

**FALL 2017 RAPTOR MIGRATION ANNUAL REPORT:  
BONNEY BUTTE HAWKWATCH, HOOD RIVER CO., OREGON**



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



**Mt. Hood National Forest**

**April 2018**

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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 trapping and banding 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 2017 season marked the 24<sup>rd</sup> consecutive year of counting and the 22<sup>nd</sup> season of banding efforts. This report summarizes the 2017 fall raptor flight at Bonney Butte.

The Bonney Butte HawkWatch was 1 of 8 long-term, annual migration counts and 1 of 4 migration banding studies conducted or co-sponsored by HWI during the fall 2017 (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 forest and the central Oregon shrub-steppe region lies immediately to the east.

## METHODS

### STANDARDIZED COUNTS

Weather permitting; two observers conducted standardized daily counts of migrating raptors from late August through late October. Observations start between 0800–0900 hrs and end 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 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 2017 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. We use linear and quadratic regression on effort-adjusted annual passage rates (raptors/100hrs) to identify long-term trends in migrating raptors over time.

## **TRAPPING AND BANDING**

Similar to the counts, trapping and banding efforts start in late August and continue 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 lure 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, we fit all captured birds with a uniquely numbered USGS Biological Resources Division aluminum leg band and release them within 45 minutes of capture. Data collection followed standardized protocols used at all HWI migration-banding sites (Hoffman et al. 2002).

## **2017 RESULTS AND DISCUSSION**

### **OBSERVATION EFFORT**

Bonney Butte HawkWatch's standard season runs 27 August – 31 October; in 2017, observers were able to count on 54 of 66 possible days during this period for a total of 430.1 hours (Appendix C). Weather prohibited counting on 12 days with an additional day suspended with <4 hrs of observation due to weather.

## 2017 FLIGHT SUMMARY

### Overall Flight:

Observers counted 2,141 migrating raptors of 15 species in 2017, a below average year based on the long-term site average (Table 1).

The flight consisted of 44.6 % accipiters, 18.7 % buteos, 21.1 % vultures, 4.9 % falcons, 5.4% eagles, 3.8 % Ospreys, 1.1% harriers, and 0.7% unknown raptors. The relative proportions of accipiters and buteos in this year's flight were low compared to site averages (lowest ever for accipiters); while proportions of eagles, falcons, and vultures exceeded site averages (Fig. 3). Sharp-shinned Hawks were the most common species (25 % of the total), followed by Turkey Vultures (22%), Red-tailed Hawks (17%), Cooper's Hawks (16%), Bald Eagles (4%), Ospreys (4%), and Merlins (3%). The remaining species each accounted for 1% or less of the total count (Table 1).

The following sections summarize the 2017 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 public, and could represent the beginning of meaningful long-term changes.

### Total Flight (Fig.4):

The 498 raptors counted per 100 hours of observation at the Bonney Butte HawkWatch in 2017 was significantly lower than the site average of 768 raptors/100 hrs from 1994-2016, and the second lowest in site history. The fall flight at Bonney Butte has been stable over the history of the site (no significant trend over time).

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

We counted above average numbers of Turkey Vulture and Osprey in 2017, and an average number of Northern Harriers. Effort-adjusted passage rates (raptors/100 hrs) were average for Osprey and Turkey Vultures, but low for Northern Harriers (Table 1). Based on regression analysis of passage rates, regional Harrier populations are declining (slope = -0.26,  $r^2 = 0.3$ ,  $p=0.006$ ). Turkey Vultures are increasing (slope= 2.57,  $r^2 = 0.23$ ,  $p=0.02$ ), and Osprey numbers have been stable over the 24 years that HWI has been monitoring migration at Bonney Butte (no significant statistical trend).

### Accipiters (Fig. 3b):

We counted the lowest number of Sharp-shinned Hawks (525 total, 122 birds/100 hr) in 24 years of monitoring at Bonney Butte. Seasonal counts and passage rates for Cooper's Hawks, and Northern Goshawks did not differ from long-term site averages (Table 1). The long-term regional population trends for all three accipiter species are stable based on regression of yearly passage rates (no significant trends).

### Buteoine Hawks (Fig. 3c):

We counted 405 total buteos in 2017, low compared to average for this group at the Bonney Butte HawkWatch. This is driven by a low Red-tailed Hawk count (371), a species with declining regional populations in the region based on regression analysis of annual fall passage rates (slope= -4.1,  $r^2 = 0.32$ ,  $p=0.004$ ).

### Eagles (Fig.3d):

Observers counted a record low 27 migrant Golden Eagles (passage rate of 6.3 birds/100 hr, also a record low) in 2017, the sixth consecutive below average year. Golden Eagle passage rates continue to decline over time at this site (slope = -0.91,  $r^2 = 0.44$ ,  $p < 0.001$ ). Efforts elsewhere document similar declines across North America and targeted research efforts are underway, including some by HWI, to better understand Golden Eagle, ecology, movements and demographics. We counted an above average number of Bald Eagles (86 total, 20 birds/100 hr). Regional populations of Bald Eagles are increasing based on regression of Bonney Butte annual passage rates (slope = 0.27,  $r^2 = .29$ ,  $p = 0.028$ ).

#### Falcons (Fig. 3e):

We observed average counts and passage rates for Merlins, Peregrine Falcons and Prairie Falcons at Bonney Butte in 2017. American Kestrel count (7) and passage rate (1.6 birds/100hr) tied or set record lows for Bonney Butte, respectively (Table 1). Despite traditionally low passage rates (below the 10 per 100 hr threshold), it is worth noting that Kestrel passage rate at Bonney Butte is declining annually (slope = -0.3,  $r^2 = 0.62$ ,  $p < 0.001$ ) because similar trends are 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 ([www.hawkwatch.org/kestrels](http://www.hawkwatch.org/kestrels)) and at the continental scale and have partnered under the umbrella of the American Kestrel Partnership (<http://kestrel.peregrinefund.org/>).

#### **TRAPPING EFFORT**

Crews trapped on 41 days (totaling 275.8 hours) between 27 August and 28 October and captured 210 raptors of seven different species. The number of hours trapped was low compared to historic annual site average (Appendix D), the number of birds caught was below average, and the overall capture rate (birds captured/10hrs trapping) (Table 2), was also low. Capture totals were low for Northern Harrier (0), Sharp-shinned Hawk (92), Cooper's Hawk (44), and Merlin (3). We captured and banded a record 28 Northern Goshawks in 2017.

#### **VISITOR PARTICIPATION AND PUBLIC OUTREACH**

Approximately 250 individuals visited the site during the 2017 season. The largest attendance in a single day was September 26<sup>th</sup>, with 49 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 Arizona, Florida, and the United Kingdom.

#### **2017 FALL MIGRATION ACROSS HWI'S NETWORK**

HawkWatch International and partners operated 8 fall count sites in 2017 (Fig. 1). During the 4,486 hours of standardized observation, we counted 305,549 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 2017 included (Table 4):



- No sites with above average overall counts in 2017
- Below average Sharp-shinned Hawk numbers at 5 of 8 sites (including 2 sites w/ record low counts).
- Below average count of American Kestrels at 6 of 8 sites (3 with record lows) and no sites with above average counts
- Below average counts for Prairie Falcons at 4 of 8 sites (2 with record lows).
- Below average counts for Red-tailed Hawks at 4 of 8 sites, including a record low at Corpus Christi; above average counts at 3 sites.
- Record highs for:
  - Broad-winged Hawks at Chelan Ridge and Manzano Mountains
  - Sharp-shinned Hawks and Peregrine Falcons at Corpus Christi
  - Zone-tailed Hawks (6) at Manzano Mountains

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**Table 1. Historic fall raptor migration counts (mean±95% CI), counts from fall 2017, and site records at Bonney Butte, OR.**

Species	1994-2016		All-time Historic Records		
	Mean Count ± 95 % CI	2017	% Change	Season	Year
Turkey Vulture	364.0 ± 66.9	474	30	790.0	2012
Osprey	68.4 ± 9.1	78	14	121	2012
Northern Harrier	26.5 ± 5.1	22	-17	56	1998
					12 (1998)
<b>Accipiters</b>					
Sharp-shinned Hawk	1122.1 ± 124.4	525	-53	1790	2004
Cooper's Hawk	344.5 ± 37.1	347	1	485	2004
Northern Goshawk	27.3 ± 5.0	26	-5	53	2014
Unidentified accipiter	77.4 ± 17.0	33	-57	160	2008
TOTAL ACCIPITERS	1571.3 ± 152.5	931	-41	2337	2004
<b>Buteos</b>					
Red-shouldered Hawk	1.1 ± 0.7	0	-100.0	7	2004
Broad-winged Hawk	6.0 ± 6.4	7	15.8	75	1999
Swainson's Hawk	0.8 ± 0.5	2	155.6	4	2010
Red-tailed Hawk	553.7 ± 63.9	371	-33.0	932	1999
Ferruginous Hawk	0.3 ± 0.2	1	228.6	1	2017
Rough-legged Hawk	11.1 ± 3.5	6	-46.1	30	2000
Unidentified buteo	25.3 ± 7.3	18	-28.9	58	1999
TOTAL BUTEOS	598.4 ± 70.2	405	-32.3	1090	1999
<b>Eagles</b>					
Golden Eagle	81.0 ± 12.6	27	-67	176	1999
Bald Eagle	53.4 ± 6.7	86	61	93	2011
Unknown eagles	3.4 ± 1.3	2	-41.2	12	2016
TOTAL EAGLES	137.7 ± 14.0	115	-17	231	1999
<b>Falcons</b>					
American Kestrel	17.6 ± 3.3	7	-60	35	1997
Merlin	75.2 ± 10.1	74	-2	114	2011
Prairie Falcon	4.7 ± 1.1	5	7	10	1998
Peregrine Falcon	9.1 ± 2.3	11	20	21	2011
Unidentified falcon	4.2 ± 1.7	9.00	113	18	2005
TOTAL FALCONS	110.7 ± 10.9	106	-4	148	1997
Unidentified Raptor	19.4 ± 8.4	10	-49	90	1997
<b>Grand Total</b>	<b>2896.5 ± 260.4</b>	<b>2141</b>	<b>-26</b>	<b>4133</b>	<b>1999</b>
					<b>425 (2011)</b>

**Table 2. Mean and 2017 capture totals by species for migrating raptors banded at Bonney Butte HawkWatch 1996-2017.**

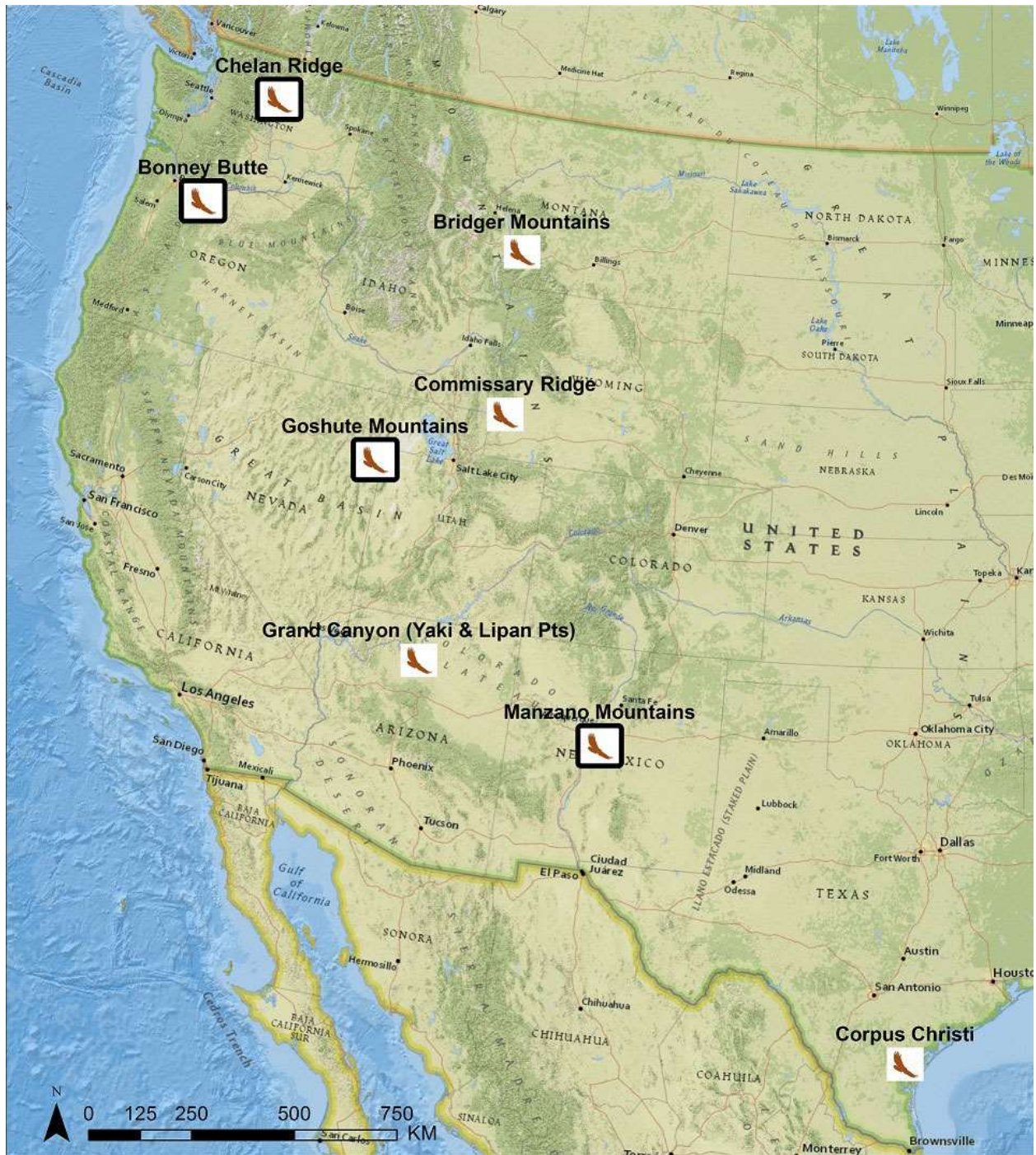
	Capture Totals			Season Record
	1996-2015 <sup>2</sup>		2017	
Northern Harrier	1.8 ± 0.8		0	7
Sharp-shinned Hawk	177.4 ± 31.8		92	337
Cooper's Hawk	60 ± 11.7		44	101
Northern Goshawk	9.5 ± 2.8		28	28
Red-shouldered Hawk	0.1 ± 0.2		0	1
Broad-winged hawk	0.2 ± 0.2		0	1
Red-tailed Hawk	47 ± 11.2		39	108
Rough-legged Hawk	0.3 ± 0.2		0	1
Golden Eagle	1.7 ± 0.5		2	6
Bald Eagle	0.2 ± 0.2		0	2
American Kestrel	0.5 ± 0.3		0	2
Merlin	6.1 ± 1.5		3	13
Prairie Falcon	1.5 ± 0.6		2	4
Peregrine Falcon	0.5 ± 0.4		0	4
All Species	306.7 ± 53		210	522

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

<sup>2</sup> Mean of annual values ± 95% confidence interval.

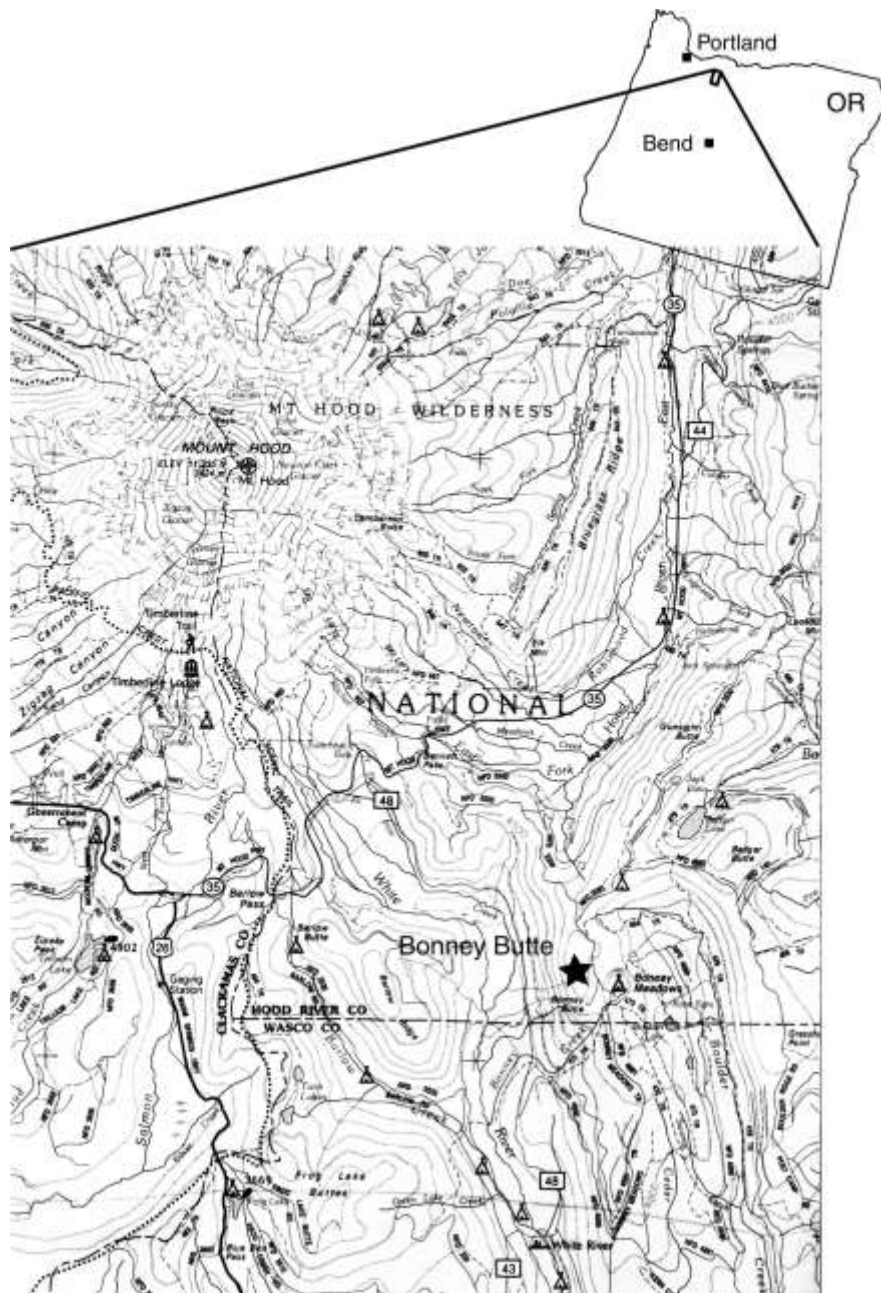
**Table 3 Summary of the 2017 fall flight of migrating raptors across HWT's monitoring network. Values are counts ; green indicates a count significantly higher (outside the 95% confidence interval) than the historic site average, red indicates a count significantly lower than average, and black indicates a count that does not differ from the site average. Asterisks denote a record high or low count. In 2017 HWT monitored fall migration for 4,486 hrs and counted 305,549 birds.**

	Bonney Butte, OR	Chelan Ridge, WA	Bridger Mtn, MT	Commissary Ridge, WY	Goshute Mts, NV	Yaki Pt, AZ	Manzano Mts, NM	Corpus Christi, TX
	<i>Hours Counted in 2017</i>							
<b>Species</b>	<b>430.1</b>	<b>409.1</b>	<b>424.3</b>	<b>530.5</b>	<b>697.75</b>	<b>595.4</b>	<b>570.8</b>	<b>828.3</b>
Black Vulture								409
Turkey Vulture	474	29	*29*	94	264	na	480	87934
Osprey	78	*11*	7	49	88	48	52	138
Northern Harrier	22	74	50	27	157	55	54	351
Crested Caracara								4
Common Black Hawk								0
Harris' Hawk								10
<b>Accipiters</b>								
Sharp-shinned Hawk	*525*	*245*	321	695	2519	1234	1658	*2681*
Cooper's Hawk	347	*110*	191	414	1528	761	1244	1358
Northern Goshawk	26	19	39	36	125	5	21	0
Unidentified accipiter	33	49	45	44	324	133	169	100
TOTAL ACCIPITERS	931	*423*	596	1189	4496	2133	3092	4139
<b>Buteos</b>								
Red-shouldered Hawk	0	0	0	0	0	*1*	0	*15*
Broad-winged Hawk	7	*21*	11	34	95	31	*23*	*160916*
Short-tailed Hawk								1
Swainson's Hawk	2	17	5	112	499	68	496	8891
White-tailed Hawk								16
Zone-tailed Hawk							*6*	16
Red-tailed Hawk	371	*107*	208	846	3884	1291	930	139
Ferruginous Hawk	1	0	5	2	26	4	11	1
Rough-legged Hawk	6	17	64	10	19	0	0	0
Unidentified buteo	18	29	19	31	212	21	53	42
TOTAL BUTEOS	405	*191*	312	1035	4735	1416	1519	*170037*
<b>Eagles</b>								
Golden Eagle	*27*	*11*	1476	289	252	3	117	0
Bald Eagle	86	5	69	155	14	12	1	13
Unknown eagles	2	2	1	1	3	0	1	0
TOTAL EAGLES	115	*18*	1549	445	269	15	119	13
<b>Falcons</b>								
American Kestrel	*7*	11	74	87	*616*	*332*	388	960
Merlin	74	*18*	22	17	60	13	32	113
Prairie Falcon	5	6	13	*2*	31	*2*	13	5
Peregrine Falcon	11	8	13	9	25	10	79	*343*
Aplomado Falcon								1
Unidentified falcon	9	14	6	11	17	7	14	14
TOTAL FALCONS	106	57	128	126	749	*364*	526	1436
<b>Kites</b>								
Hook-billed Kite								0
Swallow-tailed Kite								109
White-tailed Kite								7
Mississippi Kite								11362
Unidentified Kites								0
TOTAL KITES								11478
Unidentified Raptor	10	50	25	15	48	7	34	205
<b>GRAND TOTAL</b>	<b>2141</b>	<b>*853*</b>	<b>2696</b>	<b>2980</b>	<b>10806</b>	<b>4041</b>	<b>5877</b>	<b>*276155*</b>

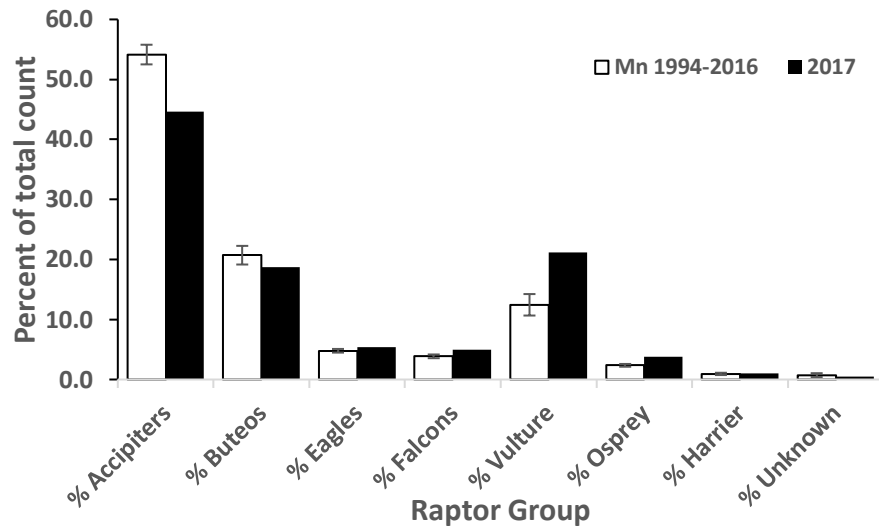


**Figure 1. Locations of fall HawkWatch sites operated by HWI and partners (symbols with borders represent banding sites in 2016).**

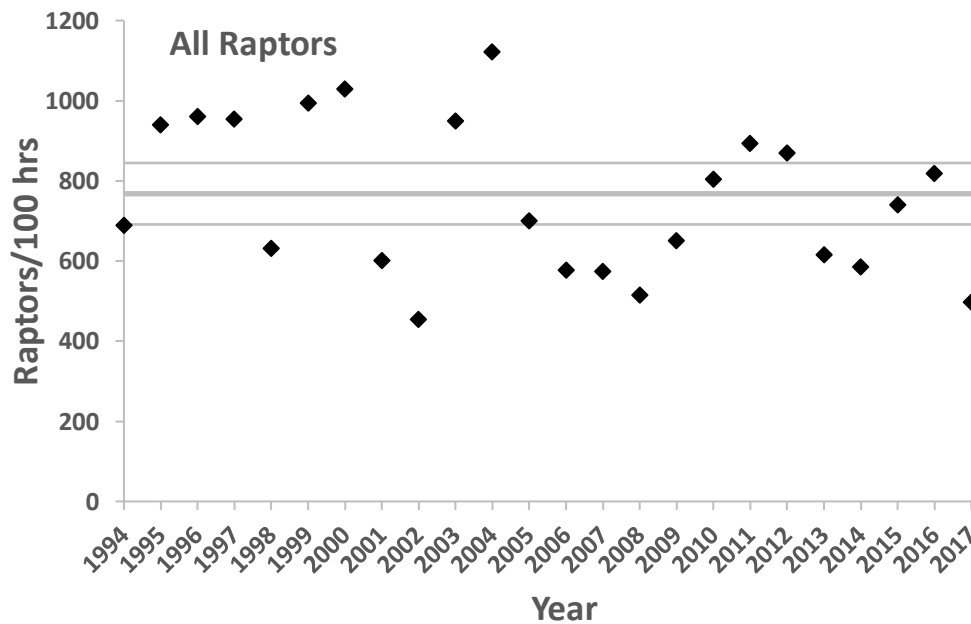




**Figure 2. Location of the Bonney Butte HawkWatch near Mt. Hood, Oregon.**



**Figure 3. Fall raptor migration flight composition by major species groups at Bonney Butte, Oregon: 1994–2016 versus 2017.**



**Figure 4. Fall migration passage rates at Bonney Butte, OR for all migrating raptors: 1994-2017. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (1998-2016) at Bonney Butte.**



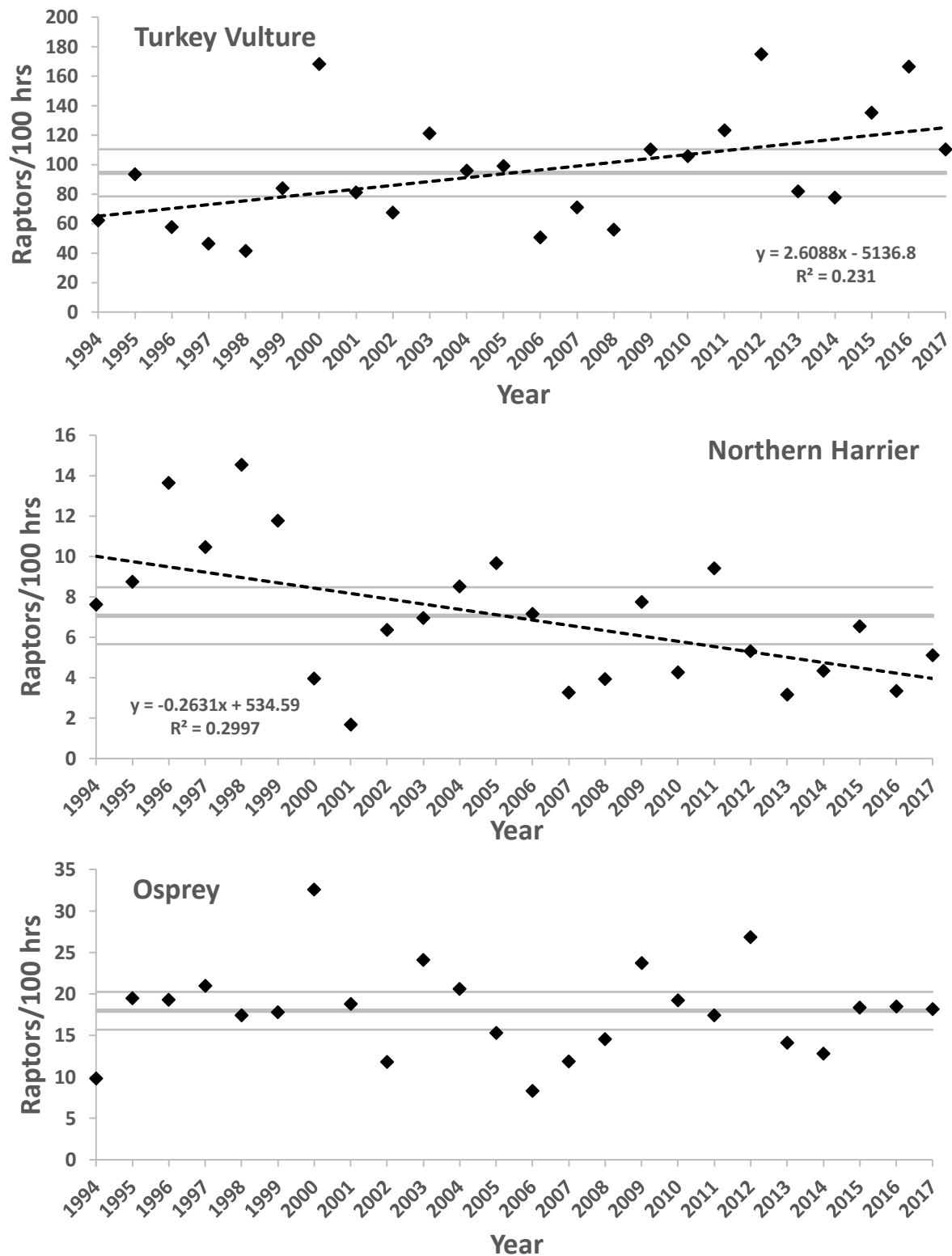
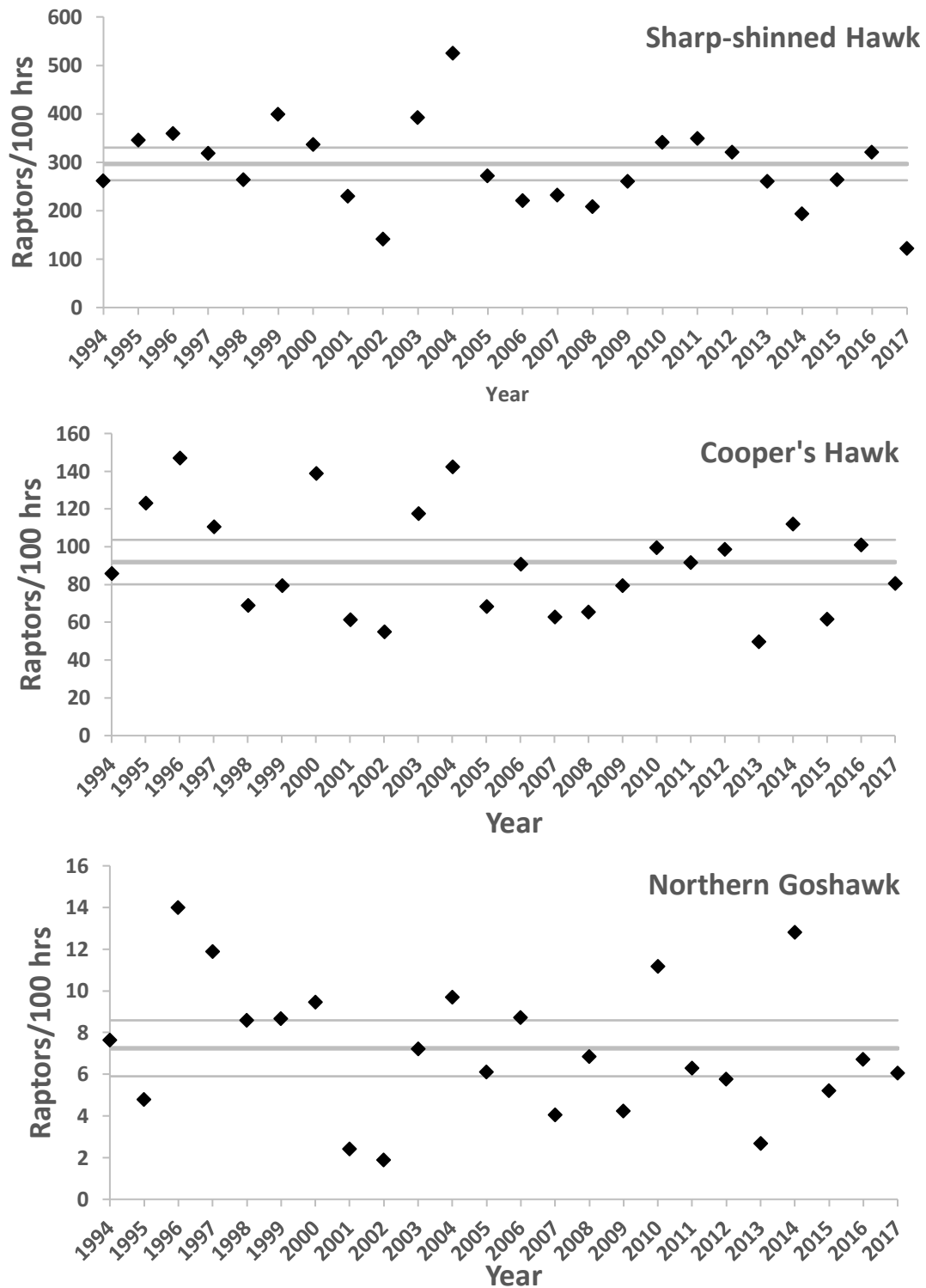


Figure 5a. Fall-migration passage rates at Bonney Butte, OR for Turkey Vultures, Ospreys, and Northern Harriers: 1994–2017. Dashed lines indicate trends for significant ( $p < 0.05$ ) linear or quadratic regressions. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (1994-2016).



**Figure 5b. Fall-migration passage rates at Bonney Butte, OR for the three North American accipiter species: 1994–2017. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (1994-2016).**

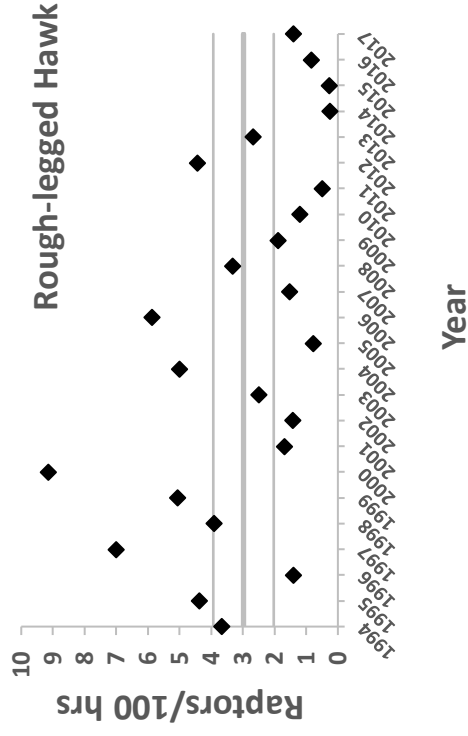
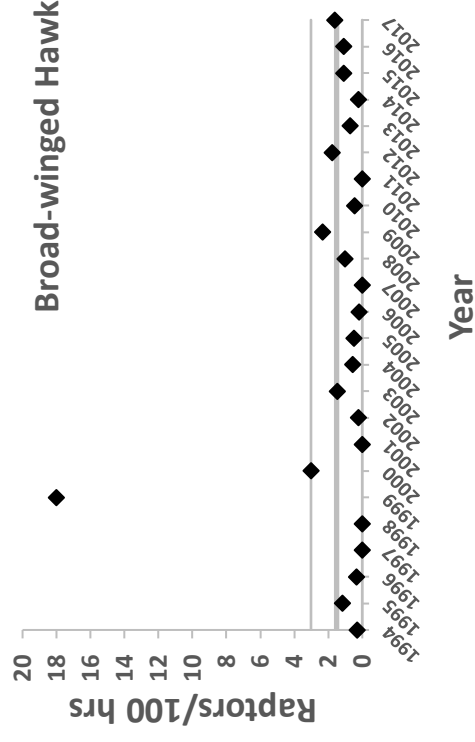
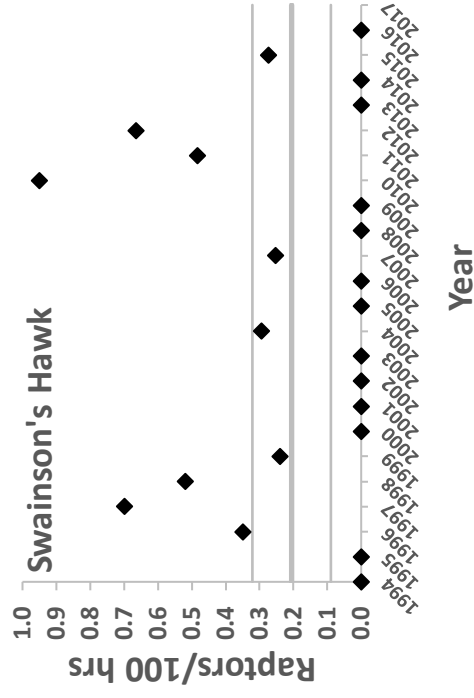
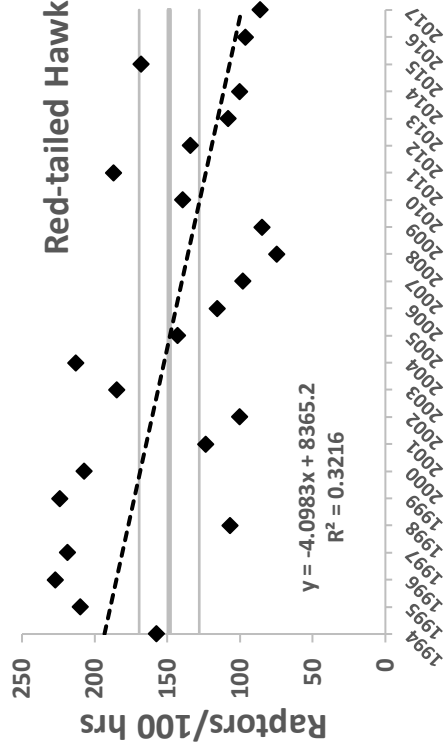
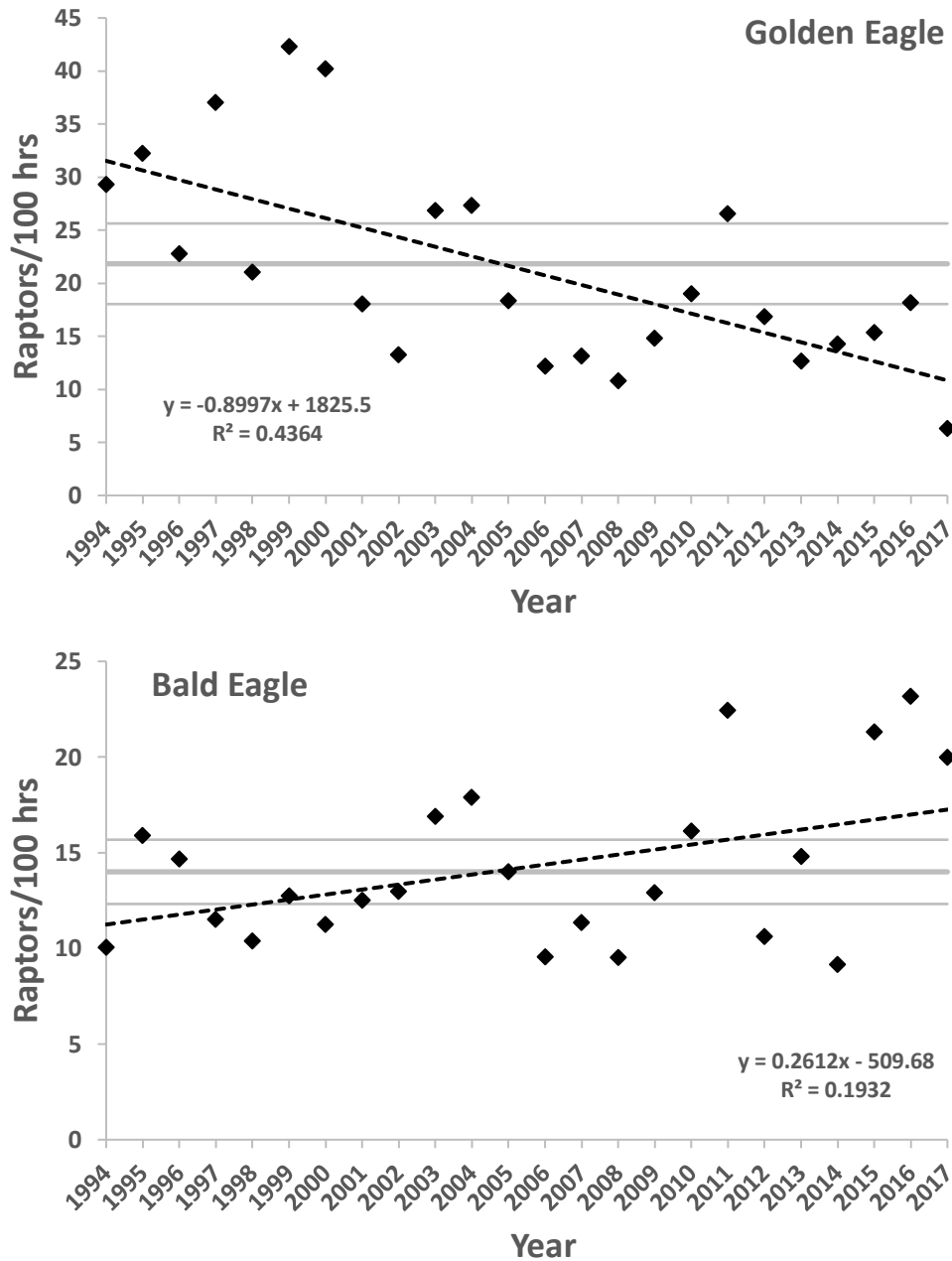


Figure 5c. Fall-migration buteo passage rates at Bonney Butte, OR: 1994–2017. Dashed lines indicate significant ( $p < 0.05$ ) population trends based on linear or quadratic regressions. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (1994–2016).



**Figure 5d. Eagle passage rates for the fall migration at Bonney Butte, OR: 1994–2017. 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 (1994-2016).**

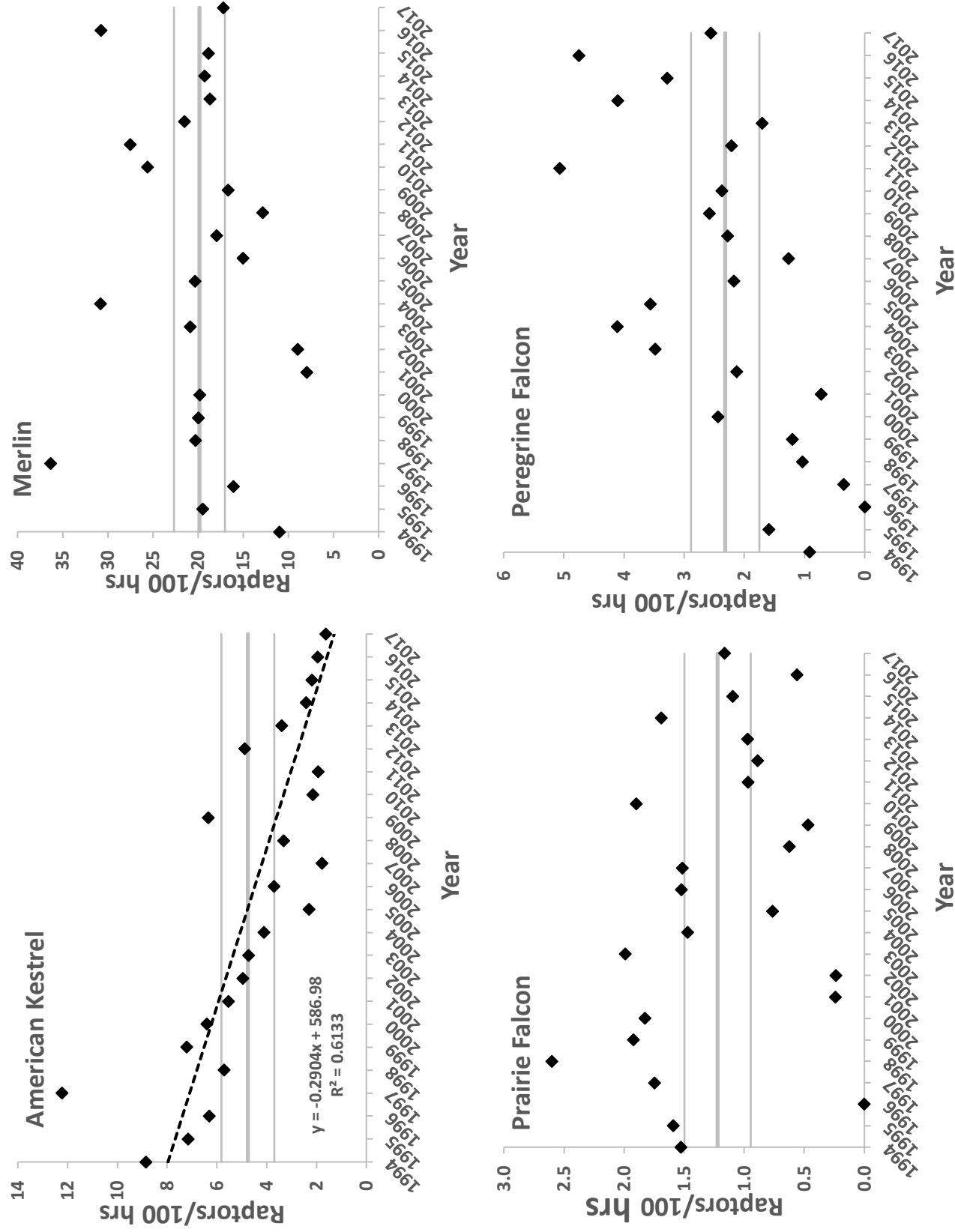


Figure 5c. Fall-migration falcon passage rates at Bonney Butte, OR: 1994–2017. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (1994-2016).

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

- 1994:** Single observer throughout: David Schuetze (0) and Sean O'Connor (0)<sup>1</sup>.
- 1995:** Two observers throughout: David Schuetze (1) and Alison Clark (0).
- 1996:** Two observers throughout: David Schuetze (2) and Alison Clark (1).
- 1997:** Two observers throughout: Rose Jaffe (0) and Sean Donaghy (0).
- 1998:** Two observers throughout: Nick Vulgares (1) and Jeremy Davit (0).
- 1999:** Two observers throughout: Nick Vulgares (3) and Sue Vulgares (0).
- 2000:** Two observers throughout: Nick Vulgares (5) and Sue Vulgares (2).
- 2001:** Two observers throughout: Alison Cebula Benedict (1) and Eric Hallingstad (0).
- 2002:** Two observers throughout: Eric Hallingstad (1) and Sue Bruner (1).
- 2003:** Two observers throughout: David Haines (0) and Lindsay Reynolds (0).
- 2004:** Two observers throughout: David Haines (1) and Amy Scarpignato (+).
- 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).
- 2015:** Two observers throughout: Jeremy Halka (2), Liz Bartholomew (0), Scott Shively (0), and Maddie Ore (0).
- 2016:** Two observers throughout: Scott Shively (1), Kate Owens (1), Ben Sweet (1), Sarah Hecocks (0), Ceeanna Zulla (0).
- 2017:** Two observers throughout: Lauren di Baccarri (1), Caleb Hansen (2), Isa Schwartz (0), Joshua Parrott (0), Alex Ramsey (0).

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

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

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

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

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

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

**Appendix C. Annual observation effort and fall raptor migration counts by species at Bonney Butte, Oregon: 1994–2017.**

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



Appendix C. continued

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Start date	27-Aug	27-Aug	28-Aug	27-Aug	28-Aug	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug
End date	29-Oct	27-Oct	31-Oct	31-Oct	31-Oct	25-Oct	22-Oct	29-Oct	25-Oct	31-Oct
Observation days	46	49	57	51	60	51	52	55	53	54
Observation hours	341.25	392.92	459.92	397.00	481.83	425.75	421.42	414.33	451.42	412.25
Raptors / 100 hours	1119.7	699.6	577.5	571.5	514.5	649.9	804.4	893.2	869.3	613.9
SPECIES										
Turkey Vulture	326	389	232	281	269	469	446	510	790	337
Osprey	70	60	38	47	70	101	81	72	121	58
Northern Harrier	29	38	33	13	19	33	18	39	24	13
Sharp-shinned Hawk	1790	1067	1015	921	1003	1110	1438	1448	1446	1072
Cooper's Hawk	485	269	418	249	316	339	420	380	446	205
Northern Goshawk	33	24	40	16	33	18	47	26	26	11
Unknown accipiter	29	73	69	74	160	77	47	82	130	73
TOTAL ACCIPITERS	2337	1433	1542	1260	1512	1544	1952	1936	2048	1361
Red-shouldered Hawk	7	0	0	3	3	1	0	0	1	0
Broad-winged Hawk	2	2	1	0	5	10	2	0	8	3
Swainson's Hawk	1	0	0	1	0	0	4	2	3	0
Red-tailed Hawk	725	562	531	388	359	361	588	775	605	444
Ferruginous Hawk	0	1	0	0	0	0	0	0	0	1
Rough-legged Hawk	17	3	27	6	16	8	5	2	20	11
Unidentified buteo	9	4	30	40	16	3	7	5	23	57
TOTAL BUTEOS	761	572	589	438	399	383	606	784	660	516
Golden Eagle	93	72	56	52	52	63	80	110	76	52
Bald Eagle	61	55	44	45	46	55	68	93	48	61
Unidentified eagle	2	1	1	2	8	5	1	3	1	2
TOTAL EAGLES	156	128	101	99	106	123	149	206	125	115
American Kestrel	14	9	17	7	16	27	9	8	22	14
Merlin	105	80	69	71	62	71	108	114	97	77
Prairie Falcon	5	3	7	6	3	2	8	4	4	4
Peregrine Falcon	14	14	10	5	11	11	10	21	10	7
Unknown falcon	1	18	2	9	2	2	0	1	8	4
TOTAL FALCONS	139	124	105	98	94	113	135	148	141	106
Unidentified raptor	3	5	16	33	10	1	3	6	15	25
GRAND TOTAL	3821	2749	2656	2269	2479	2767	2390	3701	3924	2531

	2014	2015	2016	2017	MEAN
Start date	27-Aug	27-Aug			28-Aug
End date	19-Oct	27-Oct			28-Oct
Observation days	49	45			51.3
Observation hours	417.48	365.7			386.6
Raptors / 100 hours	580.4	739.4			765.1
SPECIES					
Turkey Vulture	322	494			353.5
Osprey	53	67			68.5
Northern Harrier	18	24			27.1
Sharp-shinned Hawk	802	964			1121.0
Cooper's Hawk	465	226			343.7
Northern Goshawk	53	19			27.5
Unknown accipiter	41	44			79.0
TOTAL ACCIPITERS	1361	1598			1586.8
Red-shouldered Hawk	2	1			1.2
Broad-winged Hawk	1	4			6.1
Swainson's Hawk	0	1			0.8
Red-tailed Hawk	415	614			563.2
Ferruginous Hawk	0	0			0.3
Rough-legged Hawk	1	1			11.5
Unidentified buteo	6	3			25.3
TOTAL BUTEOS	425	624			608.5
Golden Eagle	59	56			81.7
Bald Eagle	38	78			52.0
Unidentified eagle	5	1			3.0
TOTAL EAGLES	102	135			136.7
American Kestrel	10	8			18.0
Merlin	80	69			73.6
Prairie Falcon	7	4			4.8
Peregrine Falcon	17	12			8.8
Unknown falcon	7	7			4.2
TOTAL FALCONS	121	100			109.4
Unidentified raptor	21	7			20.2
GRAND TOTAL	2423	2704			2849.6

**Appendix D. Annual trapping effort and capture totals by species for migrating raptors at Bonney Butte, Oregon: 1995–2015.**

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Start date	7-Oct	18-Sep	31-Aug	6-Sep	5-Sep	28-Aug	25-Aug	27-Aug	26-Aug	27-Aug
End date	28-Oct	10-Oct	1-Nov	30-Oct	24-Oct	24-Oct	28-Oct	27-Oct	27-Oct	15-Oct
Blinds in operation	1	1	1	1	1	1	1	1	1	1
Station days	10	21	39	34	22	58	50	55	47	36
Station hours	44.5	127.2	202.8	200.0	142.8	239.8	320.5	357.8	345.4	236.0
Captures/100 stn hrs	40.5	99.1	110.0	125.5	100.2	129.7	102.7	103.7	124.5	167.4
Species	Raptor Captures									
Northern Harrier	0	1	0	2	1	1	0	6	4	2
Sharp-shinned Hawk	14	80	139	163	82	161	171	172	268	219
Cooper's Hawk	0	20	29	39	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	2	2	1	2	3	1	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	3	0	1	0	1	3	4
Peregrine Falcon	0	0	0	0	0	2	0	1	0	0
All Species	18	126	223	251	143	311	329	371	430	395
Recaptures <sup>1</sup>	0	0	0	0	0	0	0	0	0	2
Foreign Recaptures <sup>2</sup>	0	0	1	1	0	0	1	0	2	2

Appendix D. Continued

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Start date	27-Aug	27-Aug	27-Aug	28-Aug	27-Aug	27-Aug	1-Sep	27-Aug	27-Aug	27-Aug
End date	27-Oct	28-Oct	30-Oct	30-Oct	25-Oct	21-Oct	26-Sep	25-Oct	30-Oct	19-Oct
Blinds in operation	1	1	1	1	1	1	1	1	1	1
Station days	48	49	45	56	49	38	30	51	49	48
Station hours	342.3	354.3	317.3	406.0	359.5	263.3	139.5	376.3	328.0	335.5
Captures/100 stn hrs	152.5	138.9	105.3	104.9	138.5	134.9	106.1	76.8	70.7	92.1
Species	Raptor Captures									
Northern Harrier	7	2	1	3	3	0	0	1	0	1
Sharp-shinned Hawk	310	259	200	247	337	199	93	168	137	184
Cooper's Hawk	101	88	75	100	98	68	30	72	50	55
Northern Goshawk	12	11	3	16	3	21	2	6	3	18
Red-shouldered Hawk	0	0	1	1	0	0	0	0	0	1
Broad-winged hawk	0	0	0	1	0	0	0	1	0	1
Red-tailed Hawk	67	106	42	45	39	57	19	33	31	38
Rough-legged Hawk	1	1	0	1	0	0	0	1	0	0
Golden Eagle	3	6	0	1	2	1	0	2	2	1
Bald Eagle	1	0	0	0	2	0	0	0	0	0
American Kestrel	0	2	1	1	1	1	2	0	1	1
Merlin	13	12	9	8	12	8	2	5	5	8
Prairie Falcon	3	4	2	1	1	0	0	0	2	1
Peregrine Falcon	4	1	0	1	0	0	0	0	1	0
All Species	522	492	334	426	498	355	148	289	232	309
Recaptures <sup>1</sup>	1	1	0	0	0	0	0	0	0	0
Foreign Recaptures <sup>2</sup>	3	1	1	1	2	1	0	1	0	0

Appendix D. Continued

	2015	2016	2017	Mean*	Total
Start date	27-Aug	27-Aug		29-Aug	---
End date	25-Oct	28-Oct		23-Oct	---
Blinds in operation	1	1		1.0	---
Station days	42	41		43.2	918
Station hours	306.5	266.2		284.1	6011.0
Captures/100 stn hrs	84.8	79.6		111.8	---
Species					
Northern Harrier	1	3		1.8	39
Sharp-shinned Hawk	147	149		177.2	3899
Cooper's Hawk	57	38		59.0	1299
Northern Goshawk	10	4		8.2	181
Red-shouldered Hawk	0	0		0.1	3
Broad-winged hawk	0	0		0.2	4
Red-tailed Hawk	34	10		46.1	1015
Rough-legged Hawk	0	0		0.3	7
Golden Eagle	2	1		1.6	35
Bald Eagle	0	0		0.1	3
American Kestrel	0	0		0.5	12
Merlin	6	6		6.1	134
Prairie Falcon	2	1		1.4	30
Peregrine Falcon	1	0		0.5	11
All Species	260	212		303.3	6672
Recaptures <sup>1</sup>	0	0		0.2	4
Foreign Recaptures <sup>2</sup>	1	2		1.0	20

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

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

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