FALL 2013 RAPTOR MIGRATION STUDIES AT BONNEY BUTTE, OREGON

HawkWatch International
Conserving Raptors and Our Shared Environment

HawkWatch International, Inc.Salt Lake City, Utah

April 2014

FALL 2013 RAPTOR MIGRATION STUDIES AT BONNEY BUTTE, OREGON

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April 2014

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

The Bonney Butte Raptor Migration Project in the northern Cascade Mountains of Oregon is an ongoing effort to monitor long-term regional population trends of raptors that migrate through the Cascade Mountain 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 2013 season marked the 20th consecutive year of counting and the 18th season of banding efforts. This report summarizes the 2013 results of those activities.

The Bonney Butte project was 1 of 8 long-term, annual migration counts and 1 of 4 migration banding studies conducted or co-sponsored by HWI during 2013. 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). 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. 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; and blood sampling to track changes in raptor health and populations (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, our migration studies offer unique opportunities for the public to learn about raptors and the natural environment. Providing such opportunities is another important component of the Bonney Butte Raptor Migration Project and outreach efforts here reach 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 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 gathering and recording followed standardized protocols used at all HWI migration sites (Hoffman and Smith 2003). The observers routinely recorded the following data:

1. Species, age, sex, and color morph of each migrant raptor, whenever possible and applicable (Appendix B lists common and scientific names for all species, information about the applicability of age, sex, and color morph distinctions, and two-letter codes used to identify species in 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.

Calculation of "adjusted" (to standardize sampling periods and adjust for incompletely identified birds) passage rates (migrants counted per 100 hours of observation) and analysis of trends including 2013 data follows Farmer et al. (2007). In comparing 2013 annual statistics against means and 95% confidence intervals for previous seasons, we equate significance with a 2013 value falling outside the bounds of the confidence interval for the associated mean.

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 gathering and recording followed standardized protocols used at all HWI migration-banding sites (Hoffman et al. 2002). All birds are released within 45 minutes of capture.

2013 RESULTS AND DISCUSSION

OBSERVATION EFFORT AND WEATHER SUMMARY

During the 2013 season, observers were able to count on 51 of 66 possible days for a total of 412.25 hours between 27 August and 31 October, which is on par with the 1994-2012 long term average of 51 days (Appendix C). Six of the 66 days had abbreviated counts (<4 hrs) due to weather. Weather varies throughout every season, in 2013 based on hourly recording of conditions during observation it was clear 53% of the time, hazy 50% of the time, foggy 11% of the time, and rainy 1% of the time.

2013 FLIGHT SUMMARY

Overall Flight:

A total of 2,531 migrating raptors including 16 species were counted during the 2013 season, a significant ($p < 0.05$) decrease of 14% compared to the long-term site average of 2,949 (Table 1). The flight consisted of 53.8% accipiters, 20.4% buteos, 13.3% vultures, 4.5% eagles, 4.2% falcons, 2.3% Ospreys,

0.5% harriers, and 0.99% unknown raptors. Despite a lower overall flight, the relative proportions of each species were in line with historic means with the exception of a higher proportion of falcons and a lower proportion of harriers (Fig. 2). As per usual, Sharp-shinned Hawks were the most commonly observed species (42% of the total), followed by Red-tailed Hawks (18%), Turkey Vultures (13%), Cooper's Hawks (8%), Merlins (3%), Ospreys (2%), Bald Eagles(2%), and Golden Eagles (2%). The remaining species each accounted for 1% or less of the total count (Table 1).

The following sections summarize the 2013 count relative to historic means at the site, and any statistically significant ($p < 0.05$) or near significant ($p < 0.1$) 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 very 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.

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

In 2013 standardized counts for both Osprey and Northern Harriers were below historic averages. Turkey Vulture standardized counts were in line with historic means and the species is increasing long-term at the site ($r^2 = 0.204$, $p=0.046$).

Accipiters (Fig. 3b):

Overall and standardized counts for accipiters were down in 2013 (Table 1), apparently driven by below average numbers of Cooper's Hawks and Goshawks. The 2013 flight of Sharp-shinned Hawks was in line with average historic counts. The long-term regional population trends for all three species are stable, with no significant trend.

Buteoine Hawks (Fig. 3c):

The 2013 Red-Tailed Hawk count at Bonney Butte was lower than the historic average for this species; and over the long term, the regional population of Red-Tailed Hawks is declining ($r^2 = 0.249$, $p=0.025$). Other buteo species are historically counted in very low numbers at Bonney Butte, 2013 was no different with 3 Broad-winged Hawks and 11 Rough-legged Hawks counted this season. Of note, there were no observations of Red-shouldered or Swainson's Hawks, usually one is seen. Also noteworthy was the observation of a single Ferruginous Hawk, the first one seen since 2005.

Eagles (Fig.3d):

For the second straight season, Golden Eagle counts were below the site historic average, and the long-term declining trend for this species continues ($r^2 = 0.297$, $p = 0.013$); and is primarily driven by significant declines in adult Golden Eagles passing by the site ($r^2 = 0.571$, $p = 0.000$). Similar declines for Golden Eagles have been documented across North America and HWI and others are conducting targeted research to understand threats to Golden Eagles, in part based on findings from fall migration sites. It was an above average year for Bald Eagles passing by Bonney Butte, and there is a near significant ($p < 0.01$) long term increase for this species at this site ($r^2 = 0.196$, $p=0.050$).

Falcons (Fig. 3e):

Counts for all falcon species were in line with historic site averages with the exception of American Kestrels. Kestrel counts were low for the third time in the past four years and could reflect regional declines for this species similar to those found elsewhere across North America. Based on findings from

Bonney Butte and other regional monitoring sites across North America, HWI scientists, along with many other North American researchers and Citizen Scientists have partnered to understand Kestrel declines locally and at the continental scale under the umbrella of the American Kestrel Partnership (http://kestrel.peregrinefund.org/).

TRAPPING EFFORT

Crews trapped for 49 days (totaling 328.00 hours) between 27August and 30 October and caught 232 raptors of nine different species. While the trapping effort was above historic averages for the site, the number of birds caught was low (Appendix D). This may reflect the overall low numbers of migrants counted during the 2013 season since trapping success this season was above average (Table 2).

The highlights of the season were the successful captures of two Golden Eagles, one American Kestrel, two Prairie Falcons, and one Peregrine Falcon; all species that are captured in low numbers at Bonney Butte (Appendix D). All the other species capture totals were below average (Table 2).

ENCOUNTERS WITH PREVIOUSLY BANDED BIRDS

A total of 85 birds banded at Bonney Butte have been recovered and reported to the Bird Banding Laboratory (Fig. 4). During 2013, we received notification of three recoveries: two Sharp-shinned Hawks and one Red-tailed Hawk (Fig. 4, Table 3). Both Sharp-shinned Hawks were females, one banded as a hatch-year in 2009, and the other banded in 2010 as an after-hatch-year bird. The hatch-year bird is still alive, it was recaptured in mid September 2013 by another bander in remote Alaska, near Chickaloon, which is about 32 miles northeast of Palmer, AK. The other Sharp-shinned Hawk was found dead of unknown cause, perhaps near her wintering grounds near Paso Robles, California. The Red-tailed Hawk was banded in 2005 as an adult, and was killed by a vehicle collision Corvallis, OR, approximately 211 km southwest from Bonney Butte (Table 3).

There were no recaptures at Bonney Butte in 2013, either of 'foreign birds' banded elsewhere or of birds originally banded at the site (Appendix D).

VISITOR PARTICIPATION AND PUBLIC OUTREACH

A total of 708 individuals visited the site during the 2013 season. Organized events included a visit by the Outdoor Project, a non-profit from Portland. This included a group of 34 people and they graciously created a new map and directions to the Bonney Butte site. The Audubon Society of Portland, a long-time Bonney Butte partner, gave a raptor ID workshop which included a field trip to the site and brought this group of 25 people to the site for a day. Many other folks enjoyed visiting the site to see raptors in hand prior to their release after being banded, and learning 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. Most visitors were from Oregon, but visitors also traveled from Washington, and in late October a party of two arrived from Texas.

ACKNOWLEDGMENTS

Funding and logistical support for this project were provided by the USDA Forest Service–Mt. Hood National Forest, Oregon Community Foundation – Oregon Parks Foundation Fund, Kinsman Foundation, Audubon Society of Portland, and HWI private donors and members. As always, a special thanks to Dan Sherman and Rick Gerhardt for their collaboration, leadership, and support in helping with local logistics.

Finally, enormous thanks to all of the members of our 2013 field crew: Dan Sherman, Mary Coolidge, Jade Ajani, Andrew Rosenberg, Jeremy Halka, and Rick Gerhardt. Jeremy was the newest member to the site but all others have enjoyed the site for at least a season, and some many! Without your skill, dedication, and willingness to brave the elements over the course of a long field season these efforts would not be possible. Local volunteers have also greatly assisted the project for several years now and we want to give special thanks them as well: Adam Baz, Dwight Porter, Mark Lundgren, Tom Jordan, Aurora Gerhardt, Nathan Gerhardt, and Craig Plummer.

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Table 1. Fall raptor migration unadjusted counts and adjusted passage rates by species at Bonney Butte, OR: 1994–2012 versus 2013.

	COUNT			RAPTORS / 100 HOURS		
SPECIES	1994–2012[1]	2013	% CHANGE	1994–2012[1]	2013	% CHANGE
Turkey Vulture	349 ± 73.9	337	-3	138.1 ± 24.98	146.1	+6
Osprey	70 ± 10.7	58	-17	22.7 ± 3.29	19.1	-16
Northern Harrier	29 ± 5.6	13	-54	8.3 ± 1.67	3.8	-54
Sharp-shinned Hawk	1149 ± 142.5	1072	-7	393.8 ± 49.85	363.3	-8
Cooper's Hawk	351 ± 37.4	205	-42	118.8 ± 15.25	74.0	-38
Northern Goshawk	27 ± 4.8	11	-60	8.3 ± 1.55	3.3	-60
Unknown small accipiter[2]	44 ± 22.5	64	+47	–	–	–
Unknown large accipiter[2]	6 ± 2.8	6	+7	–	–	–
Unknown accipiter	52 ± 22.3	3	-94	–	–	–
TOTAL ACCIPITERS	1610 ± 174.5	1361	-15	–	–	–
Red-shouldered Hawk	1 ± 0.8	0	-100	0.4 ± 0.28	0.0	-100
Broad-winged Hawk	7 ± 7.6	3	-55	3.8 ± 3.98	2.8	-25
Swainson's Hawk	1 ± 0.5	0	-100	0.3 ± 0.18	0.0	-100
Red-tailed Hawk	575 ± 69.3	444	-23	174.3 ± 25.60	135.0	-23
Ferruginous Hawk	0 ± 0.2	1	+217	0.1 ± 0.06	0.3	+233
Rough-legged Hawk	13 ± 3.7	11	-13	9.1 ± 2.80	6.3	-31
Unidentified buteo	26 ± 7.4	57	+121	–	–	–
TOTAL BUTEOS	622 ± 76.6	516	-17	–	–	–
Golden Eagle	86 ± 14.0	52	-39	27.8 ± 5.03	15.1	-46
Bald Eagle	51 ± 6.5	61	+20	15.2 ± 1.91	17.7	+17
Unidentified eagle	3 ± 1.2	2	-34	–	–	–
TOTAL EAGLES	140 ± 15.8	115	-18	–	–	–
American Kestrel	19 ± 3.5	14	-27	6.0 ± 1.28	4.1	-31
Merlin	73 ± 11.3	77	+5	26.4 ± 4.35	27.9	+6
Prairie Falcon	5 ± 1.2	4	-16	1.5 ± 0.37	1.7	+9
Peregrine Falcon	8 ± 2.4	7	-15	2.4 ± 0.73	1.9	-20
Unknown small falcon[2]	1 ± 1.1	0	-100	–	–	–
Unknown large falcon[2]	2 ± 1.6	3	+80	–	–	–
Unknown falcon	2 ± 1.1	1	-54	–	–	–
TOTAL FALCONS	109 ± 12.4	106	-3	–	–	–
Unidentified Raptor	21 ± 9.6	25	-21	–	–	–
ALL SPECIES	2949 ± 301.5	2531	-14	–	–	–

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

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

Table 2. Capture totals, rates, and success by species for fall migrating raptors at Bonney Butte, OR: 1996–2012 versus 2013.

	Capture Totals		Capture Rate[1]		Capture Success[2]	
	1996–2012[3]	2013	1996–2012[3]	2013	1996–2012[3]	2013
Northern Harrier	2 ± 1.0	0	0.7 ± 0.28	0.0	7.1 ± 3.3	14.5
Sharp-shinned Hawk	192 ± 35.6	137	68.7 ± 6.65	41.8	16.6 ± 3.6	16.8
Cooper's Hawk	65 ± 13.4	50	22.4 ± 2.84	15.2	18.1 ± 4.4	29.0
Northern Goshawk	9 ± 2.5	3	3.1 ± 0.88	0.9	34.1 ± 13.3	74.7
Broad-winged Hawk	0 ± 0.2	0	0.1 ± 0.06	0.0	3.5 ± 3.8	5.6
Red-tailed Hawk	53 ± 12.7	31	18.9 ± 3.29	9.5	9.5 ± 2.6	10.4
Rough-legged Hawk	0 ± 0.2	0	0.2 ± 0.10	0.0	4.2 ± 4.0	3.2
Golden Eagle	2 ± 0.7	2	0.7 ± 0.31	0.6	2.3 ± 1.2	3.5
American Kestrel	0 ± 0.3	1	0.2 ± 0.18	0.3	4.7 ± 3.4	4.4
Merlin	6 ± 1.8	5	2.3 ± 0.60	1.5	8.6 ± 2.6	8.0
Prairie Falcon	1 ± 0.7	2	0.5 ± 0.28	0.6	32.5 ± 15.1	30.0
Peregrine Falcon	1 ± 0.5	1	0.2 ± 0.16	0.3	4.5 ± 3.8	6.2
All species	332 ± 58.8	232	118.0 ± 9.91	70.7	13.9 ± 3.1	15.5

[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 3. Foreign encounters in 2013 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
1623-25654	SS-F	07-Oct-09	HY	16-Sep-13	ATY	Chickaloon, AK	3377	Recapture/Release by another bander
1623-24273	SS-F	03-Oct-10	AHY	29-Dec-13	ATY	Paso Robles, CA	886	found dead – cause unknown
0987-93399	RT-U	01-Sep-05	AHY	21-Feb-13	ATY	Corvallis, OR	211	found dead – vehicle collision

[1] Species: SS = Sharp-shinned 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.

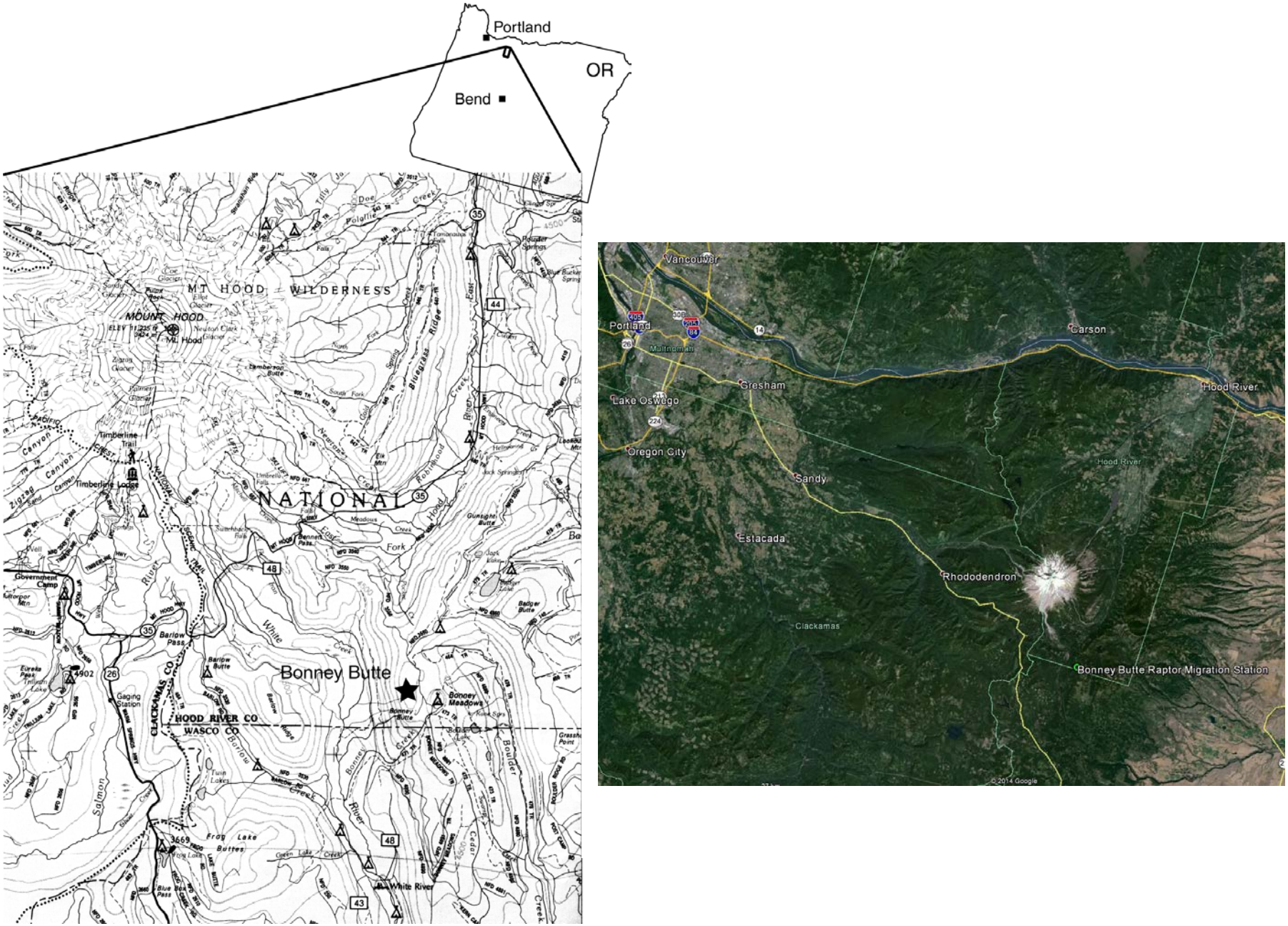

Figure 1. Location of the Bonney Butte Raptor Migration Project study site near Mt. Hood, Oregon.

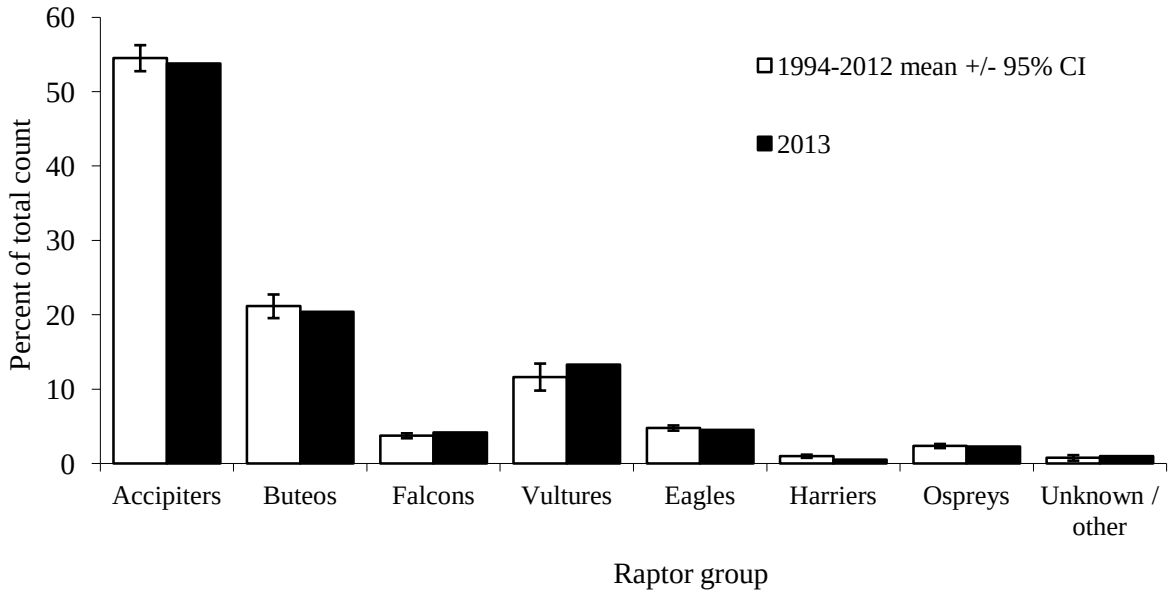

Figure 2. Fall raptor migration flight composition by major species groups at Bonney Butte, Oregon: 1994–2012 versus 2013.

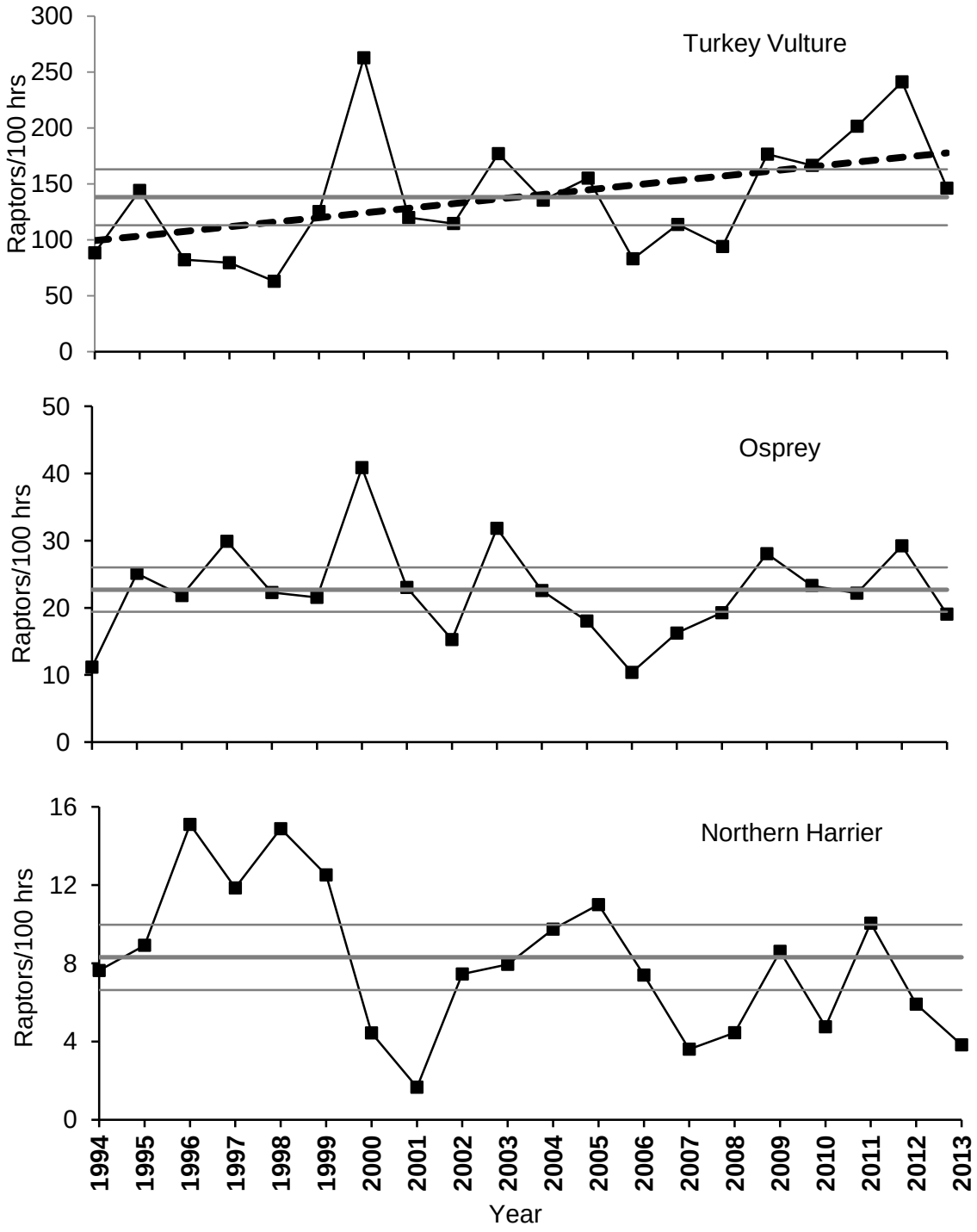

Figure 3a. Adjusted fall-migration passage rates at Bonney Butte, OR for Turkey Vultures, Ospreys, and Northern Harriers: 1994–2013. Dashed lines indicate trends for significant ($p < 0.05$) linear or quadratic regressions. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (1994-2012) at Chelan Ridge.

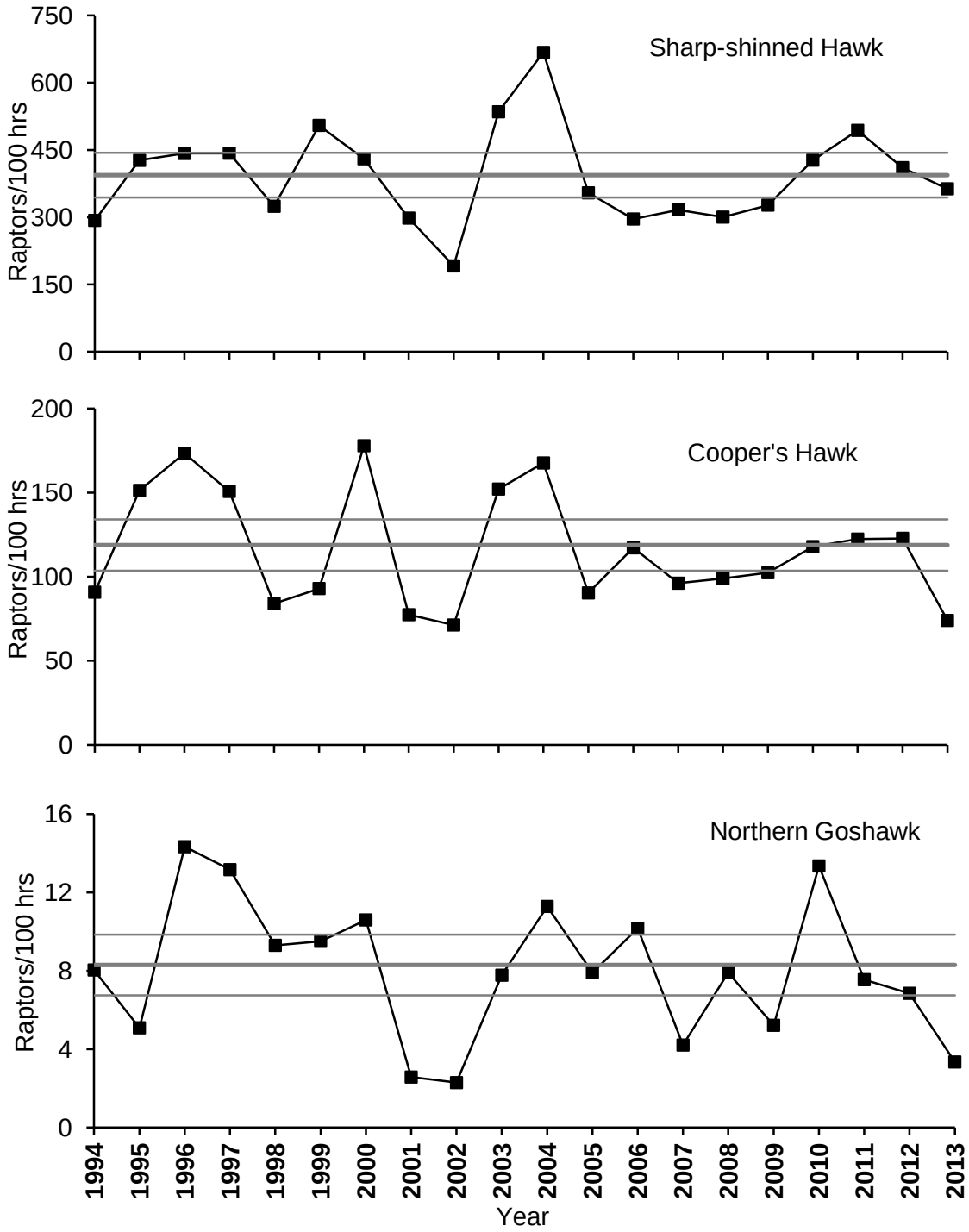

Figure 3b. Adjusted fall-migration passage rates at Bonney Butte, OR for the three North American accipiter species: 1994–2013. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (1994-2012).

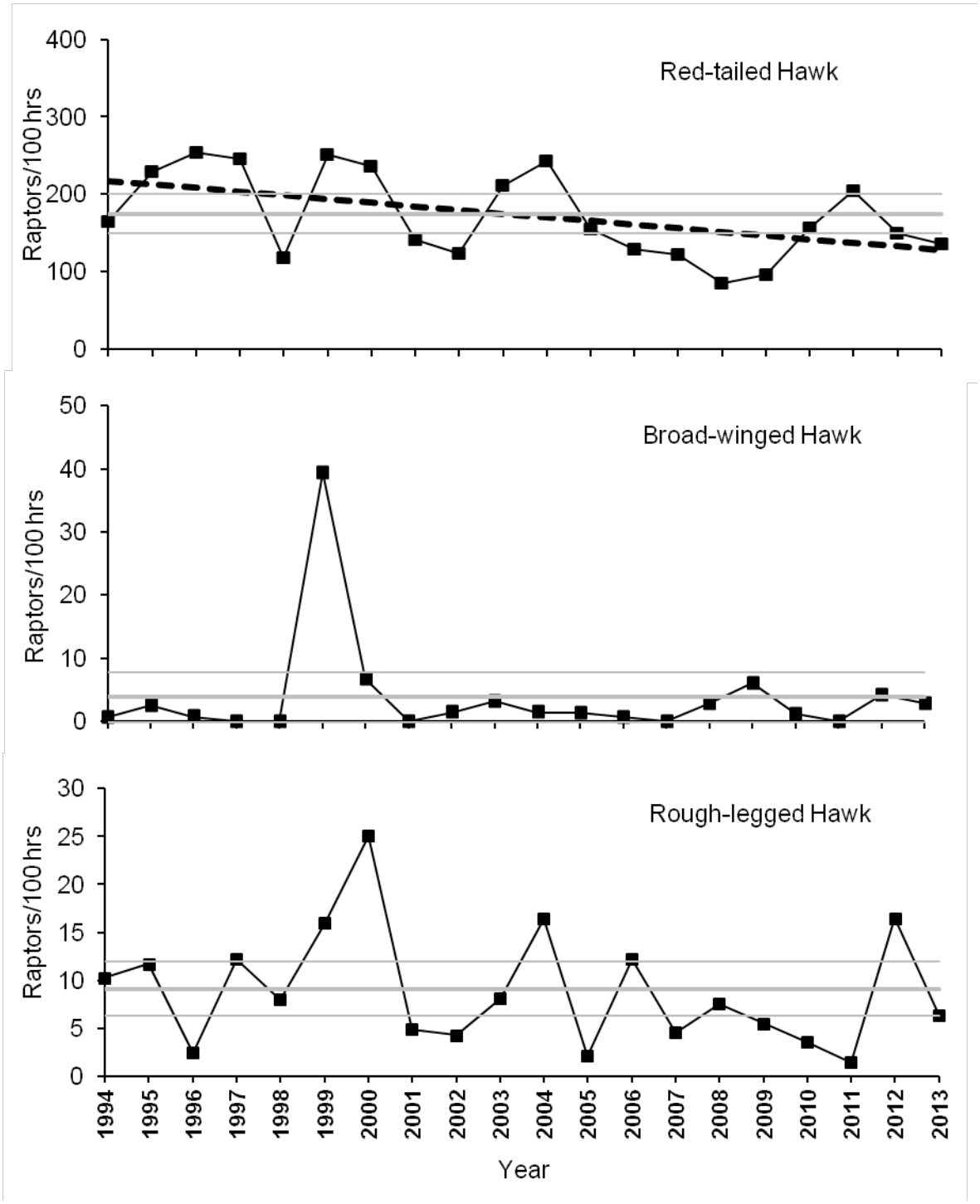

Figure 3c. Adjusted fall-migration buteo passage rates at Bonney Butte, OR: 1994–2013. Dashed lines indicate significant ($p < 0.05$) population trends based on linear or quadratic regressions. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (1994-2012).

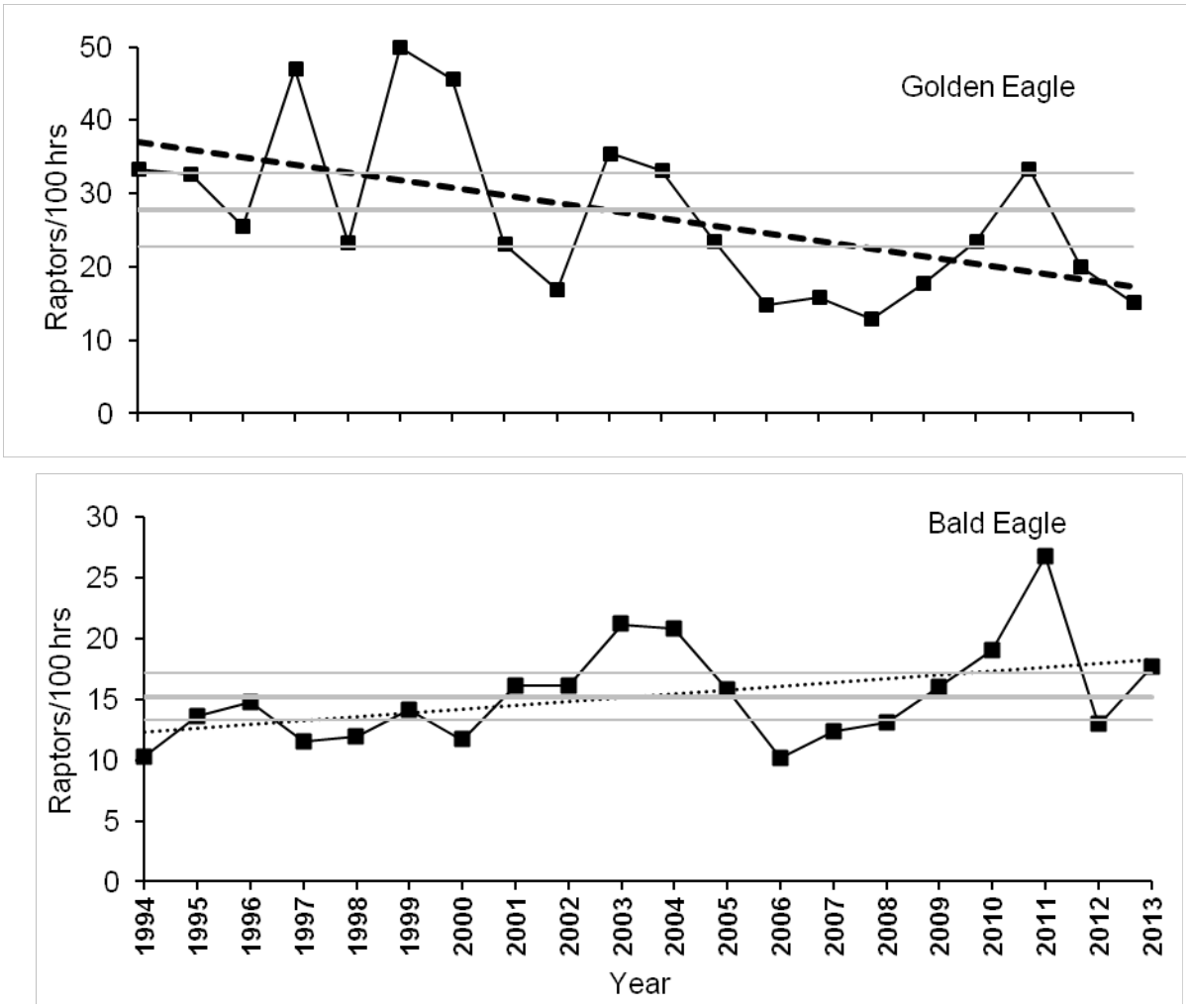

Figure 3d. Adjusted eagle passage rates for the fall migration at Bonney Butte, OR: 1994–2013. Dashed lines indicate trends for significant ($p < 0.05$) linear or quadratic regressions and dotted lines represent near significant trends ($p < 0.1$). Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (1994-2012).

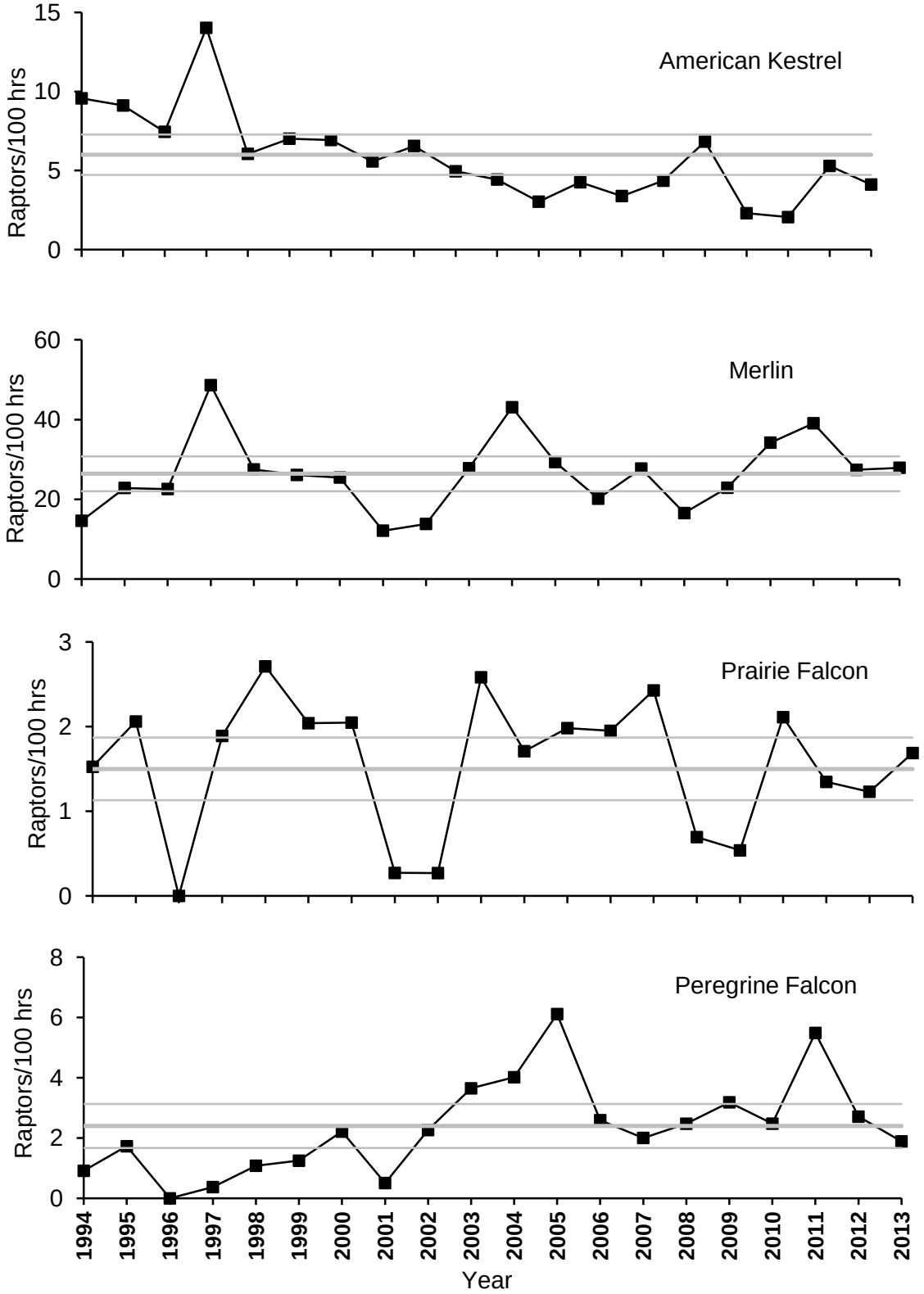

Figure 3e. Adjusted fall-migration falcon passage rates at Bonney Butte, OR: 1994–2013. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (1994-2012).

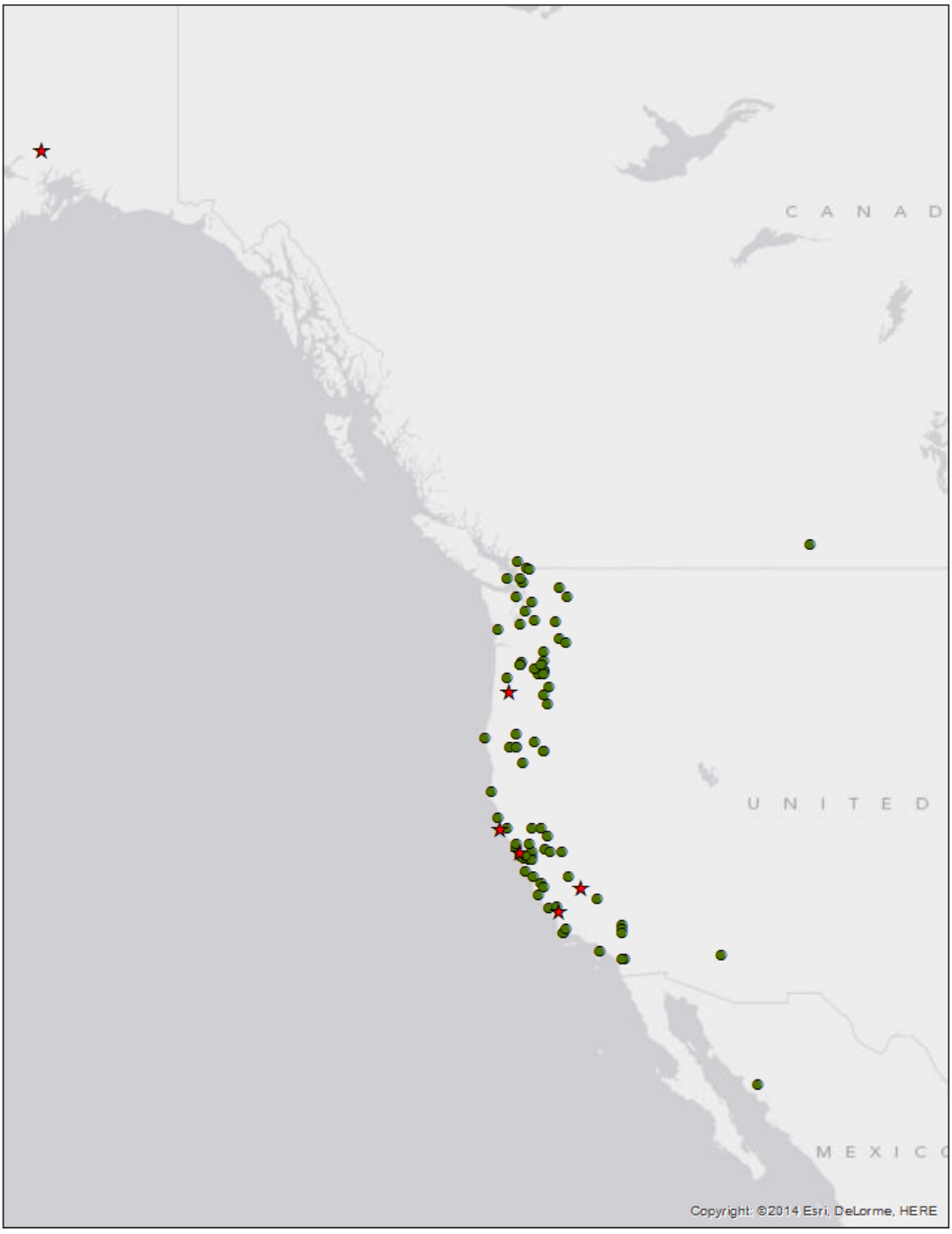

Figure 4. Recovery locations of raptors banded at Bonney Butte, OR. Circles indicate recoveries from 1995-2012, red stars indicate 2013 and early 2014 (through 1 April 2014) recoveries.

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)

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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: 1994–2013.

	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 small accipiter[1]	–	–	–	–	–	–	–	84	11	33	27
Unknown large accipiter[1]	–	–	–	–	–	–	–	0	1	1	2
Unknown accipiter	27	67	85	156	99	155	98	0	21	1	0
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 small falcon[1]	–	–	–	–	–	–	–	0	1	0	1
Unknown large falcon[1]	–	–	–	–	–	–	–	0	0	0	0
Unknown falcon	8	3	2	3	4	0	0	7	2	2	0
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	MEAN
Start date	27-Aug	28-Aug	27-Aug	28-Aug	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug
End date	27-Oct	31-Oct	31-Oct	31-Oct	25-Oct	22-Oct	29-Oct	25-Oct	31-Oct	28-Oct
Observation days	49	57	51	60	51	52	55	53	54	51
Observation hours	392.92	459.92	397.00	481.83	425.75	421.42	414.33	451.42	412.25	384.60
Raptors / 100 hours	699.6	577.5	571.5	514.5	649.9	804.4	893.2	869.3	613.9	784.33
SPECIES	RAPTOR COUNTS									
Turkey Vulture	389	232	281	269	469	446	510	790	337	349
Osprey	60	38	47	70	101	81	72	121	58	70
Northern Harrier	38	33	13	19	33	18	39	24	13	29
Sharp-shinned Hawk	1067	1015	921	1003	1110	1438	1448	1446	1072	1149
Cooper's Hawk	269	418	249	316	339	420	380	446	205	351
Northern Goshawk	24	40	16	33	18	47	26	26	11	27
Unknown small accipiter[1]	14	7	52	111	71	10	81	106	64	44
Unknown large accipiter[1]	13	2	10	12	6	10	1	9	6	6
Unknown accipiter	46	60	12	37	0	27	0	15	3	52
TOTAL ACCIPITERS	1433	1542	1260	1512	1544	1952	1936	2048	1361	1610
Red-shouldered Hawk	0	0	3	3	1	0	0	1	0	1
Broad-winged Hawk	2	1	0	5	10	2	0	8	3	7
Swainson's Hawk	0	0	1	0	0	4	2	3	0	1
Red-tailed Hawk	562	531	388	359	361	588	775	605	444	575
Ferruginous Hawk	1	0	0	0	0	0	0	0	1	0
Rough-legged Hawk	3	27	6	16	8	5	2	20	11	13
Unidentified buteo	4	30	40	16	3	7	5	23	57	26
TOTAL BUTEOS	572	589	438	399	383	606	784	660	516	622
Golden Eagle	72	56	52	52	63	80	110	76	52	86
Bald Eagle	55	44	45	46	55	68	93	48	61	51
Unidentified eagle	1	1	2	8	5	1	3	1	2	3
TOTAL EAGLES	128	101	99	106	123	149	206	125	115	140
American Kestrel	9	17	7	16	27	9	8	22	14	19
Merlin	80	69	71	62	71	108	114	97	77	73
Prairie Falcon	3	7	6	3	2	8	4	4	4	5
Peregrine Falcon	14	10	5	11	11	10	21	10	7	8
Unknown small falcon[1]	2	0	5	0	0	0	0	5	0	1
Unknown large falcon[1]	10	1	3	0	2	0	1	3	3	2
Unknown falcon	6	1	1	2	0	0	0	0	1	2
TOTAL FALCONS	124	105	98	94	113	135	148	141	106	109
Unidentified raptor	5	16	33	10	1	3	6	15	25	21
GRAND TOTAL	2749	2656	2269	2479	2767	2390	3701	3924	2531	2949

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

Appendix D. Annual trapping effort and capture totals by species for migrating raptors at Bonney Butte, Oregon: 1995–2012.

	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	5

Appendix D. continued

	2005	2006	2007	2008	2009	2010	2011	2012	2013	Mean*	Total
First trapping day	27-Aug	27-Aug	27-Aug	28-Aug	27-Aug	27-Aug	1-Sep	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	24-Oct	
Number of stations	1	1	1	1	1	1	1	1	1	1	
Station days	48	49	45	56	49	38	30	51	49	43	
Station hours	342.25	354.25	317.25	406.00	359.50	263.25	139.52	376.25	328.00	279.84	
Captures / 10 stn hrs	15.3	13.9	10.5	10.5	13.9	13.5	10.6	7.7	7.1	11.8	
Species											
Northern Harrier	7	2	1	3	3	0	0	1	0	2.0	34
Sharp-shinned Hawk	310	259	200	247	337	199	93	168	137	192.2	3423
Cooper's Hawk	101	88	74	100	98	68	30	73	50	64.9	1154
Northern Goshawk	12	11	3	15	3	21	2	6	3	8.5	149
Red-shouldered Hawk	0	0	1	1	0	0	0	0	0	0.1	2
Broad-winged Hawk	0	0	0	1	0	0	0	1	0	0.2	3
Red-tailed Hawk	67	106	42	45	39	57	19	33	31	52.9	933
Rough-legged Hawk	1	1	0	1	0	0	0	1	0	0.4	7
Golden Eagle	3	6	0	1	2	1	0	2	2	1.8	33
Bald Eagle	1	0	0	0	2	0	0	0	0	0.2	3
American Kestrel	0	2	1	1	1	1	2	0	1	0.6	11
Merlin	13	12	9	8	12	8	2	5	5	6.4	114
Prairie Falcon	3	4	2	1	1	0	0	0	2	1.5	27
Peregrine Falcon	4	1	0	1	0	0	0	0	1	0.5	10
All species	522	492	333	425	498	355	148	290	232	332.3	5903
Recaptures[1]	1	1	0	0	0	0	0	0	0	0.2	4
Foreign Recaptures[2]	3	1	1	1	2	1	0	1	0	1.0	17
Foreign Encounters[3]	9	6	7	3	8	9	4	2	3	4.8	85

[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 2012, 1995 excluded because of banding effort.