

**FALL 2007 RAPTOR MIGRATION STUDY IN THE
WELLSVILLE MOUNTAINS OF NORTHERN UTAH**



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



March 2008

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Report prepared by:

Jeff P. Smith and Mike C. Neal

Counts conducted by:

Laurel Ferreira and Aaron Viducich

Project coordinated by:

HawkWatch International, Inc.

Principal Investigator: Dr. Jeff P. Smith

2240 South 900 East, Salt Lake City, Utah 84106

(801) 484-6808

March 2008

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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, Smith et al. in press). 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 2007 season, which marked the 22nd full-season autumn count of migrating 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" (see Bildstein 2006) funneling migrating raptors into the Wellsvilles. In addition, the Great Salt Lake and Great Salt Desert to the west likely serve as barriers to migration for many raptors. 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, two official or designated observers conducted standardized daily counts of migrating raptors at the site from late August through October. Observations typically began between 0830 and 0930 H Mountain Standard Time (MST) and ended between 1630 and 1730 H MST. This was the first season of migration counting for official observers Laurel Ferreira and Aaron Viducich (see Appendix A for a complete history of official observer participation). Both attended pre-season protocol

and field training, and received additional on-site training. Experienced visitors, previous official observers, and 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 1991–2007; 1991 was the first year that a standardized two-observer system was instituted at the site (see Appendix A). Calculation of “adjusted” (to standardize sampling periods and adjust for incompletely identified birds) passage rates (migrants counted per 100 hours of observation) and analysis of trends updated through 2007 follows Hoffman and Smith (2003). In comparing 2007 annual statistics against means and 95% confidence intervals for previous seasons, we equate significance with a 2007 value falling outside the bounds of the confidence interval for the associated mean.

RESULTS AND DISCUSSION

WEATHER

Inclement weather fully precluded seven full days of potential observations between the targeted survey period of 27 August through 31 October, and reduced observation time to ≤ 4 hours on four other days (see Appendix C for daily weather records). The 1997–2006 averages, calculated across variable annual observation periods, are 9.3 full and 3.3 partial days (see Appendix D for annual effort and count summaries). Thus, unlike especially last year when stormy weather and low-hanging clouds hindered the count to a record-setting degree, conditions were much more typical for the site in 2007.

Based on hourly weather records collected during actual observation periods, the array of sky conditions documented in 2007 was similar to the average pattern for the last decade. Fair skies prevailed on a slightly below average 54% 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 a slightly above average 29% (average 25%), and mostly cloudy to overcast skies on an average 17% of the active days. Visibility reducing fog and/or haze occurred on a slightly below average 36% of the active days (average 43%), and scattered rain and/or snow occurred on a slightly below average 9% of the active days

(average 10%). These characteristics appeared to contribute to above-average visibility, with the 2007 averages of 84–87 km visibility to the east and west markedly higher than the 1997–2007 averages of 57–58 km.

The 2007 season was much windier than average, but the pattern of prevailing wind directions was more typical for the site. Light winds (<12 kph) prevailed on only 17% of the active days, with moderate winds (12–28 kph) prevailing on 48% and strong winds (>28 kph) on 17% of the active observation days. The comparative averages for the previous decade are 46% light, 45% moderate, and 8% strong winds. S-SW winds, commonly the most prevalent pattern, prevailed on an average 53% of the active days. The only noteworthy variant in terms of wind directions was that variable SE-SW winds were three times more prevalent than average (12% vs. average of 4% of the active observation days).

The daily-average (mean of hourly readings) temperature averaged 15.1°C, ranging from 0 to 27.6°C. In absolute terms, the average is only slightly higher than the 1997–2006 mean of 14.6°C, but ranks second highest since 1997. The minimum and the maximum temperatures are well within the range of normal variability. The daily-average (mean of hourly readings) barometric pressure averaged 30.30 in Hg, ranging from 29.78 to 30.79 in Hg. The average and maximum are the highest recorded since 2001 (when we started recording such data), and the minimum is the second highest recorded to date. The proportion of days rated as good to excellent for thermal lift in 2007 (14%) was, for the second year in a row, a new record low since 1997 (average 51%), which is consistent with winds speeds averaging much higher than average in 2007.

In summary, the weather in 2007 was fairly typical for the site; however, it was considerably windier than usual, which translated to below-average thermal lift; variable SE-SW winds were more prevalent than usual; and the visibility, barometric pressure, and temperatures during active observation periods all averaged slightly higher than usual.

OBSERVATION EFFORT

The observers worked on 59 of 66 possible observation days between 27 August and 31 October. The number of observation days was a significant 9% higher than the 1977–2006 average of $54 \pm 95\%$ CI of 2.9 days, and the number of observation hours (458.50) was a significant 18% higher than the 1977–2006 average of $387.29 \pm 95\%$ CI of 23.80 hours. The 2007 average of 2.0 observers per hour (includes official and guest observers; value is mean of daily values, which are in turn means of hourly values) was a non-significant 5% higher than the 1977–2006 average of $1.9 \pm 95\%$ CI of 0.22 observers/hr.

FLIGHT SUMMARY

The observers tallied 3,274 migrant raptors of 16 species during the 2007 season (Table 1, and see Appendix E for daily count records). The flight was composed of 48% accipiters, 21% falcons, 17% buteos, 7% harriers, 4% eagles, and 1% each of Ospreys, vultures, unidentified raptors (Figure 2). The proportional representations of accipiters, Ospreys, and vultures were significantly above average, whereas the proportional representations of falcons and buteos were significantly below average. The most numerous species were the Sharp-shinned Hawk (29% of the total count), American Kestrel (19%), Cooper's Hawk (14%), Red-tailed Hawk (14%), Northern Harrier (7%), Golden Eagle (4%), and Swainson's Hawk (2%). All other species each comprised $\leq 1\%$ of the total count.

The total combined-species count was a non-significant 10% below the 1991–2006 average. Counts of 8 species (Northern Harriers, Swainson's, Red-tailed and Ferruginous Hawks, Bald Eagles, American Kestrels, Merlins, and Prairie Falcons) were significantly below average, whereas counts of 4 species (Turkey Vultures, Ospreys, Rough-legged Hawks, and Peregrine Falcons) were significantly above average (Table 1). The count of 27 Peregrine Falcons was a new record high for the site, and comprises a

particularly stark contrast to none having been tallied during the first three years of counts from 1977–1979 (Appendix D).

Passage Rates and Long-term Trends

Adjusted passage rates were significantly above average in 2007 only for Turkey Vultures and Peregrine Falcons, whereas they were significantly below average for 12 species (Table 1). Updated regression analyses (after Hoffman and Smith 2003) of adjusted passage rates through 2007 revealed at least marginally significant ($P \leq 0.10$) quadratic trends for nine species (Osprey, Northern Harrier, Cooper's Hawk, Northern Goshawk, Swainson's Hawk, Red-tailed Hawk, Ferruginous Hawk, Golden Eagle, 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 have shown a roughly similar pattern, except that significant fluctuations from very low to very high rates since 2004 preclude a significant model fit (Figure 3). A similar quadratic fit also previously applied to American Kestrels, but a steady declining pattern for the last decade has now produced simply a highly significant ($P = 0.003$), long-term linear declining trend for 1987–2007 (Figure 7), which is further magnified upon recognizing that three years of counts in the late 1970s averaged significantly higher than the average for 1987–2007 (t -test, $P = 0.011$). The common pattern of increases through the late 1990s, then declines since then, correlates 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 beginning in 1999. 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 et al. in press). Note, however, that the American Kestrel and Ferruginous Hawk are the only species for which a significant, overall decline since 1987 is currently indicated. That said, passage rates of Ferruginous Hawks were as low in the late 1970s as they have been in the past several years, whereas other species for which record-low passage rates occurred in the past five years include Northern Harrier, Cooper's Hawk, Northern Goshawk, and Golden Eagle. Of particular concern at present is evidence of widespread declines across North America among American Kestrels (Farmer et al. in press, Farmer and Smith in review). In contrast, the only other significant, species-level regression was a highly significant, long-term increasing trend for Peregrine Falcons, which is a common pattern across much of North America (Hoffman and Smith 2003, Farmer et al. in press).

Smith et al. (in press) present trend analyses of data collected through 2005 for most of the long-term, ongoing, autumn migration studies in western North America, including the Wellsvilles (1987–2004). These analyses (hereafter called the Raptor Population Index or “RPI” analyses; see <http://www.rpi-project.org>) are based on a more complex analytical approach (also see Farmer et al. 2007) than that represented in Hoffman and Smith (2003) and used herein to present analyses updated through 2007. Among other refinements, this new approach both fits polynomial trajectories to the complete series of annual count indexes and allows for estimating rates of change between various periods, while also allowing for assessments of trend significance and precision. Note, however, that restrictions related to the mathematical assumptions behind the new approach precluded analyzing data for rare species, which in this case included Bald Eagle, all buteos except Swainson's and Red-tailed Hawks, and all falcons except kestrels.

The overall patterns of change and derived trend estimates suggested by the new modeling technique yielded similar inferences as those derived using the simpler methodology of Hoffman and Smith (2003) and presented herein to provide trend assessments updated through 2007. Differences between the RPI results and those presented herein that clearly relate to addition of two more years of data include: a) new marginally significant, hill-shaped, second-order model fits to the count indexes for Northern Harriers, Red-tailed Hawks, and Northern Goshawks, reflecting addition of low counts in 2006 and 2007; b) elimination of a significant second-order model fit and overall decline since 1987 for Sharp-shinned Hawks, reflecting continuation of a steady increasing trend since passage rates dropped to a near-record-low in 2001; and c) indication of only a marginally significant overall decline for kestrels through 2004 in

the RPI analyses, but a highly significant decline through 2007 based on the updated analyses and addition of a record-low count in 2006. No other substantial differences in results for commonly analyzed species were evident.

Age Ratios

Eight of 10 species with data suited to such comparisons showed below average immature : adult ratios in 2007, with the differences significant for all but Broad-winged Hawks (Table 2). Northern Goshawks and Golden Eagles were the only species to show above-average age ratios in 2007, with the differences significant for both. For most species with below-average age ratios, low abundance of immature birds clearly contributed to the reduced ratios, suggesting that reduced productivity may have been responsible for the patterns (Table 2). In contrast, the low age ratio for Peregrine Falcons primarily reflected a substantially higher than average abundance of aged adults, rather than a reduction in abundance of aged juveniles. For Northern Goshawks and Golden Eagles, their high age ratios partly reflected slightly above-average abundances of aged immatures and subadults, but even more so substantial reductions in the abundance of aged adults. For both species, this combination may be indicative of improving habitat quality and breeding success in the Intermountain and central Rocky Mountain region, as largely sedentary adults of these species may tend to disperse/wander less when conditions are improving (e.g., see Hoffman and Smith 2003).

Seasonal Timing

The combined-species median passage date of 21 September was a marginally significant two days earlier than the 1991–2006 average of 23 September \pm 1.1 days (Table 3). Reasons for this difference are evident in the seasonal distribution pattern, with significantly above average proportional flight volume during the middle of September, significantly below average volume during the last 10 days of September, and a mixed pattern through the rest of the season (Figure 8). The late September dip in activity corresponded to the first two snow events of the season between 23 and 29 September (Appendix C.) At the species level, 7 of 14 species for which a comparison was possible showed significantly earlier than average median passage dates in 2007, whereas only two species (Northern Goshawk and Merlin) showed significantly late timing (Table 3). Age and sex-specific data illustrated additional complexity, but no clear commonalities within or among species groups (Table 4).

RESIDENT RAPTORS

The observers recorded one tentative observation of a resident, adult Turkey Vulture on 29 August, but questioned that designation later after having recorded no further observations of local birds during the season. At least one resident, immature Northern Harrier routinely patrolled the ridgetop throughout the season. An adult male was similarly observed beginning on 27 September, and an adult female beginning on 4 October, often accompanying the male. This suggests that there was at least one family group in the area, with the adults simply not evident until later in the season; however, it is also possible that the immature and adult birds were not related and that the adults simply moved in mid-season for the winter.

The observers were confident that there was at least one resident Sharp-shinned Hawk in the area, but whether the resident bird was an adult or immature was unclear. The local accipiters were most often seen diving down into Deep Canyon off the east side of the ridge, but also hunting along the west flank of the ridge northwest of observation. Observations of one or more apparently resident, immature Cooper's Hawks were recorded between 1 September and 4 October, with three other sightings of unknown-age, local birds recorded early in the season. It is typical for there to be local Cooper's Hawks around the site early in the season, but for this species, the observers were not 100% confident in distinguishing residents from migrants.

This year, it appeared that only one family group of light-morph Red-tailed Hawks (2 adults and 1 immature) frequented the ridgetop surrounding observation. The core home range area for the family

appeared to be somewhere between Deep Canyon and the ridge south of Mendon Peak. At least one adult bird was observed almost daily throughout the season; the last time the immature bird was seen was on 24 October. An apparent family group of four Golden Eagles resided in the area, including two adults, at least one definite first-year bird, and one other non-adult. The adult male was routinely observed displaying and “escorting” migrating eagles through the area. The last date all four birds were seen together was 18 September, but both adults and at least one of the younger birds remained in the area through the end of the season.

An apparent family group of at least three American Kestrels was observed near the observation point very early in the season. After that, a male was seen fairly regularly perching, hunting, and patrolling just northwest of observation (a typical scenario), and multiple individuals were seen regularly hunting and perching to the south of observation. The last observation of an obviously resident kestrel occurred on 30 September. At least one apparently resident, adult Peregrine Falcon was observed on several occasions throughout the season (last observation on 26 October), with the area around observation likely only a small component of the bird’s overall home range.

This assemblage is fairly typical for the site, except that the lack of two obvious family groups of Red-tailed Hawks is atypical (but similar to 2006) and several sightings of resident Northern Goshawks as is more the norm. In contrast, this was the first time in four years where there was clear evidence of a family group of kestrels, with offspring.

VISITATION

Unfortunately, we ended up with no official record of visitation to the site in 2007. We can report, however, that visitation occurred on at least 16 days during the season, and that organized groups included members of the Bridgerland Audubon Society and a group led by HWI Conservation Scientist, Steve Slater, which included HWI’s Board Chair, Dr. John Mull, two university colleagues of his, and several high school students they brought with them.

In 2007, 467 hourly assessments of visitor disturbance resulted in the following ratings: 93% none, 6% low, and 1% moderate. 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

Funding for this project was provided by the USDA Forest Service – Wasatch-Cache National Forest, the USDI Fish and Wildlife Service – Neotropical Migratory Bird Conservation Act grant program, Kennecott Utah Copper Corporation, the Walbridge Fund, and HWI private donors and members. We also extend our deepest appreciation to long-time allies Carolyn Barcus for horse-packing water and food to the site for the crew; Randy and Julie Stacey for providing a staging area for supply transfers; Maureen Wagner for housing the observers on days off and weather days; and to Bryan Dixon, Jean Lown, Keith Archibald, and former site observers David Tidhar and Wendy Peacock for supporting this year’s observers, assisting with the count, and promoting the project within their communities.

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Table 1. Unadjusted fall-migration counts and adjusted passage rates by raptor species in the Wellsville Mountains, UT: 1987–2006 versus 2007.

SPECIES	COUNTS			BIRDS / 100 HRS		
	1991–2006 ¹	2007	% CHANGE	1991–2006 ¹	2007	% CHANGE
Turkey Vulture	22 ± 6.3	39	+75	7.9 ± 1.84	12.1	+52
Osprey	28 ± 4.6	35	+27	11.9 ± 2.41	11.6	-3
Northern Harrier	283 ± 54.5	222	-22	79.7 ± 17.20	50.5	-37
Sharp-shinned Hawk	885 ± 74.6	958	+8	294.9 ± 30.06	302.2	+2
Cooper’s Hawk	529 ± 79.6	462	-13	174.3 ± 31.23	140.3	-20
Northern Goshawk	21 ± 6.7	15	-30	6.4 ± 2.19	3.8	-40
Unknown small accipiter ²	52 ± 31.6	141	+174	–	–	–
Unknown large accipiter ²	3 ± 3.8	6	+85	–	–	–
Unidentified accipiter	42 ± 14.7	4	-90	–	–	–
TOTAL ACCIPITERS	1,489 ± 149.0	1586	+7	–	–	–
Broad-winged Hawk	5 ± 1.7	3	-36	1.9 ± 0.9	1.0	-46
Swainson’s Hawk	159 ± 71.1	69	-57	75.5 ± 37.4	26.4	-65
Red-tailed Hawk	608 ± 115.3	443	-27	184.8 ± 35.3	118.0	-36
Ferruginous Hawk	11 ± 2.6	3	-72	3.1 ± 1.0	0.8	-75
Rough-legged Hawk	2 ± 0.7	3	+69	0.7 ± 0.4	0.5	-33
Unidentified buteo	19 ± 5.6	28	+44	–	–	–
TOTAL BUTEOS	804 ± 172.5	549	-32	–	–	–
Golden Eagle	162 ± 42.3	128	-21	46.7 ± 12.9	28.6	-39
Bald Eagle	4 ± 1.9	2	-52	1.0 ± 0.6	0.2	-77
TOTAL EAGLES	166 ± 43.3	130	-22	–	–	–
American Kestrel	785 ± 128.4	630	-20	253.2 ± 50.0	183.4	-28
Merlin	12 ± 2.3	10	-19	3.8 ± 0.7	1.4	-64
Prairie Falcon	17 ± 3.0	10	-41	5.1 ± 1.0	3.1	-39
Peregrine Falcon	11 ± 2.5	27	+145	3.4 ± 0.9	7.6	+122
Unknown small falcon ²	2 ± 2.6	2	-11	–	–	–
Unknown large falcon ²	3 ± 2.3	5	+82	–	–	–
Unidentified falcon	3 ± 1.2	3	+10	–	–	–
TOTAL FALCONS	829 ± 127.8	687	-17	–	–	–
Unidentified raptor	18 ± 8.2	26	+48	–	–	–
GRAND TOTAL	3,639 ± 465.8	3274	-10	–	–	–

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: 1991–2006 versus 2007.

	TOTAL AND AGE-CLASSIFIED COUNTS							IMMATURE : ADULT			
	1991–2006 AVERAGE			2007			% UNKNOWN AGE		RATIO		
	TOTAL	IMM.	ADULT	TOTAL	IMM.	ADULT	1991–2006 ¹	2007	1991–2006 ¹	2007	
Northern Harrier	294	158	80	222	52	70	19 ± 4.1	45	2.23 ± 0.86	0.74	
Sharp-shinned Hawk	899	354	359	958	198	361	20 ± 5.4	42	1.08 ± 0.29	0.55	
Cooper's Hawk	548	222	192	462	71	157	24 ± 7.6	51	1.43 ± 0.38	0.45	
Northern Goshawk	24	11	7	15	12	2	29 ± 11.5	7	2.62 ± 1.00	6.00	
Broad-winged Hawk	4	1	2	3	1	2	39 ± 64.3	0	0.87 ± 0.79	0.50	
Red-tailed Hawk	658	268	321	443	71	283	10 ± 2.9	20	0.85 ± 0.31	0.25	
Ferruginous Hawk	11	3	3	3	0	3	56 ± 15.7	0	2.16 ± 1.73	0.00	
Golden Eagle	170	81	76	128	86	26	7 ± 2.1	13	1.23 ± 0.25	3.31	
Bald Eagle	4	3	1	2	1	1	7 ± 9.2	0	3.14 ± 1.92	1.00	
Peregrine Falcon	12	2	3	27	4	13	59 ± 10.8	37	0.99 ± 0.44	0.31	

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 2007, with a comparison of 2007 and 1991–2006 average median passage dates.

SPECIES	2007				1991–2006	
	FIRST DATE OBSERVED	LAST DATE OBSERVED	BULK PASSAGE DATES ¹	MEDIAN PASSAGE DATE ²	MEDIAN PASSAGE DATE ³	
Turkey Vulture	27-Aug	9-Oct	2-Sep – 2-Oct	2-Oct	09-Sep	± 6.4
Osprey	27-Aug	1-Oct	29-Aug – 26-Sep	14-Sep	14-Sep	± 1.9
Northern Harrier	27-Aug	30-Oct	3-Sep – 16-Oct	21-Sep	25-Sep	± 1.8
Sharp-shinned Hawk	27-Aug	29-Oct	11-Sep – 15-Oct	26-Sep	26-Sep	± 1.9
Cooper’s Hawk	28-Aug	31-Oct	8-Sep – 12-Oct	25-Sep	25-Sep	± 1.8
Northern Goshawk	2-Sep	28-Oct	28-Sep – 21-Oct	11-Oct	25-Sep	± 4.6
Broad-winged Hawk	26-Sep	26-Sep	–	–	23-Sep	± 3.4
Swainson’s Hawk	27-Aug	27-Sep	28-Aug – 15-Sep	3-Sep	16-Sep	± 4.6
Red-tailed Hawk	27-Aug	29-Oct	31-Aug – 11-Oct	20-Sep	22-Sep	± 1.7
Ferruginous Hawk	29-Aug	16-Oct	–	–	15-Sep	± 5.2
Rough-legged Hawk	22-Oct	30-Oct	–	–	19-Oct	± 0.0
Golden Eagle	27-Aug	30-Oct	1-Sep – 21-Oct	30-Sep	30-Sep	± 2.7
Bald Eagles	29-Aug	28-Oct	–	–	05-Oct	± 11.3
American Kestrel	27-Aug	15-Oct	7-Sep – 4-Oct	16-Sep	20-Sep	± 2.1
Merlin	3-Sep	29-Oct	3-Sep – 29-Oct	11-Oct	30-Sep	± 2.3
Prairie Falcon	29-Aug	28-Sep	29-Aug – 20-Sep	3-Sep	13-Sep	± 3.2
Peregrine Falcon	27-Aug	31-Oct	30-Aug – 29-Oct	14-Sep	11-Sep	± 3.6
Total	27-Aug	31-Oct	6-Sep – 12-Oct	21-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: 1991–2006 versus 2007.

SPECIES	2007	1991–2006 MEAN	2007	1991–2006 MEAN
		± 95% CI (days)		± 95% CI (days)
		ADULT	IMMATURE / SUBADULT	
Northern Harrier	25-Sep	30-Sep ± 2.4	19-Sep	24-Sep ± 2.2
Sharp-shinned Hawk	4-Oct	02-Oct ± 2.0	21-Sep	19-Sep ± 2.6
Cooper’s Hawk	1-Oct	30-Sep ± 2.2	16-Sep	19-Sep ± 2.3
Northern Goshawk	–	29-Sep ± 8.1	11-Oct	25-Sep ± 5.9
Red-tailed Hawk	21-Sep	28-Sep ± 1.8	16-Sep	15-Sep ± 2.0
Golden Eagle	26-Sep	01-Oct ± 3.7	4-Oct	01-Oct ± 2.5
Peregrine Falcon	16-Sep	15-Sep ± 8.5	–	20-Sep ± 10.8
		MALE	FEMALE	
Adult Northern Harrier	21-Sep	02-Oct ± 2.1	26-Sep	24-Sep ± 5.9
American Kestrel	16-Sep	24-Sep ± 1.8	20-Sep	15-Sep ± 2.4

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.

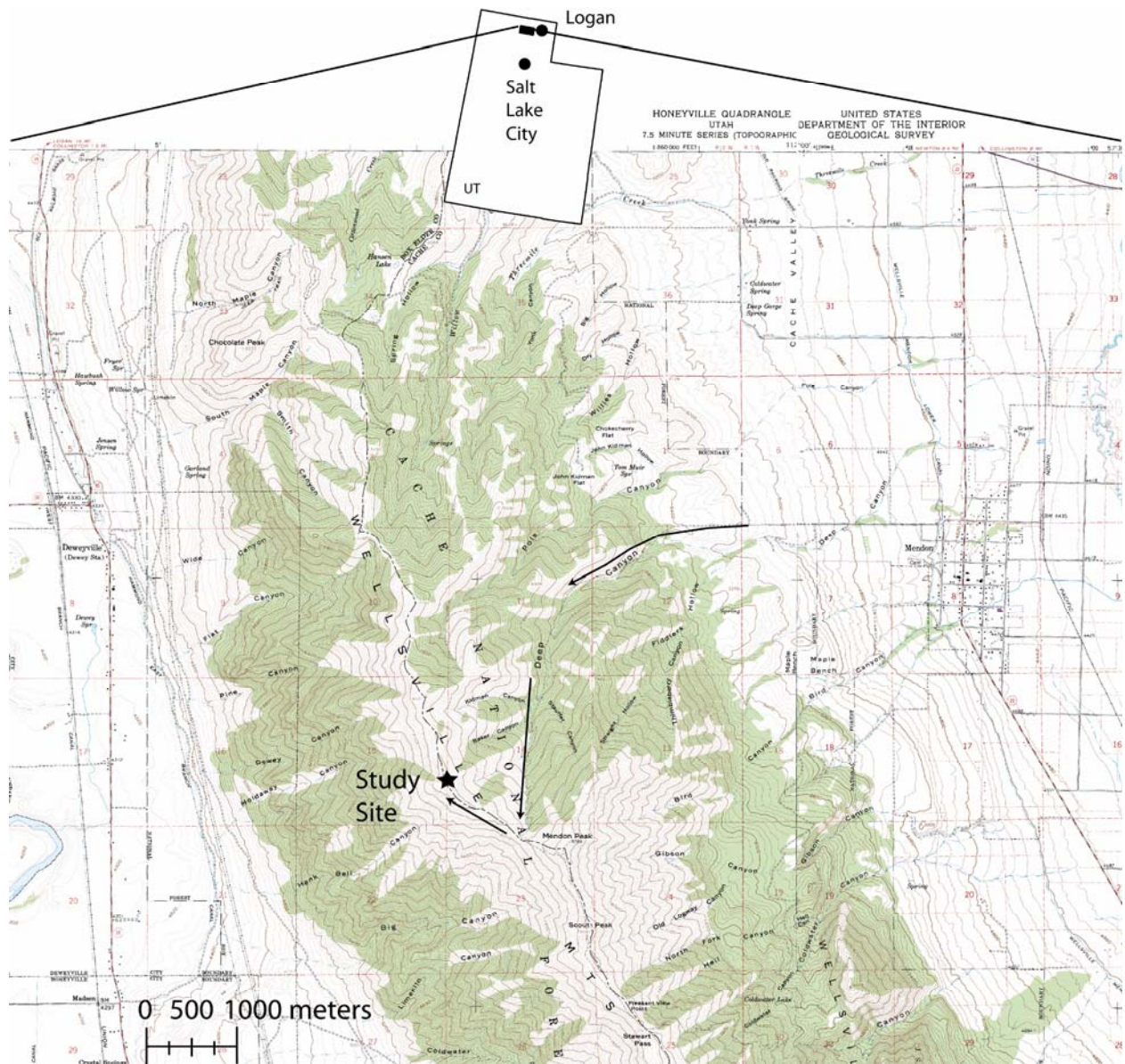


Figure 1. Location of the Wellsville Mountains Raptor Migration Project site in northern Utah.

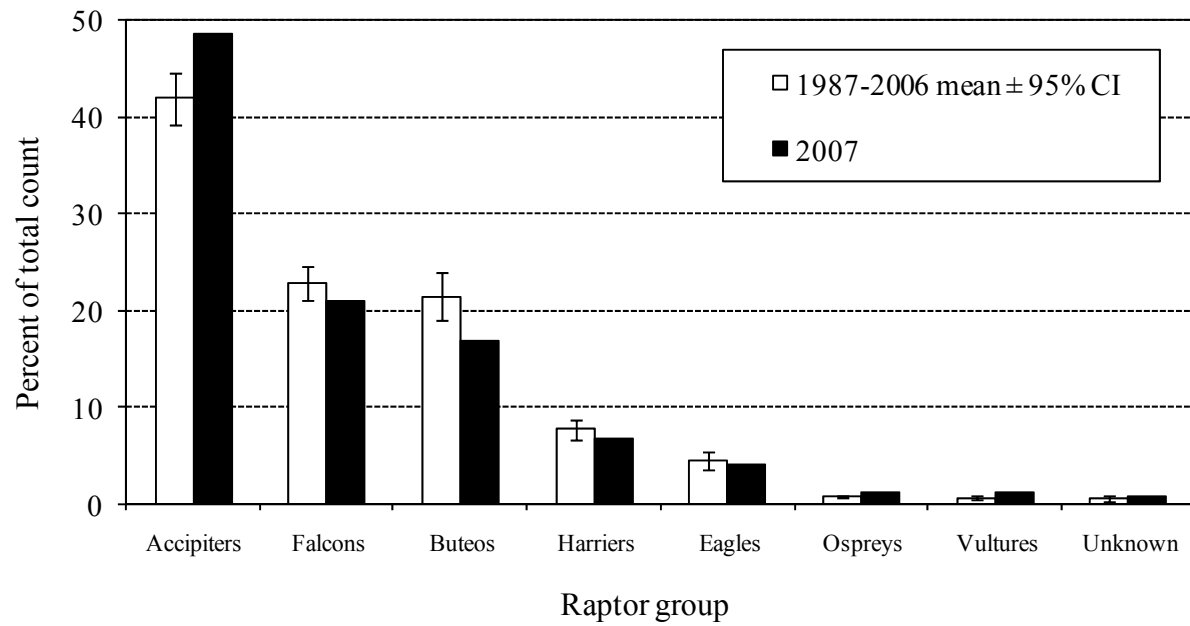


Figure 2. Fall-migration flight composition by major raptor species groups: 1987–2006 versus 2007.

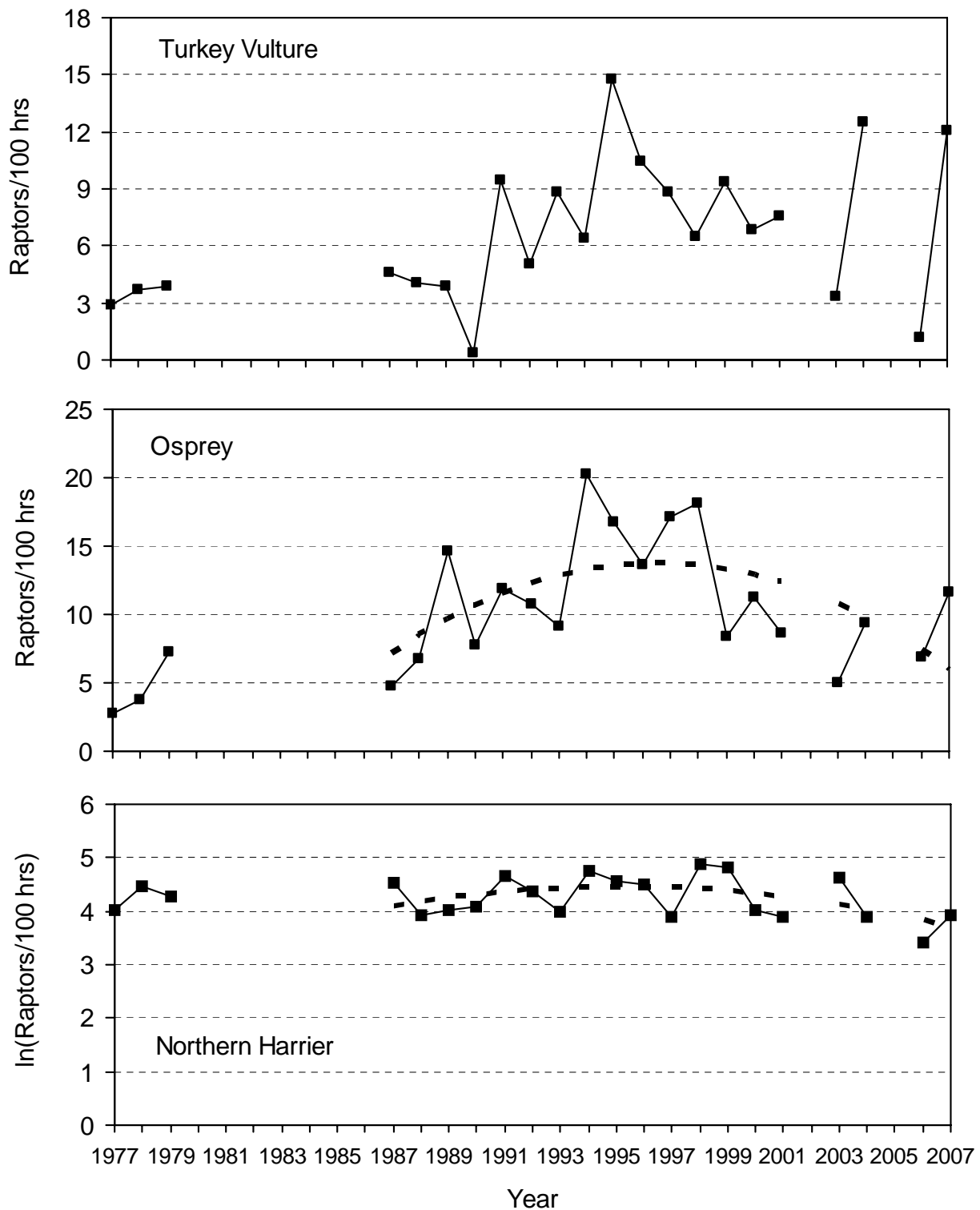


Figure 3. Adjusted fall-migration passage rates for Turkey Vultures, Ospreys, and Northern Harriers: 1977–2007. Dotted lines indicate significant ($P \leq 0.10$) linear or quadratic regressions.

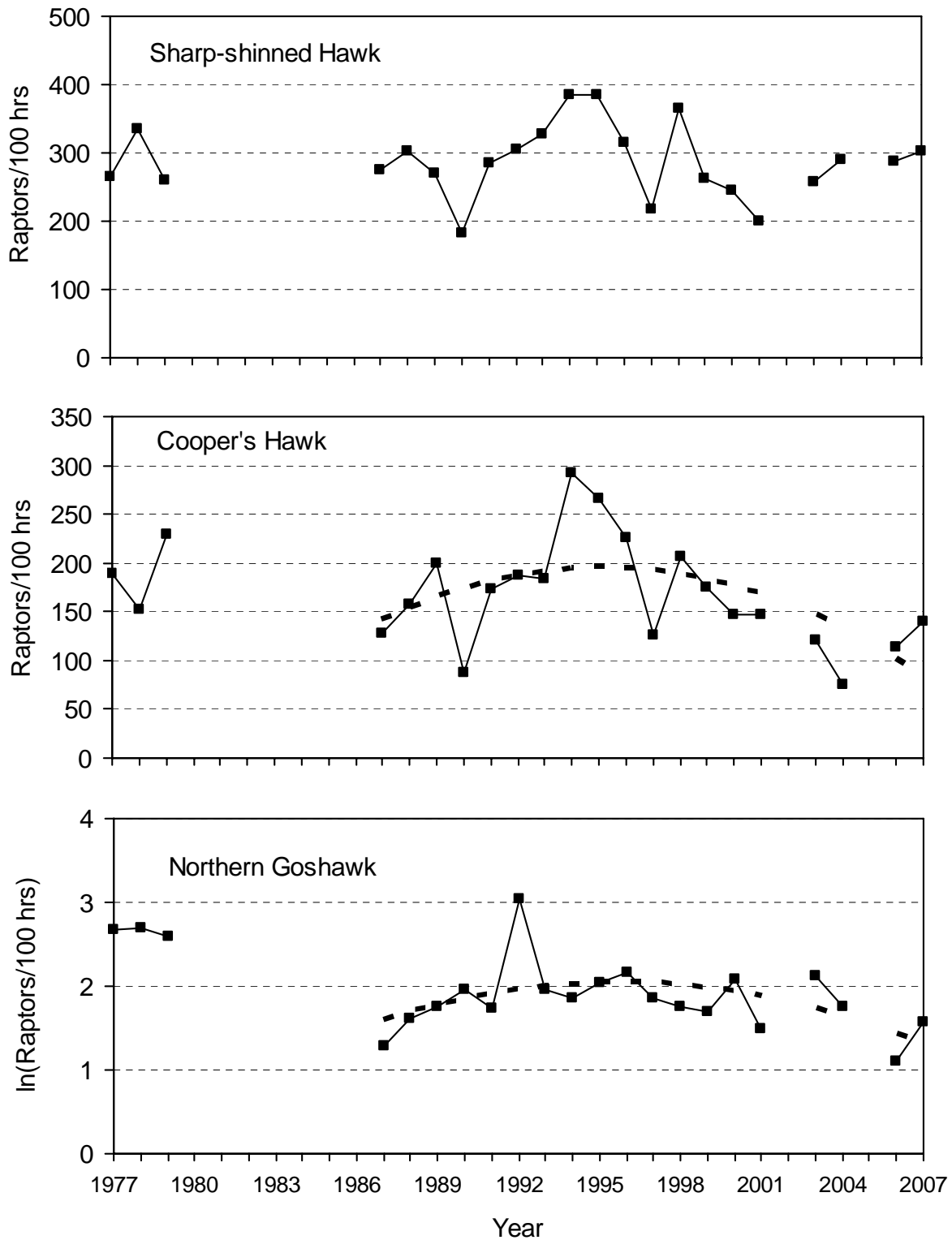


Figure 4. Adjusted fall-migration passage rates for Sharp-shinned Hawks, Cooper's Hawks, and Northern Goshawks: 1977–2007. Dotted lines indicate significant ($P \leq 0.10$) linear or quadratic regressions.

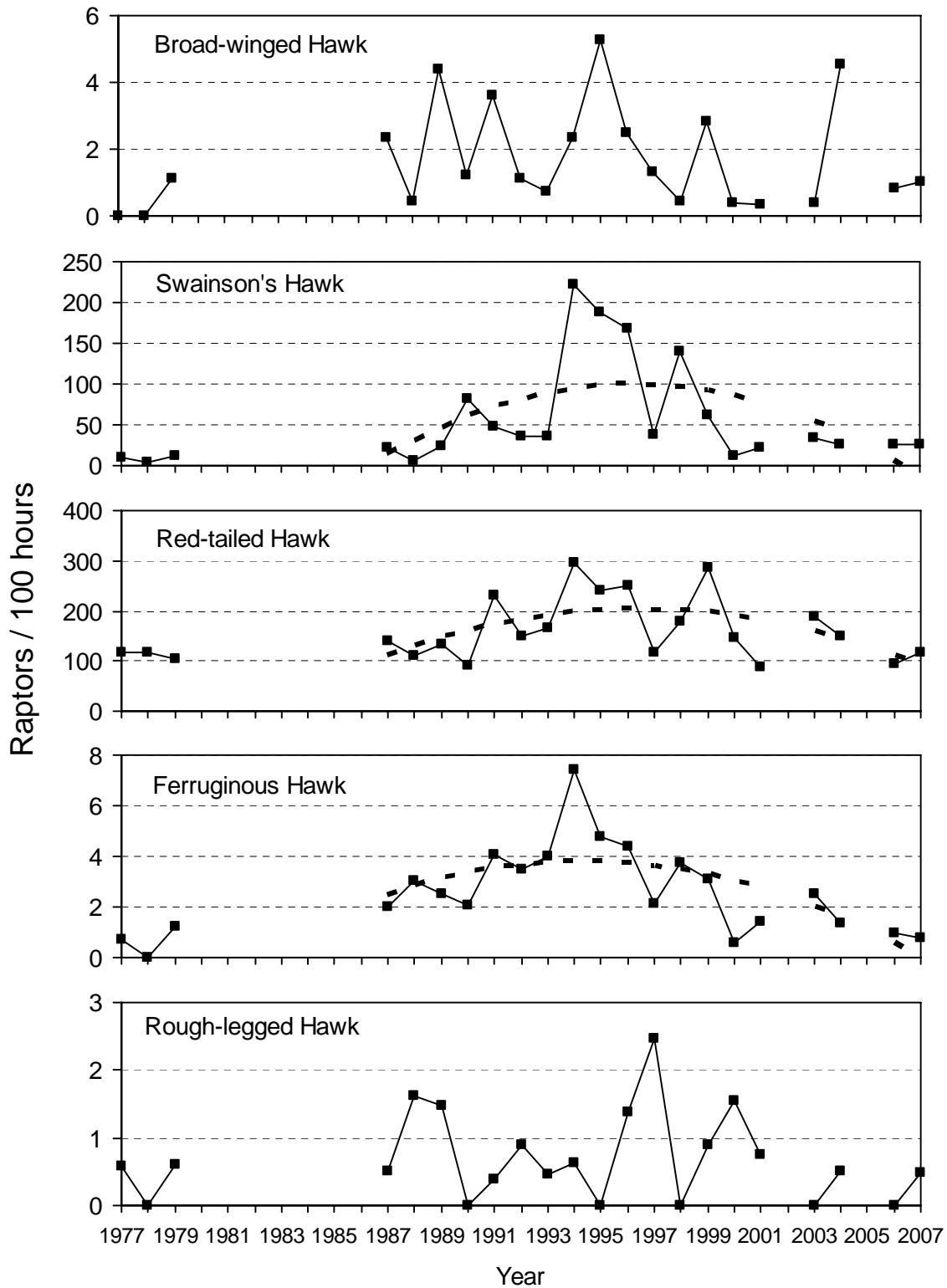


Figure 5. Adjusted fall-migration passage rates for Broad-winged, Swainson's, Red-tailed, Ferruginous, and Rough-legged Hawks: 1977–2007. Dotted lines indicate significant ($P \leq 0.10$) linear or quadratic regressions.

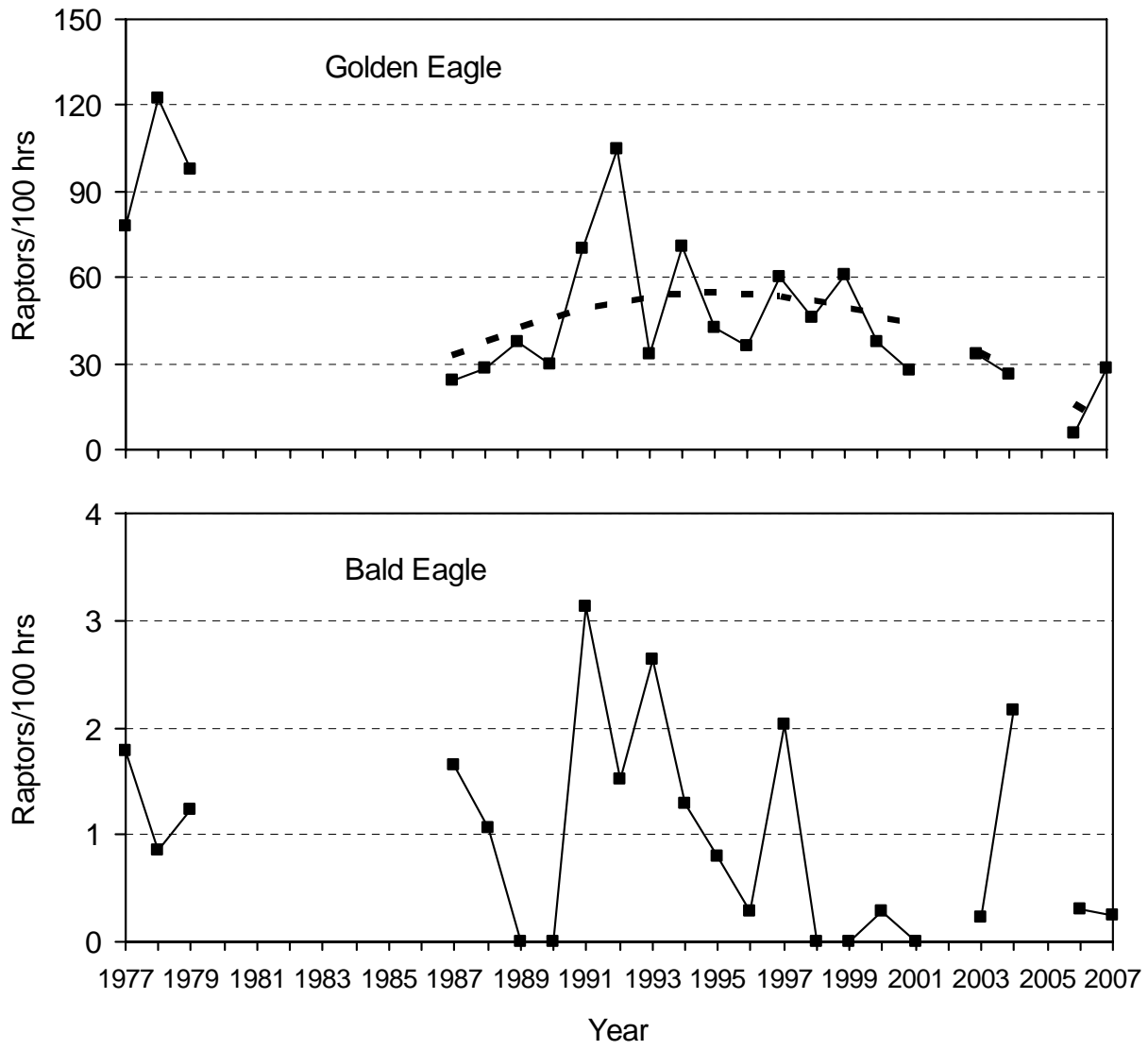


Figure 6. Adjusted fall-migration passage rates for Golden and Bald Eagles: 1977–2007. Dotted lines indicate significant ($P \leq 0.10$) linear or quadratic regressions.

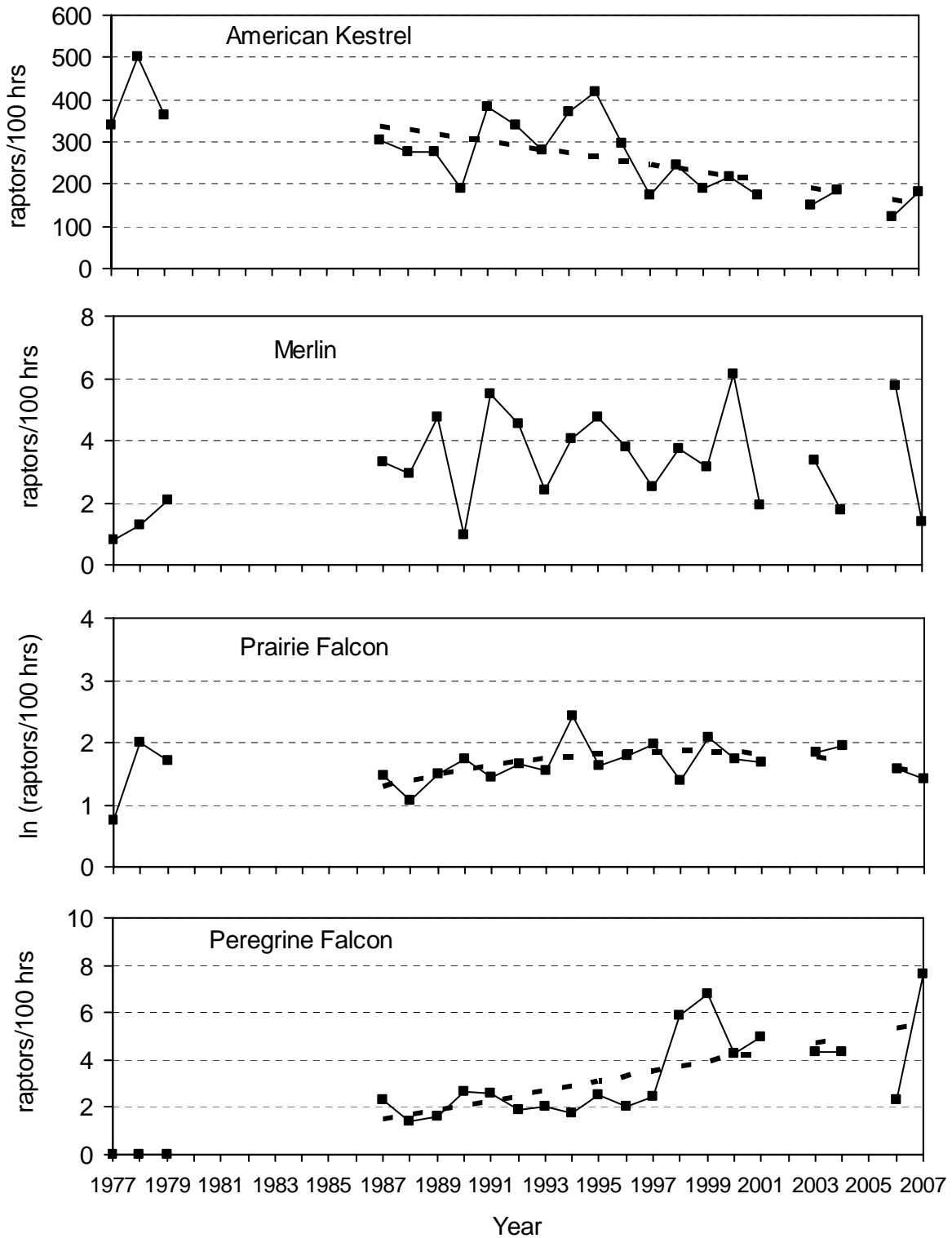


Figure 7. Adjusted fall-migration passage rates for American Kestrels, Merlins, Prairie Falcons, and Peregrine Falcons in the Wellsville Mountains, UT: 1977–2007. Dotted lines indicate significant ($P \leq 0.10$) linear or quadratic regressions.

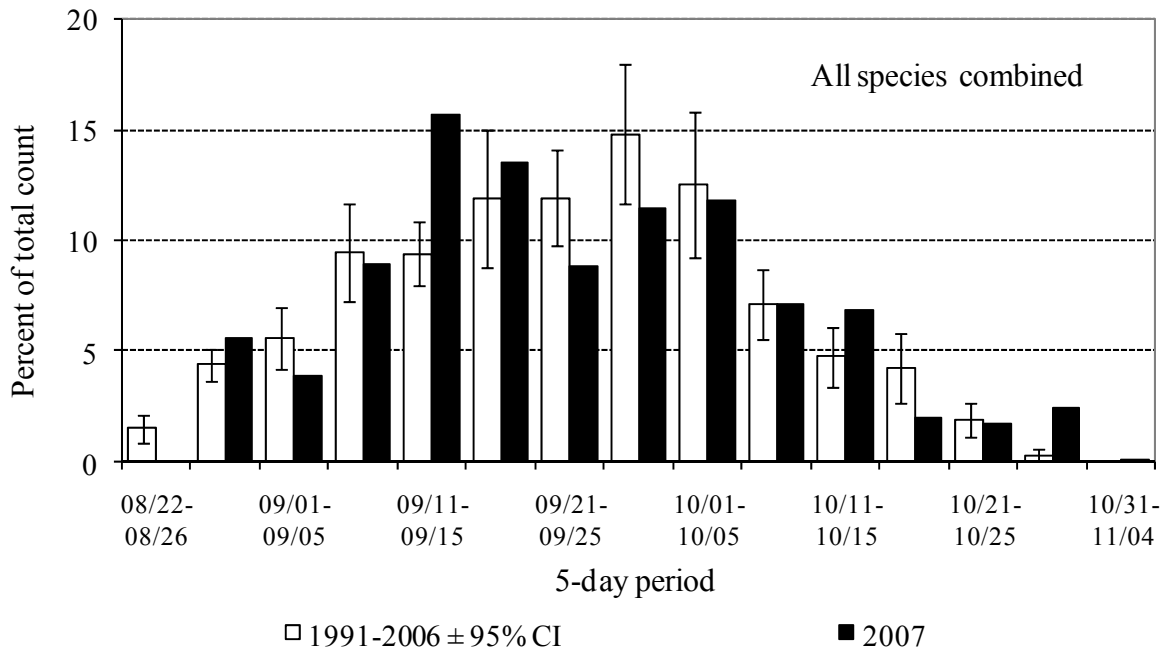


Figure 8. Combined-species, fall-migration passage volume by five-day periods in the Wellsville Mountains, UT: 1991–2006 versus 2007.

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)
- 2007:** Two observers throughout: Laurel Ferreira (0) and Aaron Viducich (0)

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	<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 ⁴	U	NA
Bald Eagle	<i>Haliaeetus leucocephalus</i>	BE	I, S1, S2, NA, A, U ⁵	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

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: 2007.

DATE	OBS. HOURS	OBSRVR / HOUR ¹	MEDIAN	PREDOMINANT WEATHER ³	WIND		TEMP (°C) ¹	BAROM.	MEDIAN	VISIB.	VISIB.	MEDIAN	BIRDS / HOUR
			VISITOR DISTURB ²		SPEED (KPH) ¹	WIND DIRECTION		PRESS. (IN HG) ¹	THERMAL LIFT ⁴	WEST (KM) ¹	EAST (KM) ¹	FLIGHT DISTANCE ⁵	
27-Aug	8.25	2.0	0	clr-pc	22.3	ssw	22.8	30.24	2.5	99	100	2	5.0
28-Aug	9.08	2.0	0	clr	9.9	ssw, wnw	23.6	30.37	2	100	100	2	4.7
29-Aug	9.00	1.9	0	clr-pc	8.4	ssw, w	27.2	30.47	1	100	98	2	3.3
30-Aug	8.50	2.0	0	clr-pc, haze	15.9	s, w	27.6	30.48	3	99	96	1	4.4
31-Aug	9.00	2.0	0	pc-ovc, PM haze	15.7	var	24.2	30.42	2	99	98	2	3.6
01-Sep	9.00	1.8	0	clr-pc, AM haze	14.1	var	25.2	30.43	2.5	100	100	1	3.3
02-Sep	8.00	3.1	0	pc-mc	12.9	s-ssw	27.3	30.42	3	100	100	2	3.9
03-Sep	9.00	2.0	0	clr	15.1	s-ssw	25.6	30.40	2	100	100	2	6.1
04-Sep	6.75	1.0	0	clr-ovc	18.3	sw	23.6	30.23	3.5	99	91	2	1.9
05-Sep	0.67	2.0	0	fog	23.5	ne	13.5	30.12	4	0	0	-	0.0
06-Sep	9.00	1.9	0	pc-ovc, haze	13.4	s, w	17.3	30.33	3	32	27	1	5.1
07-Sep	9.00	1.9	0	clr, haze	15.3	ssw	19.4	30.40	3	78	59	2	8.7
08-Sep	9.00	1.9	0	clr, haze	12.4	w	22.0	30.40	3	87	90	2	12.8
09-Sep	9.00	1.9	0	clr-pc, haze	10.7	wnw	17.1	30.35	3	51	52	2	4.0
10-Sep	9.00	1.9	0	clr, AM haze	6.0	ne, wsw	16.9	30.56	1.5	95	99	2	2.0
11-Sep	9.00	1.9	0	clr, haze	15.7	s-ssw	19.7	30.48	3	79	77	2	4.4
12-Sep	9.00	1.9	0	clr, haze	19.8	s-ssw	22.7	30.37	3	95	91	2	5.2
13-Sep	9.00	1.9	0	pc-mc	11.9	ssw	22.2	30.33	2	95	98	2	10.9
14-Sep	9.00	2.4	0	clr-pc	26.2	ssw	22.5	30.26	2.5	99	99	2	12.3
15-Sep	9.00	2.6	0	clr-mc	25.8	ssw	21.2	30.35	3	98	91	2	24.1
16-Sep	9.00	2.0	0	pc-mc	33.4	sw	20.8	30.22	3	99	96	2	25.0
17-Sep	7.50	2.0	0	pc-ovc, haze	9.4	ne, ssw	15.3	30.13	3	96	88	2	12.4
18-Sep	8.00	2.0	0	pc-ovc	27.2	ssw	16.0	30.22	3	100	100	1	2.6
19-Sep	8.00	2.0	0	mc-ovc	24.4	ssw	17.6	30.05	3	97	88	2	2.6
20-Sep	9.00	1.9	0	clr	34.2	ssw	20.0	30.18	3	100	100	2	9.1
21-Sep	9.00	1.7	0	clr-mc	19.4	ssw	18.4	30.37	3	100	100	2	21.2
22-Sep	3.75	2.0	1	mc-ovc, PM rain	29.0	ssw	18.4	30.20	4	97	86	2	4.3
23-Sep	0.00			snow									
24-Sep	2.75	1.8	0	ovc, fog, PM snow	9.7	wnw	3.0	30.21	4	1	2	1	0.7
25-Sep	9.00	1.9	0	clr-pc	9.9	sw	7.1	30.40	3	100	98	2	8.8
26-Sep	9.00	1.9	0	clr	16.4	sw	12.3	30.45	3	99	99	2	19.2
27-Sep	8.50	2.0	0	clr	13.4	ssw	15.0	30.35	3	100	97	2	12.9
28-Sep	8.50	1.9	0	pc-mc	35.3	ssw	16.6	29.96	3.5	100	100	2	7.8
29-Sep	0.00			rain/snow									
30-Sep	8.50	1.9	0	clr-pc	24.6	s	5.6	30.36	3	78	79	2	3.1
01-Oct	8.00	2.0	0	pc-ovc	29.6	ssw, wsw	11.4	30.19	4	98	100	2	6.9
02-Oct	8.50	1.9	0	pc-ovc	26.2	s	5.4	30.37	3	85	74	1.5	11.9
03-Oct	8.50	2.2	0	pc-ovc	33.9	ssw	13.5	30.06	4	100	95	2	8.2
04-Oct	8.50	1.9	0	pc-mc	18.7	ssw	14.2	29.88	3	94	90	1	18.5
05-Oct	6.00	2.0	0	ovc, PM snow	10.3	var	8.9	29.78	4	83	94	1	0.3
06-Oct	0.00			snow									
07-Oct	0.00			fog									

Appendix C. continued

DATE	OBS. HOURS	OBSRVR / HOUR ¹	MEDIAN	PREDOMINANT WEATHER ³	WIND		TEMP (°C) ¹	BAROM.	MEDIAN	VISIB.	VISIB.	MEDIAN	BIRDS / HOUR
			VISITOR DISTURB ²		SPEED (KPH) ¹	DIRECTION		PRESS. (IN HG) ¹	THERMAL LIFT ⁴	WEST (KM) ¹	EAST (KM) ¹	FLIGHT DISTANCE ⁵	
08-Oct	7.50	2.0	0	clr	18.5	s	6.9	30.39	4	100	98	2	1.5
09-Oct	8.50	1.9	0	clr	20.8	var, s	15.1	30.37	3	100	100	2	0.0
10-Oct	8.75	2.3	0	clr-pc	34.1	s	14.9	30.12	3	98	93	2	15.8
11-Oct	8.00	2.0	0	clr-pc, haze	12.8	sse, sw	11.9	30.24	3	97	98	1	4.4
12-Oct	8.00	2.0	0	ovc, haze	16.9	s	13.3	29.96	4	93	84	1	9.4
13-Oct	0.00			fog/rain									
14-Oct	8.00	2.0	0	clr-pc	12.0	ne, wsw	9.3	30.23	2.5	99	99	2	7.1
15-Oct	8.00	2.0	0	clr, haze	18.9	ssw	11.0	30.14	3	93	83	2	7.3
16-Oct	8.00	2.0	0	mc-ovc	18.8	ssw	11.8	29.80	4	94	83	2	7.9
17-Oct	0.00			snow									
18-Oct	2.50	2.0	0	ovc	33.0	ssw	0.0	30.12	4	0	0	-	0.0
19-Oct	6.00	2.0	0	mc-ovc		ne	7.7	30.06	4	95	99	2	0.7
20-Oct	0.00			snow									
21-Oct	6.00	2.0	0	pc-mc, PM snow	4.3	var	0.7	30.50	4	81	96	2	1.3
22-Oct	8.00	2.0	0	pc-mc	13.1	ne, ssw, w	2.1	30.73	4	93	88	1	0.6
23-Oct	8.00	2.0	0	clr-pc	15.6	ne	8.6	30.79	3	96	94	1	0.4
24-Oct	8.00	1.9	0	clr, PM haze	29.4	ssw	13.4	30.59	4	94	80	1	2.4
25-Oct	6.00	2.0	0	clr-pc	31.1	ssw	13.7	30.36	4	96	99	1	3.7
26-Oct	6.00	2.0	0	clr, haze	12.4	ssw	13.6	30.34	3	74	59	1	1.5
27-Oct	8.00	2.0	0	pc, haze	22.9	ssw	12.3	30.54	4	83	69	2	2.4
28-Oct	8.00	2.0	0	clr, haze	17.3	ssw	12.7	30.67	4	47	46	1	2.3
29-Oct	8.00	2.0	0	clr-pc, haze	20.8	s	13.4	30.47	3	84	73	2	3.6
30-Oct	7.00	2.0	0	mc-ovc, scat snow	12.3	ssw, nw	9.6	30.23	3	71	86	2	0.9
31-Oct	5.00	2.0	1	clr	6.2	ssw	5.8	30.46	4	100	98	2	0.6

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: 1977–2007.

	1977	1978	1979	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
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
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
Observation days	67	41	41	43	47	47	52	59	63	55	49	62	55
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
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
Turkey Vulture	6	7	8	11	11	9	1	36	15	28	16	43	32
Osprey	5	8	13	11	17	30	19	37	29	25	44	41	35
Northern Harrier	159	200	173	278	185	172	191	443	330	208	363	362	315
Sharp-shinned Hawk	618	737	570	793	1,093	832	526	990	990	1,000	901	1,217	928
Cooper's Hawk	457	333	495	362	561	603	253	619	601	596	778	874	701
Northern Goshawk	35	32	30	8	15	15	19	18	74	26	16	23	27
Unknown small accipiter ¹	–	–	–	–	–	–	–	–	–	–	–	–	–
Unknown large accipiter ¹	–	–	–	–	–	–	–	–	–	–	–	–	–
Unidentified accipiter	86	53	122	64	26	43	41	56	124	44	70	66	73
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
Broad-winged Hawk	0	0	2	5	1	9	4	10	3	2	5	13	7
Swainson's Hawk	19	5	21	44	12	47	184	128	97	91	487	468	419
Red-tailed Hawk	311	258	238	409	403	413	281	898	566	621	891	926	872
Ferruginous Hawk	2	0	3	6	11	8	6	16	13	15	23	18	15
Rough-legged Hawk	2	0	1	1	4	3	0	1	2	1	2	0	3
Unidentified buteo	10	13	21	12	5	5	32	15	38	26	14	24	32
TOTAL BUTEOS	344	276	286	477	436	485	507	1,068	719	756	1,422	1,449	1348
Golden Eagle	236	285	237	73	106	119	113	294	423	133	224	163	127
Bald Eagle	5	3	3	5	4	0	2	13	10	10	4	3	2
TOTAL EAGLES	241	288	240	78	110	119	115	307	433	143	228	166	129
American Kestrel	808	970	799	817	862	744	542	1,303	1,118	888	975	1,371	922
Merlin	2	3	5	10	11	15	3	21	17	8	11	17	12
Prairie Falcon	4	15	11	10	7	11	15	12	17	14	33	18	17
Peregrine Falcon	0	0	0	7	5	5	12	11	7	7	6	11	8
Unknown small falcon ¹	–	–	–	–	–	–	–	–	–	–	–	–	–
Unknown large falcon ¹	–	–	–	–	–	–	–	–	–	–	–	–	–
Unidentified falcon	0	0	2	2	1	2	4	2	3	3	0	1	1
TOTAL FALCONS	814	988	817	846	886	777	576	1,349	1,162	920	1,025	1,418	960
Unidentified raptors	42	31	57	12	2	16	77	36	10	18	8	8	20
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

Appendix D. continued

	1997	1998	1999	2000	2001	2003	2004	2006	2007	MEAN
Start date	22-Aug	23-Aug	25-Aug	23-Aug	28-Aug	22-Aug	22-Aug	28-Aug	27-Aug	25-Aug
End date	25-Oct	25-Oct	31-Oct	26-Oct	30-Oct	29-Oct	17-Oct	31-Oct	31-Oct	25-Oct
Observation days	58	54	59	49	59	65	49	50	59	54
Observation hours	377.92	358.75	407.83	373.84	488.00	495.53	391.59	370.25	458.50	373.82
Raptors / 100 hours	712.3	1,134.2	1,044.8	796.1	605.7	733.0	747.0	527.2	714.1	957.5
SPECIES	RAPTOR COUNTS									
Turkey Vulture	47	17	28	20	26	18	40	3	39	21
Osprey	39	39	21	28	27	14	24	18	35	25
Northern Harrier	171	443	487	198	230	440	183	97	222	266
Sharp-shinned Hawk	652	1,005	901	790	764	871	918	750	958	855
Cooper's Hawk	388	587	577	482	545	441	241	312	462	512
Northern Goshawk	17	14	16	24	15	33	17	8	15	23
Unknown small accipiter ¹	–	–	–	–	87	64	44	11	141	69
Unknown large accipiter ¹	–	–	–	–	2	1	9	1	6	4
Unidentified accipiter	22	55	20	31	0	6	7	1	4	46
TOTAL ACCIPITERS	1,079	1,661	1,514	1,327	1,413	1,416	1,236	1,083	1,586	1,452
Broad-winged Hawk	3	1	7	1	1	1	9	2	3	4
Swainson's Hawk	106	309	154	29	61	101	63	58	69	135
Red-tailed Hawk	430	609	1088	508	357	848	536	296	443	555
Ferruginous Hawk	8	14	13	2	6	12	6	3	3	9
Rough-legged Hawk	6	1	2	3	2	0	1	0	3	2
Unidentified buteo	9	19	22	4	19	35	37	2	28	19
TOTAL BUTEOS	562	953	1,286	547	446	997	652	361	549	724
Golden Eagle	212	154	245	130	122	155	104	20	128	173
Bald Eagle	7	0	2	1	0	1	10	1	2	4
TOTAL EAGLES	219	154	247	131	122	156	114	21	130	177
American Kestrel	524	727	600	660	623	515	616	328	630	788
Merlin	8	11	13	20	8	13	6	18	10	11
Prairie Falcon	23	13	28	14	16	23	20	13	10	16
Peregrine Falcon	9	19	24	13	16	17	14	7	27	10
Unknown small falcon ¹	–	–	–	–	6	1	2	0	2	2
Unknown large falcon ¹	–	–	–	–	6	1	3	1	5	3
Unidentified falcon	3	2	6	10	2	1	4	1	3	2
TOTAL FALCONS	567	772	671	717	677	571	665	368	687	829
Unidentified raptors	8	30	4	7	15	29	16	1	26	22
GRAND TOTAL	2,692	4,069	4,258	2,975	2,956	3,641	2,930	1,952	3,274	3,516

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: 2007.

DATE	HOURS	SPECIES ¹																							TOTAL	BIRDS /HOUR			
		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
27-Aug	8.25	3	2	5	2	0	0	0	1	0	0	5	7	0	0	0	4	0	0	10	0	0	1	0	0	0	1	41	5.0
28-Aug	9.08	0	0	4	2	3	0	0	0	0	0	11	7	0	0	2	3	0	0	9	0	0	0	0	1	0	1	43	4.7
29-Aug	9.00	0	3	2	1	1	0	1	0	0	0	1	12	1	0	1	0	1	0	3	0	1	1	0	1	0	0	30	3.3
30-Aug	8.50	0	0	3	1	5	0	6	0	0	0	2	8	0	0	2	3	0	0	5	0	0	1	0	0	0	1	37	4.4
31-Aug	9.00	0	0	5	2	3	0	4	0	0	0	1	11	0	0	0	2	0	0	2	0	0	0	0	0	0	2	32	3.6
01-Sep	9.00	0	1	2	1	3	0	2	0	0	0	5	4	0	0	0	1	0	0	8	0	3	0	0	0	0	0	30	3.3
02-Sep	8.00	6	0	1	10	3	1	1	0	0	0	0	3	0	0	0	2	0	0	2	0	0	0	0	0	0	2	31	3.9
03-Sep	9.00	0	1	2	7	3	0	2	1	0	0	13	5	0	0	4	3	0	0	11	1	1	1	0	0	0	0	55	6.1
04-Sep	6.75	0	0	1	2	2	0	1	0	0	0	0	1	0	0	0	1	0	0	3	0	0	1	0	0	1	0	13	1.9
05-Sep	0.67	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
06-Sep	9.00	1	0	3	9	5	0	2	0	0	0	8	4	0	0	1	1	0	0	9	0	0	1	0	1	0	1	46	5.1
07-Sep	9.00	0	0	5	20	9	0	3	0	1	0	1	15	0	0	1	2	0	0	15	0	1	2	0	1	0	2	78	8.7
08-Sep	9.00	0	1	9	22	21	0	9	1	1	0	5	11	0	0	4	2	0	0	24	0	0	1	0	1	0	3	115	12.8
09-Sep	9.00	1	1	1	5	11	0	2	0	0	0	2	6	0	0	0	0	0	5	0	0	1	0	0	0	1	36	4.0	
10-Sep	9.00	0	2	1	4	2	0	1	0	0	0	0	7	0	0	1	0	0	0	0	0	0	0	0	0	0	0	18	2.0
11-Sep	9.00	0	1	2	16	8	0	0	0	0	0	0	10	0	0	1	0	0	0	1	1	0	0	0	0	0	0	40	4.4
12-Sep	9.00	0	1	1	14	7	0	1	0	0	0	0	17	0	0	0	0	0	5	0	0	1	0	0	0	0	0	47	5.2
13-Sep	9.00	0	2	11	37	12	0	0	0	0	0	5	9	0	0	0	4	0	0	18	0	0	0	0	0	0	0	98	10.9
14-Sep	9.00	0	8	4	22	9	0	11	0	0	0	3	19	0	0	2	3	0	0	26	0	0	3	0	0	0	1	111	12.3
15-Sep	9.00	1	2	11	52	9	0	5	0	1	0	1	23	0	0	1	4	0	0	106	0	0	0	0	0	0	1	217	24.1
16-Sep	9.00	0	2	5	52	12	0	18	0	0	0	2	20	0	0	0	3	0	0	104	1	1	3	0	0	0	2	225	25.0
17-Sep	7.50	0	0	9	16	29	0	6	0	0	0	2	13	0	0	0	2	0	0	15	0	0	1	0	0	0	0	93	12.4
18-Sep	8.00	0	0	2	8	5	0	1	0	0	0	0	3	0	0	0	1	0	0	1	0	0	0	0	0	0	0	21	2.6
19-Sep	8.00	0	2	4	8	2	0	0	0	0	0	0	3	0	0	0	1	0	0	0	0	1	0	0	0	0	0	21	2.6
20-Sep	9.00	0	0	10	17	14	0	5	0	0	0	1	11	0	0	0	6	0	0	13	0	1	2	0	0	1	1	82	9.1
21-Sep	9.00	1	0	19	77	24	0	2	0	0	0	0	19	0	0	0	2	0	0	44	0	0	2	0	0	0	1	191	21.2
22-Sep	3.75	0	0	1	9	5	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	16	4.3
23-Sep	0.00																												
24-Sep	2.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	2	0.7
25-Sep	9.00	0	1	7	21	24	0	4	0	0	0	0	8	0	0	2	5	0	0	5	0	0	0	0	0	0	2	79	8.8
26-Sep	9.00	0	3	6	61	28	0	4	0	0	3	0	21	0	0	2	1	0	0	44	0	0	0	0	0	0	0	173	19.2
27-Sep	8.50	0	0	9	30	21	0	5	0	0	0	1	17	0	0	0	1	0	0	26	0	0	0	0	0	0	0	110	12.9
28-Sep	8.50	0	1	5	22	9	2	3	1	0	0	0	16	0	0	0	5	0	0	1	0	1	0	0	0	0	0	66	7.8
29-Sep	0.00																												
30-Sep	8.50	0	0	1	10	3	1	0	0	0	0	0	5	0	0	0	2	0	0	4	0	0	0	0	0	0	0	26	3.1

Appendix E. continued

DATE	HOURS	SPECIES ¹																								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
01-Oct	8.00	4	1	5	8	12	0	3	0	0	0	0	12	0	0	1	2	0	0	4	0	0	0	2	0	0	1	55	6.9
02-Oct	8.50	21	0	5	20	13	0	1	0	0	0	0	6	0	0	0	3	0	0	31	0	0	1	0	0	0	0	101	11.9
03-Oct	8.50	0	0	2	32	13	0	3	0	0	0	0	14	0	0	0	1	0	0	5	0	0	0	0	0	0	0	70	8.2
04-Oct	8.50	0	0	4	56	32	1	8	1	0	0	0	5	0	0	0	5	0	0	44	0	0	0	0	0	0	1	157	18.5
05-Oct	6.00	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0.3
06-Oct	0.00																												
07-Oct	0.00																												
08-Oct	7.50	0	0	1	2	0	0	1	0	0	0	0	3	0	0	0	1	0	0	3	0	0	0	0	0	0	0	11	1.5
09-Oct	8.50	1	0	6	47	10	1	1	0	0	0	0	6	0	0	0	5	0	0	7	0	0	0	0	0	0	0	84	9.9
10-Oct	8.75	0	0	8	46	26	1	4	0	0	0	0	37	0	0	3	6	0	0	5	1	0	1	0	0	0	138	15.8	
11-Oct	8.00	0	0	2	17	3	2	1	0	0	0	0	4	0	0	0	0	0	0	5	1	0	0	0	0	0	35	4.4	
12-Oct	8.00	0	0	4	40	15	1	4	0	0	0	0	3	1	0	0	3	0	0	4	0	0	0	0	0	0	75	9.4	
13-Oct	0.00																												
14-Oct	8.00	0	0	6	18	9	1	3	0	0	0	0	5	0	0	0	13	0	0	0	0	0	0	0	0	1	1	57	7.1
15-Oct	8.00	0	0	3	25	9	1	2	0	0	0	0	11	0	0	0	6	0	0	1	0	0	0	0	0	0	58	7.3	
16-Oct	8.00	0	0	3	28	11	1	4	1	0	0	0	10	1	0	0	4	0	0	0	0	0	0	0	0	0	63	7.9	
17-Oct	0.00																												
18-Oct	2.50	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
19-Oct	6.00	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	4	0.7	
20-Oct	0.00																												
21-Oct	6.00	0	0	0	2	0	1	2	0	0	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	8	1.3	
22-Oct	8.00	0	0	1	0	1	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	5	0.6	
23-Oct	8.00	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0.4	
24-Oct	8.00	0	0	6	7	2	0	0	0	0	0	0	1	0	0	0	2	0	0	0	1	0	0	0	0	0	19	2.4	
25-Oct	6.00	0	0	3	16	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	22	3.7	
26-Oct	6.00	0	0	2	4	0	0	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	9	1.5	
27-Oct	8.00	0	0	2	12	2	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	19	2.4	
28-Oct	8.00	0	0	2	6	0	1	1	0	0	0	0	1	0	0	0	5	1	0	0	1	0	0	0	0	0	18	2.3	
29-Oct	8.00	0	0	4	9	7	0	1	0	0	0	0	2	0	0	0	1	0	0	0	3	0	2	0	0	0	29	3.6	
30-Oct	7.00	0	0	1	0	3	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	6	0.9	
31-Oct	5.00	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	3	0.6	
TOTAL	458.50	39	35	222	958	462	15	141	6	4	3	69	443	3	3	28	128	2	0	630	10	10	27	2	5	3	26	3274	7.1

¹ See Appendix B for explanations of species codes.