

**FALL 2008 RAPTOR MIGRATION STUDIES AT  
BONNEY BUTTE, OREGON**



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



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## INTRODUCTION

The Bonney Butte Raptor Migration Project in the northern Cascade Mountains of Oregon is an ongoing effort to monitor long-term trends in populations of raptors using the Cascade Mountains portion of the Pacific Coast Flyway (Hoffman et al. 2002, Smith et al. 2008). HawkWatch International (HWI) initiated standardized counts of the autumn raptor migration at Bonney Butte in 1994, and began a trapping and banding program at the site in 1995. To date, HWI observers have recorded 18 species of migratory raptors at the site, with counts typically ranging between 2,000 and 4,000 migrants per season. The 2008 season marked the 15<sup>th</sup> consecutive count and the 14<sup>th</sup> consecutive season of trapping and banding conducted at the site by HWI. This report summarizes the 2008 count and banding results.

The Bonney Butte project was 1 of 14 long-term, annual migration counts and 1 of 5 migration-banding studies conducted or co-sponsored by HWI in North America during 2008. The primary objective of these efforts is to track long-term population trends of diurnal raptors in western North America and around the Gulf Coast region (Hoffman and Smith 2003; Smith et al. 2001, 2008 a, b). Raptors serve as important biological indicators of ecosystem health (Bildstein 2001) and long-term migration counts are one of the most cost effective and efficient methods for monitoring the regional status and trends of multiple raptor species (Zalles and Bildstein 2000).

The intensive counting and banding operations, along with related research activities such as satellite tracking of migrants, also provide valuable information about species' ranges, migratory routes and behaviors, and population demographics (e.g., Hoffman et al. 2002, Lott and Smith 2006, Goodrich and Smith 2008), as well as affording rich opportunities for a variety of other biological assessments and studies (e.g., DeLong and Hoffman 2004, McBride et al. 2004). This information helps us understand the life histories, ecology, status, and conservation needs of raptor populations in North America. In addition, these migration studies offer unique opportunities for the public to learn about raptors and the natural environment, and providing such opportunities is another important component of all HWI migration projects.

## STUDY SITE

Bonney Butte is located approximately 9.5 km ESE of Government Camp, on the east side of the White River drainage within the Mt. Hood National Forest, Hood River County, Oregon (45°15'46.8" N, 121°35'31.2" W; elevation 1,754 m; Figure 1). The butte is the southern terminus of Surveyor's Ridge, which originates near Hood River, Oregon south of the Columbia River Gorge. The ridge extends southward for approximately 50 km and ends southeast of Mt. Hood. The central Oregon shrubsteppe region lies immediately to the east. The observation site is located on the highest point of the butte. The trapping station is located approximately 500 m north on a separate knoll and slightly lower in elevation. The intervening space is largely forested.

## METHODS

### COUNT

Weather permitting; two official or designated observers conducted standardized daily counts of migrating raptors from a single, traditional observation site from late August through late October. Observations typically began between 0800–0900 hrs and ended near 1700 hrs Pacific Standard Time (PST). Lead Observer Aaron Viducich had one strong season of prior raptor migration counting experience with HWI at the Wellsville Mountains site. Official observer James Butch had one season of prior raptor migration counting experience (see Appendix A for a complete observer history). As is typical for the site, on-site educator Nicholle Stephens frequently assisted with the count; this was her first season of exposure to raptor migration counting. Aaron attended preseason protocol and field

training in 2007, while James and Nicholle were trained on-site in 2008 by knowledgeable crew members and volunteers. Other visitors also periodically assisted with the count.

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

1. Species, age, sex, and color morph of each migrant raptor, whenever possible and applicable (Appendix B lists common and scientific names for all species, information about the applicability of age, sex, and color morph distinctions, and two-letter codes used to identify species in some tables and figures).
2. Hour of passage for each migrant; e.g., the 1000–1059 hrs PST.
3. Wind speed and direction, air temperature, percent cloud cover, predominant cloud type(s), presence or of precipitation, visibility, and an assessment of thermal-lift conditions, recorded for each hour of observation on the half hour.
4. Predominant direction, altitude, and distance from the lookout of the flight during each hour.
5. Total minutes observed and the mean number of observers present during each hour (included designated observers plus volunteers/visitors who actively contributed to the count [active scanning, pointing out birds, recording data, etc.] for more than 10 minutes in a given hour), recorded on the hour.
6. A subjective visitor-disturbance rating for each hour, recorded on the hour.
7. Daily start and end times for each official observer.

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

## **TRAPPING AND BANDING**

Weather permitting; the trappers operated a single traditional banding station daily from late August through late October, generally between 0900–1700 hrs PST. Capture devices included mist nets and remotely triggered bow nets. Trappers lured migrating raptors into the capture stations from camouflaged blinds using live, non-native avian lures attached to lines manipulated from the blinds. Unless already banded, all captured birds were fitted with a uniquely numbered USGS Biological Resources Division aluminum leg band. Data gathering and recording followed standardized protocols used at all HWI migration-banding sites (Hoffman et al. 2002). All birds were released within 45 minutes of capture.

## **RESULTS AND DISCUSSION**

### **WEATHER SUMMARY**

Inclement weather entirely precluded 6 full days of potential observations in 2008 and reduced observation time to  $\leq 4$  hrs on 7 other days between the targeted operation dates of 27 August and 31 October (see Appendix C for daily weather records). The number of fully precluded days was significantly below the 1997–2007 (the period for which detailed summary data have been compiled) average of 13.7 days, whereas the number of otherwise severely hampered days was slightly above the long-term average of 5.4 days. The combination made for the second highest number of total observation days (60) in the project’s history (Appendix E).

Fog and low clouds that hovered on the ridge and obscured visibility were prevalent in 2008, but half of the lost observations days occurred during one protracted rain/snow event in early October. The October event kept the crew away for three days, but in general the observation crew stayed on through more weather than usual. Similar to the last two seasons, the weather allowed for the season to continue through the projected end date of 31 October (Appendix E).

Weather data collected on site during active observation periods reflected an above-average prevalence of days featuring mostly cloudy to overcast skies (15% vs. 1997–2007 average of 5%), a below-average prevalence of days featuring predominantly clear to partly cloudy skies (17% vs. average of 22%), and a near-average prevalence (8% vs. average of 9%) of days with transitional weather (defined as days that changed from fair or partly cloudy to mostly cloudy or overcast skies during the day, or vice versa). The proportion of active days that featured noteworthy levels of visibility reducing fog and/or haze (66%) was above average (60%), and the proportion of active observation days that featured some rain or snow (21%) was almost double the average (11%). The daily-average temperature (average of hourly values for each day) during active observation periods averaged 12.9°C, ranging from 1.9–25.5°C. The annual average was slightly below the 1997–2007 grand average of 13.4°C, and the minimum and maximum daily values fell well within the normal ranges of variation. Thermal lift was rated good to excellent on a significantly below average proportion of the active observations days (12% vs. average of 42%), continuing a pattern of recent years.

Days where light winds (<12 kph) prevailed were more prevalent than usual in 2008 (93% of the active days vs. 1997–2007 average of 85%), whereas the proportions of active observation days that featured predominantly moderate (12–29 kph) or strong (>29 kph) winds were below average (7% and 0% vs. averages of 14% and 1%, respectively). In terms of wind directions, 2008 was similar to the average pattern in that westerly winds were most common. Relatively consistent SW-W winds typically are the most common pattern at this site, with an average prevalence of 31% of the active days plus another 2% where other wind patterns intervened for two or more hours of the day. In 2008, steadier SW-W winds were much less common than usual (13%), whereas the SW-W/variable pattern was much more common than usual (12%). More variable SW-NW winds prevailed on 13% of the active days in 2008 and SW-NW/variable winds prevailed on another 17%; the comparative averages for these patterns are 13% and 11%, respectively. As usual, storm-bringing NE-E and NE-E/variable winds rounded out the top three most prevalent basic patterns, prevailing on 10% (average 13%) and 8% (average 3%) of the active days. Similar to last year, days featuring entirely mixed calm/variable winds were more common than usual: 5% of the active days versus an average of <1%.

In summary, compared to averages for the past 11 years, inclement weather did not keep the observers away from the hill as much as usual. Indications of above-average prevalence during active observations of mostly cloudy to overcast skies, visibility reducing fog and haze, and rain/snow showers may reflect primarily a harder than usual observation team that conducted more monitoring under inclement conditions. However, the temperature regime was moderate and the winds averaged lighter than average and more variable than usual, which suggests unsettled but not particularly harsh conditions.

## COUNT SUMMARY

The observers worked on 60 of 66 possible days between 27 August and 31 October 2008. The number of observation days was a significant 19% above the 1994–2007 average of  $50 \pm 95\%$  CI of 3.2 days, and the number of observation hours (481.00) was a record-high 32% above the long-term average of  $365.19 \pm 32.41$  hours. The 2008 average of 2.9 observers per hour (including official and guest observers; value is mean of daily values, which are in turn means of hourly values) was a significant 23% above the long-term average of  $2.4 \pm 0.25$  observers per hour.

The observers counted 2,479 migrant raptors of 16 species, with the count a marginally significant 13% below the 1994–2007 average (Table 1, and see Appendix D for daily count records). The count dropped to a record low for the Red-tailed Hawk (see Appendix E for annual count summaries). The five lowest



kestrel counts for the project have all occurred in the last five years. No record-high species-specific counts occurred in 2008.

The 2008 flight was composed of 61% accipiters, 23% buteos, 11% vultures, 4% eagles, 4% falcons, 3% Ospreys, 1% harriers and 1% unidentified raptors. The season featured significantly higher than average proportions of accipiters and Ospreys and significantly below average proportions of buteos, eagles, and harriers (Figure 2). As usual, the Sharp-shinned Hawk was by far the most abundant species, followed by Red-tailed Hawk, Cooper's Hawk, Turkey Vulture, Osprey, Golden Eagle, Bald Eagle, and Merlin (Table 1, Appendix E).

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

Adjusted passage rates were significantly below average in 2008 for 13 species (Turkey Vulture, Northern Harrier, Sharp-shinned Hawk, Cooper's Hawk, Swainson's Hawk, Red-tailed Hawk, Ferruginous Hawk, Golden Eagle, American Kestrel, Merlin, and Prairie Falcon) and were not significantly above average for any species (Table 1; Figures 3–8). Updated regression analyses (after Hoffman and Smith 2003) of adjusted passage rates through 2008 revealed a marginally significant ( $0.05 < P \leq 0.10$ ) overall decline for Northern Harriers (Figure 3); significant ( $P \leq 0.05$ ) overall declines for Red-tailed and Ferruginous Hawks (Figure 6), and Golden Eagles (Figure 7); and a highly significant ( $P \leq 0.01$ ) overall decline for American Kestrels (Figures 8). Ferruginous Hawks are too uncommon at this site to place much faith in statistical trend analyses; nevertheless, the species was recorded only once in the past eight years, but five times during the previous seven years (Appendix E). The decline in Golden Eagle numbers is most pronounced among adult birds, but counts of both adult and non-adult birds have dropped to record lows in the past three years (Figure 7). The long-term decline in American Kestrel numbers appears to have stabilized since about 2003, but has yet to rebound at all (Figure 8). The Peregrine Falcon was the only other species for which a significant trend was indicated (Figure 8). Overall, this species is showing a strong, long-term increase; however, the count dropped markedly in 2006 and has remained at a moderate level since then.

For several species, high passage rates in both 2003 and 2004 sharply reversed patterns of decline that had set in between 1998 and 2001/2002 coincident with the onset of widespread drought throughout much of the interior West (Hoffman and Smith 2003). For most such species, however, passage rates have since dropped back down and generally remained at moderate levels. These fluctuations likely reflect a complex mix of factors relating to climatic trends and effects on both population viability and migration geography (e.g., see Goodrich and Smith 2008 and Smith et al. 2008).

Smith et al. (2008) present trend analyses of data collected through 2005 for most of the long-term, on-going, autumn migration studies in western North America, including Bonney Butte for the first time. 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 2008. Among other refinements, this new approach both fits polynomial trajectories to the complete series of annual count indices 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 all buteos except Red-tailed Hawk, and Prairie and Peregrine Falcons. Otherwise, with a few notable exceptions, the overall patterns of change and derived trend estimates suggested by the new modeling technique generally yielded similar inferences as those derived using the simpler methodology of Hoffman and Smith (2003) and presented herein to provide trend assessments updated through 2008.

Differences between the RPI results and those presented herein that clearly relate to addition of three more years of data include: a) addition of three low to moderate counts from 2006–2008 eliminated a marginally significant increasing trend for Turkey Vultures shown in the RPI analyses; b) addition of

three years of declining counts, including a new record low in 2008, resulted in a significant long-term decline for Red-tailed Hawks in the 2008 analyses; and c) addition of three years of low counts resulted in a significant long-term decline for Golden Eagles in the 2008 analyses. Otherwise, for all remaining species analyzed in common, the RPI analyses of data through 2005 and the updated analyses of data through 2007 presented herein indicate the same conclusions; i.e., a highly significant ( $P < 0.01$ ) decline for American Kestrels (averaging  $7.9 \pm 95\%$  CI of 3.7% per year; Smith et al. 2008) and no statistically significant trends ( $P > 0.10$ ) for all other commonly analyzed species.

At the 2007 joint meeting of the Raptor Research Foundation and Hawk Migration Association of North America in Allentown, Pennsylvania, a special symposium on American Kestrels was convened to draw attention to evidence of widespread declines of this otherwise common and ubiquitous species. The proceedings of this symposium are expected to be published in the *Journal of Raptor Research* in 2009, and will include another manuscript that specifically summarizes migration trend data for the species from across the continent, including Bonney Butte (Farmer and Smith in review).

### **Age Ratios**

Among eight species for which reasonable age-specific comparisons were possible, Sharp-shinned Hawks, Red-tailed Hawks, and Bald Eagles showed significantly above-average immature : adult ratios in 2008, whereas Northern Harriers showed a significantly lower than average immature : adult ratio (Table 2). For Northern Harriers, the low age ratio likely reflects the influence of a substantial reduction in the proportion of aged individuals (Table 2), with immature birds often difficult to distinguish from adult females, and therefore may be misleading. The high ratio for Sharp-shinned Hawks, however, was due to a combination of an increased count of immature birds and a substantially reduced count of adults (Table 2). The numbers suggest that Sharp-shinned Hawks in the Pacific Northwest experienced good productivity in 2008 but low adult survival in the past year. For Red-tailed Hawks, the absolute counts of both young and adult birds were well below average in 2008 due to a substantially reduced total count as well as a higher-than-average proportion of unaged birds; accordingly, the high age ratio suggests primarily a proportional reduction in the abundance of adults due to low adult survival rather than the influence of high productivity. In contrast, the total count of Bald Eagles was near average and the proportion of unaged birds was only slightly higher than average, such that the indication of a higher-than-average absolute count of young birds and the high age ratio may well reflect above-average productivity for this species in the past few years.

### **Seasonal Timing**

The 2008 combined-species median passage date of 27 September was a significant three days earlier than the long-term average for the site (Table 3). The seasonal distribution of activity also was unusual due to the influence of two multi-day weather events in late September and early October that each kept the crew away from the site for several days (Appendix C). These events resulted in proportionately below-average activity during the 21–25 September and 1–5 October five-day periods, and proportionately above-average activity levels during much of the rest of September and portions of later October (Figure 9). Species-level median passage dates also reflected the overall shift to proportionately earlier activity, with 9 of 14 species for which a comparison was possible showing significantly earlier than average median passage dates in 2008 (Table 3). The Peregrine Falcon was the only species that showed significantly late timing in 2008, with the Golden Eagle marginally late. Northern Harrier and Rough-legged Hawk were the only other species that did not show at least slightly earlier than average timing in 2008. Age-specific median dates generally followed the same patterns as the species-level data, except for clarifying late timing for immature Northern Harriers, early timing for adult Golden Eagles but late timing for non-adults, and apparently a bias toward early timing for unaged Bald Eagles (Table 4).

## RESIDENT RAPTORS

A pair of adult, light-morph Red-tailed Hawks was observed on nearly a daily basis throughout the season. Their territory was centered from the banding station north to Adam's gap, with the birds usually seen foraging in the White River Valley to the west and up along the ridge to the northeast of the banding station. They were observed escorting migrants through the area on several occasions. It appeared that this pair may have produced one light-morph offspring, which was seen regularly until 15 October mostly hunting in the Bonney Meadows area.

At least one immature, apparently resident Cooper's Hawk was seen pestering migrants from about 3–11 September. At least one adult Northern Goshawk was seen in the area several times between 30 September and 23 October, usually heading north up the White River Valley fairly close to the observation site. An immature Northern Goshawk was seen several times between 31 August and 5 September.

Other species seen on multiple occasions that appeared to be displaying resident behavior included American Kestrels on 30 August and 15 September; Bald Eagles on 1, 3, and 12 September; Golden Eagles on 2 and 6 September and 18 October; and Rough-Legged Hawks twice in mid-October.

This is a typical local assemblage except that sightings of local Golden Eagles have diminished markedly since 2001.

## TRAPPING AND BANDING SUMMARY

Trapping occurred on 56 of 66 possible days between 27 August and 31 October, with effort totaling a record 406.00 hours (see Appendix F for daily trapping records and Appendix G for annual trapping summaries). The number of trapping days was a significant 28% above the 1997–2007 (period of comparable seasonal effort) average of  $43.9 \pm 95\%$  CI of 6.2 days, and the hours of effort was a significant 45% above the 1997–2007 average of  $280.5 \pm 44.2$  hours. The combination made 2008 the most effort-intensive trapping season to date.

The 2008 capture total of 426 birds of 13 species was a significant 28% above average (Table 5). The captures included one recapture of a bird previously banded elsewhere and new record-high capture totals for Cooper's Hawks and Northern Goshawks (Appendix G). The 2008 effort raises the total number of birds captured since project inception to 3,951. As usual, the three most frequently captured species were the Sharp-shinned Hawk (60% of captures), Cooper's Hawk (22%), and Red-tailed Hawk (13%). Highlights of the season included the second Red-shouldered Hawk (an immature bird) ever captured at the site, a rare capture of a Broad-winged Hawk, and only the sixth American Kestrel ever captured at the site.

The only commonly captured species for which the capture totals, rates, and successes were all above average in 2008 were the Northern Harrier, Cooper's Hawk, and Northern Goshawk (Table 5). No other commonly captured species showed a significantly above average capture total or rate; however, both the capture total and capture success were significantly above average for Sharp-shinned Hawks.

At this site, compared to the counts, banding data yield unique and useful sex-age specific data only for the three accipiters. In 2008, the immature : adult ratio for Sharp-shinned Hawks derived from the banding data was slightly below average (Table 6), whereas the count age ratio was significantly above average (Table 2); nevertheless, as is typical for the site, the banding age ratio (1.7) was much higher than count age ratio (1.1). In combination, these data suggest that immature birds were more susceptible to capture than adults, which is typical, but to a lesser degree than usual. This suggests that immature birds were both more abundant and healthier than average in 2008. The capture data indicated an average female : male ratio (Table 6).

For Cooper's Hawks, the 2008 capture age ratio was a non-significant 6% above average (Table 6); whereas the count age ratio was a significant 24% above average (Table 2). As is typical for this species,

the absolute values of the two estimated age ratios were more similar than for Sharp-shinned Hawks, but indicated the same relationship; i.e., a lower count (2.0) than capture (2.4) age ratio. In combination, these data suggest that, similar to the case for Sharp-shinned Hawks, immature Cooper's Hawks were more susceptible to capture than adults in 2008, but less so than usual. In turn, this suggests that although the overall abundance of Cooper's Hawks was below average in 2008, the immature birds may have been healthier than average. Also similar to Sharp shinned Hawks, the capture data indicated an average female : male ratio for Cooper's Hawks in 2008 (Table 6).

For Northern Goshawks, the 2008 count age ratio (2.2) matched the average (Table 2), whereas the capture age ratio (2.0) was significantly below the long-term average of  $2.8 \pm 1.29$  (Table 6). Thus, unlike for both smaller accipiters, these data suggest an atypical situation where adult goshawks appeared to be more susceptible to capture than immature birds in 2008, suggesting that immature birds were both more abundant and healthier (less hungry) than usual.

Another way to assess the relative condition of the three accipiter species is examining measures of body condition collected during banding; i.e., crop fullness, keel muscle, and wing-pit fat ratings (Table 7). For all three species, these measures indicated proportionately fewer birds with substantial food in their crops, but proportionately more birds with at least moderately healthy keels and wing-pit fat. Thus, the body condition data seem to support the age ratio inferences in suggesting that, although overall abundance may have been near average for all three species, most of the captured birds appeared reasonably healthier than usual.

#### **ENCOUNTERS WITH BANDED BIRDS**

To date, 57 birds banded at Bonney Butte have subsequently been encountered elsewhere, with three new "foreign encounters" involving two Cooper's Hawks and a Red-tailed Hawk recorded in 2008 (Table 8). The new Cooper's Hawk encounter locations both fell within the expected confines of the Pacific Coast Flyway; i.e., west of the Cascade-Sierra Nevada ranges from southern British Columbia to Baja California (Hoffman et al. 2002). Both hawks were found dead of unknown causes in southern California.

This was the third year in a row that exchanges of banded Red-tailed Hawks occurred between the Bonney Butte project and a project coordinated by former Bonney Butte trapper Carole Hallett at the Portland Airport. In 2006, our crew recaptured a hatch-year (HY) bird on 5 October that Carole banded at the airport on 26 September, released farther west on the coast, and then caught again at the airport four days later before it moved up to Bonney Butte. That year, she also recaptured another HY bird 28 days after we banded it at Bonney Butte; in 2007 she recaptured a HY bird 22 days after we banded it; and in 2008 she recaptured a HY bird 6 days after we banded it at Bonney Butte (Table 8). Thus, the evidence is growing that east-west movement along the Columbia River may be commonplace for some young Red-tailed Hawks moving through or within Oregon.

Fourteen birds banded elsewhere have been recaptured at Bonney Butte, with one new "foreign recapture" in 2008. The new foreign recapture was a hatch-year male Sharp-shinned Hawk banded 12 days earlier at HWI's Chelan Ridge site in the northern Cascades of Washington. This is the fourth exchange of banded birds between these two sites, with a Cooper's Hawk and two Sharp-shinned Hawks having been recaptured downstream after banding at Chelan Ridge, and a Red-tailed Hawk having done the opposite (i.e., documented moving north rather than south in the fall). This year's Sharp-shinned Hawk averaged 24 km per day in making the 287 km trip between the two sites, while gaining 10 g in mass during the 12-day trip!

#### **SATELLITE TRACKING**

We did not outfit any new birds with satellite transmitters at this site in 2008.

The male Golden Eagle outfitted at the site during fall 2005 remained alive and continued to transmit until mid-November 2008 when its transmitter battery finally failed. After capture, this bird spent the winters of 2005 and 2006 mostly in northern New Mexico, with another significant late fall and early spring activity center in southwestern Utah; however, he then spent the winters of 2007 and 2008 in southwestern Saskatchewan (Figure 10). In contrast, he consistently summered for three seasons above the Arctic Circle, ranging from Prudhoe Bay on the north-central coast of Alaska to Franklin Bay on the northwestern coast of the Northwest Territories in Canada. In addition to the shift in winter range, this eagle's migration pathways also varied considerably. His fall 2005 and spring 2006 migrations appeared to follow essentially the same pathway, connecting his summer range on the north coast to a winter range in northern New Mexico via a route from near Inuvik on the north coast, south to the Cascade Mountains of northern Oregon, then southeast across the Great Basin to northern New Mexico. After that, however, his migration routes consistently converged along the northern Rocky Mountains, but sometimes following along the west flank and in other years/seasons along the east flank. Although we have tracked other young eagles that have shown a similar range of variation in their summer and winter ranges, thus far this bird has shown the greatest variation in use of different migration routes.

Tracking maps and summaries for all of HWI's satellite-tracked raptors can be found at <http://www.hawkwatch.org>.

## **VISITATION**

Public visitation occurred on both the first and last day of this year's monitoring season, and on 44 of 60 potential visitor days. A total of 271 visitors signed our logs this season, with about 35% having visited Bonney Butte in a previous year. The average length of stay was about 2 hours. The highest visitor day was 20 September, when 38 individuals visited the site, including a large group from the Portland Audubon Society. Visitors represented a variety of age groups, ranging from about 5–80 years old. Most visitors were from Oregon, with others from Washington, Florida, and Puerto Rico. Three groups made reservations to visit in 2008, but unfortunately one school group cancelled due to budget cuts. Another group of 34 people from the Portland Audubon Society visited on 20 September and included folks with varying degrees of raptor knowledge and ranging in age from the late 20s to late 50s. A second group of 5 people (three high school freshmen, a teacher, and the mother of one of the students) represented a small science club from a Portland-area high school and visited on 27 September.

In 2008, 401 hourly assessments of visitor disturbance by the primary observers resulted in the following ratings: 76% none, 18% low, 6% moderate, and <1% high. These ratings reflect a slightly lower level of disturbance than during the previous two years, but a higher level than was typical prior to 2006 when we implemented stricter regulations governing public visitation to the trapping blind.

## **ACKNOWLEDGMENTS**

Funding and logistical support for this project were provided by the USDA Forest Service, Mt. Hood National Forest; Oregon Parks Foundation; Fledgling Fund; Kinsman Foundation; Arthur and Elaine Johnson Foundation; Portland and Central Oregon Audubon societies; and HWI private donors and members. We also extend special thanks to former site bander, Sherri Kies, for her assistance with the banding operation this season, and to the following individuals who directly assisted the observation crew for more than 10 hours this season: Tom Jordan, Mark Lundgren, Dwight Porter, Laurel Ferreira, and Galen Reed.

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**Table 1. Fall raptor migration unadjusted counts and adjusted passage rates by species at Bonney Butte, OR: 1994–2007 versus 2008.**

SPECIES	COUNT			RAPTORS / 100 HOURS		
	1994–2007 <sup>1</sup>	2008	% CHANGE	1994–2007 <sup>1</sup>	2008	% CHANGE
Turkey Vulture	296 ± 64.3	269	-9	128.8 ± 27.87	98.2	-24
Osprey	63 ± 11.1	70	+11	23.5 ± 4.57	21.3	-9
Northern Harrier	29 ± 7.1	19	-35	9.0 ± 2.13	4.3	-52
Sharp-shinned Hawk	1099 ± 177.2	1003	-9	389.8 ± 63.21	293.8	-25
Cooper's Hawk	340 ± 47.5	316	-7	120.9 ± 20.52	99.0	-18
Northern Goshawk	27 ± 5.7	33	+25	8.1 ± 1.88	7.7	-5
Unknown small accipiter <sup>2</sup>	21 ± 13.3	111	+440	–	–	–
Unknown large accipiter <sup>2</sup>	4 ± 3.8	12	+190	–	–	–
Unknown accipiter	65 ± 26.9	37	-43	–	–	–
TOTAL ACCIPITERS	1543 ± 216.4	1512	-2	–	–	–
Red-shouldered Hawk	1 ± 1.0	3	+133	0.5 ± 0.40	0.6	+25
Broad-winged Hawk	7 ± 10.3	5	-31	4.1 ± 5.40	2.8	-32
Swainson's Hawk	1 ± 0.4	0	-100	0.2 ± 0.17	0.0	-100
Red-tailed Hawk	588 ± 78.4	359	-39	187.2 ± 29.07	85.1	-55
Ferruginous Hawk	0 ± 0.3	0	-100	0.1 ± 0.08	0.0	-100
Rough-legged Hawk	14 ± 4.5	16	+19	9.4 ± 3.10	8.0	-15
Unidentified buteo	31 ± 8.1	16	-49	–	–	–
TOTAL BUTEOS	642 ± 89.8	399	-38	–	–	–
Golden Eagle	89 ± 17.7	52	-42	30.6 ± 6.22	13.2	-57
Bald Eagle	47 ± 5.5	46	-2	14.2 ± 1.75	12.5	-12
Unidentified eagle	3 ± 1.4	8	+180	–	–	–
TOTAL EAGLES	139 ± 18.5	106	-24	–	–	–
American Kestrel	20 ± 4.0	16	-21	6.6 ± 1.63	4.7	-28
Merlin	67 ± 12.5	62	-8	26.2 ± 5.33	16.8	-36
Prairie Falcon	5 ± 1.5	3	-39	1.8 ± 0.49	0.8	-55
Peregrine Falcon	7 ± 2.5	11	+64	2.3 ± 1.00	2.7	+19
Unknown small falcon <sup>2</sup>	1 ± 1.3	0	-100	–	–	–
Unknown large falcon <sup>2</sup>	2 ± 2.7	0	-100	–	–	–
Unknown falcon	3 ± 1.4	2	-28	–	–	–
TOTAL FALCONS	104 ± 14.4	94	-9	–	–	–
Unidentified Raptor	26 ± 12.1	10	-61	–	–	–
ALL SPECIES	2841 ± 354.8	2479	-13	–	–	–

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

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

**Table 2. Fall counts by age class and immature : adult ratios for selected species of migrating raptors at Bonney Butte, OR: 1994–2007 versus 2008.**

	TOTAL AND AGE-CLASSIFIED COUNTS						IMMATURE : ADULT			
	1994–2007 AVERAGE			2008			% UNKNOWN AGE		RATIO	
	TOTAL	IMM.	ADULT	TOTAL	IMM.	ADULT	1994–2007 <sup>1</sup>	2008	1994–2007 <sup>1</sup>	2008
Northern Harrier	29	15	5	19	5	4	32 ± 5.6	53	4.4 ± 2.07	1.3
Sharp-shinned Hawk	1099	230	347	1003	277	259	48 ± 6.6	47	0.7 ± 0.17	1.1
Cooper's Hawk	340	99	76	316	131	66	48 ± 7.0	38	1.6 ± 0.66	2.0
Northern Goshawk	27	11	7	33	20	9	33 ± 7.9	12	2.2 ± 0.75	2.2
Broad-winged Hawk	7	1	1	5	1	4	41 ± 28.9	0	0.4 ± 0.39	0.3
Red-tailed Hawk	588	167	292	359	106	130	23 ± 4.1	34	0.6 ± 0.11	0.8
Golden Eagle	89	50	20	52	26	9	20 ± 3.1	33	3.4 ± 1.20	2.9
Bald Eagle	47	10	34	46	11	30	7 ± 3.1	11	0.3 ± 0.07	0.4
Peregrine Falcon	7	1	2	11	1	5	53 ± 4.7	45	0.9 ± 0.77	0.2

<sup>1</sup> Mean ± 95% confidence interval. For age ratios, note that long-term mean immature : adult ratios are averages of annual ratios and may differ from values obtained by dividing 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 migrating raptors at Bonney Butte, OR in 2008, with a comparison of 2008 and 1994–2007 average median passage dates.**

SPECIES	2008				1994–2007
	FIRST OBSERVED	LAST OBSERVED	BULK PASSAGE DATES <sup>1</sup>	MEDIAN PASSAGE DATE <sup>2</sup>	MEDIAN PASSAGE DATE <sup>2,3</sup>
Turkey Vulture	28-Aug	8-Oct	6-Sep – 28-Sep	18-Sep	23-Sep ± 1.2
Osprey	30-Aug	28-Oct	5-Sep – 2-Oct	16-Sep	19-Sep ± 1.8
Northern Harrier	1-Sep	27-Oct	2-Sep – 25-Oct	27-Sep	27-Sep ± 3.0
Sharp-shinned Hawk	30-Aug	30-Oct	11-Sep – 19-Oct	28-Sep	05-Oct ± 1.8
Cooper's Hawk	28-Aug	27-Oct	7-Sep – 8-Oct	23-Sep	26-Sep ± 1.8
Northern Goshawk	5-Sep	29-Oct	11-Sep – 19-Oct	29-Sep	02-Oct ± 3.7
Red-shouldered Hawk	28-Aug	27-Sep	–	–	26-Sep <sup>4</sup>
Broad-winged Hawk	10-Sep	27-Sep	10-Sep – 27-Sep	16-Sep	27-Sep ± 2.6
Red-tailed Hawk	29-Aug	29-Oct	3-Sep – 21-Oct	24-Sep	28-Sep ± 1.7
Rough-legged Hawk	1-Oct	29-Oct	6-Oct – 29-Oct	21-Oct	21-Oct ± 2.3
Golden Eagle	28-Aug	29-Oct	13-Sep – 24-Oct	14-Oct	12-Oct ± 1.9
Bald Eagle	9-Sep	26-Oct	24-Sep – 19-Oct	12-Oct	07-Oct ± 2.8
American Kestrel	2-Sep	10-Oct	2-Sep – 30-Sep	13-Sep	19-Sep ± 2.9
Merlin	7-Sep	29-Oct	16-Sep – 26-Oct	6-Oct	10-Oct ± 2.2
Prairie Falcon	12-Sep	27-Sep	–	–	19-Sep ± 6.1
Peregrine Falcon	15-Sep	17-Oct	18-Sep – 15-Oct	30-Sep	24-Sep ± 3.5
Total	2-Sep	30-Oct	8-Sep – 19-Oct	27-Sep	30-Sep ± 1.8

<sup>1</sup> Dates between which the central 80% of the flight passed the lookout.

<sup>2</sup> Date by which 50% of the flight had passed the lookout.

<sup>3</sup> Mean of annual values ± 95% confidence interval in days; unless otherwise indicated, values are given only for species with annual counts ≥5 birds for ≥3 years.

<sup>4</sup> Data for 2004 only.

**Table 4. Median passage dates by age for selected species of migrating raptors at Bonney Butte, OR: 1994–2007 versus 2008.**

SPECIES	ADULT		IMMATURE	
	1994–2007 <sup>1</sup>	2008	1994–2007 <sup>1</sup>	2008
Northern Harrier	04-Oct ± 6.7	–	26-Sep ± 2.2	8-Oct
Sharp-shinned Hawk	10-Oct ± 2.0	6-Oct	23-Sep ± 1.4	17-Sep
Cooper’s Hawk	03-Oct ± 2.2	28-Sep	20-Sep ± 2.4	15-Sep
Northern Goshawk	14-Oct ± 5.7	6-Oct	30-Sep ± 5.7	18-Sep
Red-tailed Hawk	02-Oct ± 2.4	27-Sep	21-Sep ± 2.2	17-Sep
Golden Eagle	13-Oct ± 1.4	30-Sep	10-Oct ± 2.4	14-Oct
Bald Eagle	06-Oct ± 3.3	12-Oct	11-Oct ± 3.6	12-Oct
Peregrine Falcon	02-Oct ± 2.9	6-Oct	12-Sep <sup>2</sup>	–

*Note:* Median passage dates are dates by which 50% of species/age-specific flights had passed; values are based only on annual counts ≥5 birds.

<sup>1</sup> Mean ± 95% confidence interval in days; values are given only for species with annual counts ≥5 birds for ≥ 3 years.

<sup>2</sup> Data for 2000 only.

**Table 5. Fall capture totals, rates, and successes by species for migrating raptors at Bonney Butte, OR: 1995–2007 versus 2008.**

	CAPTURE TOTALS		CAPTURE RATES <sup>1</sup>		CAPTURE SUCCESS <sup>2</sup>	
	1995–2007 <sup>3</sup>	2008	1995–2007 <sup>3</sup>	2008	1995–2007 <sup>3</sup>	2008
Northern Harrier	3 ± 1.7	4	1.0 ± 0.49	1.0	9.7 ± 5.56	21.1
Sharp-shinned Hawk	171 ± 44.5	246	65.7 ± 8.61	60.6	15.5 ± 4.45	22.1
Cooper's Hawk	56 ± 17.1	100	20.7 ± 4.03	24.6	16.4 ± 5.71	27.5
Northern Goshawk	8 ± 2.4	16	3.4 ± 0.75	3.9	37.9 ± 17.96	45.7
Red-shouldered Hawk	0.3 ± 0.4	1	0.1 ± 0.12	0.2	9.5 ± 18.67	33.3
Broad-winged Hawk	0.1 ± 0.2	1	0.03 ± 0.06	0.2	1.1 ± 2.18	20.0
Red-tailed Hawk	54 ± 17.2	45	20.0 ± 4.12	11.1	9.3 ± 3.42	12.0
Rough-legged Hawk	0.4 ± 0.3	1	0.2 ± 0.13	0.2	4.6 ± 5.18	5.9
Golden Eagle	2 ± 1.0	1	0.8 ± 0.35	0.2	2.3 ± 1.75	1.8
Bald Eagle	0.2 ± 0.2	0	0.1 ± 0.13	0.0	0.5 ± 0.49	0.0
American Kestrel	0.4 ± 0.4	1	0.1 ± 0.13	0.2	2.6 ± 2.64	6.3
Merlin	6 ± 2.3	8	2.3 ± 0.73	2.0	8.1 ± 2.96	12.7
Prairie Falcon	2 ± 0.8	1	0.6 ± 0.30	0.2	35.5 ± 18.48	33.3
Peregrine Falcon	1 ± 0.6	1	0.2 ± 0.21	0.2	7.3 ± 5.71	9.1
All species	305 ± 80.0	426	115.1 ± 14.79	104.9	12.9 ± 3.87	20.0

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

<sup>2</sup> Number of birds captured / number of birds observed. The combined-species value was calculated excluding Ospreys, Turkey Vultures, and unknown raptors from the count totals. Species-specific values were calculated after birds identified only to genus were allocated across possible species in proportion to the relative abundance of birds identified to those species.

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

**Table 6. Fall capture totals by sex and age (HY = hatching year; AHY = after hatching year), female : male capture ratios, and immature : adult capture ratios for selected species of migrating raptors at Bonney Butte, OR: 1995–2007 versus 2008.**

SPECIES	YEARS	FEMALE		MALE		FEMALE : MALE	IMMATURE : ADULT
		HY	AHY	HY	AHY	RATIO <sup>1</sup>	RATIO <sup>1</sup>
Sharp-shinned Hawk	1995–2007	53	40	55	25	1.2 ± 0.17	1.8 ± 0.48
	2008	81	55	76	35	1.2	1.7
Cooper's Hawk	1995–2007	24	13	16	4	2.0 ± 0.30	2.3 ± 0.50
	2008	45	21	26	8	1.9	2.4
Northern Goshawk	1995–2007	3	1	3	1	1.4 ± 0.86	2.8 ± 1.29
	2008	2	1	8	4	0.3	2.0

<sup>1</sup> Long-term values: mean ± 95% Confidence Interval (CI).

**Table 7. Fall body condition indices for migrant accipiters captured at Bonney Butte, OR: 1995–2007 versus 2008.**

SPECIES	YEARS	CROP FULLNESS					KEEL MUSCLE <sup>1</sup>			WING-PIT FAT <sup>2</sup>			
		E	1/4	1/2	3/4	F	0	1	2	0	1	2	3
Sharp-shinned Hawk	1995-2007 mean	52	24	12	5	8	1	70	29	10	59	23	8
	2008	69	16	7	5	3	0	80	20	6	57	31	6
Cooper's Hawk	1995-2007 mean	55	17	14	6	9	8	77	15	16	63	16	5
	2008	55	15	16	7	7	2	91	7	4	55	30	11
Northern Goshawk	1995-2007 mean	61	19	4	4	13	13	82	5	14	71	14	0
	2008	73	0	13	13	0	0	100	0	0	87	13	0

<sup>1</sup> Subjective rating based on visual and tactile assessment of keel muscle mass, with 0 indicating a skinny bird, 1 indicating a moderately healthy bird, and 2 indicating a bird with a robust keel muscle.

<sup>2</sup> Subjective rating based on visual assessment of fat deposit in the "wing-pit" hollow directly under the wing, with 0 indicating no fat, 1 indicating a modest fat deposit, 2 indicating a deposit that mostly fills the wing-pit, and 3 indicating a bulging deposit.

**Table 8. Foreign encounters in 2008 of raptors banded during autumn migration at Bonney Butte, Oregon.**

BAND #	SPECIES-SEX <sup>1</sup>	BANDING DATE	BANDING AGE <sup>2</sup>	ENCOUNTER DATE	ENCOUNTER AGE <sup>2</sup>	ENCOUNTER LOCATION	DISTANCE (km)	STATUS
1005-05861	CH-F	25-Sep-03	AHY	20-Jan-08	ATY	Temecula, CA	1184	found dead – cause unknown
1005-05874	CH-F	27-Sep-03	SY	15-Feb-08	ATY	Helendale, CA	1068	found dead – cause unknown
1177-25183	RT-U	02-Sep-08	HY	08-Sep-08	HY	Portland Airport, OR	144	captured/released

<sup>1</sup> CH = Cooper's Hawk; RT = Red-tailed Hawk.

<sup>2</sup> HY = hatch year, SY = second year, TY = third year, AHY = after hatch year, ASY = after second year, ATY = after third year.

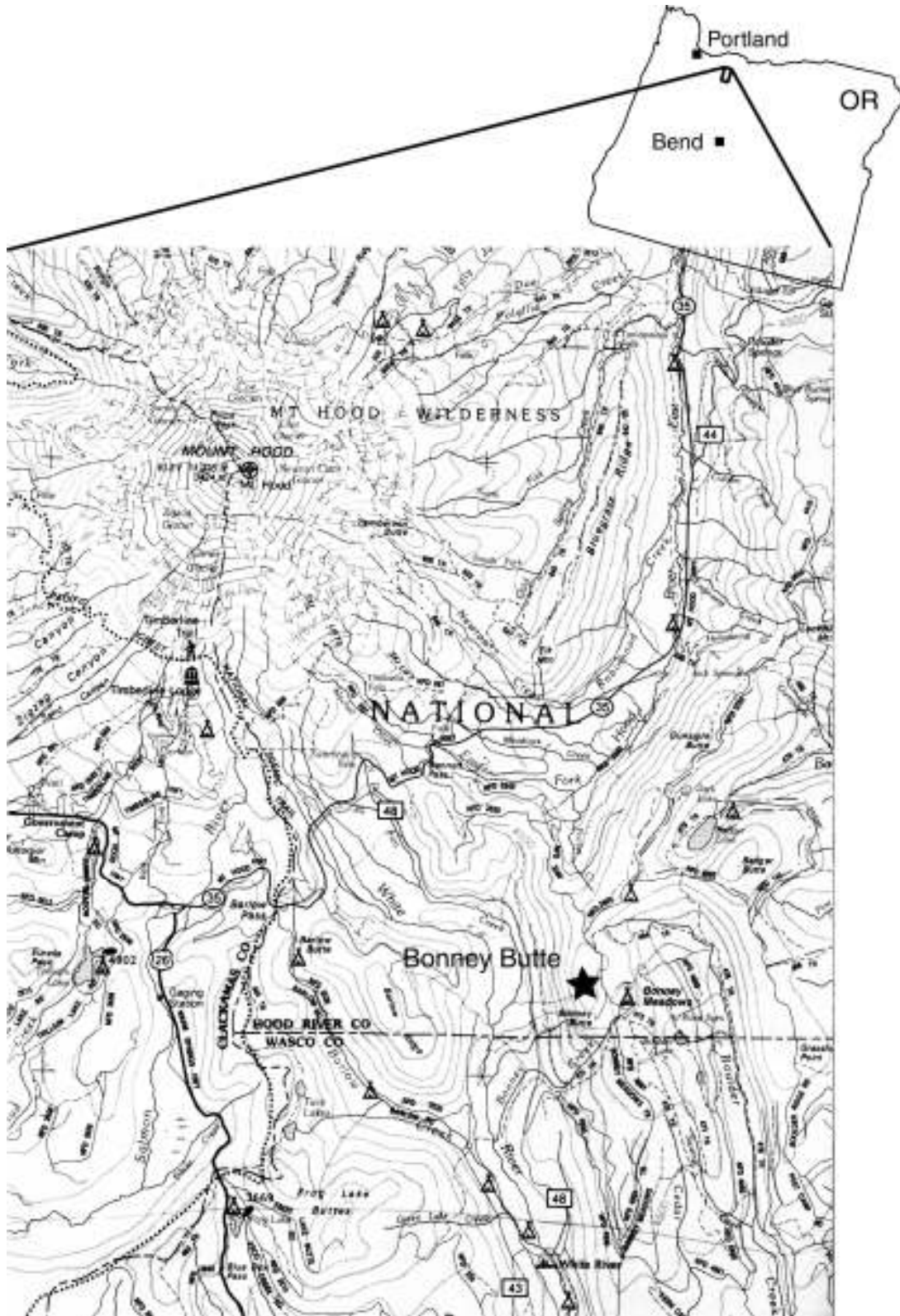
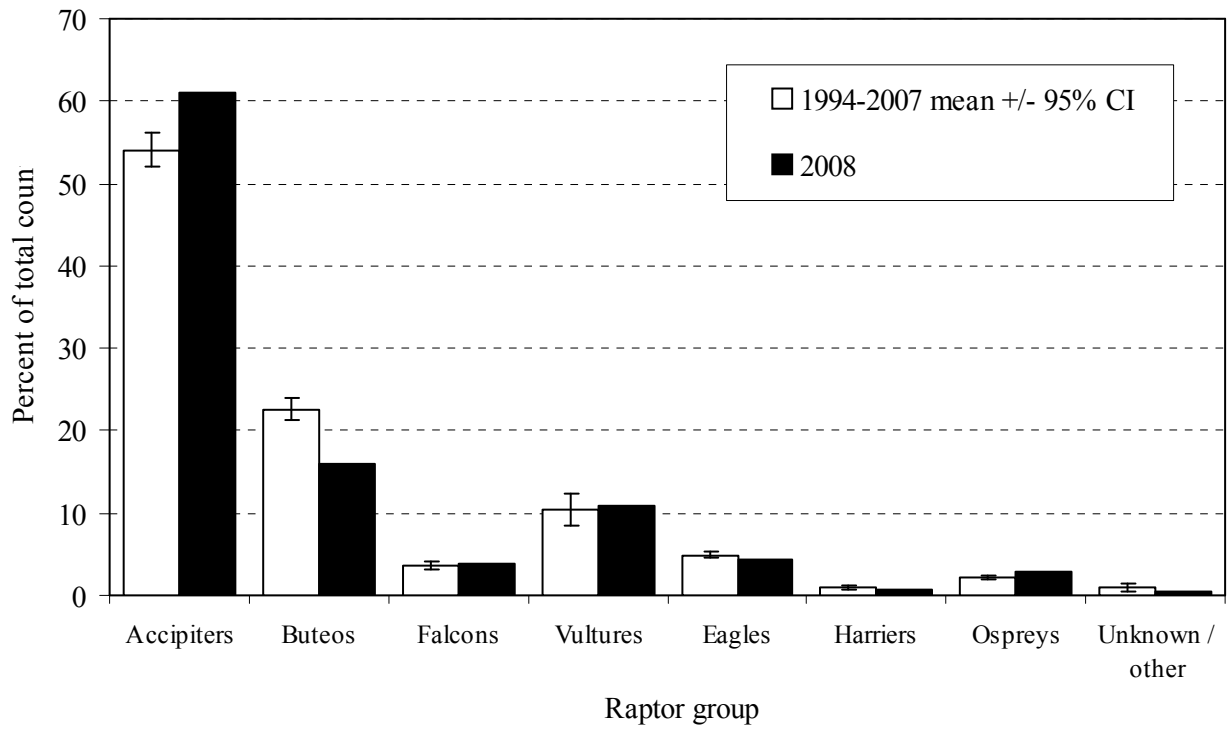
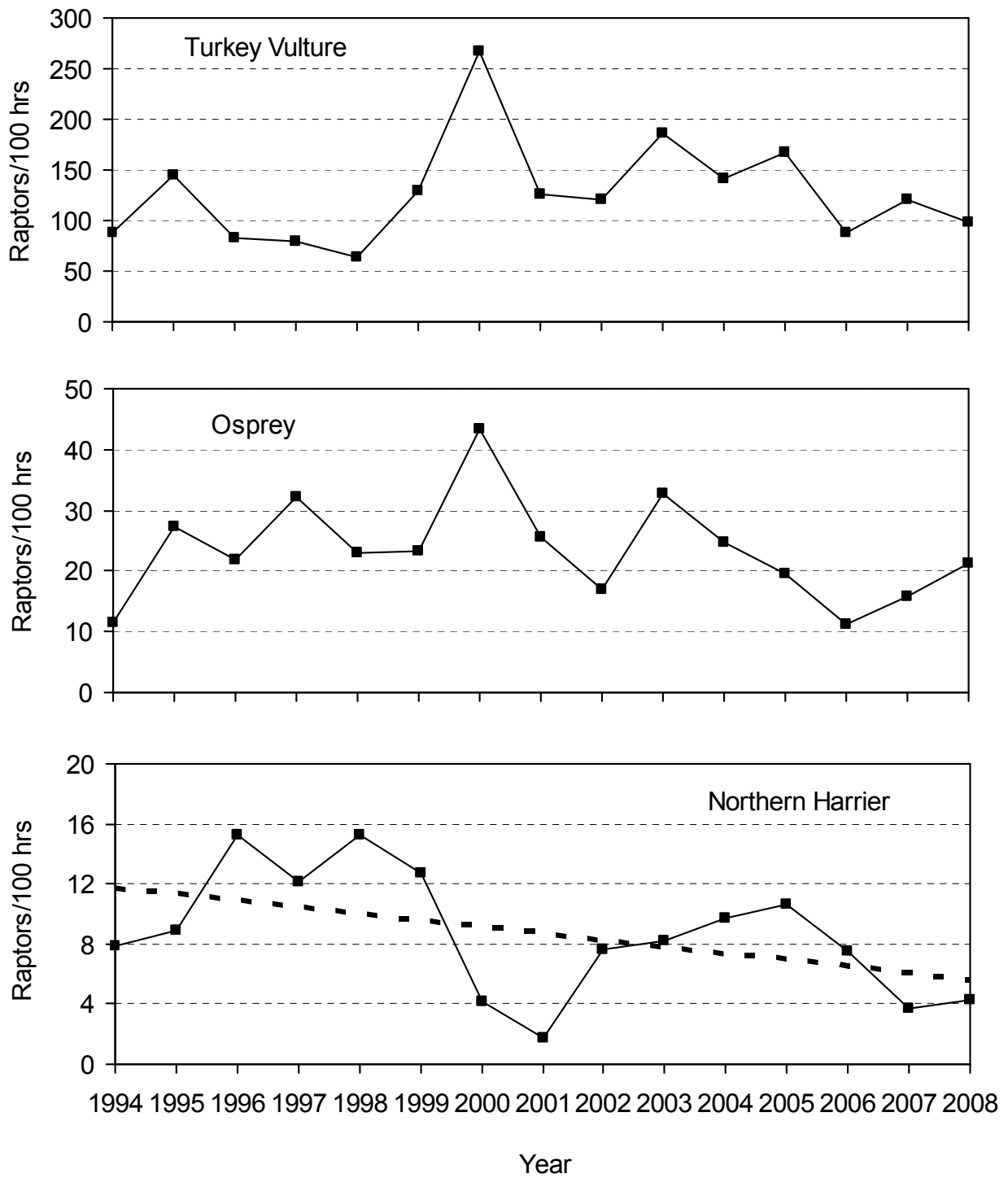


Figure 1. Location of the Bonney Butte Raptor Migration Project study site near Mt. Hood, Oregon.



**Figure 2. Fall raptor migration flight composition by major species groups at Bonney Butte, Oregon: 1994–2007 versus 2008.**



**Figure 3. Adjusted, fall-migration passage rates for Turkey Vultures, Ospreys, and Northern Harriers at Bonney Butte, Oregon: 1994–2008. Dashed lines indicate significant ( $P < 0.10$ ) regressions.**



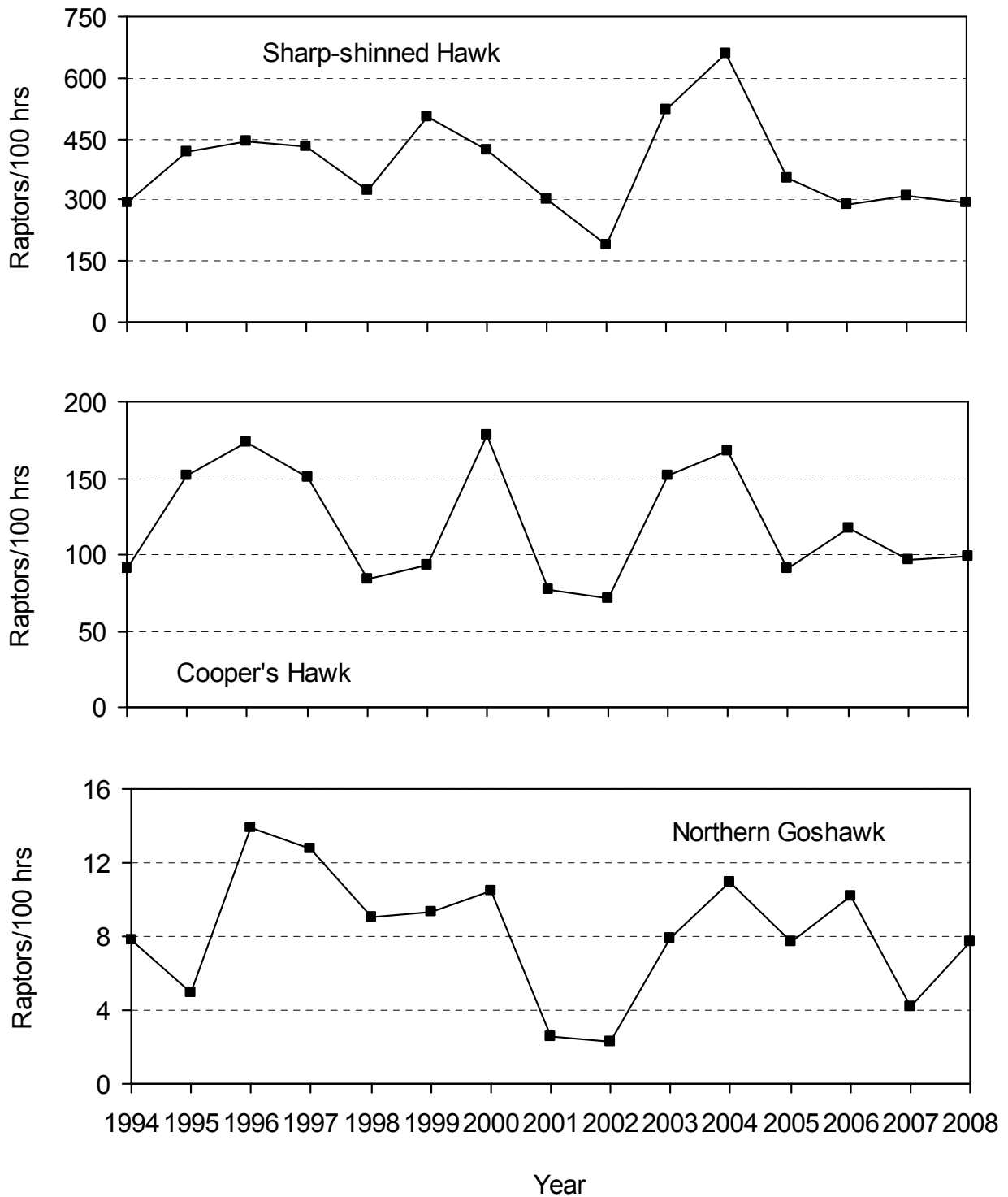
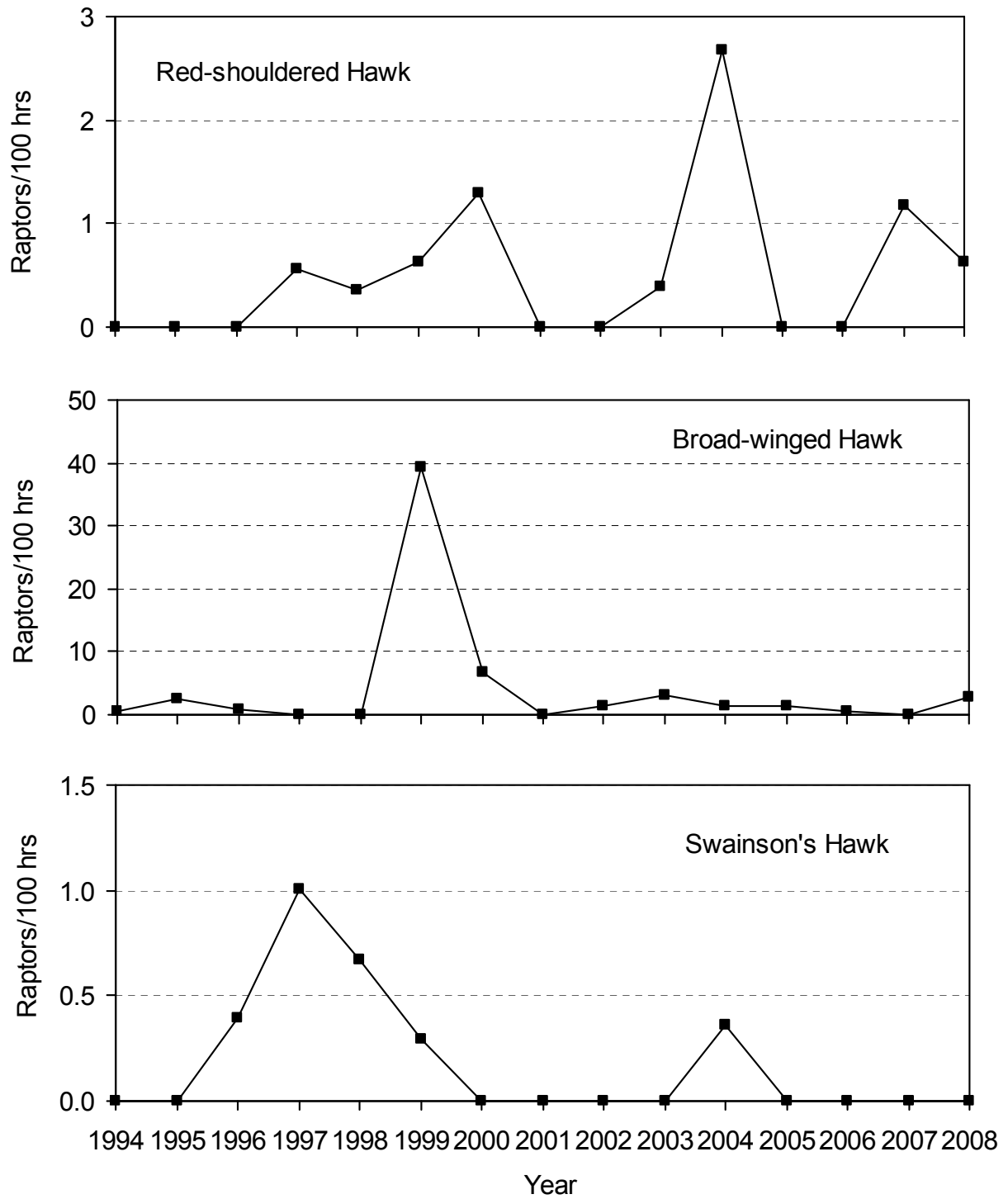


Figure 4. Adjusted, fall-migration passage rates for Sharp-shinned Hawks, Cooper's Hawks, and Northern Goshawks at Bonney Butte, Oregon: 1994–2008. Dashed lines indicate significant ( $P < 0.10$ ) regressions.



**Figure 5. Adjusted, fall-migration passage rates for Red-shouldered, Broad-winged, and Swainson's Hawks at Bonney Butte, Oregon: 1994–2008. Dashed lines indicate significant ( $P < 0.10$ ) regressions.**

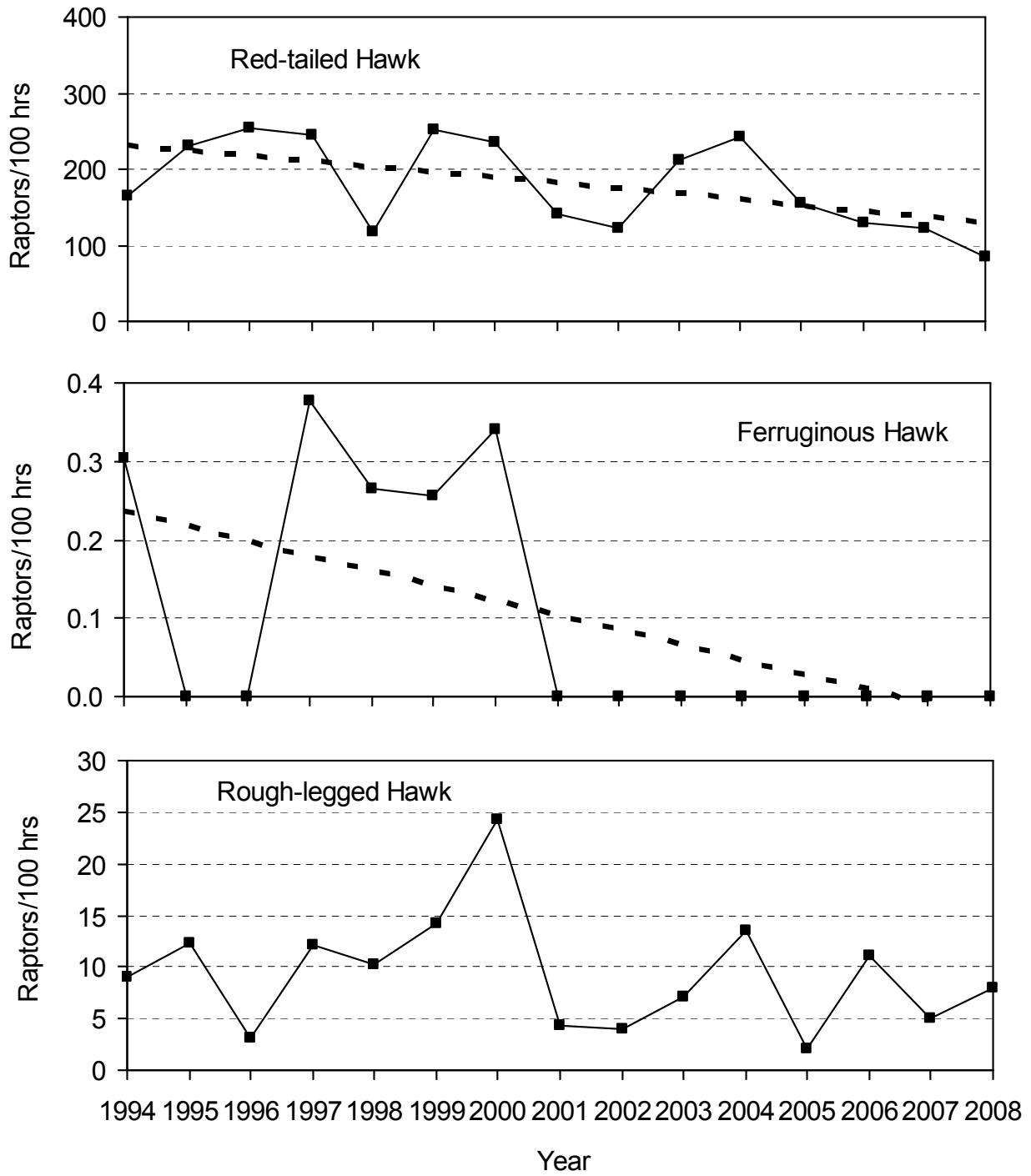


Figure 6. Adjusted, fall-migration passage rates for Red-tailed and Rough-legged Hawks at Bonney Butte, Oregon: 1994–2008. Dashed lines indicate significant ( $P < 0.10$ ) regressions.

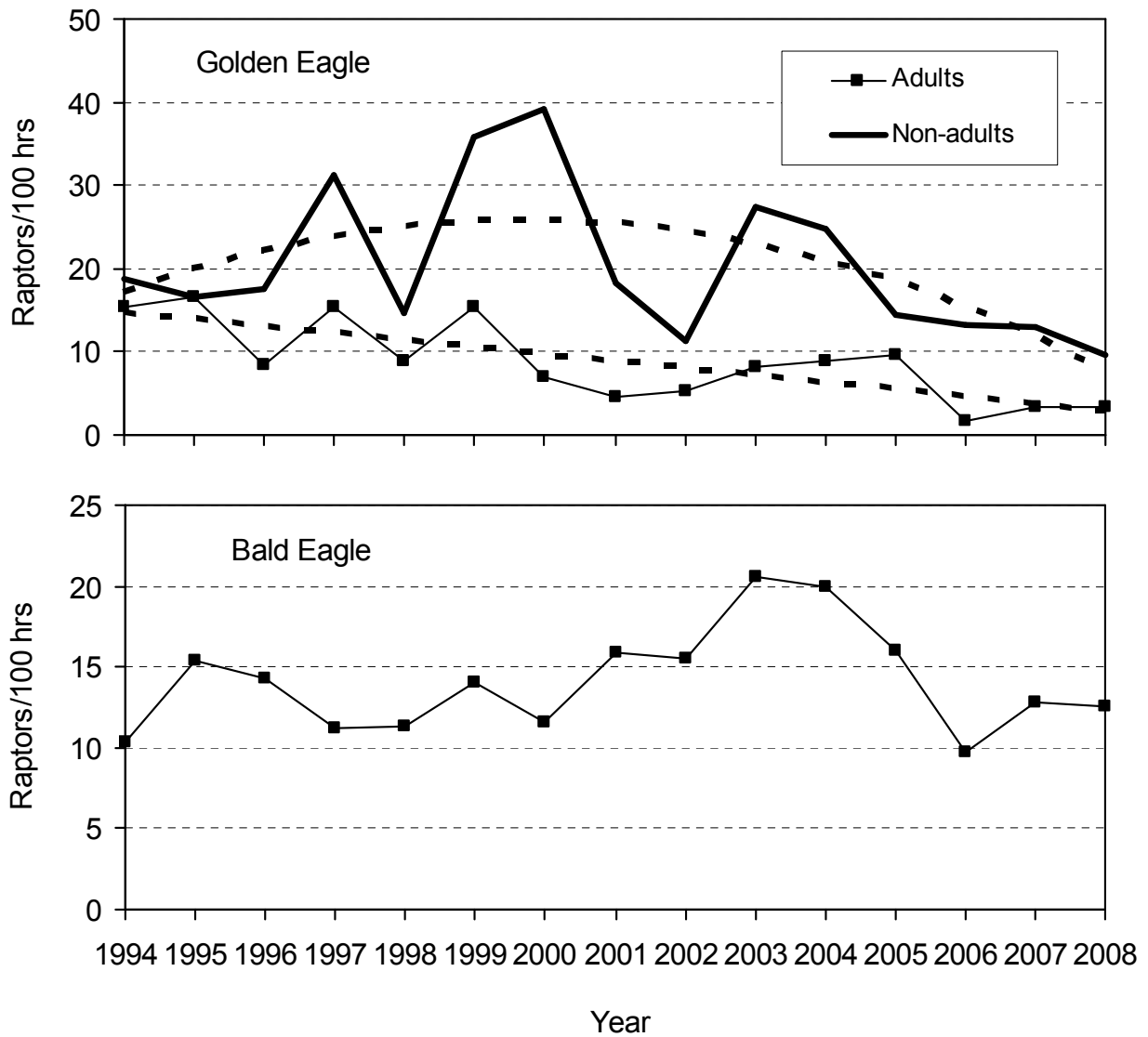


Figure 7. Adjusted, fall-migration passage rates for Golden and Bald Eagles at Bonney Butte, Oregon: 1994–2008. Dashed lines indicate significant ( $P < 0.10$ ) regressions.

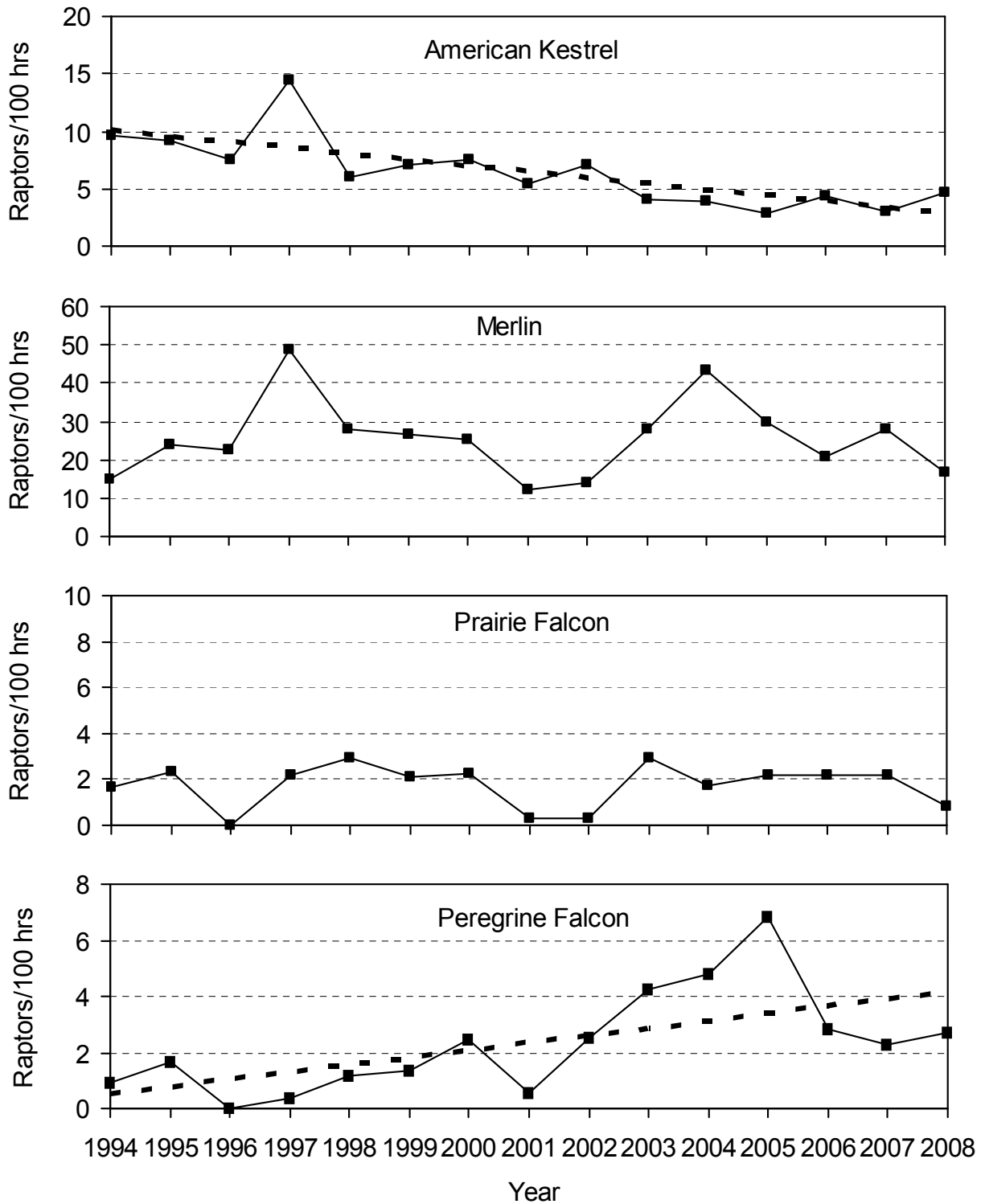
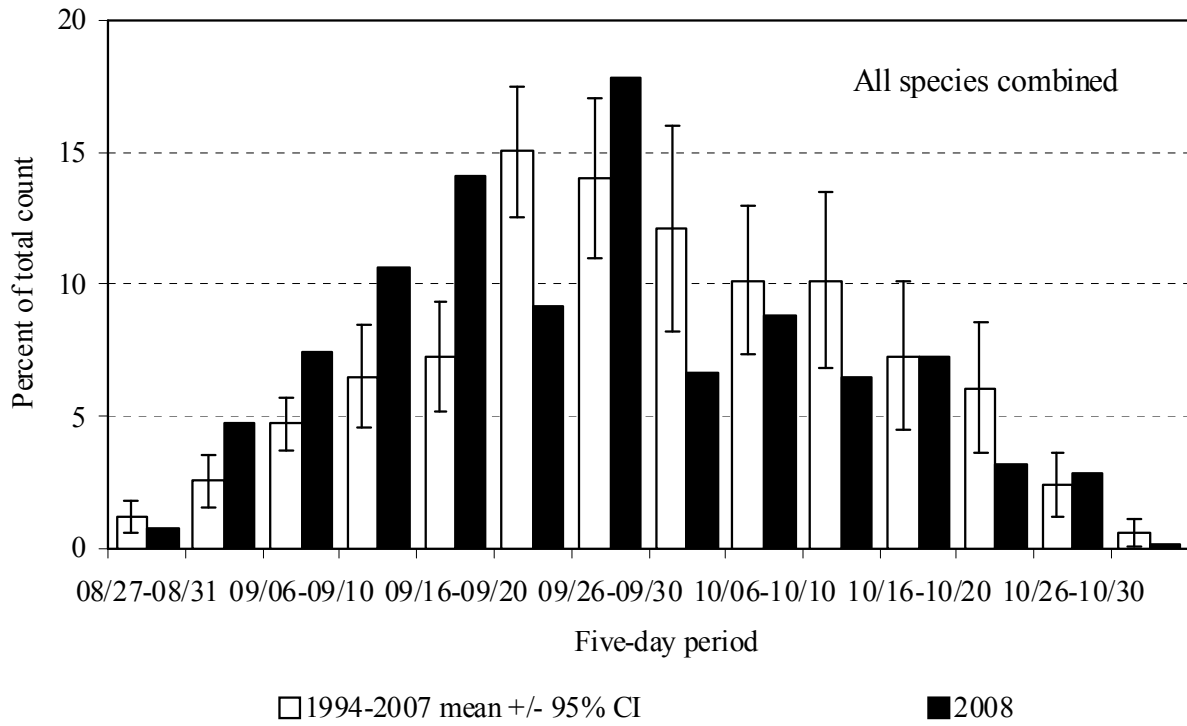


Figure 8. Adjusted, fall-migration passage rates for American Kestrels, Merlins, Prairie Falcons, Peregrine Falcons at Bonney Butte, Oregon: 1994–2008. Dashed lines indicate significant ( $P < 0.10$ ) regressions.



**Figure 9. Combined-species passage volume by five-day periods for migrating raptors at Bonney Butte, Oregon: 1994–2007 versus 2008.**

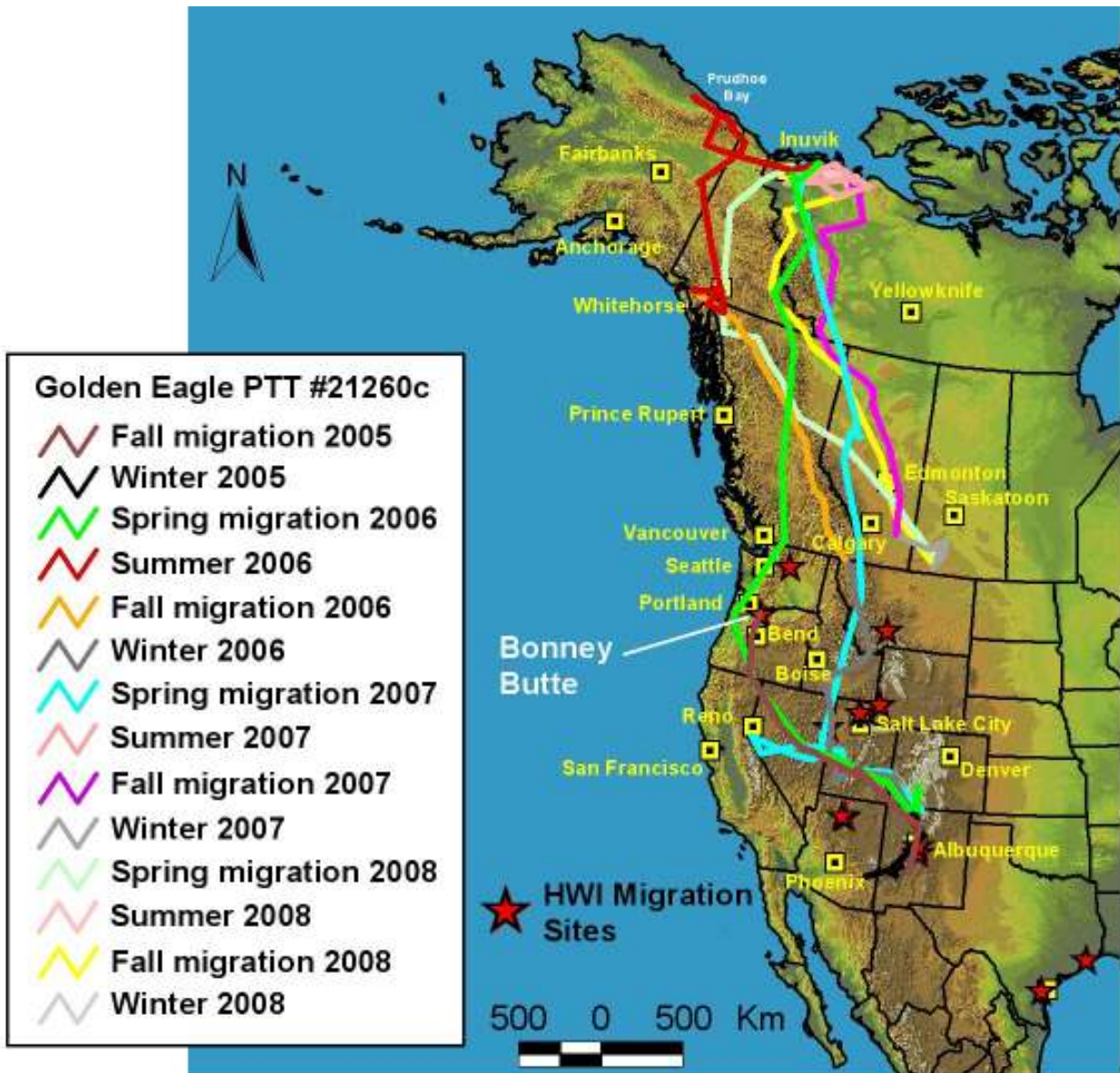


Figure 10. Satellite tracking map for a male Golden Eagle outfitted at Bonney Butte as a hatch-year bird in 2005.

**Appendix A. A history of observer participation in the Bonney Butte Raptor Migration Project in northern Oregon.**

- 1994:** Single observer throughout: David Schuetze (0) and Sean O'Connor (0)<sup>1</sup>.
- 1995:** Two observers throughout: David Schuetze (1) and Alison Clark (0).
- 1996:** Two observers throughout: David Schuetze (2) and Alison Clark (1).
- 1997:** Two observers throughout: Rose Jaffe (0) and Sean Donaghy (0).
- 1998:** Two observers throughout: Nick Vulgares (1) and Jeremy Davit (0).
- 1999:** Two observers throughout: Nick Vulgares (3) and Sue Vulgares (0).
- 2000:** Two observers throughout: Nick Vulgares (5) and Sue Vulgares (2).
- 2001:** Two observers throughout: Alison Cebula Benedict (1) and Eric Hallingstad (0).
- 2002:** Two observers throughout: Eric Hallingstad (1) and Sue Bruner (1).
- 2003:** Two observers throughout: David Haines (0) and Lindsay Reynolds (0).
- 2004:** Two observers throughout: David Haines (1) and Amy Scarpignato (1 partial).
- 2005:** Two observers throughout: Sean Wolfe (0), Jim DeStaebler (0), and James Cederstrom (0)
- 2006:** Two observers throughout: Justin Feld (0), Juliet Lamb (0), Jakob Roy (0), and assisted by Amanda Gladics (+).
- 2007:** Two observers throughout: Mary Coolidge (1), Sue Bruner (2), and Justin Roberge (0)
- 2008:** Two observers throughout: Aaron Viducich (1), James Butch (0), and Nicholle Stephens (0)

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



**Appendix B. Common and scientific names, species codes, and regularly applied age, sex, and color-morph classifications for all diurnal raptor species observed during fall migration at Bonney Butte, Oregon.**

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

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

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

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

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

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

**Appendix C. Daily observation effort, visitor disturbance ratings, weather records, and flight summaries for the Bonney Butte Raptor Migration Project in northern Oregon: 2008.**

DATE	OBS. HOURS	OBSRVR / HOUR <sup>1</sup>	MEDIAN VISITOR DISTURB <sup>2</sup>	PREDOMINANT WEATHER <sup>3</sup>	WIND SPEED (KPH) <sup>1</sup>	WIND DIRECTION	TEMP (°C) <sup>1</sup>	BAROM. PRESS. (IN HG) <sup>1</sup>	MEDIAN THERMAL LIFT <sup>4</sup>	VISIB. WEST (KM) <sup>1</sup>	VISIB. EAST (KM) <sup>1</sup>	MEDIAN FLIGHT DISTANCE <sup>5</sup> / HOUR	BIRDS
27-Aug	0.00			weather day: fog/rain									
28-Aug	9.00	2.8	0	clr-pc	7.5	w	18.1	30.69	2	100	83	2	0.6
29-Aug	9.00	2.4	0	clr	4.9	sw-nw	19.7	30.48	2	100	100	2	0.9
30-Aug	9.00	2.0	0	clr-pc	11.5	sw-wnw	9.2	30.31	4	95	57	2	0.7
31-Aug	3.33	2.5	0	ovc, fog/rain/snow	6.3	sw	7.5	30.33	4	14	1	2	0.3
1-Sep	9.00	3.3	0	ovc-pc, AM fog	7.1	sw-wnw/var	12.3	30.61	4	68	22	2	3.4
2-Sep	9.00	2.2	0	ovc-clr, haze	2.8	n, sw	16.1	30.64	3	82	81	2	3.1
3-Sep	9.00	3.0	1	clr, AM haze	6.5	w-wnw	15.6	30.63	3	94	91	2	3.3
4-Sep	9.00	2.0	0	clr, haze	5.0	var, sw-wnw	17.5	30.63	2	85	96	2	3.0
5-Sep	9.00	2.7	0	clr-pc, haze	6.6	wnw-nw	19.1	30.65	3	92	94	2	2.6
6-Sep	9.00	2.9	0	clr-pc	1.9	calm/var	19.2	30.59	2	96	96	2	6.3
7-Sep	9.00	2.8	0	clr, haze	8.5	ne	16.6	30.58	3	97	100	1	1.7
8-Sep	9.00	2.0	0	clr, haze	4.1	ne, n	17.9	30.45	3	98	100	1	3.8
9-Sep	9.00	2.0	1	clr, haze	6.7	sw-wnw	18.4	30.36	3	81	95	2	6.1
10-Sep	9.00	4.1	1	clr, haze	7.2	ne, calm	16.5	30.55	3	77	75	2	6.1
11-Sep	9.00	3.4	0	clr, haze	8.8	ne-ene	18.7	30.57	3	77	79	2	3.9
12-Sep	9.00	3.2	0	clr, haze	5.3	sw-w, var	19.5	30.50	3	78	87	2	3.6
13-Sep	9.00	3.4	1	clr, haze	6.8	n-e	16.9	30.59	3	59	58	1	6.9
14-Sep	9.00	4.2	1	clr, haze	8.8	ne-ene	19.3	30.68	3	59	67	2	8.9
15-Sep	9.00	2.0	0	clr, haze	3.6	ene-ese, sw-wnw	24.2	30.69	2	44	51	1	6.4
16-Sep	9.00	2.8	1	clr, haze	8.6	ene-se	24.8	30.61	3	40	46	1	8.7
17-Sep	9.00	2.6	0	clr, haze	5.0	ene, sse-sw	25.5	30.55	3	17	23	2	11.7
18-Sep	9.00	4.8	0	mc-pc, haze	4.5	se, sw-wnw	21.5	30.51	3	26	30	2	9.9
19-Sep	9.00	3.0	0	pc-mc, haze, scat rain	6.9	calm, w	18.9	30.48	3	30	30	1	2.1
20-Sep	4.00	3.3	2	ovc, fog/rain	12.6	sw/var	7.8	30.41	4	20	2	2	0.8
21-Sep	0.00			weather day: rain									
22-Sep	3.50	1.3	0	ovc, fog/rain/snow	6.7	sse-sw	5.1	30.57	4	2	1	2	0.3
23-Sep	9.00	2.0	0	pc-mc	6.6	e-se, calm/var	10.3	30.61	3	84	91	2	14.6
24-Sep	8.50	2.7	0	pc-ovc, PM fog/rain	7.5	sw-wsw	13.8	30.42	4	54	63	2	10.8
25-Sep	0.75	1.0	0	ovc, fog	10.0	sw	8.0	30.45	4	0	0	-	0.0
26-Sep	9.00	3.0	1	pc, haze	7.7	e, sw-w/calm	13.4	30.56	4	50	48	1	7.8
27-Sep	9.00	2.8	2	clr	2.6	sw-wnw/calm	15.7	30.66	2	75	82	2	13.2
28-Sep	9.00	3.7	1	clr, haze	11.5	ne-ene	16.1	30.71	3	71	78	1	13.2
29-Sep	9.00	3.0	0	clr-pc, haze	15.4	ne-ene	18.5	30.66	3	71	78	2	14.9
30-Sep	8.00	2.0	0	clr-ovc, haze	2.4	calm, ne-e	20.1	30.66	2	76	59	2	10.9
1-Oct	9.00	2.7	0	clr-ovc	3.3	calm/var	20.5	30.57	3	71	71	2	4.6
2-Oct	9.00	3.2	0	ovc, haze/scat rain	6.7	sw-wnw	11.4	30.33	4	47	40	2	4.1
3-Oct	0.00			weather day: fog/rain									
4-Oct	0.00			weather day: fog/rain									
5-Oct	0.00			weather day: rain/snow									
6-Oct	9.00	3.7	0	mc-ovc, AM fog	7.5	sw-wnw	10.7	30.53	4	52	44	2	10.6
7-Oct	5.50	3.5	0	ovc, fog, AM rain	14.1	sw-w	4.9	30.67	4	9	6	2	5.8
8-Oct	9.25	5.5	1	clr-mc	2.4	calm/var	5.1	30.70	3	81	63	2	9.6
9-Oct	0.50	1.0	0	ovc, fog/snow	7.5	var	2.5	30.49	4	2	1	2	4.0
10-Oct	9.00	2.1	0	pc-mc, snow	4.7	sw-wnw	1.9	30.54	4	40	35	2	2.1
11-Oct	9.00	2.0	0	clr	5.7	w-nnw	2.8	30.58	4	48	74	2	2.3
12-Oct	9.00	2.9	0	ovc-clr, scat rain	8.8	sw-wnw	6.5	30.68	4	56	61	2	8.9
13-Oct	7.50	2.4	0	mc-ovc, fog	9.1	sw-wsw/var	11.3	30.87	4	10	2	1	0.8
14-Oct	9.00	3.4	0	clr-pc	3.8	calm, sw-wnw	6.1	30.74	4	69	45	2	3.8
15-Oct	9.00	2.0	0	clr-ovc	5.3	calm, sw	6.3	30.54	3	66	75	2	3.6

Appendix C. continued

DATE	OBS. HOURS	OBSRVR / HOUR <sup>1</sup>	MEDIAN VISITOR DISTURB <sup>2</sup>	PREDOMINANT WEATHER <sup>3</sup>	WIND SPEED (KPH) <sup>1</sup>	WIND DIRECTION	TEMP (°C) <sup>1</sup>	BAROM. PRESS. (IN HG) <sup>1</sup>	MEDIAN THERMAL LIFT <sup>4</sup>	VISIB. WEST (KM) <sup>1</sup>	VISIB. EAST (KM) <sup>1</sup>	MEDIAN FLIGHT DISTANCE <sup>5</sup>	BIRDS / HOUR
16-Oct	0.00			weather day: fog/rain									
17-Oct	9.00	3.0	0	clr-pc	5.7	sw	13.8	30.62	3	74	72	2	4.3
18-Oct	6.50	2.6	0	mc-ovc, fog	8.1	sw-wnw	10.4	30.53	4	16	18	2	2.0
19-Oct	9.00	4.6	0	clr-mc	3.4	ne, sw	10.5	30.55	3	58	68	2	10.7
20-Oct	1.00	3.0	0	mc-ovc, fog/snow	21.0	sw	3.7	30.37	4	17	17	1	1.0
21-Oct	7.75	3.6	0	clr	4.2	calm/ne-ene	3.4	30.89	3	77	58	2	2.1
22-Oct	9.00	4.2	0	clr, haze	11.8	ne-e, se	6.5	30.78	4	62	57	2	5.1
23-Oct	9.00	2.8	0	mc-ovc, AM haze, PM fog	5.4	sw-wnw	8.1	30.62	4	17	14	2	0.7
24-Oct	9.00	3.0	0	pc, haze	3.0	calm/var, w	11.3	30.71	3	55	51	2	1.2
25-Oct	9.00	2.7	0	pc	0.5	calm, ene	10.5	30.79	3	62	57	3	1.1
26-Oct	9.00	3.0	0	clr, haze	18.1	ne	6.3	30.77	4	64	55	1	0.8
27-Oct	9.00	3.2	0	clr, haze	4.2	ne-ene, calm/var	12.8	30.76	4	67	53	2	2.9
28-Oct	9.00	3.7	0	pc, haze	2.3	calm/se, sw-w	14.2	30.73	3	60	50	2	0.4
29-Oct	9.00	4.7	0	pc, haze	5.5	sw-w	12.9	30.50	4	68	54	2	2.7
30-Oct	9.00	3.0	0	ovc, haze, PM rain	4.9	se-sw	12.0	30.43	4	58	55	1	0.3
31-Oct	1.75	2.0	0	ovc, fog/rain	6.8	se, wsw	8.3	30.44	4	26	15	-	0.0

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

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

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

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

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

**Appendix D. Daily observation effort and fall raptor migration counts by species at Bonney Butte, Oregon: 2008.**

DATE	OBS		SPECIES <sup>1</sup>																								BIRDS				
	HOURS	TV	OS	NH	SS	CH	NG	SA	LA	UA	RS	BW	SW	RT	FH	RL	UB	GE	BE	UE	AK	ML	PR	PG	SF	LF	UF	UU	TOTAL	/ HOUR	
27-Aug	0.00																														
28-Aug	9.00	1	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	5	0.6
29-Aug	9.00	2	0	0	0	0	0	1	0	0	0	0	0	3	0	0	0	2	0	0	0	0	0	0	0	0	0	0	8	0.9	
30-Aug	9.00	1	1	0	1	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0.7	
31-Aug	3.33	0	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	
1-Sep	9.00	5	2	1	8	1	0	0	0	1	0	0	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31	3.4	
2-Sep	9.00	3	1	1	8	2	0	0	0	0	1	0	0	10	0	0	0	0	0	0	2	0	0	0	0	0	0	0	28	3.1	
3-Sep	9.00	3	2	0	8	5	0	2	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	3.3	
4-Sep	9.00	1	0	0	8	6	0	0	0	1	0	0	0	10	0	0	0	0	0	0	1	0	0	0	0	0	0	0	27	3.0	
5-Sep	9.00	7	2	0	2	4	1	0	1	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	2.6	
6-Sep	9.00	5	1	0	27	10	0	0	0	5	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	57	6.3	
7-Sep	9.00	4	0	0	3	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	15	1.7	
8-Sep	9.00	6	0	0	7	9	0	2	0	0	0	0	0	9	0	0	0	1	0	0	0	0	0	0	0	0	0	0	34	3.8	
9-Sep	9.00	4	5	1	13	11	0	2	0	0	0	0	0	14	0	0	0	0	2	0	1	1	0	0	0	0	1	0	55	6.1	
10-Sep	9.00	10	2	0	13	12	1	4	0	2	0	2	0	4	0	0	1	1	1	0	0	1	0	0	0	0	0	1	55	6.1	
11-Sep	9.00	11	3	0	6	5	2	3	0	0	0	0	0	4	0	0	0	0	0	0	1	0	0	0	0	0	0	0	35	3.9	
12-Sep	9.00	4	1	0	5	2	0	5	0	0	0	0	0	13	0	0	0	0	0	0	0	1	1	0	0	0	0	0	32	3.6	
13-Sep	9.00	13	3	0	19	14	1	3	1	0	0	0	0	5	0	0	0	1	0	0	2	0	0	0	0	0	0	0	62	6.9	
14-Sep	9.00	17	4	1	25	13	2	4	0	1	0	0	0	11	0	0	0	0	0	0	0	1	0	0	0	0	0	1	80	8.9	
15-Sep	9.00	12	5	1	16	12	0	4	3	0	0	0	0	3	0	0	0	0	0	0	0	1	0	1	0	0	0	0	58	6.4	
16-Sep	9.00	13	5	1	32	5	2	0	0	0	0	2	0	14	0	0	0	0	0	0	2	1	0	0	0	0	0	1	78	8.7	
17-Sep	9.00	9	2	1	55	18	0	7	0	2	0	0	0	9	0	0	0	1	0	0	1	0	0	0	0	0	0	0	105	11.7	
18-Sep	9.00	13	5	0	39	9	2	1	1	4	0	0	0	10	0	0	1	0	0	0	0	3	0	1	0	0	0	0	89	9.9	
19-Sep	9.00	3	4	0	9	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	19	2.1	
20-Sep	4.00	0	2	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	3	0.8	
21-Sep	0.00																														
22-Sep	3.50	0	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	
23-Sep	9.00	33	1	1	53	14	2	4	0	2	0	0	0	14	0	0	0	1	1	0	0	2	1	0	0	0	0	2	131	14.6	
24-Sep	8.50	28	4	0	28	10	0	3	1	0	0	0	0	12	0	0	1	2	1	0	0	1	0	1	0	0	0	0	92	10.8	
25-Sep	0.75	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	0.0	
26-Sep	9.00	10	0	1	42	6	0	1	0	1	0	0	0	7	0	0	1	0	0	0	0	0	1	0	0	0	0	0	70	7.8	
27-Sep	9.00	18	3	1	45	27	1	2	0	4	1	1	0	10	0	0	1	0	1	0	0	3	1	0	0	0	0	0	119	13.2	
28-Sep	9.00	16	0	0	61	17	0	4	0	3	0	0	0	12	0	0	0	0	4	0	1	1	0	0	0	0	0	0	119	13.2	
29-Sep	9.00	3	2	0	68	19	3	16	3	3	0	0	0	8	0	0	0	4	0	0	0	3	0	1	0	0	0	1	134	14.9	
30-Sep	8.00	2	1	0	42	17	2	6	0	1	0	0	0	6	0	0	0	4	0	0	3	2	0	1	0	0	0	0	87	10.9	
1-Oct	9.00	0	1	1	25	7	0	1	0	1	0	0	0	1	0	1	0	0	0	0	0	3	0	0	0	0	0	0	41	4.6	
2-Oct	9.00	1	1	1	24	0	0	4	0	1	0	0	0	2	0	0	1	0	0	0	0	2	0	0	0	0	0	0	37	4.1	
3-Oct	0.00																														

Appendix D. continued

DATE	OBS		SPECIES <sup>1</sup>																							BIRDS						
	HOURS	TV	OS	NH	SS	CH	NG	SA	LA	UA	RS	BW	SW	RT	FH	RL	UB	GE	BE	UE	AK	ML	PR	PG	SF	LF	UF	UU	TOTAL	/HOUR		
4-Oct	0.00																															
5-Oct	0.00																															
6-Oct	9.00	5	0	0	46	15	2	4	1	0	0	0	0	12	0	1	0	2	0	0	0	5	0	2	0	0	0	0	95	10.6		
7-Oct	5.50	0	0	0	18	1	0	7	0	0	0	0	0	4	0	0	0	0	0	1	0	1	0	0	0	0	0	0	32	5.8		
8-Oct	9.25	6	2	1	30	10	0	5	0	1	0	0	0	25	0	0	2	0	1	0	0	5	0	1	0	0	0	89	9.6			
9-Oct	0.50	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	2	4.0			
10-Oct	9.00	0	0	0	3	0	1	1	0	2	0	0	0	4	0	0	1	0	2	4	1	0	0	0	0	0	0	19	2.1			
11-Oct	9.00	0	2	0	10	1	0	1	0	0	0	0	0	3	0	0	1	2	1	0	0	0	0	0	0	0	0	21	2.3			
12-Oct	9.00	0	0	2	32	8	0	2	0	0	0	0	0	9	0	0	1	3	18	2	0	2	0	0	0	0	1	80	8.9			
13-Oct	7.50	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	6	0.8			
14-Oct	9.00	0	0	0	8	5	0	1	0	2	0	0	0	14	0	2	1	1	0	0	0	0	0	0	0	0	0	34	3.8			
15-Oct	9.00	0	0	2	22	2	0	1	0	0	0	0	0	2	0	0	1	0	1	0	0	0	0	1	0	0	0	32	3.6			
16-Oct	0.00																															
17-Oct	9.00	0	0	0	13	2	4	3	0	0	0	0	0	7	0	1	1	3	2	0	0	2	0	1	0	0	0	39	4.3			
18-Oct	6.50	0	1	0	4	0	1	2	0	0	0	0	0	3	0	0	0	2	0	0	0	0	0	0	0	0	0	13	2.0			
19-Oct	9.00	0	0	0	64	6	2	2	0	0	0	0	0	6	0	2	0	5	4	0	0	5	0	0	0	0	0	96	10.7			
20-Oct	1.00	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	0	1	1.0			
21-Oct	7.75	0	1	0	7	0	0	0	0	0	0	0	0	5	0	1	0	2	0	0	0	0	0	0	0	0	0	16	2.1			
22-Oct	9.00	0	0	0	24	0	1	1	0	0	0	0	0	10	0	4	0	4	0	0	0	2	0	0	0	0	0	46	5.1			
23-Oct	9.00	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	1	6	0.7			
24-Oct	9.00	0	0	0	1	0	0	0	0	0	0	0	0	2	0	2	0	4	1	0	0	1	0	0	0	0	0	11	1.2			
25-Oct	9.00	0	0	1	4	0	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0	2	0	0	0	0	0	10	1.1			
26-Oct	9.00	0	0	0	3	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	2	0	0	0	0	0	7	0.8			
27-Oct	9.00	0	0	1	7	1	0	0	1	0	0	0	0	7	0	0	1	4	0	1	0	1	0	0	0	0	1	26	2.9			
28-Oct	9.00	0	1	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	4	0.4			
29-Oct	9.00	0	0	0	7	0	1	0	0	0	0	0	0	9	0	2	0	1	0	0	0	3	0	0	0	0	0	1	24	2.7		
30-Oct	9.00	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0.3			
31-Oct	1.75	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			
Total	481.83	269	70	19	1003	316	33	111	12	37	3	5	0	359	0	16	16	52	46	8	16	62	3	11	0	0	2	10	2479	5.1		

<sup>1</sup> See Appendix B for full names associated with species codes.

**Appendix E. Annual observation effort and fall raptor migration counts by species at Bonney Butte, Oregon: 1994–2008.**

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Start date	2-Sep	4-Sep	1-Sep	1-Sep	1-Sep	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug
End date	25-Oct	31-Oct	2-Nov	3-Nov	30-Oct	28-Oct	30-Oct	28-Oct	31-Oct	31-Oct
Observation days	47	38	46	45	52	63	48	58	59	51
Observation hours	327.74	251.51	285.82	286.25	384.91	416.00	328.50	415.75	423.67	402.65
Raptors / 100 hours	688.4	939.9	959.7	953.7	631.8	993.5	1029.5	601.1	453.7	948.0
SPECIES	RAPTOR COUNTS									
Turkey Vulture	204	235	165	133	160	349	553	338	286	488
Osprey	32	49	55	60	67	74	107	78	50	97
Northern Harrier	25	22	39	30	56	49	13	7	27	28
Sharp-shinned Hawk	857	871	1027	912	1018	1660	1105	957	600	1578
Cooper's Hawk	282	310	420	317	266	331	456	256	233	473
Northern Goshawk	25	12	40	34	33	36	31	10	8	29
Unknown small accipiter <sup>1</sup>	–	–	–	–	–	–	–	84	11	33
Unknown large accipiter <sup>1</sup>	–	–	–	–	–	–	–	0	1	1
Unknown accipiter	27	67	85	156	99	155	98	0	21	1
TOTAL ACCIPITERS	1191	1260	1572	1419	1416	2182	1690	1307	874	2115
Red-shouldered Hawk	0	0	0	1	1	2	3	0	0	1
Broad-winged Hawk	1	3	1	0	0	75	10	0	1	6
Swainson's Hawk	0	0	1	2	2	1	0	0	0	0
Red-tailed Hawk	516	528	649	626	411	932	680	513	425	744
Ferruginous Hawk	1	0	0	1	1	1	1	0	0	0
Rough-legged Hawk	12	11	4	20	15	21	30	7	6	10
Unidentified buteo	23	30	40	52	30	58	26	29	48	18
TOTAL BUTEOS	553	572	695	702	460	1090	750	549	480	779
Golden Eagle	96	81	65	106	81	176	132	75	56	108
Bald Eagle	33	40	42	33	40	53	37	52	55	68
Unidentified eagle	3	2	1	9	4	2	0	6	7	0
TOTAL EAGLES	132	123	108	148	125	231	169	133	118	176
American Kestrel	29	18	18	35	22	30	21	23	21	19
Merlin	36	49	46	104	78	83	65	33	38	84
Prairie Falcon	5	4	0	5	10	8	6	1	1	8
Peregrine Falcon	3	4	0	1	4	5	8	3	9	14
Unknown small falcon <sup>1</sup>	–	–	–	–	–	–	–	0	1	0
Unknown large falcon <sup>1</sup>	–	–	–	–	–	–	–	0	0	0
Unknown falcon	8	3	2	3	4	0	0	7	2	2
TOTAL FALCONS	81	78	66	148	118	126	100	67	72	127
Unidentified raptor	38	25	43	90	30	32	0	20	15	7
GRAND TOTAL	2256	2364	2743	2730	2432	4133	3382	2499	1922	3817

## Appendix E. continued

	2004	2005	2006	2007	2008	MEAN
Start date	27-Aug	27-Aug	28-Aug	27-Aug	28-Aug	28-Aug
End date	29-Oct	27-Oct	31-Oct	31-Oct	31-Oct	29-Oct
Observation days	46	49	57	51	60	51
Observation hours	341.25	392.92	459.92	397.00	481.83	372.96
Raptors / 100 hours	1119.7	699.6	577.5	571.5	514.5	779.02
SPECIES	RAPTOR COUNTS					
Turkey Vulture	326	389	232	281	269	294
Osprey	70	60	38	47	70	64
Northern Harrier	29	38	33	13	19	29
Sharp-shinned Hawk	1790	1067	1015	921	1003	1092
Cooper's Hawk	485	269	418	249	316	339
Northern Goshawk	33	24	40	16	33	27
Unknown small accipiter <sup>1</sup>	27	14	7	52	111	32
Unknown large accipiter <sup>1</sup>	2	13	2	10	12	5
Unknown accipiter	0	46	60	12	37	63
TOTAL ACCIPITERS	2337	1433	1542	1260	1512	1541
Red-shouldered Hawk	7	0	0	3	3	1
Broad-winged Hawk	2	2	1	0	5	7
Swainson's Hawk	1	0	0	1	0	1
Red-tailed Hawk	725	562	531	388	359	573
Ferruginous Hawk	0	1	0	0	0	0
Rough-legged Hawk	17	3	27	6	16	14
Unidentified buteo	9	4	30	40	16	30
TOTAL BUTEOS	761	572	589	438	399	626
Golden Eagle	93	72	56	52	52	87
Bald Eagle	61	55	44	45	46	47
Unidentified eagle	2	1	1	2	8	3
TOTAL EAGLES	156	128	101	99	106	137
American Kestrel	14	9	17	7	16	20
Merlin	105	80	69	71	62	67
Prairie Falcon	5	3	7	6	3	5
Peregrine Falcon	14	14	10	5	11	7
Unknown small falcon <sup>1</sup>	1	2	0	5	0	1
Unknown large falcon <sup>1</sup>	0	10	1	3	0	2
Unknown falcon	0	6	1	1	2	3
TOTAL FALCONS	139	124	105	98	94	103
Unidentified raptor	3	5	16	33	10	24
GRAND TOTAL	3821	2749	2656	2269	2479	2817

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

**Appendix F. Daily capture totals of migrating raptors at Bonney Butte, Oregon: 2008.**

DATE	STATION HOURS	SPECIES <sup>1</sup>														TOTAL CAPTURES/HR	
		NH	SS	CH	NG	RS	BW	RT	RL	GE	BE	AK	ML	PR	PG		
28-Aug	7.75	0	0	1	1	1	0	0	0	0	0	0	0	0	0	3	0.4
29-Aug	8.00	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2	0.3
30-Aug	6.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
31-Aug	2.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
01-Sep	8.00	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2	0.3
02-Sep	8.00	0	4	6	1	0	0	2	0	0	0	0	0	0	0	13	1.6
03-Sep	8.25	0	2	4	0	0	0	0	0	0	0	0	0	0	0	6	0.7
04-Sep	8.75	0	0	7	1	0	0	3	0	0	0	0	0	0	0	11	1.3
05-Sep	8.00	0	1	0	1	0	0	0	0	0	0	0	0	0	0	2	0.3
06-Sep	8.00	0	7	6	0	0	0	2	0	0	0	0	0	0	0	15	1.9
07-Sep	8.25	0	0	4	0	0	0	0	0	0	0	1	0	0	5	0.6	
08-Sep	8.00	0	1	3	0	0	0	2	0	0	0	0	0	0	6	0.8	
09-Sep	8.00	0	2	5	0	0	0	1	0	0	0	0	0	0	8	1.0	
10-Sep	8.00	0	6	4	0	0	0	1	0	0	0	0	0	0	11	1.4	
11-Sep	8.00	0	1	3	1	0	0	1	0	0	0	0	0	0	6	0.8	
12-Sep	8.00	0	3	1	0	0	0	4	0	0	0	1	0	0	9	1.1	
13-Sep	8.00	0	2	5	1	0	0	0	0	0	0	0	0	0	8	1.0	
14-Sep	8.25	0	5	3	1	0	0	0	0	0	0	0	0	0	9	1.1	
15-Sep	8.00	0	7	2	0	0	0	0	0	0	0	0	0	0	9	1.1	
16-Sep	7.75	0	11	0	0	0	1	1	0	0	0	0	0	0	13	1.7	
17-Sep	8.00	0	12	4	0	0	0	2	0	0	0	1	0	0	19	2.4	
18-Sep	8.00	0	3	1	1	0	0	2	0	0	0	1	0	0	8	1.0	
19-Sep	7.75	0	4	1	0	0	0	0	0	0	0	0	0	0	5	0.6	
20-Sep	2.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
21-Sep	0.00																
22-Sep	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
23-Sep	7.75	0	17	4	0	0	0	2	0	0	0	1	0	0	24	3.1	
24-Sep	6.00	0	18	3	0	0	0	2	0	0	0	0	0	0	23	3.8	
25-Sep	0.00																
26-Sep	8.00	0	16	1	0	0	0	0	0	0	0	0	0	0	17	2.1	
27-Sep	8.00	0	19	7	0	0	0	1	0	0	0	0	1	0	28	3.5	
28-Sep	8.00	0	5	1	0	0	0	1	0	0	0	0	0	0	7	0.9	
29-Sep	8.00	0	3	3	0	0	0	0	0	0	0	0	0	0	6	0.8	
30-Sep	8.00	0	9	1	0	0	0	0	1	0	0	1	0	0	12	1.5	
01-Oct	7.75	0	11	1	0	0	0	1	0	0	0	0	0	0	13	1.7	
02-Oct	4.75	0	5	0	0	0	0	0	0	0	0	1	0	0	6	1.3	
03-Oct	0.00																
04-Oct	0.00																
05-Oct	0.00																



Appendix F. continued

DATE	STATION		SPECIES <sup>1</sup>													TOTAL CAPTURES/HR		
	HOURS		NH	SS	CH	NG	RS	BW	RT	RL	GE	BE	AK	ML	PR		PG	
06-Oct	7.75		0	17	7	1	0	0	1	0	0	0	0	1	0	1	28	3.6
07-Oct	1.50		0	1	1	0	0	0	0	0	0	0	0	0	0	0	2	1.3
08-Oct	8.25		1	8	3	0	0	0	3	0	0	0	0	1	0	0	16	1.9
09-Oct	0.00																	
10-Oct	5.25		0	2	0	0	0	0	0	0	0	0	0	0	0	0	2	0.4
11-Oct	8.00		0	2	1	0	0	0	1	0	0	0	0	0	0	0	4	0.5
12-Oct	8.00		1	5	3	0	0	0	1	0	0	0	0	0	0	0	10	1.3
13-Oct	8.00		0	4	0	0	0	0	1	0	0	0	0	0	0	0	5	0.6
14-Oct	8.00		0	5	0	0	0	0	1	0	0	0	0	0	0	0	6	0.8
15-Oct	8.00		0	7	2	1	0	0	2	0	0	0	0	0	0	0	12	1.5
16-Oct	0.00																	
17-Oct	8.00		0	3	2	2	0	0	1	0	0	0	0	0	0	0	8	1.0
18-Oct	5.50		0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0.2
19-Oct	8.00		0	6	0	1	0	0	0	0	0	0	0	0	0	0	7	0.9
20-Oct	0.00																	
21-Oct	6.25		0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0.2
22-Oct	7.75		0	5	0	0	0	0	0	0	0	0	0	0	0	0	5	0.6
23-Oct	7.00		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
24-Oct	7.75		0	0	0	1	0	0	0	1	0	0	0	0	0	0	2	0.3
25-Oct	7.75		1	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0.3
26-Oct	7.75		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
27-Oct	7.75		0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0.1
28-Oct	7.75		0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0.1
29-Oct	7.75		0	4	0	0	0	0	1	0	0	0	0	0	0	0	5	0.6
30-Oct	7.75		0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0.1
Total	406.00		3	247	100	15	1	1	45	1	1	0	1	8	1	1	425	1.0

<sup>1</sup> See Appendix B for full names associated with species codes.

**Appendix G. Annual trapping effort and capture totals by species for migrating raptors at Bonney Butte, Oregon: 1995–2008.**

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	MEAN	TOTAL
First trapping day	7-Oct	18-Sep	31-Aug	6-Sep	5-Sep	28-Aug	25-Aug	27-Aug	26-Aug	27-Aug	27-Aug	27-Aug	27-Aug	28-Aug		
Last trapping day	28-Oct	10-Oct	1-Nov	30-Oct	24-Oct	24-Oct	28-Oct	27-Oct	27-Oct	15-Oct	27-Oct	28-Oct	30-Oct	30-Oct		
Number of stations	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Trapping days	10	21	39	34	22	58	50	55	47	36	48	49	45	56	41	
Trapping hours	44.50	127.20	202.80	199.95	142.75	239.75	320.50	357.75	345.35	263.00	342.25	354.25	317.25	406.00	261.66	
Captures / 10 hours	4.9	10.0	11.0	12.8	10.0	13.0	10.3	10.4	12.5	14.9	15.2	13.9	10.5	10.5	11.4	
SPECIES	RAPTOR CAPTURES															
Northern Harrier	0	1	0	2	1	1	0	6	4	2	7	2	1	3	2.1	30
Sharp-shinned Hawk	18	80	139	163	82	161	171	172	268	219	310	259	200	247	177.8	2489
Cooper's Hawk	0	20	29	43	14	67	74	71	64	90	101	88	74	100	59.6	835
Northern Goshawk	1	7	7	3	3	8	11	7	12	14	12	11	3	15	8.1	114
Red-shouldered Hawk	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0.1	2
Broad-winged Hawk	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0.1	2
Red-tailed Hawk	2	14	39	29	36	66	66	108	73	61	67	106	42	45	53.9	754
Rough-legged Hawk	0	0	1	0	1	0	1	0	0	0	1	1	0	1	0.4	6
Golden Eagle	0	3	2	1	2	3	2	0	2	1	3	6	0	1	1.9	26
Bald Eagle	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0.1	1
American Kestrel	0	0	0	0	1	0	1	0	0	0	0	2	1	1	0.4	6
Merlin	1	2	5	11	3	1	4	5	4	4	13	12	9	8	5.9	82
Prairie Falcon	0	0	1	4	0	1	0	1	3	4	3	4	2	1	1.7	24
Peregrine Falcon	0	0	0	0	0	2	0	1	0	0	4	1	0	1	0.6	9
All species	22	127	223	256	143	311	330	371	430	395	522	492	333	425	312.9	4380
Recaptures <sup>1</sup>	0	0	0	0	0	0	0	0	0	2	1	1	0	0	0.3	4
Foreign Recaptures <sup>2</sup>	0	0	1	1	0	0	1	0	2	2	3	1	1	1	0.9	13
Foreign Encounters <sup>3</sup>	1	0	1	2	6	3	2	6	8	5	9	6	7	2	4.1	58

<sup>1</sup> Recaptures at Bonney Butte of birds originally banded at Bonney Butte.

<sup>2</sup> Recaptures at Bonney Butte of birds originally banded elsewhere.

<sup>3</sup> Birds originally banded at Bonney Butte and subsequently encountered elsewhere.