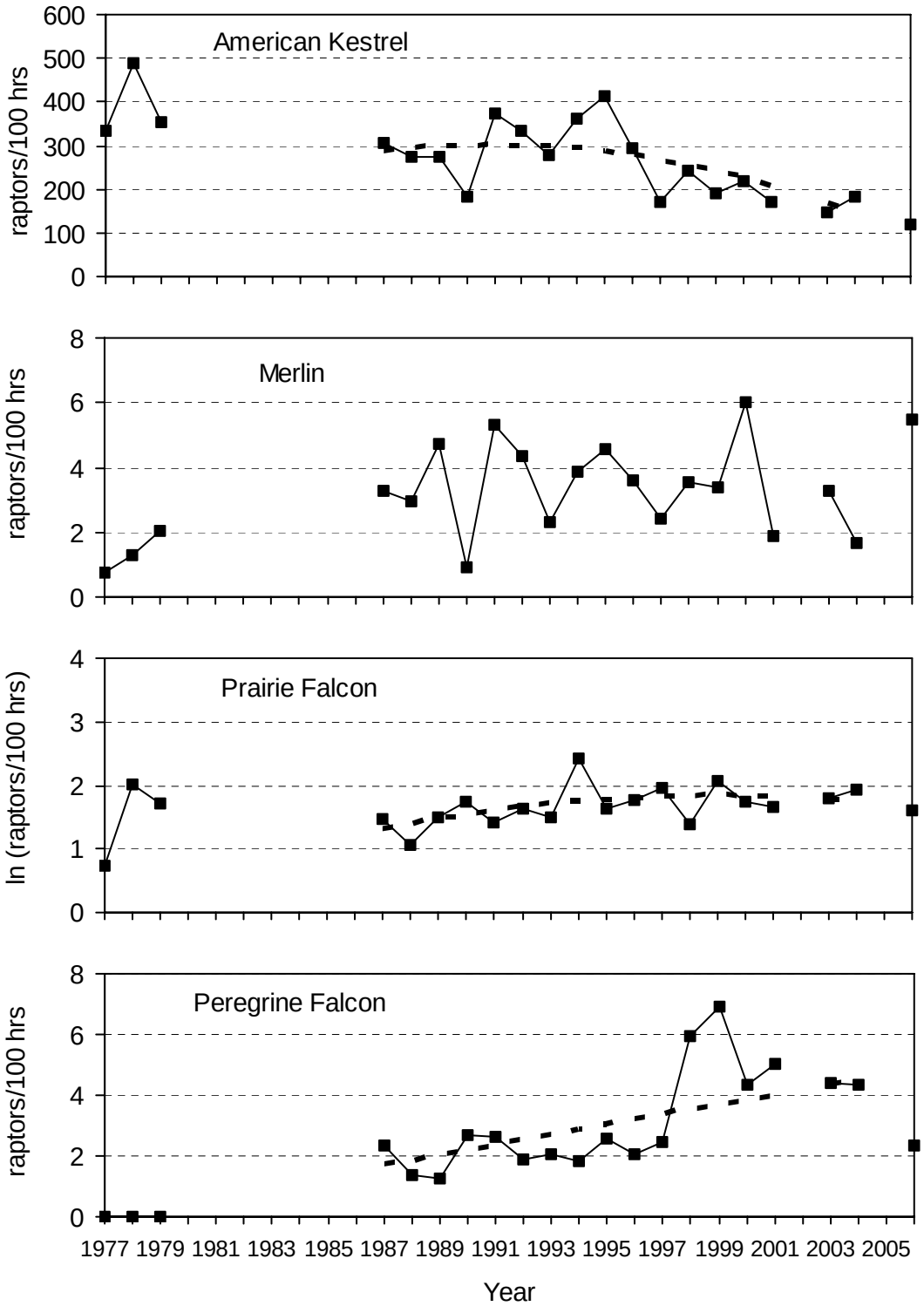

Figure 7. Adjusted fall-migration passage rates for American Kestrels, Merlins, Prairie Falcons, and Peregrine Falcons in the Wellsville Mountains, UT: 1977–2006. Dotted lines indicate significant ($P \leq 0.10$) linear or quadratic regressions.

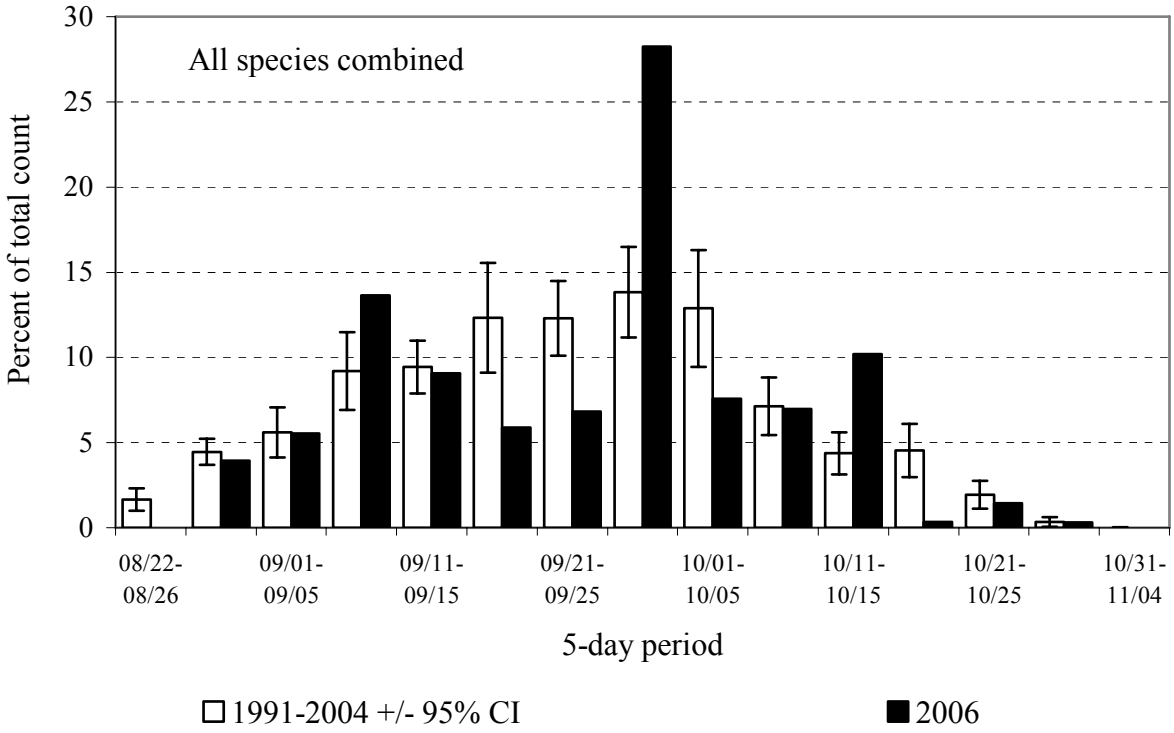

Figure 8. Combined-species, fall-migration passage volume by five-day periods in the Wellsville Mountains, UT: 1991–2004 versus 2006.

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

1977: Single observer throughout: Wayne Potts (0)[1]

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)

2005: Two observers throughout: Mark Fogg (1 partial), Rob Spaul (0)

2006: Two observers throughout: Adam Remus (0) and Adam Schmidt (0)

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

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

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

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

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

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

Appendix C. Daily observation effort, visitor disturbance ratings, weather records, and fall-migration flight summaries for raptors in the Wellsville Mountains, UT: 2006.

Date	Obs. Hours	Obsrvr / Hour[1]	Median Visitor Disturb[2]	Predominant Weather[3]	Wind Speed (kph)[1]	Wind Direction	Temp (°C)[1]	Barom. Press. (in Hg)[1]	Median Thermal Lift[4]	Visib. West (km)[1]	Visib. East (km)[1]	Median Flight Distance[5]	Birds / Hour
28-Aug	8.00	2.0	0	clr, haze	9.1	e, sw	24.3	29.34	2	100	100	2	2.9
29-Aug	8.00	2.0	0	clr-pc	13.6	s, sw	25.1	29.20	2	100	100	2	1.4
30-Aug	8.00	2.0	0	clr-pc	18.1	s, sw	24.1	29.07	2	100	100	2	3.4
31-Aug	8.00	2.0	0	clr	11.3	s, sw	19.4	29.26	2	100	100	2	2.1
01-Sep	8.00	2.0	0	clr	6.6	nne, sw, w	21.7	29.33	3	100	100	2	0.8
02-Sep	8.00	1.0	0	clr	5.4	var	24.0	29.31	3	100	100	2	1.0
03-Sep	8.00	2.0	0	clr-pc	6.1	s, sw	25.2	29.28	3	100	100	2	1.4
04-Sep	8.00	3.5	0	clr-mc	7.0	s, sw	26.5	30.06	2	100	100	2	4.8
05-Sep	8.00	2.0	0	pc-mc	7.6	sw	26.2	30.60	2	100	100	2	5.6
06-Sep	8.00	2.0	0	clr, haze	6.5	s, sw, w	24.4	30.53	2	100	100	2	17.1
07-Sep	8.00	1.0	0	mc-ovc, haze/scat rain/ts	2.8	n, sw	21.3	30.32	4	80	80	2	0.6
08-Sep	5.25	1.0	0	mc-ovc, AM rain	8.5	s, sw	19.0	30.22	3.5	62	70	2	1.9
09-Sep	8.00	2.0	0	mc-ovc	20.6	s, sw	18.2	30.25	3	100	100	2	3.8
10-Sep	8.00	2.0	0	clr	10.1	s, sw	20.1	30.42	2.5	100	100	2	10.5
11-Sep	8.00	2.0	0	clr	5.3	sw, w	20.8	30.55	4	100	100	2	1.6
12-Sep	8.00	2.0	0	clr	6.4	sw	24.0	30.56	3	100	100	2	3.4
13-Sep	8.00	1.6	0	clr	15.0	s, sw	23.2	30.30	2.5	100	100	2	12.6
14-Sep	3.75	1.0	0	mc, scat rain/snow	14.0	sw	22.8	29.88	3	100	100	2	9.6
15-Sep	0.00			weather day									
16-Sep	0.00			weather day									
17-Sep	8.00	2.0	0	pc-mc	17.4	sw	3.4	30.32	4	100	100	2	8.9
18-Sep	8.00	2.0	0	clr	9.8	sw	9.2	30.36	3	100	100	2	3.5
19-Sep	8.00	2.0	0	pc-ovc	12.5	s, sw	14.9	30.18	3	100	100	2	2.0
20-Sep	0.00			weather day									
21-Sep	0.00			weather day									
22-Sep	0.00			weather day									
23-Sep	5.50	2.0	0	clr-pc	5.1	s, sw	5.3	30.39	3.5	100	100	2	6.2
24-Sep	8.00	2.0	0	clr	7.5	s, sw	9.3	30.47	3	100	100	2	4.0
25-Sep	8.00	2.4	0	clr	12.4	s, sw	12.6	30.48	3	100	100	2	8.4
26-Sep	8.00	2.0	0	clr	8.9	s, sw	13.8	30.51	3.5	100	100	2	15.3
27-Sep	8.00	2.0	0	clr	6.7	sw	16.5	30.53	3.5	100	100	2	13.8
28-Sep	8.00	1.0	0	clr	15.0	s, sw	16.3	30.50	3	100	100	2	13.3
29-Sep	8.00	1.3	0	clr, PM haze	10.5	sw	17.6	30.44	2	100	91	2	16.6
30-Sep	8.00	2.0	0	clr-mc	14.7	sw	18.2	30.35	3	100	100	2	10.0
01-Oct	8.00	2.0	0	pc-mc	18.1	s, sw	17.4	30.26	3	100	100	2	14.0
02-Oct	0.00			weather day									
03-Oct	8.00	2.0	0	clr	8.6	s, sw	15.5	30.39	3	100	100	2	4.4
04-Oct	3.00	2.0	1	ovc, rain	17.8	s	12.3	30.34	3	100	100	2	0.3
05-Oct	0.00			weather day									
06-Oct	0.00			weather day									
07-Oct	0.00			weather day									
08-Oct	6.00	4.3	0	pc, AM fog	5.6	nne, sw, w	7.6	30.36	4	52	51	2	6.5
09-Oct	4.00	3.0	0	mc, fog	12.3	ene, nne	4.3	30.12	3.5	13	34	2	11.3
10-Oct	8.00	2.0	0	clr-pc	9.5	s, sw	8.3	30.22	3	100	86	2	6.5
11-Oct	0.00			weather day									
12-Oct	8.00	1.0	0	clr-pc, haze	11.7	ssw	9.4	30.23	3	100	100	2	11.4
13-Oct	8.00	1.3	0	clr	13.4	sw	12.6	30.18	3	100	100	2	3.5
14-Oct	8.00	2.0	0	pc	12.8	s, sw	12.2	30.04	3	100	100	2	4.8
15-Oct	8.00	2.6	0	mc	19.8	s, sw	9.4	29.91	4	100	100	2	5.3

Appendix C. continued

Date	Obs. Hours	Obsrvr / Hour[1]	Median Visitor Disturb[2]	Predominant Weather[3]	Wind Speed (kph)[1]	Wind Direction	Temp (°C)[1]	Barom. Press. (in Hg)[1]	Median Thermal Lift[4]	Visib. West (km)[1]	Visib. East (km)[1]	Median Flight Distance[5]	Birds / Hour
16-Oct	0.00			weather day									
17-Oct	0.00			weather day									
18-Oct	8.00	2.0	0	clr-ovc	13.8	ne, sw	1.6	30.20	4	100	100	2	0.9
19-Oct	0.00			weather day									
20-Oct	2.75	2.0	0	ovc, PM snow	14.2	nw	0.6	30.01	4	24	73	–	0.0
21-Oct	8.00	2.5	0	clr-pc	5.1	nne, w	2.5	30.29	4	100	100	2	0.1
22-Oct	8.00	2.0	0	clr	15.9	sw	4.8	30.38	4	100	100	1.5	1.1
23-Oct	8.00	2.0	0	clr	22.6	sw	9.4	30.33	4	100	100	2	0.8
24-Oct	8.00	2.0	0	clr-pc, pm haze	22.1	ssw	10.4	30.09	4	100	100	2	1.5
25-Oct	0.00			weather day									
26-Oct	6.00	1.0	0	pc	8.0	ssw, w	-0.1	30.44	4	100	100	–	0.0
27-Oct	8.00	1.0	0	clr-pc	7.8	ssw	4.8	30.29	3	100	100	–	0.0
28-Oct	8.00	2.0	0	clr	19.1	s	8.8	30.39	3	100	100	1	0.5
29-Oct	0.00			weather day		s							
30-Oct	8.00	2.0	0	pc	22.5	sw, w	2.2	29.91	4	100	100	2	0.3
31-Oct	6.00	2.0	0	clr	16.3	sw	1.8	30.02	4	100	100	–	0.0

[1] Average of hourly records.

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

[3] Predominant sky condition during day: clr = clear (0-15% cloud cover); pc = partly cloudy (16-50% cover); mc = mostly cloudy (51-75% cover); ovc = overcast (76-100% cover); ts = thunderstorms.

[4] Median hourly rating concerning prevalence of lift-generating thermals, based on subjective assessments of solar intensity, wind speeds, and migrant behavior: 1 = excellent, 2 = good, 3 = fair, 4 = poor.

[5] Median hourly rating concerning line-of-sight distance of flight from observation site: 1 = close, detection and identification possible with naked eye; 2 = moderate, detection possible with naked eye, but binoculars needed for identification; 3 = far, binoculars needed for both detection and identification; 4 = distant, birds detected and identified only with excellent binoculars or spotting scope and by experienced observers.

Appendix D. Annual observation effort and unadjusted fall-migration counts by raptor species in the Wellsville Mountains, UT: 1977–2006.

	1977	1978	1979	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2003	2004	2006	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	28-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	31-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	50	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	370.25	369.79
Raptors / 100 hours	885.0	1,257.5	1,160.4	968.7	893.8	981.6	699.7	1,189.9	1,048.1	908.6	1,461.7	1,389.8	1,222.4	712.3	1,134.2	1,044.8	796.1	605.7	733.0	747.0	527.2	969.1
SPECIES	RAPTOR COUNTS																					
Turkey Vulture	6	7	8	11	11	9	1	36	15	28	16	43	32	47	17	28	20	26	18	40	3	20
Osprey	5	8	13	11	17	30	19	37	29	25	44	41	35	39	39	21	28	27	14	24	18	25
Northern Harrier	159	200	173	278	185	172	191	443	330	208	363	362	315	171	443	487	198	230	440	183	97	268
Sharp-shinned Hawk	618	737	570	793	1,093	832	526	990	990	1,000	901	1,217	928	652	1,005	901	790	764	871	918	750	850
Cooper's Hawk	457	333	495	362	561	603	253	619	601	596	778	874	701	388	587	577	482	545	441	241	312	515
Northern Goshawk	35	32	30	8	15	15	19	18	74	26	16	23	27	17	14	16	24	15	33	17	8	23
Unknown small accipiter[1]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	87	64	44	11	52
Unknown large accipiter[1]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	1	9	1	3
Unidentified accipiter	86	53	122	64	26	43	41	56	124	44	70	66	73	22	55	20	31	0	6	7	1	48
TOTAL ACCIPITERS	1,196	1,155	1,217	1,227	1,695	1,493	839	1,683	1,789	1,666	1,765	2,180	1,729	1,079	1,661	1,514	1,327	1,413	1,416	1,236	1,083	1,446
Broad-winged Hawk	0	0	2	5	1	9	4	10	3	2	5	13	7	3	1	7	1	1	1	9	2	4
Swainson's Hawk	19	5	21	44	12	47	184	128	97	91	487	468	419	106	309	154	29	61	101	63	58	138
Red-tailed Hawk	311	258	238	409	403	413	281	898	566	621	891	926	872	430	609	1088	508	357	848	536	296	560
Ferruginous Hawk	2	0	3	6	11	8	6	16	13	15	23	18	15	8	14	13	2	6	12	6	3	10
Rough-legged Hawk	2	0	1	1	4	3	0	1	2	1	2	0	3	6	1	2	3	2	0	1	0	2
Unidentified buteo	10	13	21	12	5	5	32	15	38	26	14	24	32	9	19	22	4	19	35	37	2	19
TOTAL BUTEOS	344	276	286	477	436	485	507	1,068	719	756	1,422	1,449	1348	562	953	1,286	547	446	997	652	361	732
Golden Eagle	236	285	237	73	106	119	113	294	423	133	224	163	127	212	154	245	130	122	155	104	20	175
Bald Eagle	5	3	3	5	4	0	2	13	10	10	4	3	2	7	0	2	1	0	1	10	1	4
TOTAL EAGLES	241	288	240	78	110	119	115	307	433	143	228	166	129	219	154	247	131	122	156	114	21	179
American Kestrel	808	970	799	817	862	744	542	1,303	1,118	888	975	1,371	922	524	727	600	660	623	515	616	328	796
Merlin	2	3	5	10	11	15	3	21	17	8	11	17	12	8	11	13	20	8	13	6	18	11
Prairie Falcon	4	15	11	10	7	11	15	12	17	14	33	18	17	23	13	28	14	16	23	20	13	16
Peregrine Falcon	0	0	0	7	5	5	12	11	7	7	6	11	8	9	19	24	13	16	17	14	7	9
Unknown small falcon[1]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	6	1	2	0	2
Unknown large falcon[1]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	6	1	3	1	3
Unidentified falcon	0	0	2	2	1	2	4	2	3	3	0	1	1	3	2	6	10	2	1	4	1	2
TOTAL FALCONS	814	988	817	846	886	777	576	1,349	1,162	920	1,025	1,418	960	567	772	671	717	677	571	665	368	836
Unidentified raptors	42	31	57	12	2	16	77	36	10	18	8	8	20	8	30	4	7	15	29	16	1	21
GRAND TOTAL	2,807	2,953	2,811	2,940	3,342	3,101	2,325	4,959	4,487	3,764	4,871	5,667	4,568	2,692	4,069	4,258	2,975	2,956	3,641	2,930	1,952	3,527

[1] 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: 2006.

		Species[1]																									Birds
Date	Hours	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
28-Aug	8.00	0	0	3	3	0	0	0	0	0	0	1	7	1	0	0	1	0	0	5	1	1	0	0	0	0	0	23	2.9
29-Aug	8.00	0	0	0	1	0	0	0	0	0	0	1	1	0	0	2	1	0	0	1	0	0	4	0	0	0	0	11	1.4
30-Aug	8.00	0	0	1	1	1	0	0	0	0	0	14	4	0	0	0	3	0	0	2	0	1	0	0	0	0	0	27	3.4
31-Aug	8.00	0	1	1	2	5	0	0	0	0	0	2	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	2.1
01-Sep	8.00	0	0	0	1	0	0	0	0	0	0	0	3	0	0	0	1	0	0	1	0	0	0	0	0	0	0	6	0.8
02-Sep	8.00	0	0	1	2	2	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	8	1.0
03-Sep	8.00	1	0	1	0	1	0	0	0	0	0	3	3	1	0	0	1	0	0	0	0	0	0	0	0	0	0	11	1.4
04-Sep	8.00	0	1	2	13	4	1	1	0	0	0	1	6	0	0	0	0	1	0	7	0	1	0	0	0	0	0	38	4.8
05-Sep	8.00	0	1	0	9	19	0	1	0	0	0	4	3	0	0	0	0	0	0	4	2	2	0	0	0	0	0	45	5.6
06-Sep	8.00	0	1	12	32	31	0	1	0	0	0	5	11	0	0	0	0	0	0	43	1	0	0	0	0	0	0	137	17.1
07-Sep	8.00	0	0	1	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0.6
08-Sep	5.25	0	0	0	2	4	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	1.9
09-Sep	8.00	0	2	2	8	9	0	1	0	0	0	2	3	0	0	0	0	0	0	3	0	0	0	0	0	0	0	30	3.8
10-Sep	8.00	0	0	0	37	25	0	0	0	0	0	1	10	0	0	0	0	0	0	9	0	1	0	0	0	1	0	84	10.5
11-Sep	8.00	0	0	1	5	0	0	0	0	0	0	1	5	0	0	0	0	0	0	0	0	1	0	0	0	0	0	13	1.6
12-Sep	8.00	0	0	1	12	7	0	1	0	0	0	0	2	0	0	0	0	0	0	3	0	1	0	0	0	0	0	27	3.4
13-Sep	8.00	0	1	1	26	19	1	0	0	0	0	5	19	0	0	0	1	0	0	26	0	0	2	0	0	0	0	101	12.6
14-Sep	3.75	0	0	0	18	10	0	0	0	0	0	1	1	0	0	0	0	0	0	6	0	0	0	0	0	0	0	36	9.6
15-Sep	0.00																												
16-Sep	0.00																												
17-Sep	8.00	0	2	7	18	9	0	0	0	1	0	5	19	0	0	0	3	0	0	7	0	0	0	0	0	0	0	71	8.9
18-Sep	8.00	0	1	3	8	5	0	1	0	0	0	0	5	0	0	0	0	0	0	3	1	0	1	0	0	0	0	28	3.5
19-Sep	8.00	0	0	0	7	2	0	0	0	0	0	0	6	0	0	0	0	0	0	1	0	0	0	0	0	0	0	16	2.0
20-Sep	0.00																												
21-Sep	0.00																												
22-Sep	0.00																												
23-Sep	5.50	1	0	1	11	10	2	1	0	0	0	0	4	0	0	0	1	0	0	1	1	1	0	0	0	0	0	34	6.2
24-Sep	8.00	0	0	2	20	4	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	32	4.0
25-Sep	8.00	0	0	1	27	9	0	0	0	0	0	0	6	0	0	0	0	0	0	23	1	0	0	0	0	0	0	67	8.4
26-Sep	8.00	0	1	3	36	16	0	0	0	0	1	1	7	0	0	0	0	0	0	56	1	0	0	0	0	0	0	122	15.3
27-Sep	8.00	0	0	5	49	13	0	0	0	0	0	1	2	0	0	0	0	0	0	40	0	0	0	0	0	0	0	110	13.8
28-Sep	8.00	0	1	6	41	23	0	0	0	0	1	3	5	0	0	0	0	0	0	24	0	2	0	0	0	0	0	106	13.3
29-Sep	8.00	0	0	7	61	20	0	2	0	0	0	5	18	0	0	0	0	0	0	18	1	1	0	0	0	0	0	133	16.6
30-Sep	8.00	1	0	0	47	8	0	0	1	0	0	0	13	0	0	0	0	0	0	10	0	0	0	0	0	0	0	80	10.0

Appendix E. continued

		Species[1]																									Birds	
Date	Hours	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
01-Oct	8.00	0	4	3	68	14	0	0	0	0	0	1	10	0	0	0	0	0	0	10	2	0	0	0	0	0	0	112	14.0
02-Oct	0.00																												
03-Oct	8.00	0	0	2	13	8	0	0	0	0	0	0	6	1	0	0	0	0	0	4	1	0	0	0	0	0	0	35	4.4
04-Oct	3.00	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.3
05-Oct	0.00																												
06-Oct	0.00																												
07-Oct	0.00																												
08-Oct	6.00	0	1	6	17	5	0	1	0	0	0	1	2	0	0	0	1	0	0	3	1	0	0	0	0	0	1	39	6.5
09-Oct	4.00	0	0	0	3	3	0	0	0	0	0	0	38	0	0	0	0	0	0	1	0	0	0	0	0	0	0	45	11.3
10-Oct	8.00	0	0	5	27	2	1	1	0	0	0	0	12	0	0	0	1	0	0	3	0	0	0	0	0	0	0	52	6.5
11-Oct	0.00																												
12-Oct	8.00	0	0	8	32	14	0	0	0	0	0	0	32	0	0	0	3	0	0	2	0	0	0	0	0	0	0	91	11.4
13-Oct	8.00	0	0	1	21	1	0	0	0	0	0	0	4	0	0	0	0	0	0	0	1	0	0	0	0	0	0	28	3.5
14-Oct	8.00	0	0	1	27	5	0	0	0	0	0	0	4	0	0	0	0	0	0	1	0	0	0	0	0	0	0	38	4.8
15-Oct	8.00	0	0	4	22	2	0	0	0	0	0	0	8	0	0	0	0	0	0	4	2	0	0	0	0	0	0	42	5.3
16-Oct	0.00																												
17-Oct	0.00																												
18-Oct	8.00	0	0	2	2	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0.9
19-Oct	0.00																												
20-Oct	2.75	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	0	0	0.0
21-Oct	8.00	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	1	0.1
22-Oct	8.00	0	0	1	5	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	0	0	0	9	1.1
23-Oct	8.00	0	0	1	3	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	6	0.8
24-Oct	8.00	0	1	0	8	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	12	1.5
25-Oct	0.00																												
26-Oct	6.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
27-Oct	8.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
28-Oct	8.00	0	0	0	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0.5
29-Oct	0.00																												
30-Oct	8.00	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0.3
31-Oct	6.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
TOTAL	370.25	3	18	97	750	312	8	11	1	1	2	58	296	3	0	2	20	1	0	328	18	13	7	0	1	1	1	1,952	5.3

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