FALL 2017 RAPTOR MIGRATION ANNUAL REPORT: CHELAN RIDGE HAWKWATCH, WASHINGTON



A Partnership Between







SUMMARY OF 2017 FALL RAPTOR MIGRATION AT CHELAN RIDGE, WASHINGTON

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INTRODUCTION

The Chelan Ridge HawkWatch in north-central Washington is an ongoing effort to monitor long-term regional trends in raptor populations using the north Cascades migratory flyway (Smith et al. 2008a). HawkWatch International (HWI), in partnership with the Okanogan and Wenatchee National Forests (OWNF), initiated standardized counts of the autumn raptor migration through this region in 1997, with full-season counts beginning in 1998. The Falcon Research Group (FRG), in cooperation with HWI and OWNF, initiated a trapping and banding program at the site in 1999. HWI and OWNF took over coordinating the banding program in 2001, and these efforts have continued annually since. To date, observers have recorded 19 species of migratory diurnal raptors at the site, with counts ranging between ~1,500–2,900 migrant raptors per season. The 2017 season marked the 20th consecutive, full-season count and the 19th straight season of banding at the site. This report summarizes the 2017 fall raptor migration at Chelan Ridge.

The Chelan Ridge HawkWatch was 1 of 8 long-term, annual fall migration counts and 1 of 4 migration banding studies operated or co-sponsored by HWI in North America during 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 Texas Gulf Coast (Hoffman and Smith 2003; Smith et al. 2001, 2008 a, b). Chelan Ridge falls within the Great Basin bird conservation region, the Intermountain West Joint Venture, and the Columbia Plateau Partners in Flight region. Raptors can serve as important biological indicators of ecosystem health (Bildstein 2001) and long-term migration counts can be a cost effective and efficient method for monitoring regional status and trends of multiple raptor species (Zalles and Bildstein 2000).

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 Chelan Ridge HawkWatch and outreach efforts here reach hundreds of people from central Washington and beyond each season.

STUDY SITE

Chelan Ridge is located approximately 21 km north–northwest of the city of Chelan, on the Chelan / Okanogan County border, and is on the border between the Okanogan and the Wenatchee National Forests (48°01'12.8"N, 120°05'38.4"W; Fig. 2). The site is accessed by following Washington State Road 153 about 11 km northwest of Pateros, on to Black Canyon Road (USFS Road 4010) west–southwest until it ends, then on to Cooper Mountain Road (USFS Road 8020) southeast for another 5.4 km.

The Chelan Ridge count site sits at an elevation of 1,729 m and provides a 360-degree view of the surrounding landscape. Mitchell Creek Basin fills the east–west view and is often a common place to first spot raptors. This basin is approximately 3.5 km wide, and on the southern side of the basin is Goff Peak, which is a major landmark. Many migrants enter Mitchell Creek Basin through a gap in the ridge between the observation point and a similar high point further up the ridge. The view further to the east extends across the Columbia River and Waterville Plateau, while towards the west, a ridgeline (known as Cooper Ridge) extends into the Sawtooth Wilderness. The view to the north into Black Canyon is constrained by a backdrop of dark-green forest of lodgepole (*Pinus contorta*) and Ponderosa pine (*Pinus ponderosa*), and

this dark contrast makes spotting migrant raptors difficult. Although the northern view is unobstructed, Black Canyon does have blind spots where migrating raptors can be missed, or even lost. Farther north, the view extends across Methow Valley and into the Pasayten Wilderness. To the southeast, migrant raptors often fly through a gap between the lookout and Cooper Mountain--allowing some migrants to pass the lookout undetected but they can often be spotted rising on thermals above the horizon near Cooper Mountain. The south view extends across Lake Chelan and into the Wenatchee National Forest.

The lookout's southwestern slope is a cliff face of 70–80 degrees that drops about 65 m into Mitchell Creek Basin. This cliff face creates excellent updrafts on days of moderate to strong south winds, which allow for extremely close looks at migrants as they fly nearby.

Two trapping and banding stations are located approximately 1 and 2.25 km southeast of the count site (Fig. 2). The North station is located on the northwest flank of Cooper Mountain in the same area used by the FRG crew in 1999 and by HWI/OWNF since 2001. The South station is located in a saddle on the southwest flanks of Cooper Mountain in an area used regularly since 2001.

METHODS

STANDARDIZED COUNTS

Two observers, relieved or supplemented by other trained staff and volunteers, conduct standardized daily counts of migrating raptors from the observation site.

Weather permitting; observations usually begin at 0800 H and end between 1600 and 1700 H Pacific Standard Time (PST). Data collection follows standardized protocols used at all HWI migration sites (Hoffman and Smith 2003). Observers routinely record the following data:

- 1. Species, age, sex, and color morph of each migrant raptor, whenever possible and applicable (Appendix B lists common and scientific names for all species, information about the applicability of age, sex, and color morph distinctions, and two-letter codes used to identify species in some tables and figures).
- 2. Hour of passage for each migrant; e.g., the 1000–1059 H 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, 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 recorded on the hour for the preceding hour's count.
- 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.

TRAPPING AND BANDING

Crewmembers operated 1-2 banding stations daily (weather permitting) from late August through late October, generally between 0800 and 1700 H PST. Capture devices included mist nets, dho-gaza 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, we fit all captured birds 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). We released all birds within 45 minutes of capture.

2017 RESULTS AND DISCUSSION

OBSERVATION EFFORT

Observers counted on 53 of 60 possible days between 25 August and 23 October during the 2017 season, which was 7 days below the 1998-2016 long-term average of x days, and spent a total of 409 hours counting, below the long-term site average of 476 hrs (Appendix C).

2017 FLIGHT SUMMARY

Overall Flight:

We counted 853 migrating raptors of 16 species, significantly ($\alpha =0.05$) 29% below the long-term site average (Table 1), and the lowest total ever recorded for the site (Appendix C). Notables for the 2017 season included a record low counts for Sharp-shinned Hawks (245), Cooper's Hawks (110), Red-tailed Hawks (107), Golden Eagles (11), Osprey (11), and Merlins (18). The 21 Broad-winged Hawks the crew counted set a new site high.

The composition of the overall flight was: 50% accipiters, 22% buteos, 9% harriers,7% falcons, 3% vultures, 2% eagles, 1% Ospreys, and 6% unknown raptors. The proportions of buteos, vultures, falcons, harriers, and unknown were above historic averages; while the proportion of accipiters, eagles, and Osprey were below historic averages (Fig. 3). Sharp-shinned Hawks were the most commonly observed species (29% of the total), followed by Cooper's Hawks (13%), Red-tailed Hawks (13%), Northern Harriers (7%), Turkey Vultures (3%), and the remaining species each accounted for 2% or less of the total count.

The following sections summarize the 2017 count relative to historic means at the site, and any statistically significant ($\alpha = 0.05$) population trends based on first and second order regression analysis of effort adjusted passage rates. HWI only reports significant trends for species with a historic mean passage rate greater than or equal to 10 individuals per 100 hours. The rationale is that trends for counts below this threshold likely do not contain biologically useful information on regional populations—species with counts this low likely have a very dispersed migration, migrate along a different primary 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 209 raptors/100 hours of observation recorded at Chelan Ridge is an all-time low. Total number of raptors counted per 100 hours of observation at Chelan Ridge has decreased significantly since the early years of the count, (slope= -13.97, r² = 0.54, p<0.001).

Vultures, Osprey, and Harriers (Fig. 5a):

We counted below average numbers of Turkey Vulture, Osprey, and Northern Harrier in 2017 compared to past seasons. Regression results indicate that regional populations of Northern Harriers declined between 1998 and 2009, but have stabilized since 2010 (F = 5.96, r^2 = 0.44, p = 0.02). Both the Osprey total count and passage rate in 2017 were the lowest ever documented at Chelan Ridge.

Accipiters (Fig. 5b):

The crew counted the lowest number of accipiters ever in 2017; driven by record low Sharp-shinned Hawk (245) and Cooper's Hawk(110) counts (Table 1). We also documented a record low passage rate for Sharp-shinned Hawk in 2017 and regression analysis indicates significant declines (slope= -5.96, $r^2 = 0.5$, p<0.001). Passage rate for Goshawks was average, while Cooper's Hawk rate was significantly low. Cooper's hawk passage rates remain stable across the years (no significant trend over time). Northern Goshawks passage rate does not meet the 10 birds/100 hour average threshold for trend analysis.

Buteoine Hawks (Fig. 5c):

We counted the lowest total number of Buteos (191) in the history of the Chelan Ridge count this year (Table 1). We documented numbers and passage rates below average for Red-tailed Hawks and Rough-legged Hawks; and above average for Swainson's Hawks and Broad-winged Hawks in 2017 compared to historical values (Table 1). Both the count and passage rate for Red-tailed Hawks were record lows (Table 1, Fig 5c), and regional populations either continue to decline (slope = -2.2, $r^2 = 0.45$, p = 0.001), or are shifting migratory behavior (Paprocki et al 2017), based on fall migration counts.

Eagles (Fig.5d):

We also documented a record low Golden Eagle count and passage rate at Chelan Ridge in 2017 (Table 1); regression analysis of migration passage rates suggests a continued decline in regional Golden Eagle populations (slope = -0.86, $r^2 = 0.41$, p = 0.002). The five Bald Eagles counted in 2017 was below average for Chelan Ridge and passage rate was average (Table 1).

Falcons (Fig. 5e):

American Kestrel count and passage rate in 2017 were low compared to site average for the sixth consecutive season and regional Kestrel populations continue to decline based on fall migration rates (slope = -0.82, $r^2 = 0.57$, p < 0.001). Based on findings from Chelan Ridge and other migration monitoring sites across North America, HWI scientists along with many other North American researchers and Citizen Scientists are collaborating to understand these declines both locally (<u>www.hawkwatch.org/kestrels</u>) and at the continental scale under the umbrella of the American Kestrel Partnership (<u>http://kestrel.peregrinefund.org/</u>). The crew counted record low Merlins (18) and below average Prairie Falcons in 2017. The Peregrine Falcon count and passage rate was in line with site historic averages.

TRAPPING EFFORT

Trapping occurred on 40 of 45 days between 1 September and 15 October, with efforts totaling 328.3 hours split between two stations (Appendix D), a record low for Chelan Ridge. We normally try to end the season on 26 October but an approaching winter storm led to a shut down on 15 October. Due to an early finish, the number of trapping days and station hours were below site average (Appendix D).

The crew captured and banded 238 raptors of ten species in 2017, significantly below the site average of 527 birds and the lowest total ever at Chelan Ridge (Table 2). The 2017 overall capture rate was also compared historic site average. Similar to counts, total captures set record lows for Sharp-shinned Hawks, Cooper's Hawks, and Red-tailed Hawks, species comprising the bulk of captures most years.

VISITOR PARTICIPATION AND PUBLIC OUTREACH

We engaged over 500 people during the fall of 2017, either at the count site or in the city of Pateros during the Chelan Ridge Hawk Migration Festival. The festival occurred September 15-17 and included classroom visits to local schools by HWI and North Central Washington Audubon educators, a Friday night migration talk and ID workshop by HWI's Dave Oleyar, festivities and booths in Pateros, and field trips to the count site led by HWI and USFS staff. The North Cascades Institute brought two groups to the site (24 people total), and a wildlife class from Washington State University (25 people) visited to learn about field techniques and more.

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 305,550 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:
 - o Broad-winged Hawks at Chelan Ridge and Manzano Mountains
 - o Sharp-shinned Hawks and Peregrine Falcons at Corpus Christi
 - o Zone-tailed Hawks (6) at Manzano Mountains

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We especially want to thank our 2017 field crew: TC Walker, Maycee Hash, Magill Schumm, Alma Schrage, and Alyssa Davidge; plus new and veteran volunteers who made their first trip or returned to visit and help with this year's efforts. Without your pioneering spirits, skill, dedication, and willingness to brave the elements over the course of a long field season these efforts would not be possible.

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	1998-2016					All-time	Historic	, Records
Species	Mean Count -	± 95	% CI	2017	% Change	Season		Daily
Turkey Vulture	42.7	H	8.0	29	-32	81	2015	25 (2014)
Osprey	36.5	H	6.1	11	-70	71	2000	10 (2x including 14)
Northern Harrier	94.6	H	16.7	74	-22	167	1999	21 (1998)
Accipiters								
Sharp-shinned Hawk	711.2	H	102.6	245	-66	1050	2000	84(2000)
Cooper's Hawk	219.6	+H	27.9	110	-50	363	2007	32 (2009)
Northern Goshawk	27.3	+H	5.6	19	-30	50	1999	7 (2x)
Unidentified accipiter	96.3	H	26.9	49	-49	248	1999	
TOTAL ACCIPITERS	1054.4	+H	141.2	423	-60	1462	1999	
Buteos								
Red-shouldered Hawk	0.1	H	0.1	0	-100	1	2011	1 (2011)
Broad-winged Hawk	6.4	H	1.6	21	230	21	2017	10 (2015)
Swainson's Hawk	8.5	H	14.0	17	66	43	2014	13 (2003)
Red-tailed Hawk	268.7	H	47.6	107	-60	450	1999	33 (2006)
Ferruginous Hawk	0.1	H	0.1	0	-100	1	2000	1(2000)
Rough-legged Hawk	32.6	H	10.9	17	-48	117	2012	39 (2012)
Unidentified buteo	49.3	H	15.7	29	-41	148	1999	
TOTAL BUTEOS	365.6	+H	57.2	191	-48	664	1999	
Eagles								
Golden Eagle	103.1	H	17.3	11	-89	174	2000	18 (2000)
Bald Eagle	8.4	H	2.5	5	-41	18	2016	5(2016)
Unknown eagles	1.7	H	1.4	7	19	12	2003	
TOTAL EAGLES	113.2	+H	17.5	18	-84	194	2000	
Falcons								
American Kestrel	45.2	+H	12.2	11	-76	107	1998	13 (1998)
Merlin	38.4	H	4.8	18	-53	63	2010	9 (1998)
Prairie Falcon	8.1	+H	1.9	9	-26	19	2003	3 (2x)
Peregrine Falcon	8.4	+H	2.2	8	4-	20	2006	3 (3x)
Unidentified falcon	5.5	H	1.7	14	156	16	2009	
TOTAL FALCONS	105.5	H	15.9	57	-46	180	1998	
Unidentified Rantor	80.7	++	28.6	50	-38	218	1999	
CID & MID TOTE & T	1.00	- 1	0.02			1000	1000	187 (3000)
GRAND TUTAL	C.CV01	H	671.67	دده	ç	1007	1 <i>444</i>	10/ (2002)

Table 1. Historic fall raptor migration counts (mean±95% CI), counts from fall 2016, and site records at Chelan Ridge, WA.

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Table 2. Mean and 2017	capture totals for	migrating raptor s	species at Chelan	Ridge HawkWatch.
	-			

		Capture T	otals	
	2001	-2016 ¹	2017	Season Record
Northern Harrier	13.5	± 3.5	7	29
Sharp-shinned Hawk	364	± 50	167	556
Cooper's Hawk	96.9	± 16	39	140
Northern Goshawk	12.4	± 3.2	6	29
Broad-winged Hawk	0.06	± 0.1	0	1
Red-tailed Hawk	24.7	± 5.2	5	50
Rough-legged Hawk	2.59	± 1.3	0	9
Golden Eagle	2.8	± 0.9	1	6
American Kestrel	6.1	± 2.1	1	17
Merlin	21.9	± 4.4	9	49
Prairie Falcon	2.1	± 0.5	1	5
Peregrine Falcon	1.7	± 0.5	2	4
All Species	548.6	± 75.7	238	814

¹ Mean of annual totals \pm 95% confidence interval.

Table 3 Summary of the 2017 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. Asterisks denote a record high or low count. *In 2017 HWI monitored fall migration for 4,486 hrs and counted 305,550 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
					Hours Counted	l in 2017			
	Species	430.1	409.1	424.3	530.5	697.75	595.4	570.8	828.3
	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
Accipiter	rs								
	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
Buteos	N I I II III I								
	Red-shouldered Hawk	0	0	0	0	0	*1*	0	*15*
	Broad-winged Hawk	/	*21*	11	34	95	31	*23*	*160916*
	Short-tailed Hawk	2	17	-	112	400	69	406	1
	Swainson's Hawk	2	17	S	112	499	00	490	16
	Zono toiled Howk							*C*	16
	Zone-tailed Hawk	271	*107*	208	846	2884	1201	020	120
	Formainous Howk	1	107	200	2	26	1291	11	135
	Pough legged Hawk	6	17	64	10	19	4	0	0
	Unidentified buteo	18	29	19	31	212	21	53	42
	TOTAL BUTEOS	405	*191*	312	1035	4735	1416	1519	*170037*
Eagles	TOTHE BOTEOD	405	131	512	1055	4755	1410	1515	170037
Lugies	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
Falcons									
	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
Kites									
	Hook-billed Kite								0
	Swallow-tailed Kite								109
	White-tailed Kite								7
	Mississippi Kite								11362
	Unidentified Kites								0
	TOTAL KITES								11478
	Unidentified Partor	10	50	25	15	<u>48</u>	7	3/	205
GRAND	TOTAL	2141	*853*	2696	2980	10806	4041	5877	*276155*



Figure 1. Locations of fall HawkWatch sites operated by HWI and partners (symbols with borders represent sites that conducted banding in 2017).



Figure 2. a. Location of the Chelan Ridge HawkWatch counting and banding sites in north-central Washington, USA. b. Location of Chelan Ridge HawkWatch relative to Chelan and Pateros, WA (GoogleEarth View).



Figure 3. Fall raptor migration flight composition by major species groups at Chelan Ridge, WA: 1998–2016 versus 2017.



Figure 4. Fall migration passage rates at Chelan Ridge, WA for all migrating raptors: 1998-2017. Dashed line indicates trend for significant (p < 0.05) linear regressions. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (1998-2016) at Chelan Ridge.



Figure 5a. Fall-migration passage rates at Chelan Ridge, WA for Turkey Vultures, Ospreys, and Northern Harriers: 1998–2017. 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 (1998-2016) at Chelan Ridge.



Figure 5b. Fall-migration passage rates at Chelan Ridge, WA for the three North American accipiter species: 1998–2017. Dashed lines indicate trends for significant (p < 0.05) linear regression. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (1998-2016).



based on linear or quadratic regressions. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic Figure 5c. Fall-migration buteo passage rates at Chelan Ridge, WA: 1998–2017. Dashed lines indicate significant (p< 0.05) population trends counts (1998-2016).



Figure 5d. Eagle passage rates for the fall migration at Chelan Ridge, WA.: 1998–2017. Dashed lines indicate significant (p < 0.05) population trends based on linear regressions. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (1998-2016).



based on linear or quadratic regressions. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic Figure 5e. Fall-migration falcon passage rates at Chelan Ridge, WA: 1998–2017. Dashed lines indicate significant (p < 0.05) population trends counts (1998-2016).

Appendix A. History of official observer participation at the Chelan Ridge HawkWatch.

1997: Single observer throughout: Dan Rossman (0)

1998: Two observers throughout: Steve Seibel (partial), Susan Crampton (0), Richard Hendrick (0).

1999: Two observers throughout: Dan Harrington (1), Richard Hendrick (1).

2000: Two observers throughout: Dan Harrington (2), Richard Hendrick (2).

2001: Two observers throughout: Richard Hendrick (3; first half of season), Wendy King (0), Don Loock (0; primarily second half of season), Dan Harrington (3; training and substitute observer).

2002: Two observers throughout: Mark Leavens (0), Teresa Lorenz (0), Dan Harrington (3+; training and substitute observer), Richard Hendrick (4; regular substitute).

2003: Two observers throughout: Ben Kinkade (\sim 1/2), Blake Mathys (0), Dan Harrington (3+; training and substitute observer), Richard Hendrick (4+; regular substitute).

2004: Two observers throughout: Dan Russell (1), Aran Meyer (0), Richard Hendrick (4+; regular substitute).

2005: Two observers throughout: Angela Sjollema (0), James Waddell (0; first half), Steve Seibel (3+; second half), and regular substitutes Richard Hendrick (4+) and Dan Russell (2).

2006: Two observers throughout: Angela Sjollema (1), Steve Seibel (4+), with assistance from Aran Meyer (1+), Rob Spaul (2), Devon Batley (1), and Richard Hendrick (4+).

2007: Two observers throughout: Dayna Hawes (1), Shaun Hyland (0), Angela Winter (0), with assistance from Rob Spaul (2+), Ben Vang-Johnson (1+), and Richard Hendrick (4+).

2008: Two observers throughout: Grace Eger (0), Brian Connely (0), Leif Baierl (0), with assistance from Rob Spaul (2+).

2009: Two observers throughout: Brian Connely (1), Craig Waythomas (+), and Marie-Catherine Fournier (+).

2010: Two observers throughout: Brian Connely (2), Craig Waythomas (1+), and Marie-Catherine Fournier (1+).

2011: Two observers throughout: Chadette Pfaff (4), Michael Oliveira (0), and Kathryn Walpole (0).

2012: Two observers throughout: Joshua Collette (0), Kelsey Navarre (0), and Jonathan Roatch (0).

2013: Two observers throughout: Elizabeth Errickson (+), Olivia DaRugna (0), and Carla Jo Ehlinger (0).

2014: Two observers throughout: Angela Woodside (+), Monika Lapinski (0), and Leah Rensel (0).

2015: Two observers throughout: Jessica Taylor (2), Tucker Davidson (0), Secca Roettenbacher (0), and TC Walker (0)

2016: Two observers throughout: Jessica Taylor (3), Tucker Davidson (1), TC Walker (1), Jessica Buskirk (0), and Dwight Jones (0)

2017: Two observers: TC Walker (2), Alma Scrage (0), Maycee Hash (0), Magill Schumm (0), Alyssa Davidge (0)

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

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
White-tailed Kite	Elanus leucurus	WK	A, I, U	U	NA
Sharp-shinned Hawk	Accipiter striatus	SS	AIU	U	NA
Cooper's Hawk	Accipiter cooperii	СН	AIU	U	NA
Northern Goshawk	Accipiter gentilis	NG	AIU	U	NA
Unknown accipiter	Accipiter spp.	UA	U	U	NA
Broad-winged Hawk	Buteo platypterus	BW	AIU	U	DLU
Swanson's Hawk	Buteo swainsoni	SW	U	U	D L U
Red-tailed Hawk	Buteo jamaicensis	RT	AIU	U	DLU
Ferruginous Hawk	Buteo regalis	FH	AIU	U	DLU
Rough-legged Hawk	Buteo lagopus	RL	U	U	DLU
Unknown buteo	Buteo spp.	UB	U	U	DLU
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	AIU	U	NA
Unknown falcon	Falco spp.	UF	U	U	NA
Unknown raptor	Falconiformes	UU	U	U	NA

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 Chelan Ridge, WA.

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.

	1997	1998	1999	2000	2001	2002	2003	2004	2005
Start Date	5-Sep	27-Aug	27-Aug	27-Aug	27-Aug	25-Aug	23-Aug	24-Aug	24-Aug
End Date	11-Oct	21-Oct	27-Oct	5-Nov	22-Oct	25-Oct	26-Oct	23-Oct	25-Oct
Observation days	29	53	61	67	55	62	59	59	62
Observation hours	204.6	382.92	504.33	505.75	439	491.28	509.24	507.5	502.5
Raptors / 100 hours	691.1	620.2	571.2	481.3	470.4	522.1	297.1	286.1	363.4
Species									
Turkey Vulture	4	29	21	26	14	46	30	25	58
Osprey	41	24	47	71	48	57	31	34	25
Northern Harrier	115	152	167	104	91	148	99	59	113
White-tailed Kite	0	0	0	0	0	0	1	0	0
Sharp-shinned Hawk	311	949	932	1,050	878	937	421	468	730
Cooper's Hawk	150	247	232	198	198	234	136	220	228
Northern Goshawk	38	32	50	35	16	22	17	41	13
Unknown accipiter	182	221	248	98	98	144	93	17	63
Total Accipiters	681	1449	1462	1381	1190	1337	667	746	1034
Red-shouldered Hawk	0	0	0	0	0	0	0	0	0
Broad-winged Hawk	2	7	5	5	9	6	ę	7	9
Swainson's Hawk	0	8	17	7	0	7	15	5	2
Red-tailed Hawk	145	182	450	364	263	386	263	277	233
Ferruginous Hawk	0	0	0	1	0	0	0	0	0
Rough-legged Hawk	1	13	44	53	13	45	14	20	22
Unidentified Buteo	75	58	148	97	83	82	39	15	29
Total Buteos	223	268	664	522	365	529	334	319	292
Golden Eagle	105	55	141	174	105	135	142	130	130
Bald Eagle	2	7	7	15	7	8	1	7	4
Unidentified eagle	7	0	7	5	1	0	12	0	2
Total Eagles	114	57	155	194	108	143	155	132	136
American Kestrel	24	107	89	40	84	68	33	48	55
Merlin	17	55	36	26	36	38	21	39	53
Prairie Falcon	2	10	7	5	5	9	19	5	4
Peregrine Falcon	5	7	6	1	б	6	14	7	4
Unknown falcon	10	9	9	2	9	6	8	11	4
Total Falcons	58	180	147	74	137	127	95	110	120
Unidentified Raptor	178	216	218	62	112	178	134	27	48
Grand Total	1,414	2,375	2,881	2,434	2,065	2,565	1,513	1,452	1,826

Appendix C. Annual observation effort and fall raptor migration counts by species at Chelan Ridge, WA: 1997–2016.

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	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Mean
Start Date	24-	24-Aug	24-	23-	23-	23-	23-	23-	24-	11-	25-
Start Dais	Aug	gnu-17	Aug	Aug	Aug	Aug	Aug	Aug	Aug	Sep	Aug
End Date	26-	27-Oct	27-	25-	23-	25-	18-Oct	24-	21-Oct	22-	23-
	Oct		Oct	Oct	Oct	Oct	10001	Oct	11 000	Oct	Oct
Observation days	64	62	64	60	58	58	52	58	54	41	56.9
Observation hours	512	520	557.85	507.74	477.17	484.92	446.22	493.4	448.25	333.8	478.1
Raptors / 100 hours	458.8	413.3	365.2	457.9	446.8	261.9	350.7	219.1	308.8	357.2	364.0
Species											
Turkey Vulture	50	42	48	70	44	31	51	28	55	81	39.6
Osprey	50	31	37	36	36	33	27	20	41	28	37.7
Northern Harrier	127	60	82	127	114	56	68	33	75	73	96.3
White-tailed Kite	0	0	0	0	0	0	0	0	0	0	0.1
Sharp-shinned Hawk	854	880	875	852	841	587	531	350	520	367	701.7
Cooper's Hawk	270	363	269	332	249	130	133	169	190	179	217.2
Northern Goshawk	31	49	48	27	30	25	22	12	21	15	28.6
Unknown accipiter	120	56	60	137	92	43	119	41	64	41	101.9
Total Accipiters	1275	1348	1252	1348	1212	785	805	572	795	602	1049.5
Red-shouldered Hawk	0	0	0	0	0	1	0	0	0	0	0.1
Broad-winged Hawk	4	7	5	9	4	9	4	11	12	16	6.1
Swainson's Hawk	7	4	5	5	5	13	4	5	43	14	8.2
Red-tailed Hawk	441	378	304	341	315	135	204	161	119	139	268.4
Ferruginous Hawk	0	0	0	0	0	0	0	0	0	0	0.1
Rough-legged Hawk	28	22	25	48	37	22	117	28	5	35	31.2
Unidentified Buteo	57	29	10	20	14	40	71	57	22	30	51.4
Total Buteos	532	435	349	420	375	216	400	262	201	234	365.3
Golden Eagle	157	82	111	93	109	45	06	45	67	60	104.0
Bald Eagle	8	10	12	4	10	15	1	11	14	16	7.6
Unidentified eagle	0	0	0	1	0	ε	0	0	0	1	2.1
Total Eagles	165	92	123	98	119	63	91	56	81	77	113.6
American Kestrel	29	47	47	59	47	15	8	17	24	16	45.1
Merlin	34	40	44	45	63	37	24	28	42	34	37.5
Prairie Falcon	6	9	17	14	11	4	9	5	8	7	7.9
Peregrine Falcon	20	16	13	٢	10	8	4	9	10	٢	8.2
Unknown falcon	9	2	3	16	5	1	5	3	7	2	5.9
Total Falcons	98	111	124	141	136	65	47	59	91	66	104.5
Unidentified Raptor	52	30	22	85	96	20	76	51	45	31	88.5
Grand Total	2,349	2,149	2,037	2,325	2,132	1,270	1,565	1,081	1,384	1,192	1895.2
						ç					

Appendix C. Continued

1,27022

Appendix D. Annual tra	pping effort :	and capture	totals by sp	ecies for mig	grating rapt	ors at Chela	n Ridge, W ¹	A: 1999–201	6.	
	1999 ₁	2000_{1}	2001	2002	2003	2004	2005	2006	2007	2008
Start Date	28-Aug	2-Sep	30-Aug	27-Aug	23-Aug	25-Aug	25-Aug	25-Aug	25-Aug	24-Aug
End Date	16-Oct	14-Oct	17-Oct	19-Oct	25-Oct	18-Oct	22-Oct	22-Oct	16-Oct	23-Oct
Blinds in operation	2	2	2	2	2	2	2	7	2	2
Trapping days	47	42	44	54	56	53	56	56	51	09
Station Days	i	ذ	87	104	101	93	107	66	90	105
Station hours	388.0	ċ	644.6	841.3	803.3	8.669	828.2	797.3	717.1	843.5
Captures/100 stn hrs	56.7	ċ	81.4	80.6	73.3	50.3	75.2	102.1	94.0	90.6
Species					Raptor (Captures				
Northern Harrier	4	3	10	13	11	9	12	28	12	18
Sharp-shinned Hawk	139	125	341	459	394	237	389	556	449	503
Cooper's Hawk	42	46	107	127	100	58	137	100	138	140
Northern Goshawk	14	10	12	13	6	16	11	24	16	29
Broad-winged Hawk	0	0	0	0	0	0	0	0	0	0
Red-tailed Hawk	11	8	22	29	20	16	11	50	33	22
Rough-legged Hawk	0	1	1	2	1	0	5	9	1	2
Golden Eagle	0	1	2	0	4	7	7	9	7	5
American Kestrel	ŝ	0	8	10	17	5	9	8	ю	13
Merlin	9	4	17	21	25	10	49	31	15	25
Prairie Falcon	1	1	С	4	4	1	0	ю	4	5
Peregrine Falcon	0	0	2	0	4	1	1	2	1	2
All species	220	199	525	678	589	352	623	814	674	764
Recaptures ²	0	0	0	0	0	0	0	0	1	0
Foreign Recaptures ³	0	0	0	1	0	0	0	2	7	0
¹ Data collected by the Fal-	con Research	Group.								

² Recaptures at Chelan Ridge of birds originally banded at Chelan Ridge.

³ Recaptures at Chelan Ridge of birds originally banded elsewhere (includes birds initially captured at other HWI sites).

Appendix D. Annual traj	pping effort	and capture	totals by sp	ecies for mi	grating rapt	ors at Chela	n Ridge, W	A: 1999–201	.9	
	2009	2010	2011	2012	2013	2014	2015	2016	Mean	Total
Start Date	24-Aug	25-Aug	22-Aug	25-Aug	24-Aug	24-Aug	6-Sep	27-Aug	26-Aug	1
End Date	24-Oct	22-Oct	20-Oct	17-Oct	22-Oct	19-Oct	22-Oct	12-Oct	19-Oct	ł
Blinds in operation	2	2	2	2	7	2	2	2	2	ł
Trapping days	58	54	52	48	56	53	44	40	51	924
Station Days	80	99	64	59	84	63	49	47	81.1	1298
Station hours	632.8	520.7	519.1	478.1	660.7	502.4	370.4	365.6	624.3	10612.7
Captures/100 stn hrs	104.8	120.8	106.0	109.2	68.1	105.5	97.7	92.7	88.8	ļ
Species										
Northern Harrier	24	29	8	8	8	6	17	6	12.7	229
Sharp-shinned Hawk	417	395	373	350	287	386	228	238	348.1	6266
Cooper's Hawk	128	112	96	101	81	70	53	57	94.1	1693
Northern Goshawk	10	15	15	9	11	4	8	ю	12.6	226
Broad-winged Hawk	1	0	0	0	0	0	0	0	0.1	1
Red-tailed Hawk	34	35	26	25	33	29	17	13	24.1	434
Rough-legged Hawk	6	1	1	Э	2	1	8	1	2.5	45
Golden Eagle	5	5	5	4	0	2	1	2	2.7	48
American Kestrel	6	З	4	2	L	С	ю	0	5.8	104
Merlin	21	30	19	20	16	25	24	15	20.7	373
Prairie Falcon	ю	1	0	2	2	1	2	0	2.1	37
Peregrine Falcon	2	3	3	1	3	0	1	1	1.5	27
All species	663	629	550	522	450	530	362	339	526.8	9483
Recaptures ²	0	L	3	0	0	2	1	0	1	14
Foreign Recaptures ³	1	1	0	0	0	0	0	1	0	8
¹ Data collected by the Fal-	con Research	Group.								

² Recaptures at Chelan Ridge of birds originally banded at Chelan Ridge.

³ Recaptures at Chelan Ridge of birds originally banded elsewhere (includes birds initially captured at other HWI sites).