FALL 2014 RAPTOR MIGRATION ANNUAL REPORT: BONNEY BUTTE HAWKWATCH, HOOD RIVER CO.,OREGON

HawkWatch International, Inc.
Salt Lake City, Utah

Mt. Hood National Forest

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INTRODUCTION

The Bonney Butte HawkWatch in the northern Cascade Mountains of Oregon is an ongoing effort to monitor long-term regional population trends of diurnal raptors that migrate through the Cascade Mountains portion of the Pacific Coast Flyway (Hoffman et al. 2002, Smith et al. 2008a). 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 2014 season marked the 21st consecutive year of counting and the 19th season of banding efforts. This report summarizes the 2014 fall raptor migration season.

The Bonney Butte HawkWatch was 1 of 9 long-term, annual migration counts and 1 of 4 migration banding studies conducted or co-sponsored by HWI during 2014 (Fig.1). The primary objective of these efforts is to track long-term regional population trends of diurnal raptors in western North America and around the Gulf Coast region in Texas (Hoffman and Smith 2003; Smith et al. 2001, 2008a, b). Raptors can 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, Bildstein et al. 2008).

In addition to long-term counting and banding efforts, HWI conducts and supports other studies to further our knowledge about the biology of migrating raptors. Some of these efforts include: telemetry work to identify species' ranges, migratory routes, and connectivity, as well as blood sampling to track changes in raptor health (e.g., Hoffman et al. 2002, Lott and Smith 2006, Goodrich and Smith 2008, DeLong and Hoffman 2004, McBride et al. 2004).

Beyond having scientific and conservation value, each site in HWI's migration network offers unique opportunities for the public to learn about raptors and the natural environment. Providing such opportunities is another important component of the Bonney Butte HawkWatch and outreach efforts here reach hundreds of people from the Portland area, western Oregon and beyond each season.

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; Fig. 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 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 is slightly higher in elevation in relation to the observation site. The intervening space is largely forested and the central Oregon shrub-steppe region lies immediately to the east.

METHODS

STANDARDIZED COUNTS

Weather permitting; two designated observers conducted standardized daily counts of migrating raptors from late August through late October. Observations typically began between 0800–0900 hrs and ended near 1700 hrs Pacific Standard Time (PST). Visitors occasionally assisted with the count.

Data collection 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 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 of precipitation, visibility, and an assessment of thermal-lift conditions were 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.

In comparing 2014 counts against means and 95% confidence intervals for previous seasons, we consider a count value falling outside the 95% confidence interval of the historic site means as significantly different. Linear and quadratic regression was used on effort-adjusted annual passage rates (raptors/100hrs) to identify long-term trends in migrating raptors.

TRAPPING AND BANDING

Similar to the counts, trapping and banding efforts began late August and continued through late October at a single banding station, generally between 0900–1700 hrs PST (see Appendix F for daily trapping records). 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 collection followed standardized protocols used at all HWI migration-banding sites (Hoffman et al. 2002). All birds are released within 45 minutes of capture.

2014 RESULTS AND DISCUSSION

OBSERVATION EFFORT AND WEATHER SUMMARY

Bonney Butte HawkWatch's standard season runs 27 August – 31 October; in 2014 observers were able to count on 49 of 66 possible days during this period for a total of 417.48 hours (Appendix C). Efforts ended 11 days early this year due to a snow storm and series of approaching weather systems. Despite the number of count days this season being three days below the site long-term (1994-2013) average of 51 days; the total hours counted for the season were above long-term average (Appendix C). This probably occurred because only three days had abbreviated counts (<4 hrs) due to weather. Weather varies throughout every season, in 2014 based on hourly recording of conditions during observation it was clear 20% of the time; hazy 86% of the time; cloudy, overcast, and/or foggy 80% of the time (welcome to the PNW!), and rainy 5% of the time.

2014 FLIGHT SUMMARY

Overall Flight:

A total of 2,423 migrating raptors and 16 species were counted in 2014, a statistically significant ($p<0.05$) drop of 17% compared to the long-term site average (Table 1), and the fifth lowest total count in 21 years of monitoring. Despite the overall low count, this year's flight set both seasonal and single day records for Northern Goshawks counted, 53 and 9 respectively.

The flight consisted of 56.2% accipiters, 17.5% buteos, 13.3% vultures, 5.0% falcons, 4.2% eagles, 2.2% Ospreys, 0.7% harriers, and 0.87% unknown raptors. The relative proportions of buteos, eagles, harriers, and Ospreys surpassed historic averages; while accipiters, falcons, and vultures were lower than average (Fig. 2). Sharp-shinned Hawks were the most common species (33% of the total), followed by Cooper's Hawks (19%), Red-tailed Hawks (17%), Turkey Vultures (13%), Merlins (3%), Ospreys (2%), Northern Goshawks (2%), Golden Eagles (2%), and Bald Eagles(2%). The remaining species each accounted for 1% or less of the total count (Table 1).

The following sections summarize the 2014 count relative to historic means at the site, and any statistically significant ($p < 0.05$) population trends based on first and second order regression analysis. HWI only depicts significant trends for species with a historic average count rate greater than or equal to 10 individuals per 100 hours. The rationale is that trends for counts below this point likely do not contain biologically useful information on regional populations—species with counts this low likely have a dispersed migration, another primary migration route, or large portions of the population that are resident. We do include count information in the reports, as occurrences of rarer species are of interest to both managers and the general public, and could represent the beginning of meaningful long-term changes.

Total Flight (Fig.4):

The 584 raptors counted per 100 hours of observation at the Bonney Butte HawkWatch in 2014was significantly below the site average of 776 raptors/100hrs. Despite consecutive years of low counts, the fall flight appears stable over the history of the site (no significant trend over time).

Vultures, Osprey, and Harriers (Fig. 3a):

Both seasonal counts and effort-adjusted passage rates (raptors/100 hrs) were low this year for Osprey and Northern Harriers (Table 1). Based on regression analysis of passage rates, regional Harrier populations are declining (slope = -0.3, $r^2 = 0.28$, p=0.014). It was an average year for Turkey Vultures counted during fall migration.

Accipiters (Fig. 3b):

Seasonal counts and effort-adjusted passage rates were high in 2014 compared to historic averages for both Cooper's Hawks and Northern Goshawks. Conversely, Sharp-shinned Hawk counts and passage rates were low (Table 1). The long-term regional population trends for all three species are stable based on regression of yearly passage rates (no significant trends).

Buteoine Hawks (Fig. 3c):

We counted 425 total buteos in 2014—the third lowest total ever for the group at Bonney Butte. This was driven by below average counts and passage rates of Red-Tailed Hawks, which on average make up over 90% of the buteos counted at Bonney Butte. Red-tailed Hawk populations in the region are declining based on regression analysis of annual fall passage rates (slope= -4.66, $r^2 = 0.31$, p=0.008).

Eagles (Fig.3d):

Golden Eagle counts have been below average for the past three consecutive seasons, and this past season's Bald Eagle count was also below average. Golden Eagle passage rates continue to decline over

time at this site (slope = -1.0, r^2 = 0.39, p = 0.003). Similar declines have been documented across North America and targeted research efforts are underway, including some by HWI, to further understand Golden Eagle, ecology, movements and demographics. Regional populations of Bald Eagles are stable based on regression of Bonney Butte annual passage rates (no significant trend).

Falcons (Fig. 3e):

It was an above average year for counts and passage rates for Prairie and Peregrine Falcons at Bonney Butte, anaverage year for Merlins, and a below average year for American Kestrels (Table 1). Despite mean passage rates below the 10 per 100 hr threshold, it is worth noting that Kestrel passage rates at Bonney Butte have been declining annually (slope= -0.3, r^2 =0.55, p=0.0001) because similar trends have been seen for this species across the HWI network and at other count sites. In response to these declines, HWI, along with many other North American researchers and Citizen Scientists are working to understand Kestrel declines both locally and at the continental scale and have partnered under the umbrella of the American Kestrel Partnership (http://kestrel.peregrinefund.org/).

TRAPPING EFFORT AND OTHER SEASON HIGHLIGHTS

Crews trapped for 48 days (totaling 335.50 hours) between 27August and 19 October and captured 309 raptors of eleven different species. While the number of hours trapped was high compared to historic annual site average (Appendix D), the number of birds caught was average, and the overall capture rate (birds captured/100hrs trapping, Table 2) low.

Season highlights from the blind include: the second biggest Northern Goshawk season (17), the third Red-shouldered Hawk ever trapped at the site, the fourth Broad-winged Hawk for the site, an American Kestrel, and a Golden Eagle. This eagle was outfitted with a PTT satellite telemetry unit programmed to track hourly locations. Information from this and other eagles will provide valuable information on migration routes, winter and summer movements, and habitats habitat use. This bird was aged and sexed as a hatch-year male, and dubbed 'Priceless' in honor of Bill Price a long time Bonney Butte HawkWatch friend and volunteer who passed away this fall. Priceless spent most of the winter in eastern Oregon and at last check remains there.

ENCOUNTERS WITH PREVIOUSLY BANDED BIRDS

To date 98 birds banded at Bonney Butte have been recaptured/recovered and reported to the USGS Bird Banding Laboratory (Fig. 6). During 2014, seven birds banded at Bonney Butte were reported to the BBL, which then passed the information to HWI. These recoveries included one Sharp-shinned Hawk, two Cooper's Hawks, and four Red-tailed Hawks (Fig. 6, Table 3). Five of the seven birds were found dead, mean distance between recovery location and the Bonney Butte HawkWatch was 728 km (range 86-1921), and the mean time between banding and recovery for these birds was 4.6 years (range 0.2-18years).

The two live recoveries included an injured female Cooper's Hawk in California that was at least 6 years old and an injured Red-Tailed Hawk in Oregon banded as a hatch-year bird in 1996-18 years ago! The Cooper's Hawk was released, the status of the Red-tailed Hawk is unknown.

Other highlights of the season were two recaptures (Appendix D), one a hatch-year male Sharp-shinned Hawk that was captured on 13 September but originally banded 16 days earlier on 29 August at the Chelan Ridge HawkWatch in north-central Washington. The other was a Northern Goshawk captured and banded at Bonney Butte as a hatch-year female on 17 September, 2013, and then recaptured this season on 06 October.

VISITOR PARTICIPATION AND PUBLIC OUTREACH

Approximately 450 individuals visited the site during the 2014 season. The largest attendance in a single day was September 20th, with 28 visitors. Visitors to the site get to see raptors in flight and in hand prior to release post- banding, learn to identify raptors in flight and also about raptor migration ecology and what banding and counting efforts can tell us about regional raptor populations and the health of the landscapes they use. They also learn about the ecosystems found around the Bonney Butte HawkWatch and are introduced to/reminded about leave no trace outdoor ethics. Most visitors were from Oregon and Washington, but the crew also met visitors from British Columbia, Idaho, Connecticut, and Virginia.

2014 FALL MIGRATION ACROSS HWI'S NETWORK

HawkWatch International and partners operated 9 fall count sites in 2014 (Fig. 1). During the 4,884.4 hours of standardized observation we counted 504,905 migrating birds of prey. The power and utility of HWI's network of fall count sites, and long-term monitoring in general, lies in that it allows identification of patterns in regional raptor populations, both over time at a single site and also network-wide. Declines in counts or passage rates for a species or group of species at the regional level can highlight the need for more focused research or management attention at local scales, while increases may indicate the success of management and conservation efforts. While each site in HWI's network varied in terms of individual species or group counts, notable network-wide patterns in 2014 included (Table 4):

- Below average counts for the fall flight at 4 of 9 sites
    - Both Pacific Northwest sites, Commissary Ridge, and Corpus Christi
- Low or average Golden Eagle counts at all network sites--no increases at any site
- Below historic average American Kestrel counts at 6 of 9 sites
- Low Northern Harrier counts at 8 of 9 network sites
- Above average Peregrine Falcon counts at 6 of 9 sites and average counts at the other 3
- Above average Broad-winged Hawk numbers at 6 western sites and below average Broad-winged numbers at Corpus Christi – does this signify a change in the migration pathways for this species?

HWI partners with Hawk Mountain Sanctuary, the Hawk Migration Association of North America (HMANA), and Bird Studies Canada (BSC) to provide western US data for the Raptor Population Index (RPI), a collaborative standardized effort to monitor raptor migration across North America.

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Table 1. Historic fall raptor migration counts (mean±95% CI), counts from fall 2014, and site records at Bonney Butte, OR.

		1994-2013				All-time Historic Records	
	Species	**Mean Count ± 95 % CI**		**2014**	**% Change**	**Season**	**Daily**
	Turkey Vulture	348 ± 70		322	-7	790 (2012)	174 (2011)
	Osprey	69 ± 10		53	-24	121 (2012)	22 (2000)
	Northern Harrier	28 ± 5		18	-35	56 (1998)	12 (1998)
Accipiters							
	Sharp-shinned Hawk	1145 ± 135		802	-30	1790 (2004)	215 (2012)
	Cooper's Hawk	344 ± 38		465	35	485 (2004)	67 (2011)
	Northern Goshawk	27 ± 5		53	99	53 (2014)	9 (2014)
	Unidentified accipiter	83 ± 18		41	-50	160 (2008)	
	TOTAL ACCIPITERS	1598 ± 167		1361	-15	2337 (2004)	
Buteos							
	Red-shouldered Hawk	2 ± 1		2	-13	7 (2004)	2 (2004)
	Broad-winged Hawk	9 ± 8		1	-88	75 (1999)	65 (1999)
	Swainson's Hawk	2 ± 0		0	-100	4 (2010)	3 (2010)
	Red-tailed Hawk	568 ± 67		415	-27	932 (1999)	99 (2011)
	Ferruginous Hawk	<1 ±		0		1 (7x)	1 (7x)
	Rough-legged Hawk	13 ± 4		1	-92	30 (2000)	9 (2012)
	Unidentified buteo	27 ± 8		6	-78	58 (1999)	
	TOTAL BUTEOS	617 ± 73		425	-31	1090 (1999)	
Eagles							
	Golden Eagle	84 ± 14		59	-30	176 (1999)	23 (1997)
	Bald Eagle	51 ± 6		38	-26	93 (2011)	23 (2011)
	Unknown eagles	3 ± 1		5	50	9 (1997)	
	TOTAL EAGLES	139 ± 15		102	-26	231 (1999)	
Falcons							
	American Kestrel	19 ± 3		10	-47	35 (1997)	5 (2x)
	Merlin	74 ± 11		80	9	114 (2011)	28 (2011)
	Prairie Falcon	5 ± 1		7	41	10 (1998)	2 (10x)
	Peregrine Falcon	9 ± 2		17	97	21 (2011)	4 (2011)
	Unidentified falcon	4 ± 2		7	77	18 (2005)	
	TOTAL FALCONS	109 ± 12		121	11	148 (1997)	
	Unidentified Raptor	22 ± 9		21	-4	90 (1997)	
	GRAND TOTAL	2928 ± 289		2423	-17	4133 (1999)	425 (2011)

Table 2. Capture totals and rates for fall migrating raptors at Bonney Butte, OR: 1996–2013 versus 2014.

	Capture Totals		Capture Rate[1]	
	1996–2013[2]	2014	1996–2013[2]	2014
Northern Harrier	2 ± 0.9	1	0.6 ± 0.27	0.3
Sharp-shinned Hawk	189 ± 34.1	183	67.2 ± 6.92	54.5
Cooper's Hawk	64 ± 12.7	55	22.0 ± 2.79	16.4
Northern Goshawk	8 ± 2.4	17	3.0 ± 0.87	5.1
Red-shouldered Hawk	0 ± 0.1	1	0.0 ± 0.04	0.3
Broad-winged Hawk	0 ± 0.2	1	0.1 ± 0.06	0.3
Red-tailed Hawk	52 ± 12.2	38	18.4 ± 3.27	11.3
Rough-legged Hawk	0 ± 0.2	0	0.1 ± 0.10	0.0
Golden Eagle	2 ± 0.7	1	0.7 ± 0.29	0.3
American Kestrel	1 ± 0.3	1	0.3 ± 0.17	0.3
Merlin	6 ± 1.7	8	2.2 ± 0.57	2.4
Prairie Falcon	2 ± 0.7	1	0.5 ± 0.27	0.3
Peregrine Falcon	1 ± 0.5	0	0.2 ± 0.15	0.0
All species	327 ± 56.5	309	115.4 ± 10.67	92.1

[1] Captures / 100 station hours.

[2] Mean of annual values ± 95% confidence interval.

Table 3. Foreign encounters in 2014 of raptors banded during autumn migration at Bonney Butte, Oregon.

BAND #	SPECIES[1]-SEX	BANDING DATE	BANDING AGE[2]	ENCOUNTER DATE	ENCOUNTER AGE[2]	ENCOUNTER LOCATION	DISTANCE (km)	STATUS
1807-93994	RT-U	29-Sept-12	HY	9-Jan-14	SY	Marshall, CA	671	Found Dead
1483-55934	SS-F	15-Sept-09	HY	25-Jan-14	ATY	Reedley, CA	824	Found Dead
1075-01981	CH-F	20-Sept-12	HY	24-Feb-14	SY	Ft. Bragg, CA	620	Found Dead
1075-01221	CH-F	07-Sep-08	HY	27-Oct-14	ATY	Fairfield, CA	644	found injured - released
0877-77993	RT-U	21-Sep-96	HY	30-Sep-14	ATY	Grants Pass, OR	332	found injured – release status unknown
1687-27342	RT-U	19-Sep-14	HY	25-Nov-14	HY	Sandy, OR	45	found dead – cause unknown
1177-30983	RT-U	14-Sep-13	HY	08-Nov-14	SY	Santa Rosalia, Baja California, Mex	1922	found dead – cause unknown

[1] Species: CH = Cooper's Hawk, 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 4. Summary of the 2014 fall flight of migrating raptors across HWI's monitoring network. Values are counts ; green indicates a count significantly higher (outside the 95% confidence interval) than the historic site average, red indicates a count significantly lower than average, and black indicates a count that does not differ from the site average.

	Bonney Butte, OR	Chelan Ridge, WA	Bridger Mtn, MT	Commissary Ridge, WY	Goshute Mts, NV	Yaki Pt, AZ	Lipan Pt, AZ	Manzano Mts, NM	Corpus Christi, TX
	Hours Counted in 2014								
Species	414.5	448.3	392.7	491.3	690	605.6	518.1	505.1	818.8
Black Vulture									228
Turkey Vulture	322	55	8	31	661	*	*	343	57128
Osprey	53	41	6	6	125	58	45	38	211
Northern Harrier	18	75	112	6	145	31	35	42	171
Crested Caracara									1
Common Black Hawk									0
Harris' Hawk									4
Accipiters									
Sharp-shinned Hawk	802	520	422	600	6141	1806	1572	1304	2101
Cooper's Hawk	465	190	203	148	3986	862	599	770	821
Northern Goshawk	53	21	59	4	152	4	2	11	0
Unidentified accipiter	41	64	66	49	42	342	281	51	105
TOTAL ACCIPITERS	1361	795	750	801	10321	3014	2454	2136	3027
Buteos									
Red-shouldered Hawk	2				0				15
Broad-winged Hawk	1	12	22	0	203	28	23	17	370575
Short-tailed Hawk									0
Swainson's Hawk	0	43	2	16	509	59	54	2279	8035
White-tailed Hawk									23
Zone-tailed Hawk									5
Red-tailed Hawk	415	119	239	530	5095	1262	1687	696	159
Ferruginous Hawk	0		8	3	32	12	2	7	6
Rough-legged Hawk	1	5	84	3	19	0		3	0
Unidentified buteo	6	22	37	73	16	28	28	7	22
TOTAL BUTEOS	425	201	392	625	5874	1389	1794	3009	378766
Eagles									
Golden Eagle	59	67	1222	136	230	2	16	103	1
Bald Eagle	38	14	106	108	16	12	7	6	15
Unknown eagles	5	0	11	22	0	0	0	0	0
TOTAL EAGLES	102	81	1339	266	246	14	23	109	16
Falcons									
American Kestrel	10	24	138	64	1730	474	440	200	1016
Merlin	80	42	28	4	110	16	12	37	98
Prairie Falcon	7	8	13	9	43	7	0	17	8
Peregrine Falcon	17	10	23	16	33	18	11	59	237
Aplomado Falcon									0
Unidentified falcon	7	7	7	10	0	5	4	2	8
TOTAL FALCONS	121	91	209	103	1916	520	467	315	1367
Kites									
Hook-billed Kite									0
Swallow-tailed Kite									59
White-tailed Kite									4
Mississippi Kite					1				20032
Unidentified Kites									0
TOTAL KITES									20095
Unidentified Raptor	21	45	63	28	0	19	38	0	157
GRAND TOTAL	2423	1384	2879	1866	19288	5045	4856	5993	461171

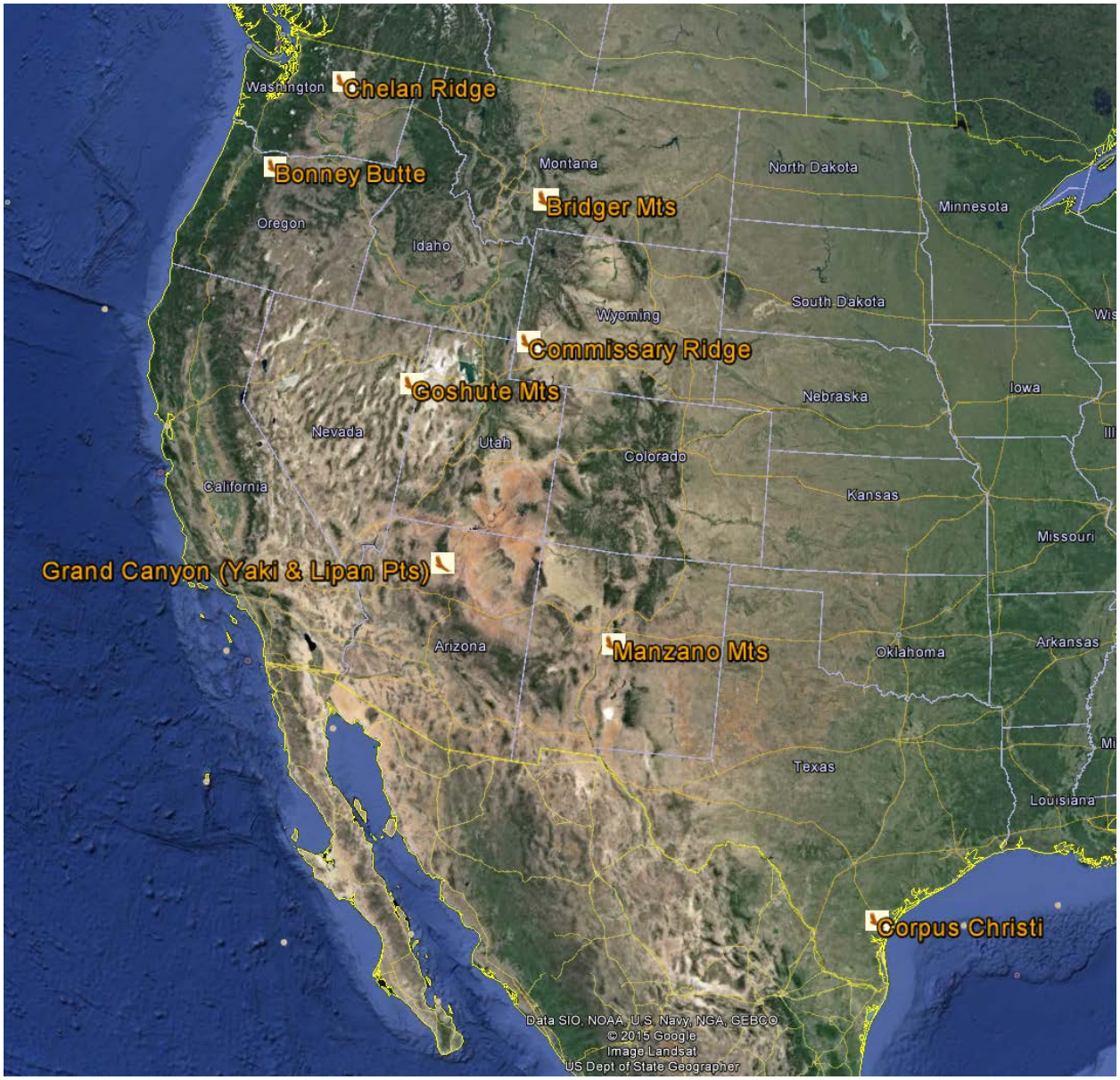

Figure 1. Locations of fall HawkWatch sites operated by HWI and partners.

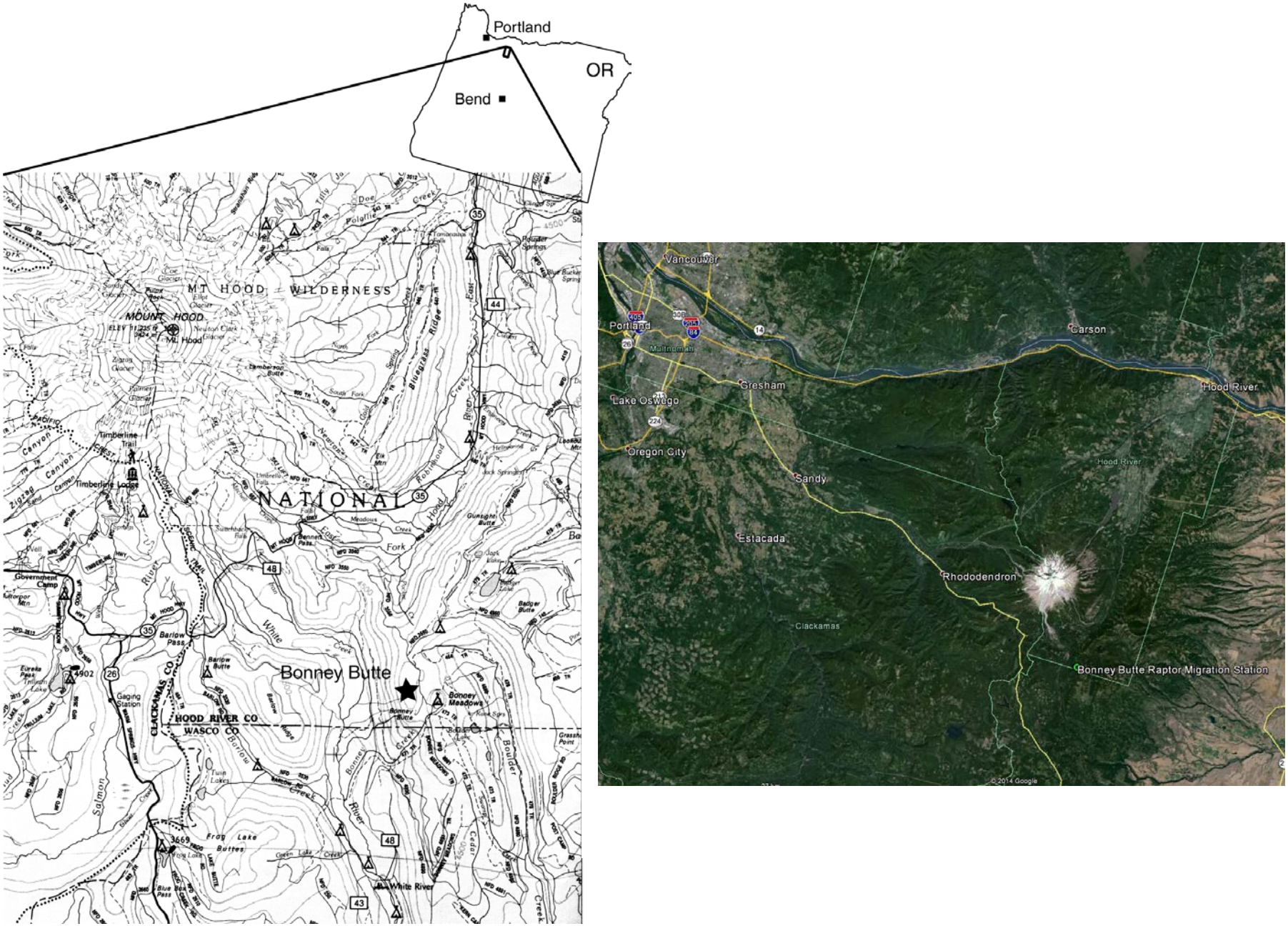

Figure 2. Location of the Bonney Butte HawkWatch near Mt. Hood, Oregon.

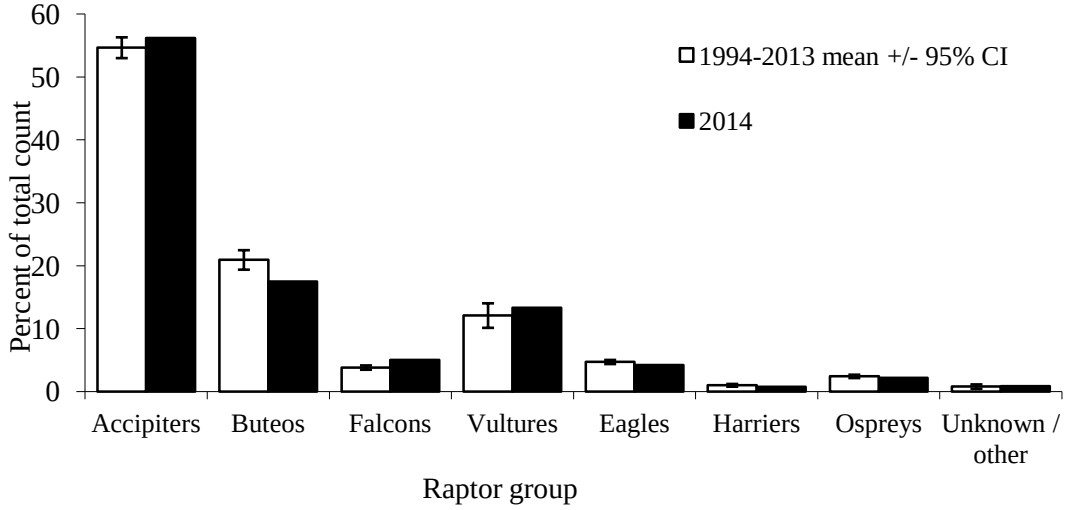

Figure 3. Fall raptor migration flight composition by major species groups at Bonney Butte, Oregon: 1994–2013 versus 2014.

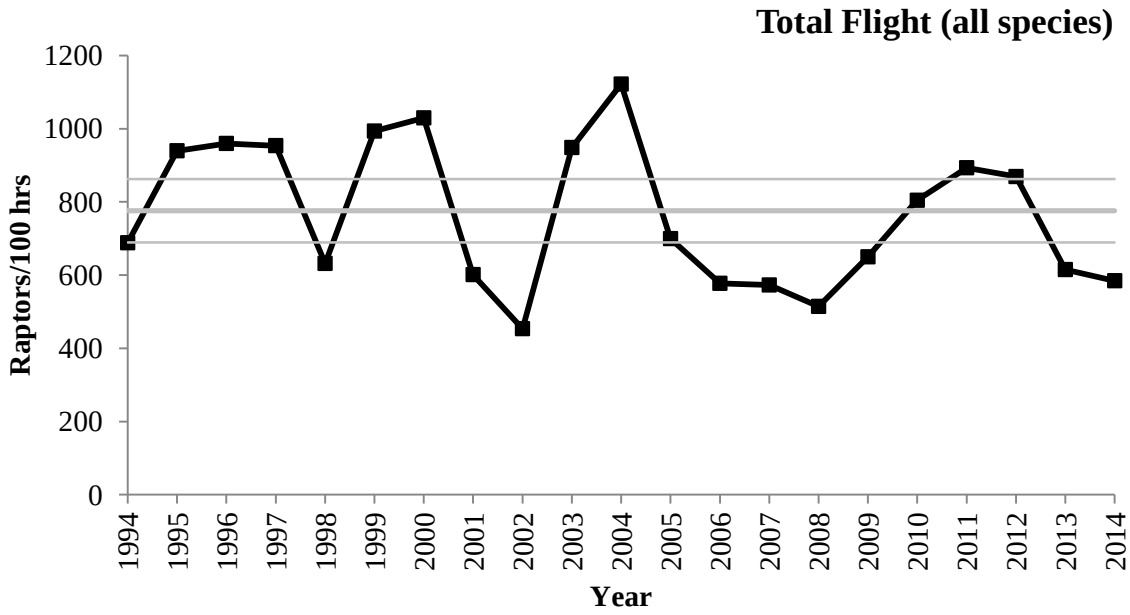

Figure 4. Fall migration passage rates at Bonney Butte, OR for all migrating raptors: 1994-2014. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (1998-2013) at Bonney Butte.

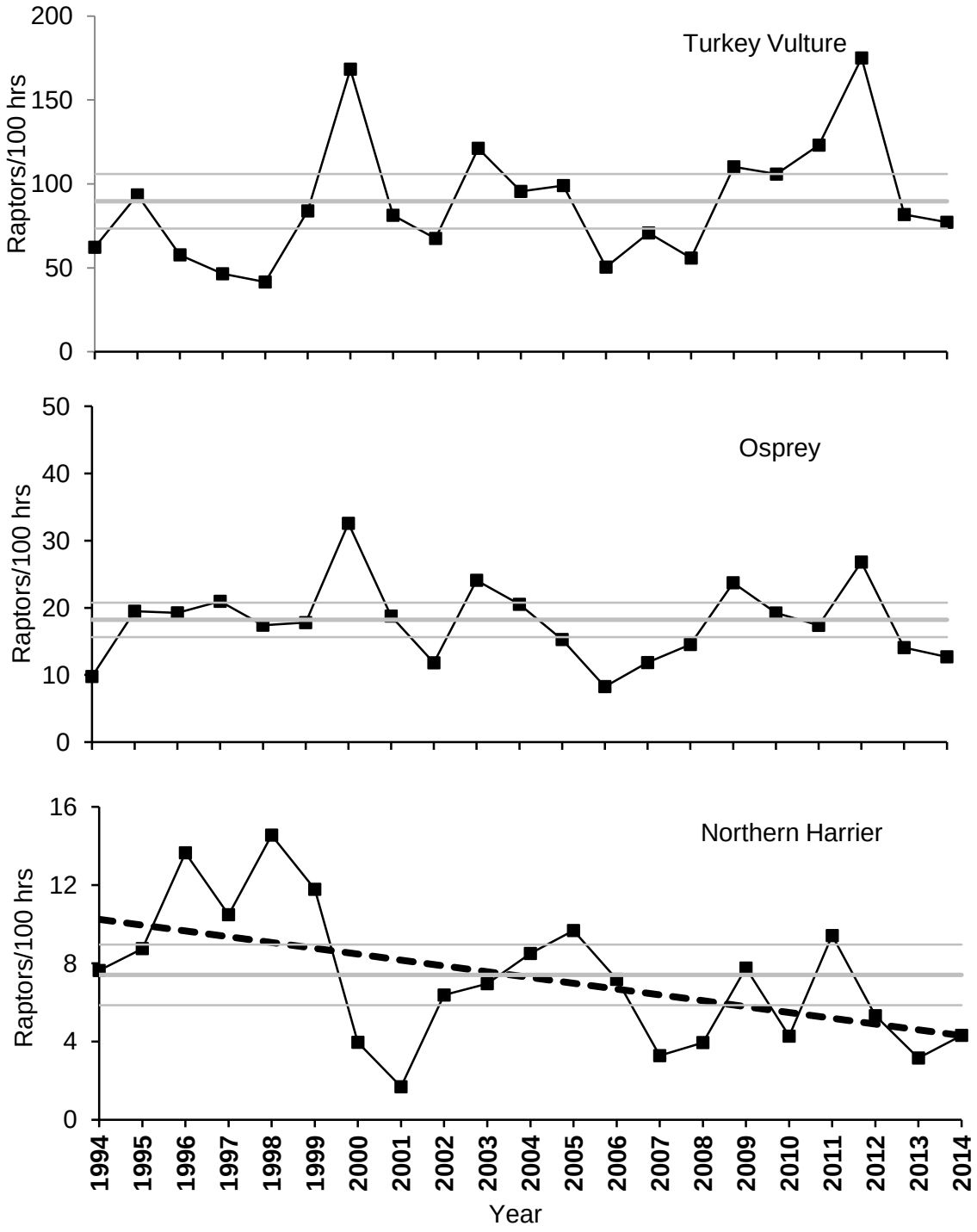

Figure 5a. Fall-migration passage rates at Bonney Butte, OR for Turkey Vultures, Ospreys, and Northern Harriers: 1994–2014. Dashed lines indicate trends for significant ($p < 0.05$) linear or quadratic regressions. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (1994-2013).

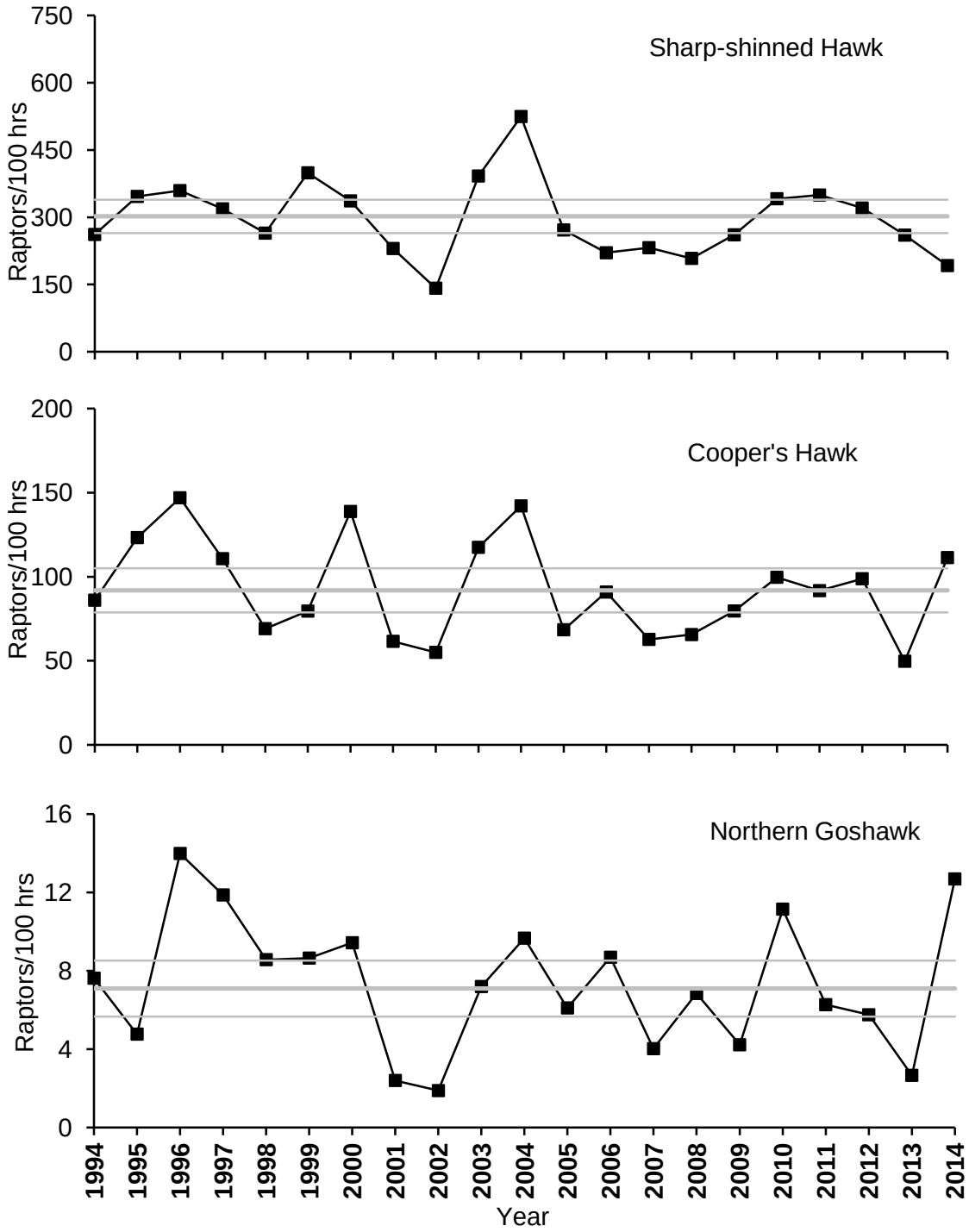

Figure 5b. Fall-migration passage rates at Bonney Butte, OR for the three North American accipiter species: 1994–2014. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (1994-2013).

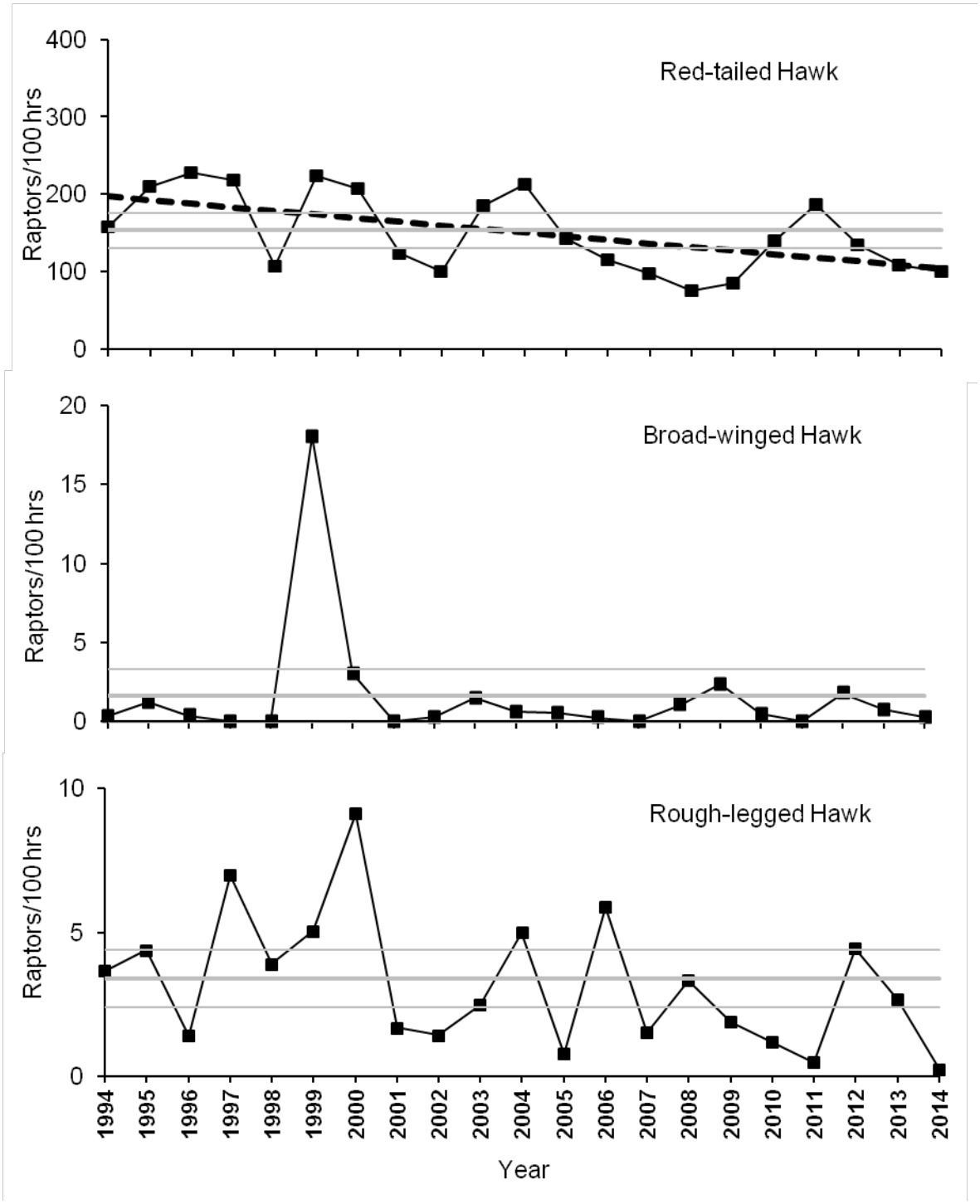

Figure 5c. Fall-migration buteo passage rates at Bonney Butte, OR: 1994–2014. Dashed lines indicate significant ($p < 0.05$) population trends based on linear or quadratic regressions. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (1994-2013).

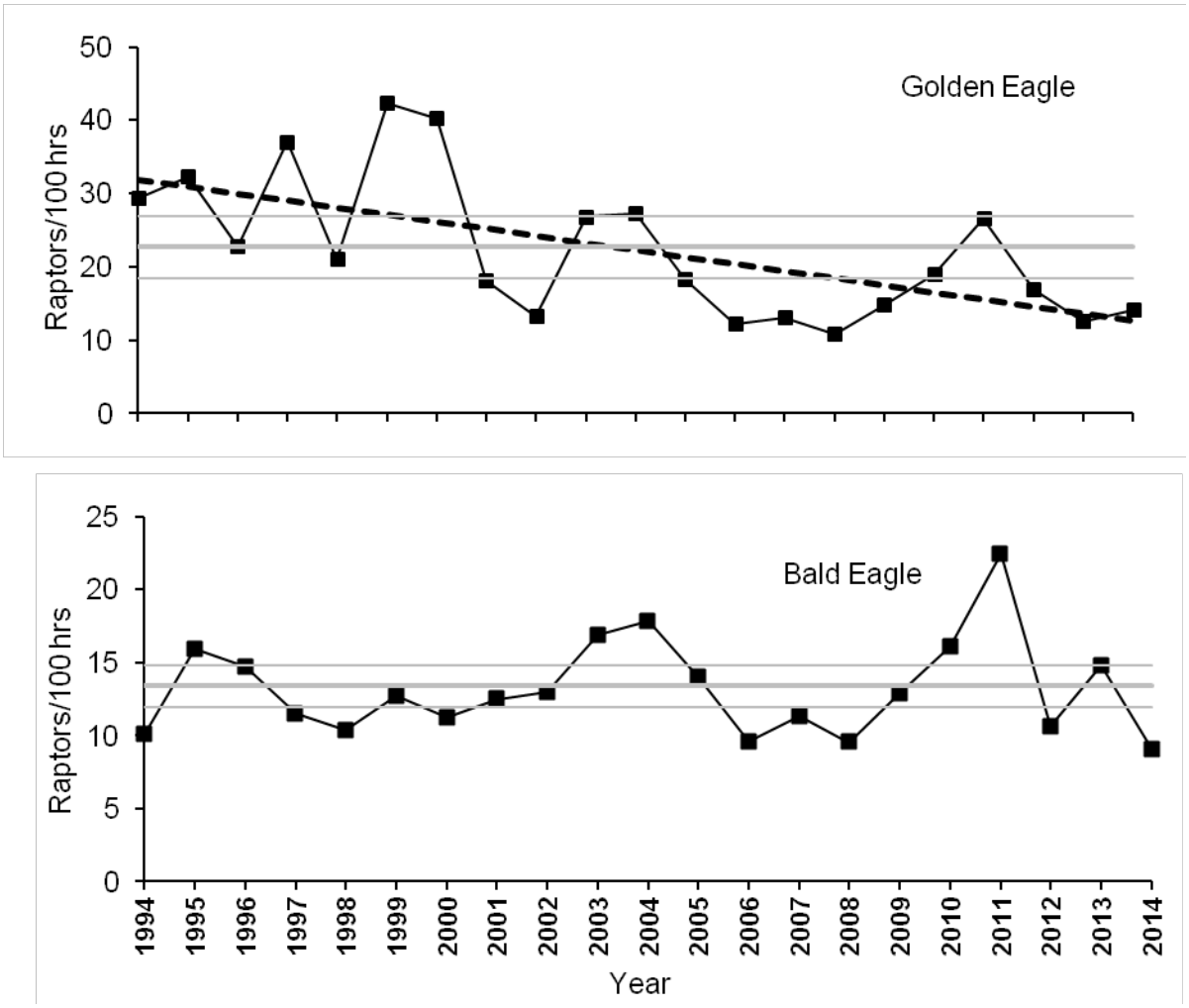

Figure 5d. Eagle passage rates for the fall migration at Bonney Butte, OR: 1994–2014. Dashed lines indicate trends for significant ($p < 0.05$) linear or quadratic regressions. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (1994-2013).

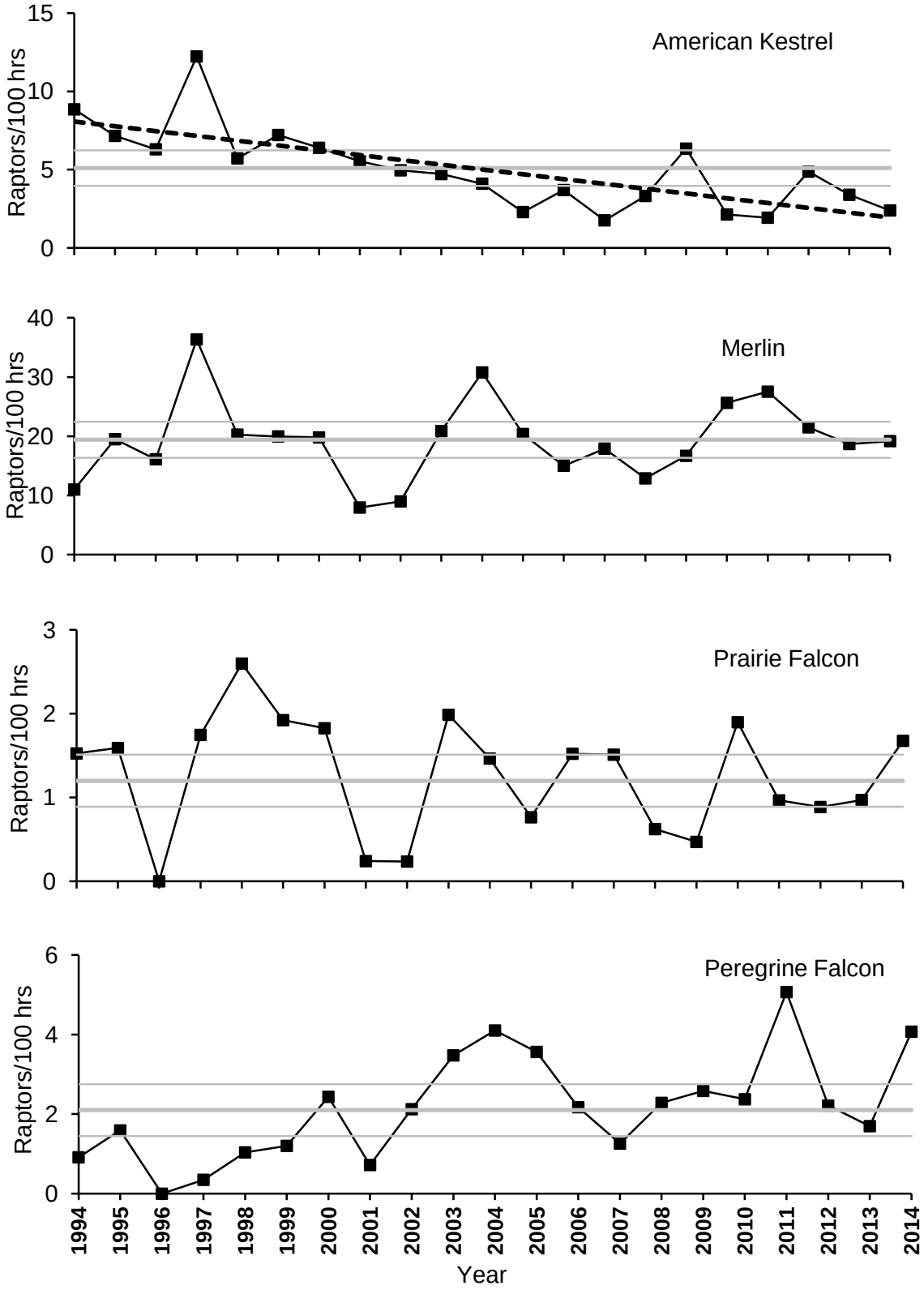

Figure 5e. Fall-migration falcon passage rates at Bonney Butte, OR: 1994–2014. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (1994-2013).

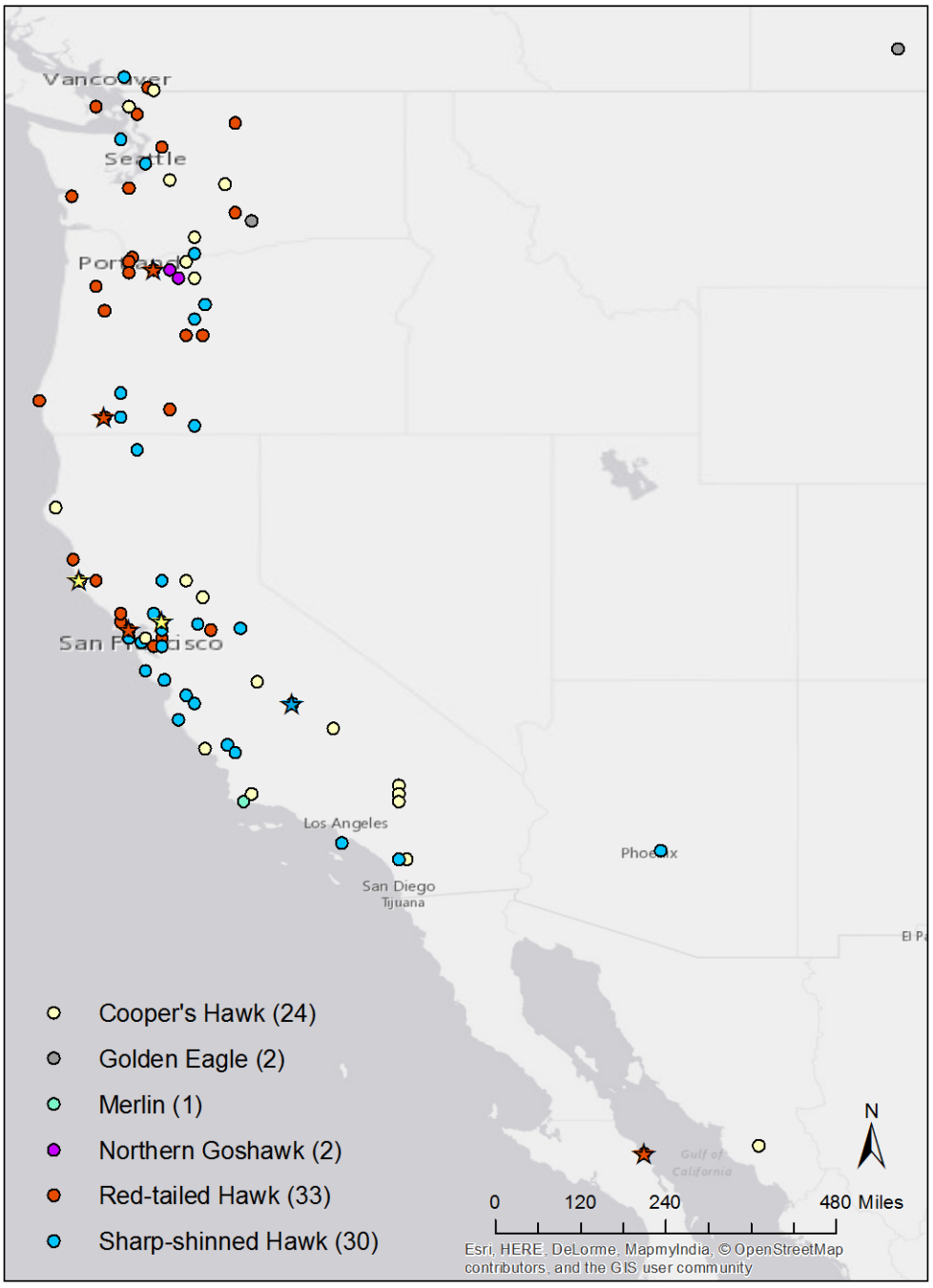

Figure 6. Recovery locations of raptors banded at Bonney Butte, OR. Circles indicate recoveries from 1995-2013, stars indicate 2014 recoveries.

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)[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).

2004: Two observers throughout: David Haines (1) and Amy Scarpignato (+).

2005: Two observers throughout: Sean Wolfe (0) and Jim DeStaebler (0)

2006: Two observers throughout: Justin Feld (0) and Juliet Lamb (0).

2007: Two observers throughout: Mary Coolidge (1) and Sue Bruner (2)

2008: Two observers throughout: Aaron Viducich (1) and James Butch (0)

2009: Two observers throughout: James Butch (2) and Glen McHargue (0)

2010: Two observers throughout: Juliet Lamb (1), Yvan Satge (0), and Andrew Tillinghast (0)

2011: Two observers throughout: Robert Baez (2), Jade Ajani (0), and Adam Baz (0)

2012: Two observers throughout: Frank Mayer (4), Jade Ajani (1), Andrew Rosenberg (0), and Sanders Li Ho (0)

2013: Two observers throughout: Mary Coolidge (2), Jeremy Halka (0), Jade Ajani (2), and Andrew Rosenberg (1)

2014: Two observers throughout: Gaelyn Tso-Jun Ong (1), Allison Beard (0), Dustin Maloney (0)

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

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

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

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

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

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

Appendix C. Annual observation effort and fall raptor migration counts by species at Bonney Butte, Oregon: 1994–2014.

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Start date	2-Sep	4-Sep	1-Sep	1-Sep	1-Sep	27-Aug	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	29-Oct
Observation days	47	38	46	45	52	63	48	58	59	51	46
Observation hours	327.74	251.51	285.82	286.25	384.91	416.00	328.50	415.75	423.67	402.65	341.25
Raptors / 100 hours	688.4	939.9	959.7	953.7	631.8	993.5	1029.5	601.1	453.7	948.0	1119.7
SPECIES	RAPTOR COUNTS										
Turkey Vulture	204	235	165	133	160	349	553	338	286	488	326
Osprey	32	49	55	60	67	74	107	78	50	97	70
Northern Harrier	25	22	39	30	56	49	13	7	27	28	29
Sharp-shinned Hawk	857	871	1027	912	1018	1660	1105	957	600	1578	1790
Cooper's Hawk	282	310	420	317	266	331	456	256	233	473	485
Northern Goshawk	25	12	40	34	33	36	31	10	8	29	33
Unknown accipiter	27	67	85	156	99	155	98	84	33	35	29
TOTAL ACCIPITERS	1191	1260	1572	1419	1416	2182	1690	1307	874	2115	2337
Red-shouldered Hawk	0	0	0	1	1	2	3	0	0	1	7
Broad-winged Hawk	1	3	1	0	0	75	10	0	1	6	2
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	725
Ferruginous Hawk	1	0	0	1	1	1	1	0	0	0	0
Rough-legged Hawk	12	11	4	20	15	21	30	7	6	10	17
Unidentified buteo	23	30	40	52	30	58	26	29	48	18	9
TOTAL BUTEOS	553	572	695	702	460	1090	750	549	480	779	761
Golden Eagle	96	81	65	106	81	176	132	75	56	108	93
Bald Eagle	33	40	42	33	40	53	37	52	55	68	61
Unidentified eagle	3	2	1	9	4	2	0	6	7	0	2
TOTAL EAGLES	132	123	108	148	125	231	169	133	118	176	156
American Kestrel	29	18	18	35	22	30	21	23	21	19	14
Merlin	36	49	46	104	78	83	65	33	38	84	105
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	14
Unknown falcon	8	3	2	3	4	0	0	7	3	2	1
TOTAL FALCONS	81	78	66	148	118	126	100	67	72	127	139
Unidentified raptor	38	25	43	90	30	32	0	20	15	7	3
GRAND TOTAL	2256	2364	2743	2730	2432	4133	3382	2499	1922	3817	3821

Appendix C. continued

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	MEAN
Start date	27-Aug	28-Aug	27-Aug	28-Aug	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug	28-Aug
End date	27-Oct	31-Oct	31-Oct	31-Oct	25-Oct	22-Oct	29-Oct	25-Oct	31-Oct	19-Oct	27-Oct
Observation days	49	57	51	60	51	52	55	53	54	49	52
Observation hours	392.92	459.92	397.00	481.83	425.75	421.42	414.33	451.42	412.25	417.48	385.98
Raptors / 100 hours	699.6	577.5	571.5	514.5	649.9	804.4	893.2	869.3	613.9	580.4	775.81
SPECIES	RAPTOR COUNTS										
Turkey Vulture	389	232	281	269	469	446	510	790	337	322	348
Osprey	60	38	47	70	101	81	72	121	58	53	69
Northern Harrier	38	33	13	19	33	18	39	24	13	18	28
Sharp-shinned Hawk	1067	1015	921	1003	1110	1438	1448	1446	1072	802	1145
Cooper's Hawk	269	418	249	316	339	420	380	446	205	465	344
Northern Goshawk	24	40	16	33	18	47	26	26	11	53	27
Unknown accipiter	73	69	74	160	77	47	82	130	73	41	83
TOTAL ACCIPITERS	1433	1542	1260	1512	1544	1952	1936	2048	1361	1361	1598
Red-shouldered Hawk	0	0	3	3	1	0	0	1	0	2	1
Broad-winged Hawk	2	1	0	5	10	2	0	8	3	1	7
Swainson's Hawk	0	0	1	0	0	4	2	3	0	0	1
Red-tailed Hawk	562	531	388	359	361	588	775	605	444	415	568
Ferruginous Hawk	1	0	0	0	0	0	0	0	1	0	0
Rough-legged Hawk	3	27	6	16	8	5	2	20	11	1	13
Unidentified buteo	4	30	40	16	3	7	5	23	57	6	27
TOTAL BUTEOS	572	589	438	399	383	606	784	660	516	425	617
Golden Eagle	72	56	52	52	63	80	110	76	52	59	84
Bald Eagle	55	44	45	46	55	68	93	48	61	38	51
Unidentified eagle	1	1	2	8	5	1	3	1	2	5	3
TOTAL EAGLES	128	101	99	106	123	149	206	125	115	102	139
American Kestrel	9	17	7	16	27	9	8	22	14	10	19
Merlin	80	69	71	62	71	108	114	97	77	80	74
Prairie Falcon	3	7	6	3	2	8	4	4	4	7	5
Peregrine Falcon	14	10	5	11	11	10	21	10	7	17	8
Unknown falcon	18	2	9	2	2	0	1	8	4	7	4
TOTAL FALCONS	124	105	98	94	113	135	148	141	106	121	109
Unidentified raptor	5	16	33	10	1	3	6	15	25	21	21
GRAND TOTAL	2749	2656	2269	2479	2767	2390	3701	3924	2531	2423	2928

Appendix D. Annual trapping effort and capture totals by species for migrating raptors at Bonney Butte, Oregon: 1995–2014.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
First trapping day	7-Oct	18-Sep	31-Aug	6-Sep	5-Sep	28-Aug	25-Aug	27-Aug	26-Aug	27-Aug
Last trapping day	28-Oct	10-Oct	1-Nov	30-Oct	24-Oct	24-Oct	28-Oct	27-Oct	27-Oct	15-Oct
Number of stations	1	1	1	1	1	1	1	1	1	1
Station days	10	21	39	34	22	58	50	55	47	36
Station hours	44.50	127.20	202.80	199.95	142.75	239.75	320.50	357.75	345.35	263.00
Captures / 10 stn hrs	4.9	10.0	11.0	12.8	10.0	13.0	10.3	10.4	12.5	15.0
Species	Number of captures									
Northern Harrier	0	1	0	2	1	1	0	6	4	2
Sharp-shinned Hawk	18	80	139	163	82	161	171	172	268	219
Cooper's Hawk	0	20	29	43	14	67	74	71	64	90
Northern Goshawk	1	7	7	3	3	8	11	7	12	14
Red-shouldered Hawk	0	0	0	0	0	0	0	0	0	0
Broad-winged Hawk	0	0	0	0	0	1	0	0	0	0
Red-tailed Hawk	2	14	39	29	36	66	66	108	73	61
Rough-legged Hawk	0	0	1	0	1	0	1	0	0	0
Golden Eagle	0	3	2	1	2	3	2	0	2	1
Bald Eagle	0	0	0	0	0	0	0	0	0	0
American Kestrel	0	0	0	0	1	0	1	0	0	0
Merlin	1	2	5	11	3	1	4	5	4	4
Prairie Falcon	0	0	1	4	0	1	0	1	3	4
Peregrine Falcon	0	0	0	0	0	2	0	1	0	0
All species	22	127	223	256	143	311	330	371	430	395
Recaptures[1]	0	0	0	0	0	0	0	0	0	2
Foreign Recaptures[2]	0	0	1	1	0	0	1	0	2	2
Foreign Encounters[3]	1	0	1	2	6	3	2	6	8	6

Appendix D. continued

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Mean*	Total
First trapping day	27-Aug	27-Aug	27-Aug	28-Aug	27-Aug	27-Aug	1-Sep	27-Aug	27-Aug	27-Aug	29-Aug	
Last trapping day	27-Oct	28-Oct	30-Oct	30-Oct	25-Oct	21-Oct	26-Oct	25-Oct	30-Oct	19-Oct	24-Oct	
Number of stations	1	1	1	1	1	1	1	1	1	1	1	
Station days	48	49	45	56	49	38	30	51	49	48	43	
Station hours	342.25	354.25	317.25	406.00	359.50	263.25	139.52	376.25	328.00	335.50	282.52	
Captures / 10 stn hrs	15.3	13.9	10.5	10.5	13.9	13.5	10.6	7.7	7.1	9.2	11.8	
Species												
Northern Harrier	7	2	1	3	3	0	0	1	0	1	1.9	34
Sharp-shinned Hawk	310	259	200	247	337	199	93	168	137	183	189.2	3423
Cooper's Hawk	101	88	74	100	98	68	30	73	50	55	64.1	1154
Northern Goshawk	12	11	3	15	3	21	2	6	3	17	8.2	149
Red-shouldered Hawk	0	0	1	1	0	0	0	0	0	1	0.1	2
Broad-winged Hawk	0	0	0	1	0	0	0	1	0	1	0.2	3
Red-tailed Hawk	67	106	42	45	39	57	19	33	31	38	51.7	933
Rough-legged Hawk	1	1	0	1	0	0	0	1	0	0	0.4	7
Golden Eagle	3	6	0	1	2	1	0	2	2	1	1.8	33
Bald Eagle	1	0	0	0	2	0	0	0	0	0	0.2	3
American Kestrel	0	2	1	1	1	1	2	0	1	1	0.6	11
Merlin	13	12	9	8	12	8	2	5	5	8	6.3	114
Prairie Falcon	3	4	2	1	1	0	0	0	2	1	1.5	27
Peregrine Falcon	4	1	0	1	0	0	0	0	1	0	0.6	10
All species	522	492	333	425	498	355	148	290	232	309	326.7	5903
Recaptures[1]	1	1	0	0	0	0	0	0	0	0	0.2	4
Foreign Recaptures[2]	3	1	1	1	2	1	0	1	0	0	0.9	17
Foreign Encounters[3]	10	7	9	3	8	9	4	2	4	7	5.1	98

[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.
* Mean calculations 1996 through 2013, 1995 excluded because of banding effort.