

**FALL 2003 RAPTOR MIGRATION STUDIES AT
BONNEY BUTTE, OREGON**



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

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BONNEY BUTTE, OREGON**

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INTRODUCTION

The Bonney Butte Raptor Migration Project in north-central Oregon is an ongoing effort to monitor long-term trends in populations of raptors using the northern portion of the Pacific Coast Flyway (Hoffman et al. 2002). HawkWatch International (HWI) initiated standardized counts of the autumn raptor migration through this region in 1994, and began a trapping and banding program at the project 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 2003 season marked the 10th consecutive count and the 9th consecutive season of trapping and banding conducted at the site by HWI. This report summarizes the 2003 count and banding results.

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). This was the first full season of migration counting for both official observers; both attended pre-season training (see Appendix A for a complete observer history). The on-site educator and visitors also assisted with the count. Data gathering and recording followed standardized protocols used at all HWI migration sites (Hoffman and Smith 2003). Calculation of “adjusted” (to standardize sampling periods and adjust for incompletely identified birds) passage rates (migrants counted per 100 hours of observation) and analysis of trends follows Hoffman and Smith (2003). In comparing 2003 annual statistics against means and 95% confidence intervals for previous seasons, I equate significance with a 2003 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 unless outfitted with a satellite transmitter, which takes a bit longer.

RESULTS AND DISCUSSION

WEATHER SUMMARY

Inclement weather hampered observations this season to a relatively high degree, with 15 days of observation entirely precluded and seven additional days reduced to less than 4 hours of observation due to weather (see Appendix B for daily weather records). Only 1997 and 2000 saw more days (24 each) hampered by inclement weather. In 2003, the bad weather came in three major episodes: most of a 5-day stretch in early September, most of a 9-day stretch in mid-October, and most of the last four days of the season. The 2003 season also featured a very high proportion of active observation days where fog or haze was prevalent (96% vs. long-term average of 64%). Otherwise, predominantly fair skies prevailed on 45% of the active observation days (average 51%), transitional skies (i.e., changed from fair or partly cloudy to mostly cloudy or overcast during the day, or vice versa) prevailed on 35% of days (average 21%), and mostly cloudy to overcast skies prevailed on 20% of days (average 28%). Heavy fog, rain and snow led to a high number of reduced observation days; otherwise, however, scattered rain and snow were relatively uncommon during periods of active observation (only 2% of active days vs. an average of 13%).

Average daily temperatures during periods of active observation ranged from 0.0°C to 30.4°C, with an overall average of 17.2°C. This is the warmest average recorded for the project to date (long-term average 12.1°C, previous maximum 14.4°C). The season also featured a high proportion of days where light winds (<12 kph) prevailed (98% vs. average of 79%). In terms of wind directions, 2003 was fairly typical except that southeasterly winds were slightly more common while southwesterly winds were slightly less common than usual. Thermal lift was rated fair to poor on 76% of the active observation days (average 53%) and good to excellent on 26% (average 47%); however, the prevalence of marginal lift ratings appears inconsistent with the high prevalence of warm temperatures and light winds, so observer bias may confound this comparison.

In summary, three extended periods of heavy fog, rain and snow resulted in high number of reduced-observation periods during the 2003 season, cloud cover was slightly heavier than usual at other times, and persistent haze prevailed throughout most of the season. Otherwise, however, temperatures were relatively warm and the winds were lighter than usual.

COUNT SUMMARY

The observers worked on 51 of 66 possible days between 27 August and 31 October 2003. The number of observation days matched the 1994–2002 average of $51 \pm 95\%$ CI of 5.2 days. The number of observation hours (402.65) was a significant 16% higher than the 1994–2002 average of $346.7 \pm 95\%$ CI of 42.63 hours. The 2003 average of 2.3 observers per hour (including official and guest observers; value is mean of daily values, which are in turn means of hourly values) matched the long-term average of $2.3 \pm 95\%$ CI of 0.38 observers per hour.

The observers counted 3,817 migrant raptors of 16 species (Table 1, and see Appendix C for daily count records). This is the second highest total count recorded at the site to date (40% above average; see Appendix D for annual summaries). Counts reached record highs for Cooper's Hawks, Bald Eagles, and Peregrine Falcons (Appendix E; see Appendix D for scientific names of all raptor species).

The 2003 flight was composed of 55% accipiters, 20% buteos, 13% vultures, 5% eagles, 3% falcons, 3% Ospreys, and <1% harriers and unidentified raptors. The season featured significantly higher than average proportions of accipiters and vultures, and a significantly lower than average proportions of Buteos and eagles (Figure 2). As usual, Sharp-shinned and Red-tailed Hawks were the two most

abundant species, followed by Turkey Vultures, Cooper's Hawks, Golden Eagles, Ospreys, Merlins, and Bald Eagles (Table 1, Appendix D).

Adjusted passage rates were significantly higher than average for seven species seen this season (Turkey Vulture, Osprey, Sharp-shinned Hawk, Cooper's Hawk, Bald Eagle, Prairie Falcon, and Peregrine Falcon), whereas among commonly encountered species only American Kestrels showed a significantly lower than average adjusted passage rate (Table 1; Figures 3–7).

Regression analyses of data through 2003 revealed a marginally significant linear increase for Bald Eagles (Figure 6), a significant linear decrease for American Kestrels (Figure 7), a significant, accelerating increase (quadratic trend) for Peregrine Falcons (Figure 7), and no significant species-level trends for other species (Figures 3–7). Thus, for many species, relatively high counts in 2003 appeared to reverse declining patterns that had set in since 1998 when widespread drought began affecting much of the West. Northern Goshawks and Golden and Bald Eagles also showed significantly above-average immature : adult ratios in 2003, in all cases at least partly due to an increase in the abundance of young birds (Table 2). This suggests that, for these species, increases in regional productivity may have contributed to the higher than average counts. In contrast, Northern Harriers, Sharp-shinned Hawks, Cooper's Hawks, Red-tailed Hawks, and Peregrine Falcons all showed below-average age ratios, suggesting that other factors led to high total counts for the latter four species. One possibility is a shift in migration routes away from the drought-stricken Intermountain Flyway toward the more mesic Pacific Coast Flyway. Portions of the western Pacific Northwest were affected by drought in the late 1990s, but only the interior West has continued to suffer from prolonged drought. Counts have been well below average for the past two years in the Goshute Mountains of Nevada in the heart of the Intermountain Flyway.

Age-specific regression analyses revealed additional detail for Golden Eagles and Northern Goshawks. For Golden Eagles, immatures/subadults showed no significant trend, adults showed a significant linear decrease, and there was a significant linear increase in immature/subadult : adult ratios (Figure 8). For Northern Goshawks, immatures showed no significant trend, adults showed a marginally significant hill-shaped (currently declining) quadratic trend, and age ratios showed a marginally significant trough-shaped (currently increasing) quadratic trend (Figure 9). These patterns, including currently declining adult migration activity, may be a good sign for these two partially migratory species. Recently compiled evidence from HWI's long-term monitoring site in the Goshute Mountains suggested that increased migration activity among adult Golden Eagles in the West outside of the northern Rocky Mountain Flyway (where counts reflect primarily activity of more migratory northern populations) is likely an indication of declining habitat quality that forces otherwise sedentary adults to disperse more widely during winter (Hoffman and Smith 2003). Similarly, Northern Goshawks, especially adults, are well known for their irruptive southward fall invasions in response to cyclical prey fluctuations (Mueller et al. 1977), and it seems likely that on an annual and more localized basis the extent of adult movements would also be negatively correlated with winter habitat quality.

The combined-species median passage date of 23 September was a significant 6 days earlier than average (Table 3); however, the seasonal distribution showed that this was due to unusual variations in pattern from late September through October rather than substantial early activity (Figure 10). A similar conclusion applies to six species that showed significantly earlier than average median dates (Turkey Vulture, Osprey, Sharp-shinned Hawk, Northern Goshawk, Red-tailed Hawk, and Merlin; Table 3). Rough-legged Hawks and Bald Eagles were the only species that showed significantly late timing in 2003. Age-specific median dates revealed additional detail (Table 4). The species-level comparison indicated no significant variation for Cooper's Hawks; however, age-specific analyses revealed significantly early timing for both adults and immatures. For Red-tailed Hawks, only adults showed significantly early timing. For Golden Eagles, no significant variation was evident at the species level,

but age-specific data suggested that adults were late while immatures/subadults were early. For Bald Eagles, only immatures/subadults showed late timing.

Although considerable weather-related variation in pattern during October appears to confound this year's assessment of timing patterns, the prevalence of earlier than average median passage dates may be another indication of the effects of shifting migration routes. Comparing long-term average median dates for Bonney Butte and the Goshute Mountains indicates that 10 of 15 species for which robust comparisons are possible tend to pass through the Goshutes earlier than at Bonney Butte (up to 9 day differences), despite the fact that Bonney Butte lies 3° latitude farther north than the Goshutes.

RESIDENT RAPTORS

A pair of light-morph Red-tailed Hawks was resident around Bonney Butte throughout the season until perhaps the last week or so, with at least one immature bird seen regularly for at least three weeks early on. Apparent family groups of Sharp-shinned and Cooper's Hawks were seen regularly early in the season, and occasional observations of apparently local adult and immature Northern Goshawks scattered throughout the season also suggested a local family. A local immature Golden Eagle was seen on several occasions early in the season, as was a pair of adult American Kestrels. Most likely, a local Osprey also was seen early on heading towards Badger Lake, and several early Bald Eagle sightings were likely local birds as well. This is a typical local assemblage for the area except that territorial adult Golden Eagles were more commonly seen before 2001.

TRAPPING AND BANDING SUMMARY

Trapping occurred on 47 of 63 days between 26 August and 27 October, with effort totaling 345.35 hours (see Appendix F for daily trapping records). Despite a low number of trapping days compared to the last three years, the hours of effort in 2003 was the second highest for the project to date (see Appendix E for annual trapping summaries).

The 2003 capture total of 430 birds (including two foreign recaptures) of 8 species was the largest total yet recorded for the project (Table 2, Appendix G). The captures included record highs for Sharp-shinned Hawks and Northern Goshawks. The 2003 effort raises the total number of birds captured since project inception to 2,213, including five foreign recaptures (Appendix G). As usual, the three most frequently captured species were the Sharp-shinned Hawk (62% of captures), Red-tailed Hawk (17%), and Cooper's Hawk (15%; Appendix G).

Capture totals were significantly above-average for six species; however, capture rates were significantly above average only for Northern Harriers and Sharp-shinned Hawks, and capture success did not vary significantly for any species but was slightly below average for most species (Table 2). These statistics suggest that the trapping crew did a good of keeping pace with higher than average counts.

ENCOUNTERS WITH BANDED BIRDS

To date, 28 birds banded at Bonney Butte have subsequently been encountered elsewhere; 15 of these "foreign encounters" occurred between 2001 and 2003 (Table 7). In addition, five birds banded elsewhere have been recaptured at Bonney Butte; three of these "foreign recaptures" occurred between 2001 and 2003 (Table 3). All of the foreign encounter locations and known original banding locations of the foreign recaptures are located within the expected confines of the Pacific Coast Flyway between southern British Columbia and southern California (Hoffman et al. 2002). Of particular interest are five exchanges between different migration research projects: 1 Sharp-shinned Hawk and 1 Cooper's Hawk encountered at Bonney Butte and Golden Gate Raptor Observatory's project in the Marin Headlands of California; 1 Sharp-shinned Hawk and 1 Red-tailed Hawk encountered at Bonney Butte and HWI's

Chelan Ridge project in north-central Washington; and 1 Sharp-shinned Hawk originally banded by the Falcon Research Group in central Washington at Diamond Head.

Two of the foreign encounters (1 Sharp-shinned Hawk and 1 Cooper's Hawk) occurred when the birds sustained minor injuries, were captured and held temporarily, and then were released again (Table 7). All birds known to have died were simply found dead with no distinct cause of death evident.

SATELLITE TELEMETRY

The 2003 crew succeeded in outfitting one adult Red-tailed Hawk and two adult Northern Goshawks with satellite transmitters. As of mid-December, all were still alive and well, with the two goshawks still in north-central Oregon and the red-tail having moved south to the Mt. Shasta area of California.

Two of the three Red-tailed Hawks outfitted during fall 2002 provided useful data, the third having perished or shed its transmitter just west of the project site after only a few days. The other two birds wintered in northern California, one along the Calaveras River southeast of Sacramento and the other near the Russian River along the coast west of Santa Rosa. Unfortunately, the Calaveras River bird most likely did not survive the winter (signal ceased in January 2003). In contrast, the Russian River bird returned north the following spring and eventually settled for the summer near Juneau, Alaska. It then returned to the same basic wintering area in California and was alive and well as of mid-December 2003.

All four immature goshawks outfitted during fall 2002 remained within 150 km of the project site and failed to survive their first winter. Their wintering locations included the Warms Springs Indian Reservation, Timothy Lake, the Three Sisters Wilderness Area, and the north slope of Mt Hood.

Complete tracking summaries and maps for all of HWI's telemetry birds can be found at www.hawkwatch.org. Summaries and maps for the fall 2003 birds will be posted by mid-January 2004.

The author recently presented a synopsis of HWI's goshawk telemetry data at a special goshawk symposium held at the 2003 annual meeting of the Raptor Research Foundation in Anchorage, Alaska. We hope to publish this paper in the proceedings from the meeting, which will appear as a special edition of the Journal of Raptor Research in 2004.

STABLE ISOTOPE RESEARCH

In 2003, we continued to collect feather samples from Red-tailed Hawks and Northern Goshawks captured at Bonney Butte in support of two Boise State University graduate student studies designed to use analyses of stable-isotope ratios to identify migrant origins (e.g., Meehan et al. 2001). For the first time, we also collected samples from Cooper's Hawks and Sharp-shinned Hawks to support a new multi-site study that HWI is conducting thanks to a new grant from the National Fish and Wildlife Foundation.

VISITATION

In 2003, the HWI visitor logs documented 625 visits to Bonney Butte, including 123 repeat visits. This represents nearly a 50% increase in visitation compared to 2002 and is the largest total visitation for the site to date. Organized groups included five Audubon groups from Portland and Salem, three groups from Portland area high schools, a scout troop, a group from the Mt. Hood Autumn Festival, and several employee groups from Mt. Hood National Forest.

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Table 1. Fall raptor migration unadjusted counts and adjusted passage rates by species at Bonney Butte, OR: 1994–2002 versus 2003.

SPECIES	COUNT			RAPTORS / 100 HOURS		
	1994–2002 ¹	2003	% CHANGE	1994–2002 ¹	2003	% CHANGE
Turkey Vulture	269 ± 86.0	488	+81	122.2 ± 39.85	186.6	+53
Osprey	64 ± 14.0	97	+53	26.2 ± 5.77	33.5	+28
Northern Harrier	30 ± 10.4	28	-6	9.7 ± 3.13	8.3	-15
Sharp-shinned Hawk	1,001 ± 186.9	1,578	+58	372.6 ± 65.58	535.2	+44
Cooper's Hawk	319 ± 48.9	473	+48	118.9 ± 28.47	152.1	+28
Northern Goshawk	25 ± 8.0	29	+14	8.1 ± 2.68	8.0	-2
Unknown small accipiter ²	48 ± 71.5	33	-31	–	–	–
Unknown large accipiter ²	1 ± 1.0	1	+100	–	–	–
Unknown accipiter	79 ± 36.5	1	-99	–	–	–
TOTAL ACCIPITERS	1,435 ± 238.2	2,115	+47	–	–	–
Red-shouldered Hawk	1 ± 0.7	1	+29	–	–	–
Broad-winged Hawk	10 ± 16.0	6	-41	6.2 ± 9.23	3.4	-46
Swainson's Hawk	1 ± 0.6	0	-100	0.3 ± 0.32	0.0	-100
Red-tailed Hawk	587 ± 104.4	744	+27	196.8 ± 38.76	200.1	+2
Ferruginous Hawk	1 ± 0.3	0	-100	0.2 ± 0.14	0.0	-100
Rough-legged Hawk	14 ± 5.5	10	-29	10.4 ± 4.31	7.0	-32
Unidentified buteo	37 ± 8.2	18	-52	–	–	–
TOTAL BUTEOS	650 ± 126.3	779	+20	–	–	–
Golden Eagle	96 ± 24.5	108	+12	33.0 ± 7.87	35.5	+8
Bald Eagle	43 ± 5.6	68	+59	13.3 ± 1.41	20.6	+55
Unidentified eagle	4 ± 2.0	0	-100	–	–	–
TOTAL EAGLES	143 ± 24.5	176	23	–	–	–
American Kestrel	24 ± 3.8	19	-21	8.2 ± 1.75	4.0	-51
Merlin	59 ± 16.2	84	+42	24.1 ± 7.10	27.8	+15
Prairie Falcon	4 ± 2.2	8	+80	1.6 ± 0.69	3.0	+94
Peregrine Falcon	4 ± 1.9	14	+241	1.2 ± 0.58	4.2	+242
Unknown small falcon ²	1 ± 1.0	0	-100	–	–	–
Unknown large falcon ²	0 ± 0.0	0	–	–	–	–
Unknown falcon	3 ± 1.8	2	-38	–	–	–
TOTAL FALCONS	95 ± 19.3	127	34	–	–	–
Unidentified Raptor	33 ± 16.4	7	-78	–	–	–
ALL SPECIES	2,718 ± 435.0	3,817	+40	–	–	–

¹ Mean of annual values ± 95% confidence interval.

² 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: 1994–2002 versus 2003.

	TOTAL AND AGE-CLASSIFIED COUNTS						IMMATURE : ADULT			
	1994–2002 AVERAGE			2003			% UNKNOWN AGE		RATIO	
	TOTAL	IMM.	ADULT	TOTAL	IMM.	ADULT	1994–2002 ¹	2003	1994–2002 ¹	2003
Northern Harrier	30	15	4	28	16	4	33 ± 6.9	29	4.8 ± 2.97	4.0
Sharp-shinned Hawk	1001	192	307	1578	352	602	50 ± 8.9	40	0.7 ± 0.20	0.6
Cooper's Hawk	319	86	62	473	140	123	53 ± 7.8	44	1.8 ± 1.03	1.1
Northern Goshawk	25	10	6	29	19	4	38 ± 11.1	21	2.4 ± 0.87	4.8
Broad-winged Hawk	10	1	1	6	0	1	22 ± 29.9	83	0.4 ± 0.45	0.0
Red-tailed Hawk	587	164	295	744	215	380	23 ± 5.7	20	0.6 ± 0.17	0.6
Golden Eagle	96	51	24	108	66	17	21 ± 3.6	23	2.7 ± 1.05	3.9
Bald Eagle	43	7	32	68	22	46	9 ± 3.6	0	0.3 ± 0.10	0.5
Peregrine Falcon	4	1	1	14	1	6	45 ± 5.3	50	1.2 ± 1.28	0.2

¹ 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 2003, with a comparison of 2003 and 1994–2002 average median passage dates.

SPECIES	2003				1994–2002
	FIRST OBSERVED	LAST OBSERVED	BULK PASSAGE DATES ¹	MEDIAN PASSAGE DATE ²	MEDIAN PASSAGE DATE ^{2,3}
Turkey Vulture	27-Aug	22-Oct	6-Sep – 2-Oct	20-Sep	22-Sep ± 1.6
Osprey	27-Aug	25-Oct	3-Sep – 4-Oct	13-Sep	17-Sep ± 1.8
Northern Harrier	29-Aug	24-Oct	13-Sep – 5-Oct	27-Sep	27-Sep ± 4.4
Sharp-shinned Hawk	30-Aug	27-Oct	20-Sep – 21-Oct	23-Sep	4-Oct ± 2.0
Cooper's Hawk	28-Aug	27-Oct	14-Sep – 21-Oct	23-Sep	24-Sep ± 2.3
Northern Goshawk	30-Aug	27-Oct	3-Sep – 27-Oct	3-Sep	30-Sep ± 4.1
Red-shouldered Hawk	1-Oct	1-Oct	–	–	–
Broad-winged Hawk	4-Sep	4-Oct	4-Sep – 4-Oct	–	26-Sep ± 3.9 ⁴
Red-tailed Hawk	27-Aug	27-Oct	13-Sep – 25-Oct	23-Sep	27-Sep ± 2.4
Rough-legged Hawk	18-Oct	27-Oct	21-Oct – 27-Oct	23-Oct	20-Oct ± 2.8
Golden Eagle	14-Sep	27-Oct	27-Sep – 26-Oct	12-Oct	12-Oct ± 2.0
Bald Eagle	21-Sep	27-Oct	26-Sep – 27-Oct	16-Oct	5-Oct ± 3.0
American Kestrel	27-Aug	5-Oct	28-Aug – 5-Oct	20-Sep	19-Sep ± 3.3
Merlin	2-Sep	27-Oct	27-Sep – 25-Oct	1-Oct	10-Oct ± 2.7
Prairie Falcon	4-Sep	4-Oct	4-Sep – 4-Oct	–	21-Sep ± 6.0
Peregrine Falcon	4-Sep	26-Oct	17-Sep – 23-Oct	24-Sep	21-Sep ± 9.6
Total	27-Aug	31-Oct	14-Sep – 22-Oct	23-Sep	29-Sep ± 1.9

¹ Dates between which the central 80% of the flight passed the lookout.

² Date by which 50% of the flight had passed the lookout.

³ 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.

⁴ Based on data for 1999 and 2000 only.

Table 4. Median passage dates by age for selected species of migrating raptors at Bonney Butte, OR: 1994–2002 versus 2003.

SPECIES	ADULT		IMMATURE	
	1994–2002 ¹	2003	1994–2002 ¹	2003
Northern Harrier	7-Oct ± 6.9	–	25-Sep ± 2.9	27-Sep
Sharp-shinned Hawk	9-Oct ± 2.7	29-Sep	22-Sep ± 1.8	12-Sep
Cooper's Hawk	1-Oct ± 2.4	27-Sep	18-Sep ± 2.8	12-Sep
Northern Goshawk	17-Oct ± 6.1	–	26-Sep ± 6.4	–
Red-tailed Hawk	1-Oct ± 3.4	24-Sep	20-Sep ± 2.4	19-Sep
Golden Eagle	12-Oct ± 1.6	16-Oct	8-Oct ± 3.0	5-Oct
Bald Eagle	5-Oct ± 4.0	5-Oct	10-Oct ± 4.0	22-Oct

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.

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

Table 5. Fall capture totals, rates, and successes by species for migrating raptors at Bonney Butte, OR: 1995–2003.

	CAPTURE TOTALS		CAPTURE RATES ¹		CAPTURE SUCCESSES ²	
	1995–2002 ³	2003	1995–2002 ³	2003	1995–2002 ³	2003
Northern Harrier	1 ± 1.4	4	0.6 ± 0.41	1.2	4.8 ± 5.21	6.0
Sharp-shinned Hawk	123 ± 39.3	268	59.9 ± 8.96	77.0	12.6 ± 5.58	8.7
Cooper's Hawk	40 ± 19.7	64	16.5 ± 6.05	18.5	12.7 ± 7.46	8.8
Northern Goshawk	6 ± 2.3	12	2.9 ± 0.89	3.5	35.1 ± 27.84	22.6
Broad-winged Hawk	0.1 ± 0.2	0	0.1 ± 0.10	0.0	2.0 ± 3.92	1.9
Red-tailed Hawk	45 ± 23.5	73	19.1 ± 6.05	21.1	7.9 ± 4.97	6.3
Rough-legged Hawk	0.4 ± 0.36	0	0.2 ± 0.19	0.0	2.9 ± 3.49	3.3
Golden Eagle	2 ± 0.8	2	0.9 ± 0.55	0.6	1.7 ± 1.03	1.5
American Kestrel	0.3 ± 0.32	0	0.1 ± 0.18	0.0	0.9 ± 1.16	1.2
Merlin	4 ± 2.3	4	2.1 ± 1.05	1.2	6.6 ± 3.38	4.7
Prairie Falcon	1 ± 0.9	3	0.4 ± 0.47	0.9	25.2 ± 26.74	13.9
Peregrine Falcon	0.4 ± 0.5	0	0.1 ± 0.21	0.0	5.2 ± 7.17	2.4
All species	223 ± 82.1	430	103.0 ± 17.13	123.9	10.2 ± 5.02	7.6

¹ Captures / 100 station hours.

² 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.

³ 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: 2003.

SPECIES	FEMALE		MALE		FEMALE : MALE	IMMATURE : ADULT
	HY	AHY	HY	AHY	RATIO ¹	RATIO ¹
Sharp-shinned Hawk						
1994–2002	39	26	40	18	1.2 ± 0.25	1.9 ± 0.75
2003	84	68	85	31	1.3	1.7
Cooper's Hawk						
1994–2002	17	9	12	2	2.0 ± 0.32	2.4 ± 0.74
2003	31	18	10	5	3.3	1.8
Northern Goshawk						
1994–2002	2	1	2	1	1.4 ± 1.33	3.1 ± 1.76
2003	3	3	5	1	1.0	2.0

¹ Mean ± 95% Confidence Interval (CI) for 1994–2002.

Table 7. Foreign encounters associated with the Bonney Butte Raptor Migration Project: 2001–2003.

BAND #	SPECIES ¹	SEX	BANDING DATE	BANDING AGE ²	ENCOUNTER LOCATION	ENCOUNTER DATE	ENCOUNTER AGE ²	DISTANCE (KM)	STATUS
1523 – 71438	SS	F	24-Sep-00	ASY	Port Coquitlam, BC	19-Apr-01	ATY	391	found dead
1705 – 16953	CH	F	02-Sep-01	HY	Marin Headlands, CA	19-Sep-01	HY	682	research recapture
1807 – 81803	RT	U	05-Oct-01	HY	Port Orford, OR	26-Mar-02	SY	421	found dead
1204 – 60143	CH	M	03-Oct-01	HY	Roseville, CA	21-Apr-02	SY	596	found dead
1177 – 06152	RT	U	23-Sep-02	HY	Chelan Ridge, WA	06-Oct-02	HY	288	research recapture
1807 – 81846	RT	U	26-Sep-02	HY	Concord, CA	27-Dec-02	HY	673	found dead
1807 – 81828	RT	U	11-Sep-02	HY	Snohomish, WA	28-Dec-02	HY	240	found dead
1202 – 22216	SS	M	09-Sep-02	HY	Big Sur, CA	08-Jan-03	SY	820	found dead
1177 – 06120	RT	U	31-Aug-02	HY	Lompoc, CA	13-Jan-03	SY	977	unknown
1177 – 06160	RT	U	02-Oct-02	HY	Hoquiam, WA	14-Jan-03	SY	308	found dead
1177 – 06154	RT	U	26-Sep-02	ASY	Linden, CA	23-Jan-03	ATY	656	found dead
1593 – 02281	SS	F	09-Oct-02	AHY	Seattle, WA	17-Apr-03	ASY	226	injured - released
1593 – 02232	SS	F	05-Oct-01	HY	Bahia, CA	10-Jun-03	TY	658	found dead
1705 – 35424	CH	F	19-Oct-97	ASY	Abbotsford, BC	15-Jun-03	>8 th yr	346	hit object - released
1807 – 81838	NG	F	22-Sep-02	HY	Devils Half Acre, OR	25-Jun-03	SY	32	found dead

¹ SS = Sharp-shinned Hawk, CH = Cooper's Hawk, NG = Northern Goshawk, RT = Red-tailed Hawk.

² HY = hatch year, SY = second year, TY = third year, AHY = after hatch year, ASY = after second year, ATY = after third year.

Table 8. Foreign recaptures associated with the Bonney Butte Raptor Migration Project: 2001–2003.

BAND #	SPECIES ¹	SEX	BANDING LOCATION	BANDING DATE	BANDING AGE ²	RECAPTURE DATE	RECAPTURE AGE ²	DISTANCE (KM)
1593 – 02076	SS	F	Chelan Ridge, WA	02-Oct-01	HY	10-Oct-01	HY	288
1513 – 11380	SS	F	? ³	?	?	05-Oct-03	AHY	?
1023 – 28128	SS	M	? ³	?	>	21-Oct-03	AHY	?

¹ SS = Sharp-shinned Hawk.

² HY = hatch year, AHY = after hatch year, ATY = after third year.

³ Awaiting report from Bird Banding Lab.

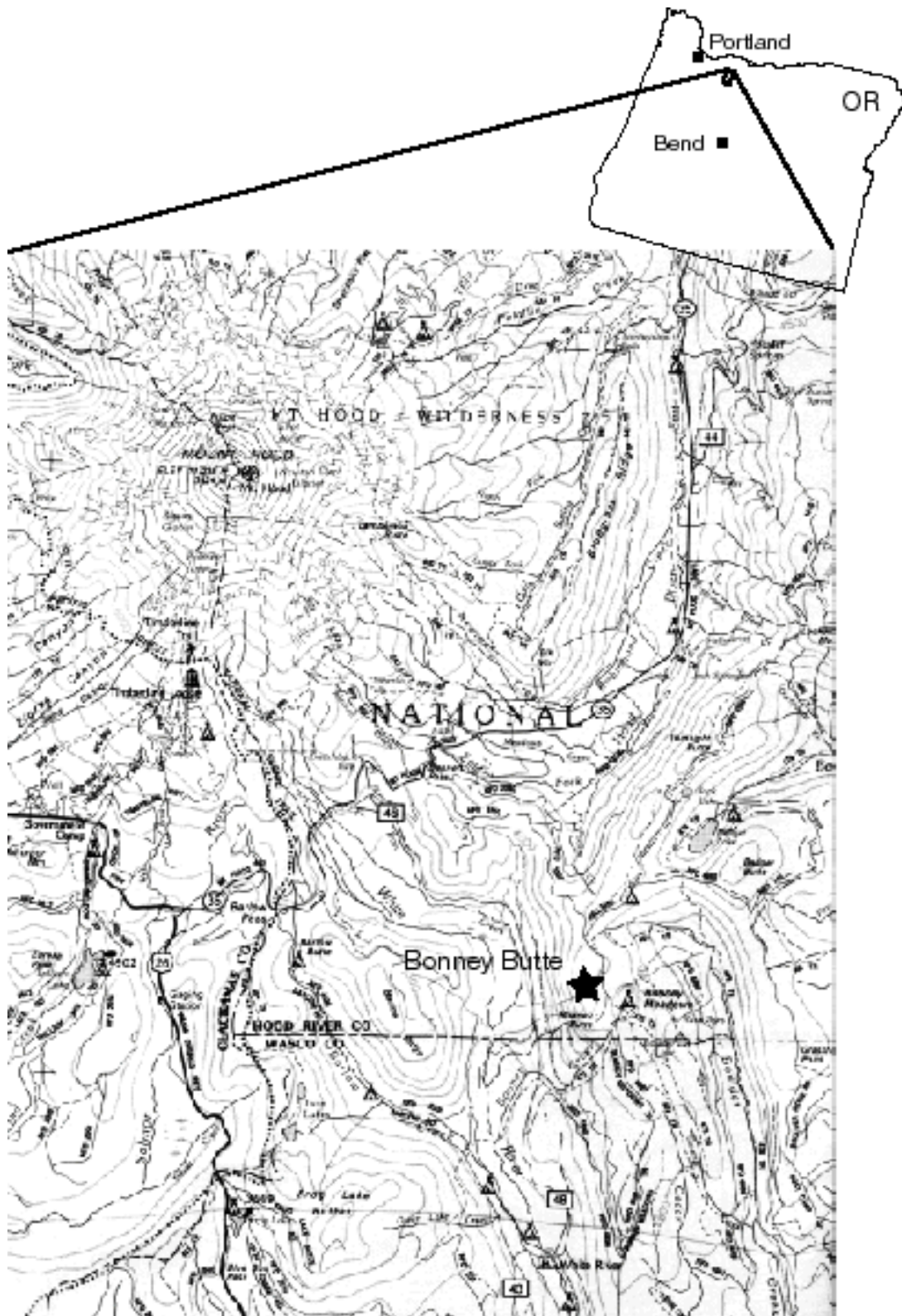


Figure 1. Location of the Bonney Butte Raptor Migration Project study site near Mt. Hood, Oregon.

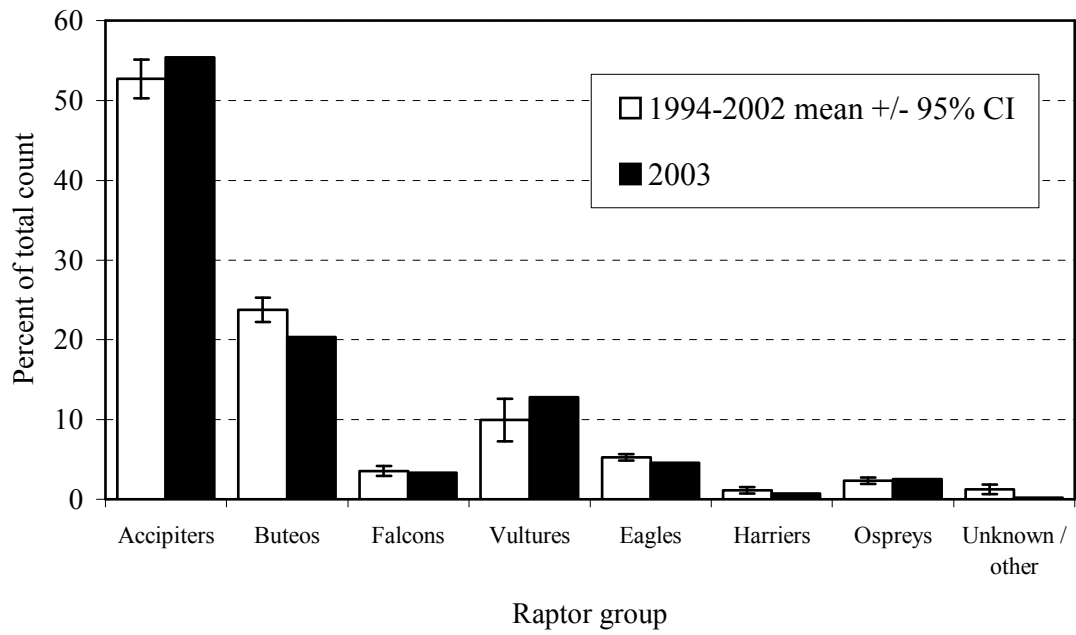


Figure 2. Fall raptor migration flight composition by major species groups at Bonney Butte, OR: 1994–2002 versus 2003.

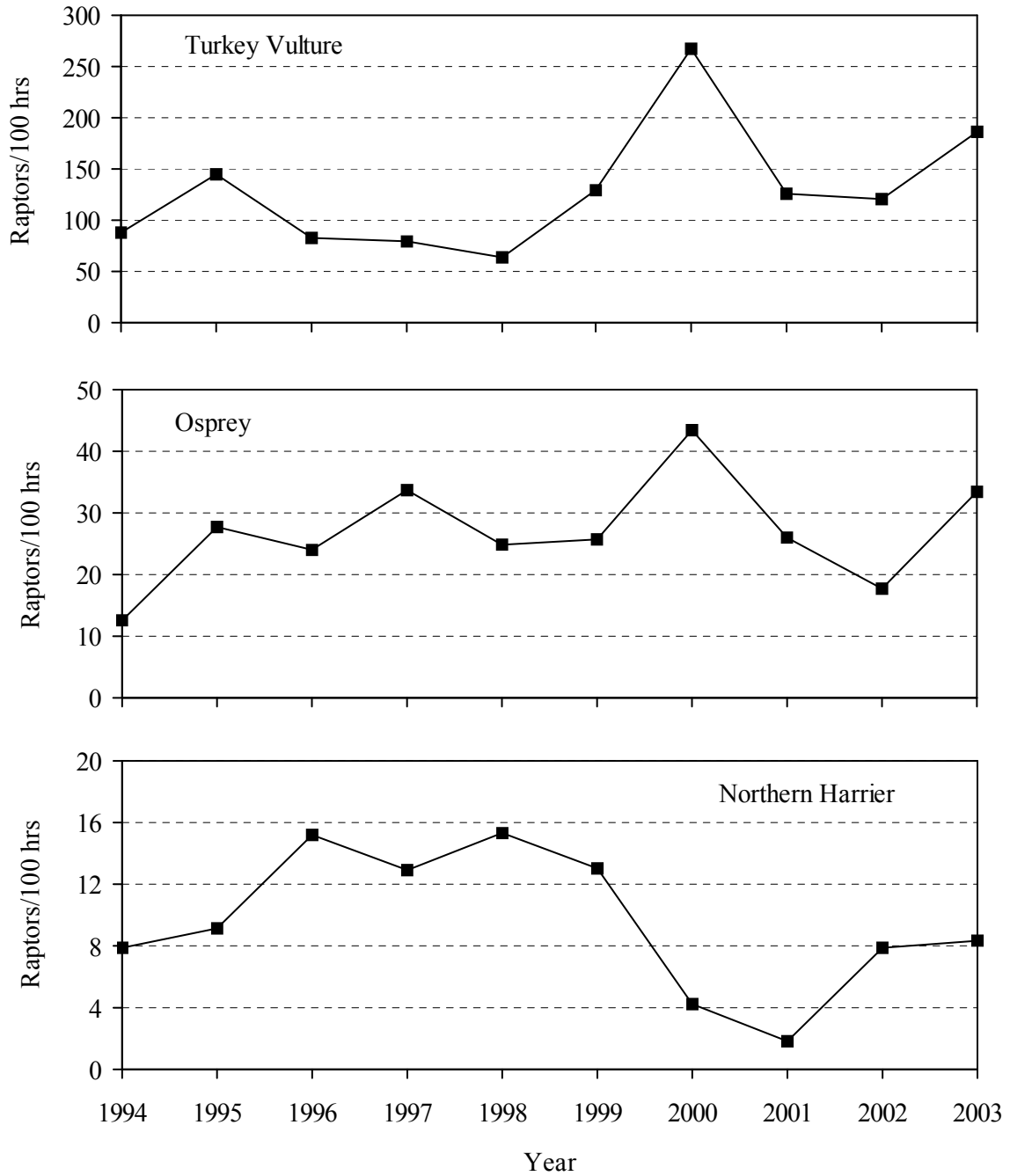


Figure 3. Adjusted, fall-migration passage rates for Turkey Vultures, Ospreys, and Northern Harriers at Bonney Butte, OR: 1994–2003. Dashed lines indicate significant ($P < 0.10$) regressions.

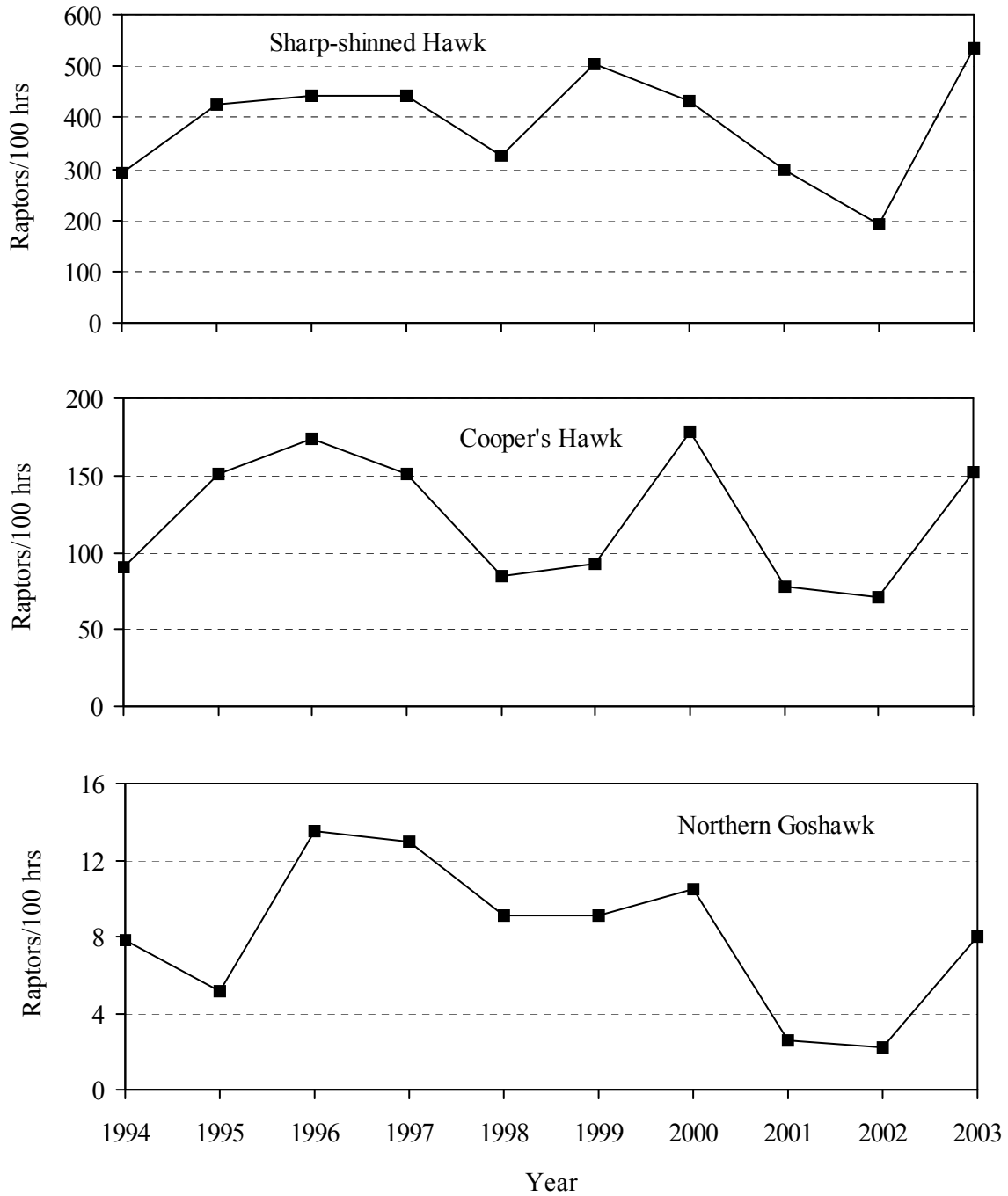


Figure 4. Adjusted, fall-migration passage rates for Sharp-shinned Hawks, Cooper's Hawks, and Northern Goshawks at Bonney Butte, OR: 1994–2003. Dashed lines indicate significant ($P < 0.10$) regressions.

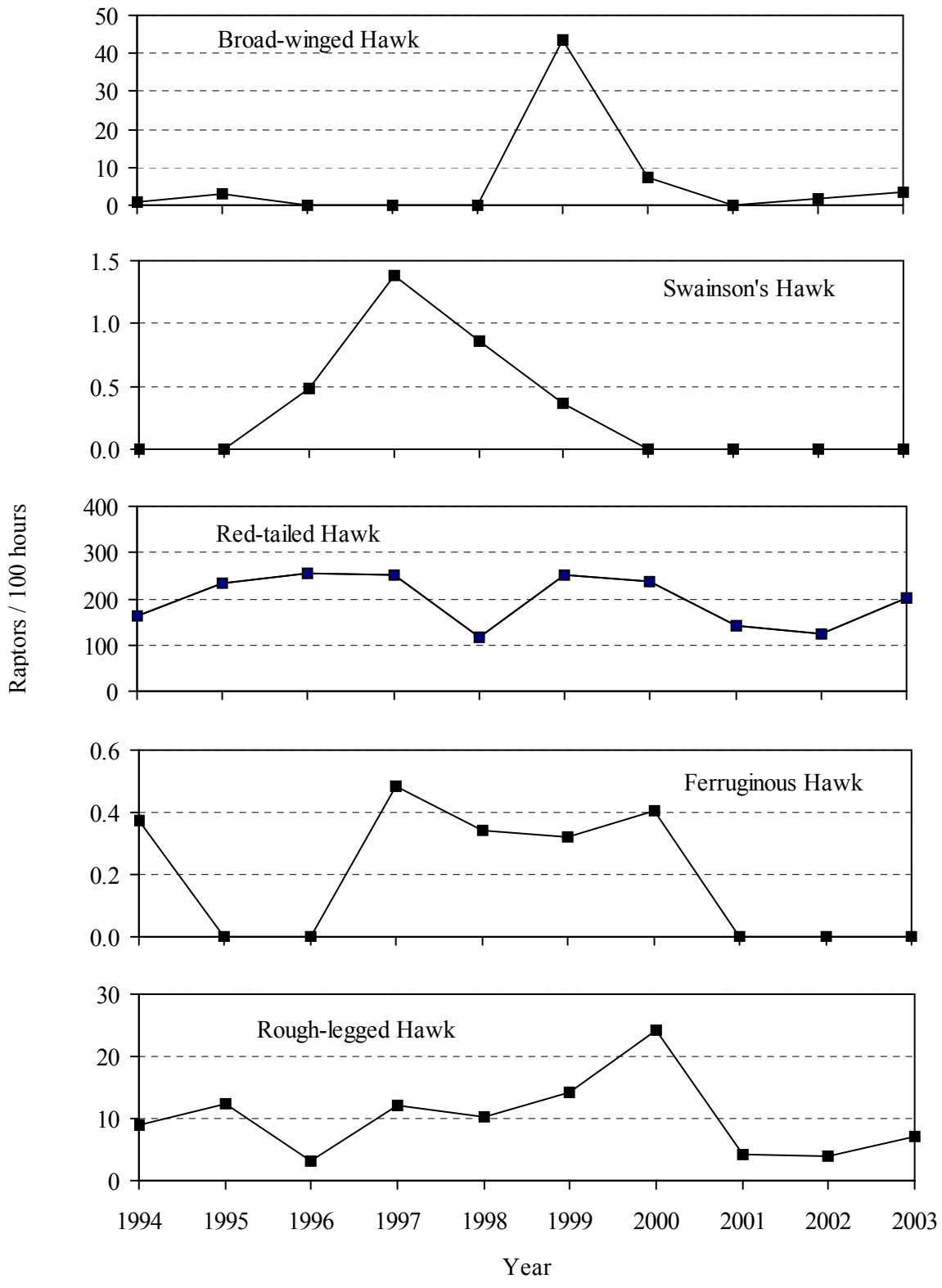


Figure 5. Adjusted, fall-migration passage rates for Broad-winged, Swainson's, Red-tailed, Ferruginous, and Rough-legged Hawks at Bonney Butte, OR: 1994–2003. Dashed lines indicate significant ($P < 0.10$) regressions.

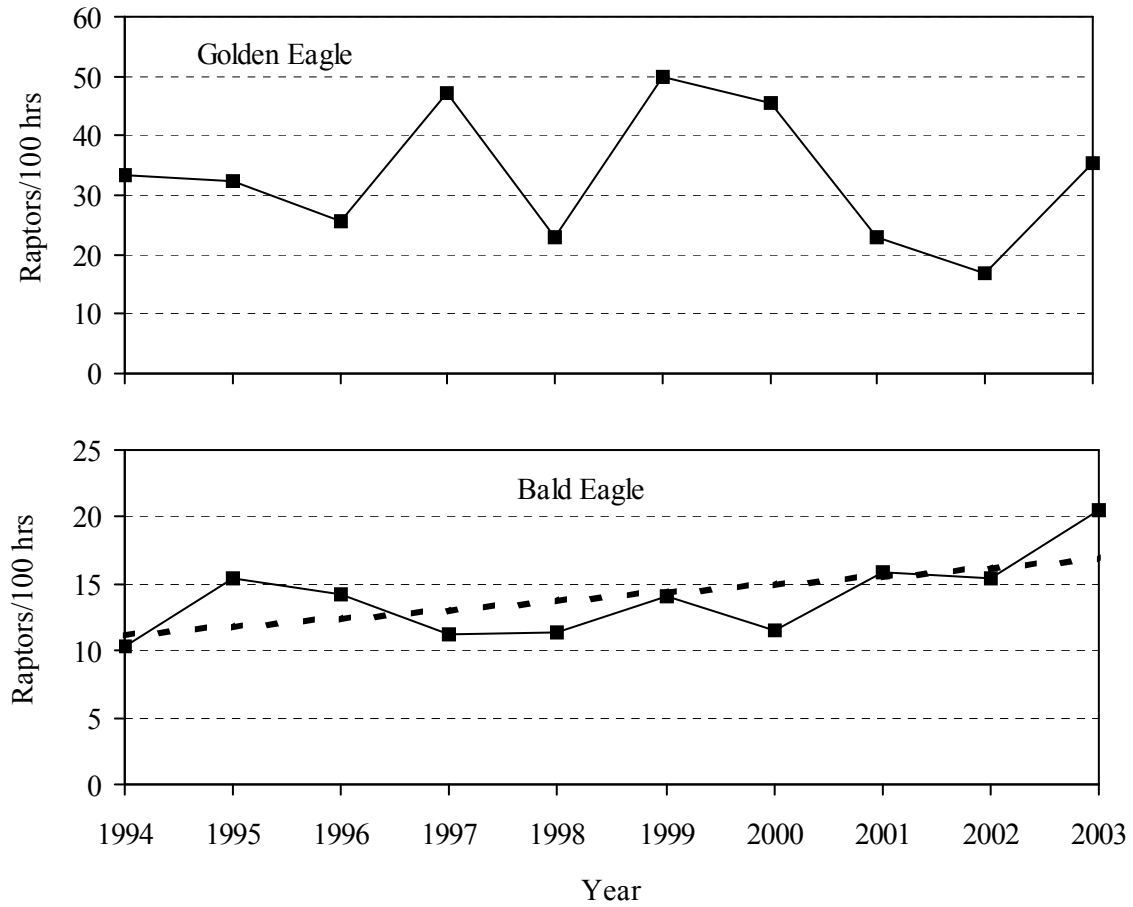


Figure 6. Adjusted, fall-migration passage rates for Golden and Bald Eagles at Bonney Butte, OR: 1994–2003. Dashed lines indicate significant ($P < 0.10$) regressions.

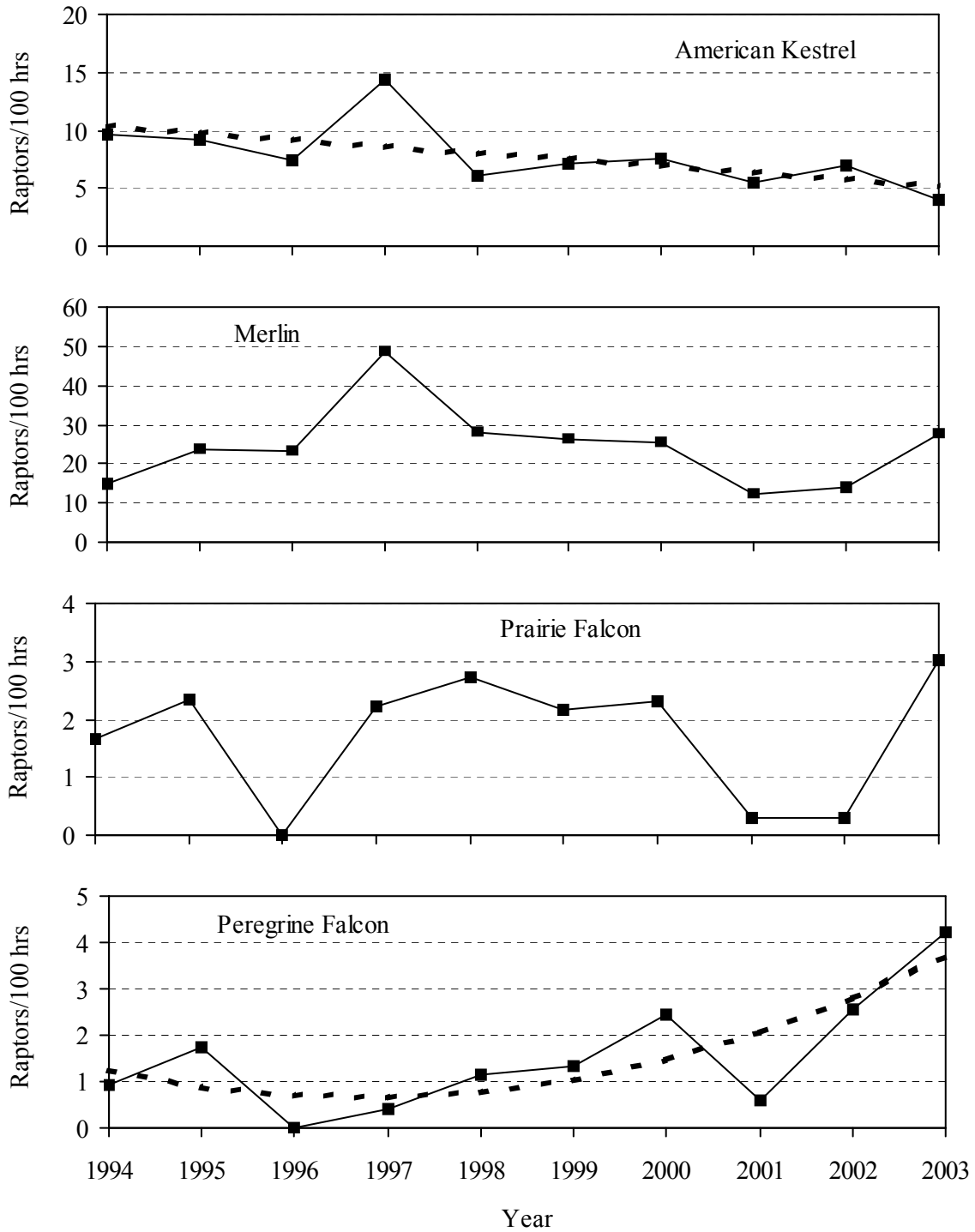


Figure 7. Adjusted, fall-migration passage rates for American Kestrels, Merlins, Prairie Falcons, Peregrine Falcons at Bonney Butte, OR: 1994–2003. Dashed lines indicate significant ($P < 0.10$) regressions.

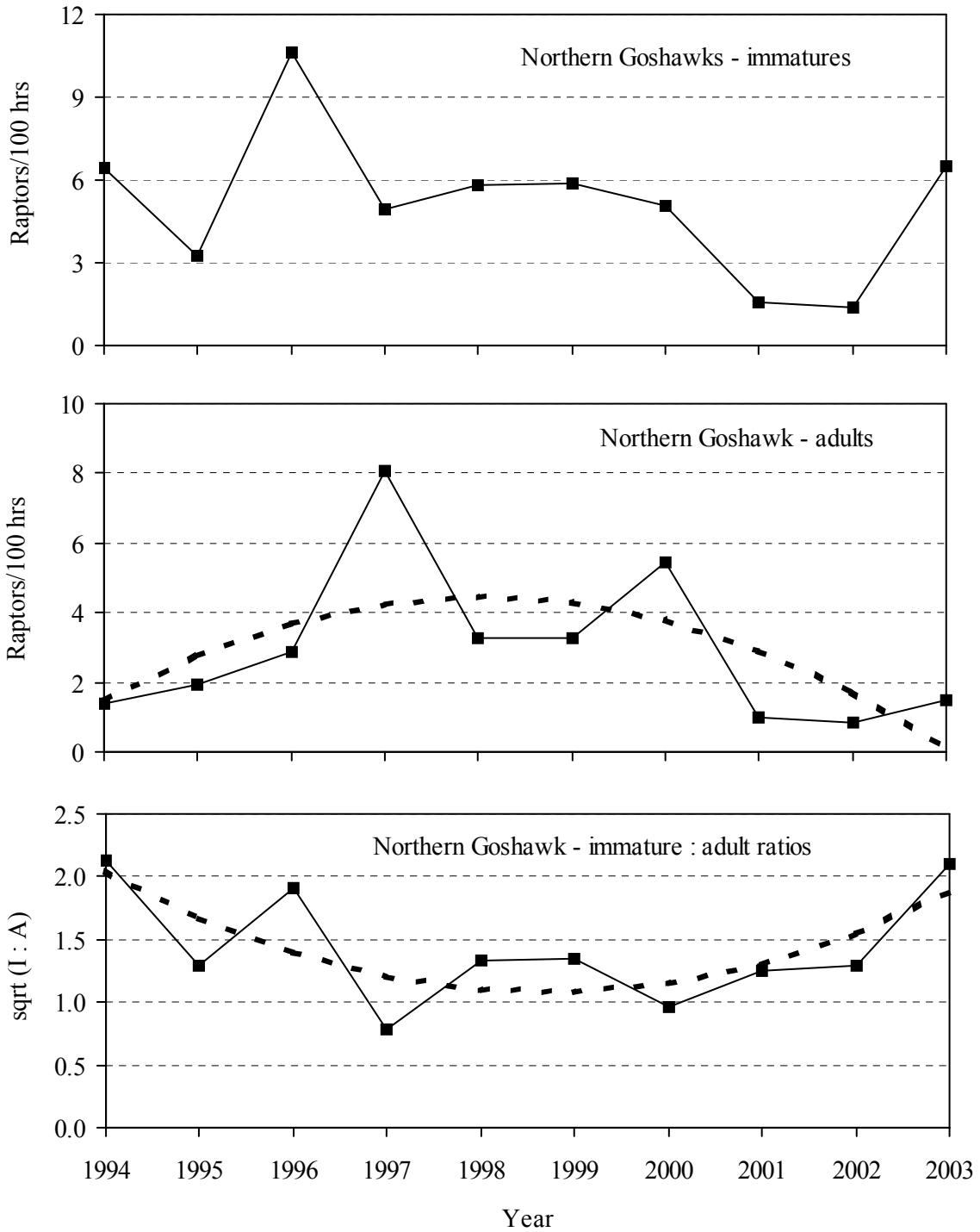


Figure 8. Adjusted, fall-migration passage rates for adult and immature Northern Goshawks and associated immature : adult ratios at Bonney Butte, OR: 1994–2003. Dashed lines indicate significant ($P < 0.10$) regressions.

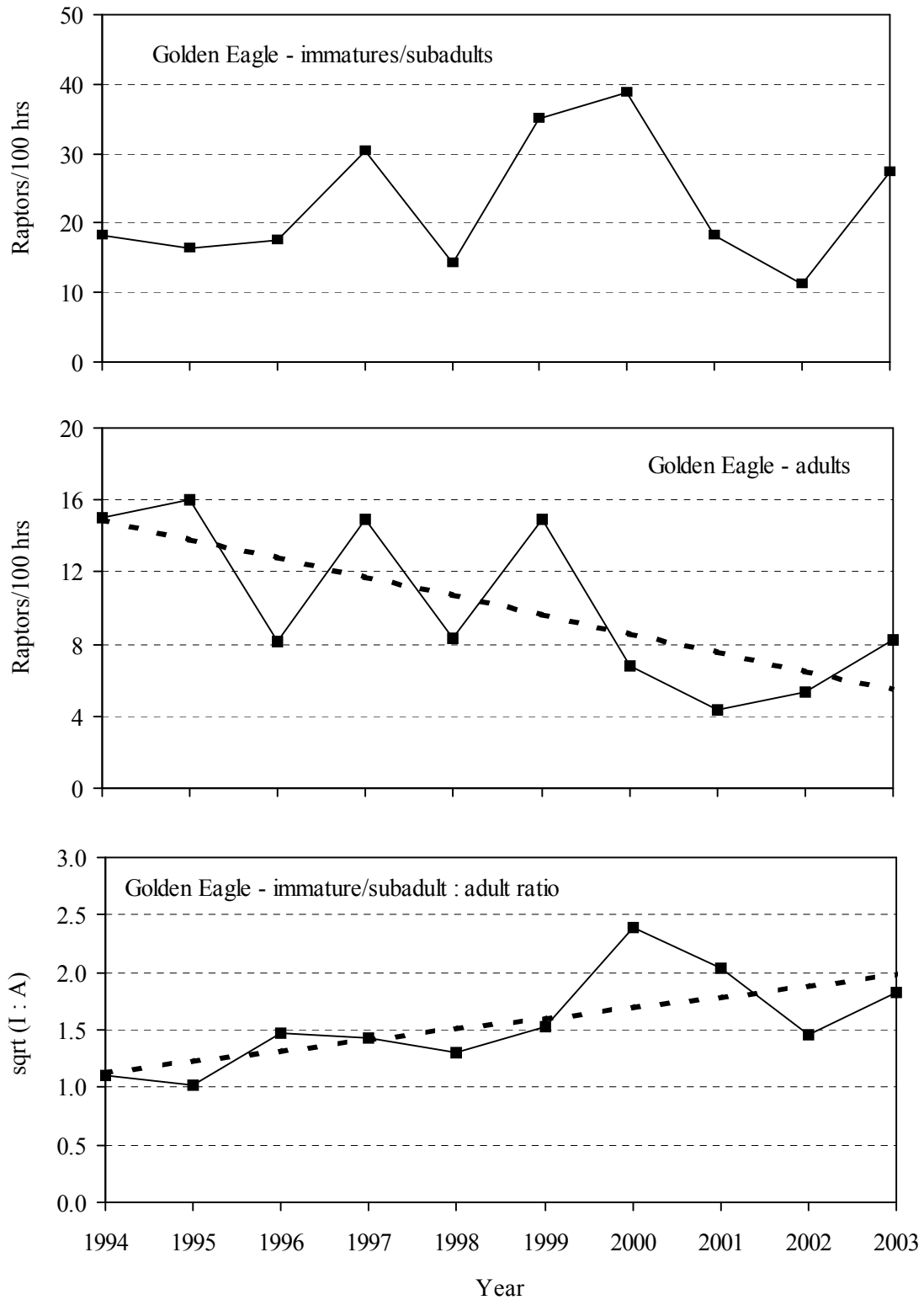


Figure 9. Adjusted, fall-migration passage rates for adult and immature/subadult Golden Eagles and associated immature/subadult : adult ratios at Bonney Butte, OR: 1994–2003. Dashed lines indicate significant ($P < 0.10$) regressions.

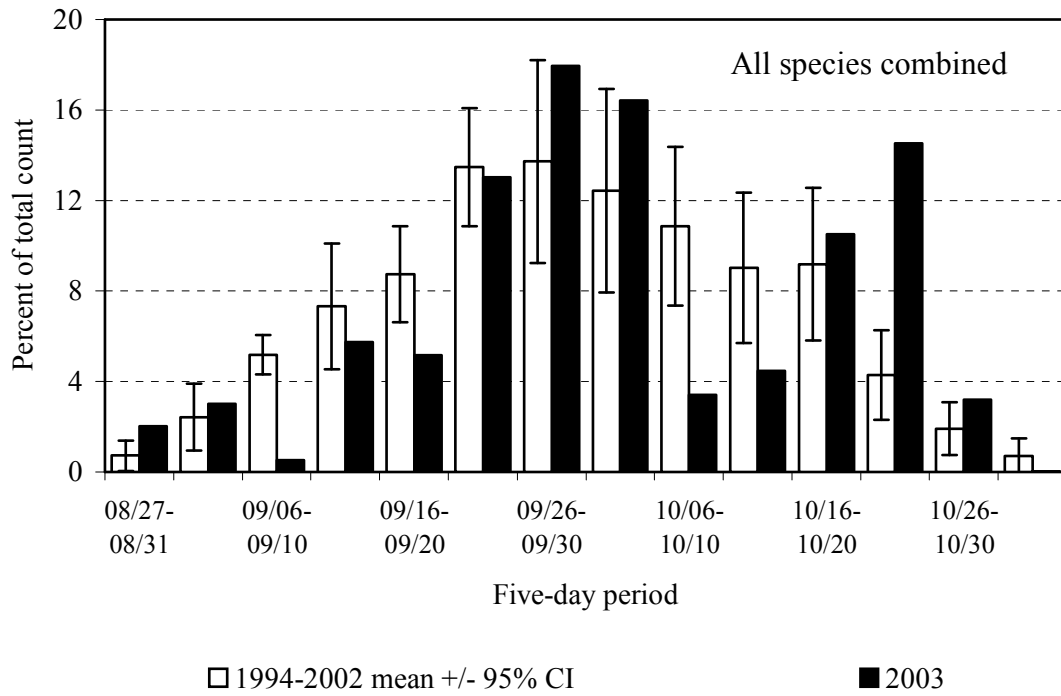


Figure 10. Combined-species passage volume by five-day periods for migrating raptors at Bonney Butte, OR: 1994–2002 versus 2003.

Appendix A. A history of observer participation in the Bonney Butte Raptor Migration Project: 1994–2003.

1994: Single observer throughout: David Schuetze (0) and Sean O’Connor (0)¹.

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).

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

Appendix B. Daily observation effort, visitor disturbance ratings, weather records, and flight summaries for the Bonney Butte Raptor Migration Project: 2003.

DATE	OBS. HOURS	OBSRVR / HOUR ¹	MEDIAN VISITOR DISTURB ²	PREDOMINANT WEATHER ³	WIND SPEED (KPH) ¹	WIND DIRECTION	TEMP (°C) ¹	BAROM. PRESS. (IN HG) ¹	MEDIAN THERMAL LIFT ⁴	VISIB. WEST (KM) ¹	VISIB. EAST (KM) ¹	MEDIAN FLIGHT DISTANCE ⁵	BIRDS / HOUR
27-Aug	9.00	2.1	0	clr, AM fog, PM haze	7.5	ws-w	17.8	29.38	3	23	32	2	1.0
28-Aug	9.00	2.4	0	clr-mc, haze	4.7	se, ne	21.0	29.43	2	13	14	2	1.0
29-Aug	9.00	2.0	0	clr, haze	6.9	ne	22.0	29.56	3	20	31	2	1.6
30-Aug	9.00	2.1	0	clr, haze	5.9	ne, var	24.5	29.54	2	10	18	2	2.0
31-Aug	9.00	3.1	0	clr-pc, haze	6.9	wnw	23.2	29.49	3	13	28	2	3.0
1-Sep	8.00	2.5	0	clr	3.8	var	23.7	29.47	2	56	38	2	0.5
2-Sep	9.00	1.0	0	pc-ovc, haze	6.1	ne/var	24.8	29.51	3	10	19	2	2.6
3-Sep	9.00	2.4	0	clr-ovc, haze	5.3	ne-sse, w	30.4	29.49	3	10	13	2	4.0
4-Sep	9.00	1.6	0	clr-mc, haze	3.8	ssw-w	27.5	29.47	2	11	22	2	2.6
5-Sep	8.00	2.9	0	clr-mc, haze	3.8	ssw-w, se	25.1	29.47	3	24	49	2	3.6
6-Sep	9.00	2.1	0	clr-ovc, haze	5.4	ene-e, sw-w	24.4	29.33	3	11	20	2	2.2
7-Sep	2.00	2.0	0	ovc, fog/rain	4.7	ssw-w	15.7	29.18	4	57	22	-	0.0
8-Sep	0.00			fog/rain									
9-Sep	0.00			fog/rain									
10-Sep	0.00			fog/rain									
11-Sep	0.00			fog/rain									
12-Sep	8.75	1.8	0	clr-mc, fog/haze	6.6	w-wnw	10.1	29.61	4	52	27	2	2.3
13-Sep	8.80	2.3	0	clr, haze	7.2	ne-e	14.5	29.63	3	63	39	2	7.0
14-Sep	9.00	3.7	0	clr-ovc, haze	3.7	s-wnw	18.4	29.40	4	66	38	2	11.4
15-Sep	9.00	1.7	0	clr-ovc, haze	5.2	ssw-wnw	12.7	29.28	4	68	43	2	3.8
16-Sep	0.00			rain/snow									
17-Sep	5.50	2.5	0	mc, haze	5.0	sw-w	10.5	29.47	4	69	25	2	2.7
18-Sep	9.00	1.9	0	clr-ovc, haze	3.0	sw-wnw	16.0	29.43	3	71	44	2	6.2
19-Sep	2.00	1.8	0	mc, haze	5.3	s-ssw	12.3	29.37	4	65	13	3	2.5
20-Sep	9.00	2.8	0	clr, haze	4.8	e, sw-w	16.0	29.49	3	71	47	3	13.4
21-Sep	9.00	3.9	1	clr, haze	5.4	n-ne	16.6	29.54	3	65	46	3	15.3
22-Sep	9.20	2.2	0	clr, haze	3.4	ne, sw-w	21.9	29.45	2	76	72	3	7.7
23-Sep	9.00	1.4	0	clr, haze	3.0	nw, sw-w	20.6	29.44	2	73	58	3	6.3
24-Sep	9.00	2.0	0	clr, haze	7.1	ene, w	21.4	29.46	3	33	35	3	11.3
25-Sep	9.00	2.0	0	clr-mc, haze	8.2	sw-w	19.8	29.60	3	74	67	3	14.3
26-Sep	9.00	1.8	0	clr, haze	5.3	ne-e	24.5	29.61	2	73	59	3	11.1
27-Sep	9.00	4.2	0	clr, haze	8.2	ne	20.4	29.52	2	67	46	2	17.4
28-Sep	9.00	3.9	0	clr, haze	7.1	ne/var	21.7	29.46	3	59	43	2	25.8
29-Sep	9.00	3.1	0	mc, haze	6.1	n-ne	18.4	29.35	4	36	39	2	11.3
30-Sep	9.00	1.3	0	clr, haze	6.6	ne-e	18.6	29.47	3	26	41	3	10.4
1-Oct	9.00	1.8	0	mc-ovc, haze	6.4	nw-ne/var	17.9	29.46	4	47	41	2	7.3
2-Oct	9.00	2.6	0	clr, haze	2.9	var	20.1	29.39	1	26	44	3	11.9
3-Oct	9.00	4.0	0	clr, haze	7.5	ne	18.5	29.32	3	23	37	3	13.6
4-Oct	9.00	3.7	0	pc-mc, haze	4.6	ne, var	20.5	29.30	3	21	43	2	20.0
5-Oct	9.00	3.2	0	clr, haze	3.4	sw-w, se	19.5	29.41	2	41	39	3	16.9
6-Oct	8.75	2.6	0	clr-mc, haze	4.7	w-wnw	17.8	29.29	3	52	42	2	14.5
7-Oct	0.00			fog/rain									

Appendix B. continued

DATE	OBS. HOURS	OBSRVR / HOUR ¹	MEDIAN VISITOR DISTURB ²	PREDOMINANT WEATHER ³	WIND SPEED (KPH) ¹	WIND DIRECTION	TEMP (°C) ¹	BAROM. PRESS. (IN HG) ¹	MEDIAN THERMAL LIFT ⁴	VISIB. WEST (KM) ¹	VISIB. EAST (KM) ¹	MEDIAN FLIGHT DISTANCE ⁵ / HOUR	BIRDS / HOUR
8-Oct	0.00			fog/rain									
9-Oct	0.00			fog/rain/snow									
10-Oct	0.80	1.0	0	clr-pc, haze	2.0	sw	3.5	29.37	4	65	25	2	3.8
11-Oct	0.00			fog/rain/snow									
12-Oct	0.00			fog/rain/snow									
13-Oct	8.00	2.3	0	pc-ovc, scat fog	4.9	ne-e	8.3	29.53	4	100	71	2	21.4
14-Oct	0.00			fog									
15-Oct	0.00			fog/rain/snow									
16-Oct	2.80	1.9	0	mc-ovc, haze	8.5	w-wnw	12.3	29.26	4	84	51	3	5.7
17-Oct	8.80	2.6	0	clr-mc	9.6	wnw	12.4	29.37	4	100	80	3	18.8
18-Oct	9.00	2.0	0	mc, haze	5.5	sw-w	15.6	29.31	3	90	67	3	19.2
19-Oct	4.00	2.0	0	mc-ovc, haze	4.8	wnw-nw	13.2	29.43	4	97	43	3	8.5
20-Oct	3.70	1.1	0	ovc, haze/rain	13.8	sw-nw	14.3	29.37	4	73	48	2	3.5
21-Oct	9.00	2.4	0	clr-mc, haze	6.6	se-ne	17.1	29.57	3	98	63	2	28.8
22-Oct	9.00	1.7	0	ovc, haze	7.6	sw-wnw	12.8	29.35	4	80	49	2	9.6
23-Oct	8.10	2.0	0	clr-pc, haze	4.2	sw-wnw	5.9	29.65	4	99	48	2	11.6
24-Oct	8.50	2.4	0	clr-pc, haze	6.9	ne	6.8	29.09	4	76	54	3	5.8
25-Oct	8.50	3.2	0	pc-mc, haze	6.6	ne	11.9	29.23	4	87	65	2	7.9
26-Oct	8.70	2.2	0	clr-pc, haze	4.4	ne, se, w	19.3	29.24	3	91	74	2	1.5
27-Oct	8.50	2.4	0	pc-mc, haze	7.9	s-w	15.4	29.09	4	77	63	3	12.8
28-Oct	0.00			rain/snow									
29-Oct	0.00			snow									
30-Oct	0.00			road impassable									
31-Oct	1.25	1.3	0	clr, haze	10.0	ne	0.0		4	60	60	3	0.8

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 C. Daily observation effort and fall raptor migration counts by species at Bonney Butte, OR: 2003.

DATE	OBS		SPECIES ¹																								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	9.00	1	1	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	1	0	0	0	0	0	0	0	9	1.0
28-Aug	9.00	1	1	0	0	2	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	0	0	0	0	0	0	1	9	1.0
29-Aug	9.00	6	0	1	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	1	0	0	0	0	0	0	14	1.6	
30-Aug	9.00	6	2	0	3	1	1	0	0	0	0	0	0	4	0	0	0	0	0	0	1	0	0	0	0	0	0	18	2.0	
31-Aug	9.00	5	4	0	7	3	0	0	0	0	0	0	0	6	0	0	0	0	0	0	2	0	0	0	0	0	0	27	3.0	
1-Sep	8.00	2	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0.5	
2-Sep	9.00	3	1	0	5	2	1	0	0	0	0	0	0	8	0	0	1	0	0	0	0	1	0	0	0	0	1	23	2.6	
3-Sep	9.00	4	1	1	8	11	1	2	0	0	0	0	0	6	0	0	0	0	0	0	2	0	0	0	0	0	0	36	4.0	
4-Sep	9.00	5	1	0	7	2	1	0	0	0	0	1	0	4	0	0	0	0	0	0	0	0	1	1	0	0	0	23	2.6	
5-Sep	8.00	10	0	0	12	2	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	1	29	3.6	
6-Sep	9.00	6	1	0	6	2	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	1	20	2.2	
7-Sep	2.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
8-Sep	0.00																													
9-Sep	0.00																													
10-Sep	0.00																													
11-Sep	0.00																													
12-Sep	8.75	2	0	0	2	2	0	0	0	0	0	0	0	11	0	0	0	0	0	0	0	1	1	0	0	0	1	20	2.3	
13-Sep	8.80	8	3	1	21	10	1	1	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	62	7.0	
14-Sep	9.00	3	15	0	42	10	2	0	0	0	0	0	0	28	0	0	0	2	0	0	0	1	0	0	0	0	0	103	11.4	
15-Sep	9.00	5	1	0	12	3	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0	0	1	0	0	0	0	34	3.8	
16-Sep	0.00																													
17-Sep	5.50	2	3	0	2	1	0	0	0	0	0	0	0	5	0	0	0	1	0	0	0	0	0	1	0	0	0	15	2.7	
18-Sep	9.00	5	2	0	24	11	0	0	0	0	0	0	0	13	0	0	0	1	0	0	0	0	0	0	0	0	0	56	6.2	
19-Sep	2.00	0	0	0	1	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	5	2.5	
20-Sep	9.00	37	6	0	46	11	0	2	0	0	0	0	0	17	0	0	0	0	0	0	0	2	0	0	0	0	0	121	13.4	
21-Sep	9.00	50	7	1	30	16	0	1	0	0	0	0	0	25	0	0	0	0	2	0	3	2	0	1	0	0	0	138	15.3	
22-Sep	9.20	17	5	2	19	11	0	1	0	0	0	0	0	14	0	0	1	0	0	0	0	0	0	1	0	0	0	71	7.7	
23-Sep	9.00	10	0	0	19	13	1	0	0	0	0	0	0	13	0	0	0	0	0	0	0	0	1	0	0	0	0	57	6.3	
24-Sep	9.00	11	2	0	40	18	0	0	0	0	0	0	0	23	0	0	0	3	2	0	1	0	1	0	0	0	1	102	11.3	
25-Sep	9.00	40	6	2	32	21	1	0	0	0	0	0	0	22	0	0	1	2	1	0	0	0	1	0	0	0	0	129	14.3	
26-Sep	9.00	15	2	0	37	13	3	1	0	0	0	0	0	20	0	0	1	1	5	0	0	1	0	1	0	0	0	100	11.1	
27-Sep	9.00	27	1	5	56	29	1	7	1	0	0	0	0	19	0	0	1	2	1	0	2	2	1	0	0	0	2	157	17.4	
28-Sep	9.00	76	5	5	56	31	2	6	0	0	0	0	0	45	0	0	1	2	0	0	1	1	0	1	0	0	0	232	25.8	
29-Sep	9.00	15	6	2	41	13	1	1	0	1	0	3	0	14	0	0	3	0	0	0	0	1	0	1	0	0	0	102	11.3	
30-Sep	9.00	28	0	1	34	10	0	0	0	0	0	1	0	15	0	0	1	1	1	0	0	2	0	0	0	0	0	94	10.4	

Appendix C. continued

DATE	OBS		SPECIES ¹																								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
1-Oct	9.00	16	5	0	23	9	0	1	0	0	1	0	0	8	0	0	0	0	0	0	0	2	0	1	0	0	0	0	66	7.3
2-Oct	9.00	32	3	2	39	14	0	0	0	0	0	0	0	12	0	0	0	0	1	0	1	3	0	0	0	0	0	107	11.9	
3-Oct	9.00	17	1	0	64	19	0	0	0	0	0	0	0	17	0	0	1	0	0	0	0	2	1	0	0	0	0	122	13.6	
4-Oct	9.00	2	3	2	120	23	1	1	0	0	0	1	0	12	0	0	3	3	1	0	0	6	1	1	0	0	0	180	20.0	
5-Oct	9.00	6	1	1	89	26	1	4	0	0	0	0	0	12	0	0	0	3	3	0	2	3	0	1	0	0	0	152	16.9	
6-Oct	8.75	13	3	1	67	16	0	1	0	0	0	0	0	18	0	0	0	4	3	0	0	1	0	0	0	0	0	127	14.5	
7-Oct	0.00																													
8-Oct	0.00																													
9-Oct	0.00																													
10-Oct	0.80	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	3	3.8	
11-Oct	0.00																													
12-Oct	0.00																													
13-Oct	8.00	0	1	0	114	20	0	0	0	0	0	0	0	24	0	0	0	3	1	0	0	8	0	0	0	0	0	171	21.4	
14-Oct	0.00																													
15-Oct	0.00																													
16-Oct	2.80	0	0	0	1	2	0	0	0	0	0	0	0	6	0	0	0	4	0	0	0	3	0	0	0	0	0	16	5.7	
17-Oct	8.80	0	1	0	84	21	0	1	0	0	0	0	0	35	0	0	0	10	10	0	0	3	0	0	0	0	0	165	18.8	
18-Oct	9.00	0	0	0	113	14	1	2	0	0	0	0	0	19	0	1	0	13	1	0	0	8	0	1	0	0	0	173	19.2	
19-Oct	4.00	0	0	0	16	9	0	0	0	0	0	0	0	5	0	0	1	0	1	0	0	2	0	0	0	0	0	34	8.5	
20-Oct	3.70	0	0	0	8	1	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	1	0	0	0	0	0	13	3.5	
21-Oct	9.00	1	0	0	167	22	1	1	0	0	0	0	0	46	0	1	0	9	3	0	0	8	0	0	0	0	0	259	28.8	
22-Oct	9.00	1	0	0	41	8	1	0	0	0	0	0	0	11	0	0	0	14	1	0	0	9	0	0	0	0	0	86	9.6	
23-Oct	8.10	0	1	0	21	9	5	0	0	0	0	0	0	42	0	0	0	8	6	0	0	1	0	1	0	0	0	94	11.6	
24-Oct	8.50	0	0	1	9	4	0	0	0	0	0	0	0	19	0	2	1	10	3	0	0	0	0	0	0	0	0	49	5.8	
25-Oct	8.50	0	2	0	20	4	0	0	0	0	0	0	0	28	0	2	0	1	6	0	0	4	0	0	0	0	0	67	7.9	
26-Oct	8.70	0	0	0	3	0	0	0	0	0	0	0	0	4	0	0	1	2	2	0	0	0	0	1	0	0	0	13	1.5	
27-Oct	8.50	0	0	0	17	2	3	0	0	0	0	0	0	55	0	4	0	9	12	0	0	6	0	0	0	0	1	109	12.8	
28-Oct	0.00																													
29-Oct	0.00																													
30-Oct	0.00																													
31-Oct	1.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0.8	
Total	402.65	488	97	28	1578	473	29	33	1	1	1	6	0	744	0	10	18	108	68	0	19	84	8	14	0	0	2	7	3817	9.5

¹ See Appendix E for full names associated with species codes.

Appendix D. Annual observation effort and fall raptor migration counts by species at Bonney Butte, OR: 1994–2003.

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	MEAN
Start date	2-Sep	4-Sep	1-Sep	1-Sep	1-Sep	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug	29-Aug
End date	25-Oct	31-Oct	2-Nov	3-Nov	30-Oct	28-Oct	30-Oct	28-Oct	31-Oct	31-Oct	29-Oct
Observation days	47	38	46	45	52	63	48	58	59	51	51
Observation hours	327.74	251.51	285.82	286.25	384.91	416.00	328.50	415.75	423.67	402.65	352.28
Raptors / 100 hours	688.4	939.9	959.7	953.7	631.8	993.5	1029.5	601.1	453.7	948.0	819.93
Species											
Turkey Vulture	204	235	165	133	160	349	553	338	286	488	291
Osprey	32	49	55	60	67	74	107	78	50	97	67
Northern Harrier	25	22	39	30	56	49	13	7	27	28	30
Sharp-shinned Hawk	857	871	1027	912	1018	1660	1105	957	600	1578	1059
Cooper's Hawk	282	310	420	317	266	331	456	256	233	473	334
Northern Goshawk	25	12	40	34	33	36	31	10	8	29	26
Unknown small accipiter ¹	–	–	–	–	–	–	–	84	11	33	43
Unknown large accipiter ¹	–	–	–	–	–	–	–	0	1	1	1
Unknown accipiter	27	67	85	156	99	155	98	0	21	1	71
TOTAL ACCIPITERS	1191	1260	1572	1419	1416	2182	1690	1307	874	2115	1503
Red-shouldered Hawk	0	0	0	1	1	2	3	0	0	1	1
Broad-winged Hawk	1	3	1	0	0	75	10	0	1	6	10
Swainson's Hawk	0	0	1	2	2	1	0	0	0	0	1
Red-tailed Hawk	516	528	649	626	411	932	680	513	425	744	602
Ferruginous Hawk	1	0	0	1	1	1	1	0	0	0	1
Rough-legged Hawk	12	11	4	20	15	21	30	7	6	10	14
Unidentified buteo	23	30	40	52	30	58	26	29	48	18	35
TOTAL BUTEOS	553	572	695	702	460	1090	750	549	480	779	663
Golden Eagle	96	81	65	106	81	176	132	75	56	108	98
Bald Eagle	33	40	42	33	40	53	37	52	55	68	45
Unidentified eagle	3	2	1	9	4	2	0	6	7	0	3
TOTAL EAGLES	132	123	108	148	125	231	169	133	118	176	146
American Kestrel	29	18	18	35	22	30	21	23	21	19	24
Merlin	36	49	46	104	78	83	65	33	38	84	62
Prairie Falcon	5	4	0	5	10	8	6	1	1	8	5
Peregrine Falcon	3	4	0	1	4	5	8	3	9	14	5
Unknown small falcon ¹	–	–	–	–	–	–	–	0	1	0	0
Unknown large falcon ¹	–	–	–	–	–	–	–	0	0	0	0
Unknown falcon	8	3	2	3	4	0	0	7	2	2	3
TOTAL FALCONS	81	78	66	148	118	126	100	67	72	127	98
Unidentified raptor	38	25	43	90	30	32	0	20	15	7	30
GRAND TOTAL	2256	2364	2743	2730	2432	4133	3382	2499	1922	3817	2828

¹ Designations used for the first time in 2001.

Appendix E. 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, OR.

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	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 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 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

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 F. Daily capture totals of migrating raptors at Bonney Butte, OR: 2003.

DATE	STATION		SPECIES ¹											CAPTURES		
	HOURS		NH	SS	CH	NG	BW	RT	RL	GE	AK	ML	PR	PG	TOTAL	/HOUR
26-Aug	0.35		0	0	0	0	0	1	0	0	0	0	0	0	1	2.9
27-Aug	6.00		0	0	1	0	0	3	0	0	0	0	0	0	4	0.7
28-Aug	7.00		0	1	0	1	0	0	0	0	0	0	0	0	2	0.3
29-Aug	8.25		0	4	2	0	0	1	0	0	0	0	0	0	7	0.8
30-Aug	8.00		0	2	1	0	0	1	0	0	0	0	0	0	4	0.5
31-Aug	7.75		0	1	3	0	0	4	0	0	0	0	0	0	8	1.0
01-Sep	7.75		0	1	0	0	0	1	0	0	0	0	0	0	2	0.3
02-Sep	8.00		0	2	0	0	0	1	0	0	0	0	0	0	3	0.4
03-Sep	8.00		0	1	2	0	0	0	0	0	0	0	0	0	3	0.4
04-Sep	8.50		0	5	1	0	0	2	0	0	0	0	0	0	8	0.9
05-Sep	8.00		0	4	0	0	0	3	0	0	0	0	0	0	7	0.9
06-Sep	8.25		0	7	1	1	0	2	0	0	0	0	0	0	11	1.3
07-Sep	0.00															
08-Sep	0.00															
09-Sep	0.00															
10-Sep	0.00															
11-Sep	0.00															
12-Sep	7.00		0	2	2	0	0	2	0	0	0	0	0	0	6	0.9
13-Sep	8.00		0	6	2	0	0	1	0	0	0	0	0	0	9	1.1
14-Sep	8.25		0	9	1	1	0	3	0	0	0	0	0	0	14	1.7
15-Sep	8.50		0	3	0	0	0	5	0	0	0	0	1	0	9	1.1
16-Sep	0.00															
17-Sep	5.00		0	4	1	0	0	2	0	0	0	0	0	0	7	1.4
18-Sep	8.25		0	11	3	0	0	3	0	0	0	0	0	0	17	2.1
19-Sep	0.00															
20-Sep	8.25		1	14	3	0	0	0	0	0	0	0	0	0	18	2.2
21-Sep	8.00		0	5	2	0	0	1	0	0	0	0	0	0	8	1.0
22-Sep	8.50		0	7	1	1	0	1	0	0	0	0	0	0	10	1.2
23-Sep	8.25		0	5	3	0	0	1	0	0	0	0	1	0	10	1.2
24-Sep	8.50		0	20	3	0	0	3	0	0	0	0	0	0	26	3.1
25-Sep	8.25		1	5	9	1	0	1	0	0	0	0	0	0	17	2.1
26-Sep	8.00		0	8	3	1	0	0	0	0	0	0	0	0	12	1.5
27-Sep	8.00		0	5	2	1	0	0	0	0	0	0	0	0	8	1.0

Appendix F. continued

DATE	STATION	SPECIES ¹											TOTAL	CAPTURES	
	HOURS	NH	SS	CH	NG	BW	RT	RL	GE	AK	ML	PR	PG	/HOUR	
28-Sep	8.00	0	6	3	0	0	1	0	0	0	0	0	0	10	1.3
29-Sep	8.25	0	7	3	0	0	1	0	0	0	0	1	0	12	1.5
30-Sep	7.75	1	4	2	0	0	1	0	0	0	1	0	0	9	1.2
01-Oct	7.50	0	10	1	0	0	0	0	0	0	0	0	0	11	1.5
02-Oct	8.00	0	5	1	0	0	2	0	0	0	0	0	0	8	1.0
03-Oct	8.00	0	6	0	0	0	2	0	0	0	0	0	0	8	1.0
04-Oct	8.00	1	8	1	0	0	0	0	0	0	0	0	0	10	1.3
05-Oct	8.25	0	15	1	0	0	4	0	0	0	0	0	0	20	2.4
06-Oct	7.00	0	7	2	0	0	3	0	0	0	0	0	0	12	1.7
07-Oct	0.00														
08-Oct	0.00														
09-Oct	0.00														
10-Oct	0.00														
11-Oct	0.00														
12-Oct	0.00														
13-Oct	5.75	0	16	0	0	0	2	0	0	0	0	0	0	18	3.1
14-Oct	0.00														
15-Oct	0.00														
16-Oct	0.00														
17-Oct	7.00	0	1	1	0	0	3	0	0	0	0	0	0	5	0.7
18-Oct	8.25	0	13	0	1	0	4	0	0	0	2	0	0	20	2.4
19-Oct	2.50	0	1	0	0	0	0	0	0	0	0	0	0	1	0.4
20-Oct	4.50	0	0	0	0	0	1	0	0	0	0	0	0	1	0.2
21-Oct	7.75	0	25	2	0	0	3	0	1	0	0	0	0	31	4.0
22-Oct	8.00	0	7	0	2	0	0	0	1	0	0	0	0	10	1.3
23-Oct	5.50	0	1	0	1	0	1	0	0	0	0	0	0	3	0.5
24-Oct	7.50	0	1	0	0	0	2	0	0	0	0	0	0	3	0.4
25-Oct	7.25	0	2	1	0	0	0	0	0	0	0	0	0	3	0.4
26-Oct	8.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
27-Oct	6.00	0	1	0	1	0	1	0	0	0	1	0	0	4	0.7
Total	345.35	4	268	64	12	0	73	0	2	0	4	3	0	430	1.2

¹ See Appendix E for full names associated with species codes.

Appendix G. Annual trapping effort and capture totals by species for migrating raptors at Bonney Butte, OR: 1995–2003.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	MEAN	TOTAL
First trapping day	7-Oct	18-Sep	31-Aug	6-Sep	5-Sep	28-Aug	25-Aug	27-Aug	26-Aug		
Last trapping day	28-Oct	10-Oct	1-Nov	30-Oct	24-Oct	24-Oct	28-Oct	27-Oct	27-Oct		
Number of stations	1	1	1	1	1	1	1	1	1	1	
Trapping days	10	21	39	34	22	39	50	55	47	37	
Trapping hours	44.50	127.20	202.80	199.95	142.75	239.75	320.50	357.75	345.35	220.06	
Captures / hour	4.9	10.0	11.0	12.8	10.0	13.0	10.3	10.4	12.4	10.5	
SPECIES	RAPTOR CAPTURES										
Northern Harrier	0	1	0	2	1	1	0	6	4	1.7	15
Sharp-shinned Hawk	18	80	139	163	82	161	171	172	268	139	1254
Cooper's Hawk	0	20	29	43	14	67	74	71	64	42	382
Northern Goshawk	1	7	7	3	3	8	11	7	12	7	59
Broad-winged Hawk	0	0	0	0	0	1	0	0	0	0	1
Red-tailed Hawk	2	14	39	29	36	66	66	108	73	48	433
Rough-legged Hawk	0	0	1	0	1	0	1	0	0	0.3	3
Golden Eagle	0	3	2	1	2	3	2	0	2	2	15
American Kestrel	0	0	0	0	1	0	1	0	0	0	2
Merlin	1	2	5	11	3	1	4	5	4	4	36
Prairie Falcon	0	0	1	4	0	1	0	1	3	1	10
Peregrine Falcon	0	0	0	0	0	2	0	1	0	0	3
All species	22	127	223	256	143	311	330	371	430	246	2213
Recaptures ¹	0	0	0	0	0	0	0	0	0	0	0
Foreign Recaptures ²	0	0	1	1	0	0	1	0	2	<1	5
Foreign Encounters ³	1	0	1	2	6	3	2	5	8	3	28

¹ Recaptures at Bonney Butte of birds originally banded at Bonney Butte.

² Recaptures at Bonney Butte of birds originally banded elsewhere.

³ Birds originally banded at Bonney Butte and subsequently encountered elsewhere.