FALL 2011 RAPTOR MIGRATION STUDIES AT CHELAN RIDGE, WASHINGTON

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INTRODUCTION

The Chelan Ridge Raptor Migration Project in north-central Washington is an ongoing effort to monitor long-term trends in populations of raptors using this 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 commencing 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 collaborative efforts have been maintained since. To date, our observers have recorded 19 species of migratory diurnal raptors at the site, with counts ranging between ~1,500–2,900 migrants per season. The 2011 season marked the 14th consecutive, full-season count and the 13th consecutive season of banding at the site. This report summarizes the 2011 results.

The Chelan Ridge project was 1 of 8 long-term, annual migration counts and 1 of 4 migration banding studies conducted or co-sponsored by HWI in North America during 2011. The primary objective of these efforts is to track long-term population trends of diurnal raptors in western North America and around the Texas Gulf Coast region (Hoffman and Smith 2003; Smith et al. 2001, 2008 a, b). 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 coordination with the long-term counting and banding efforts, HWI has and will continue to explore related research activities to further help provide valuable information about migratory behavior of raptors, as well as identify species' ranges, migratory routes and connectivity, and 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). In addition, these migration studies offer unique opportunities for the public to learn about raptors and the natural environment, and providing such opportunities are another important component of the Chelan Ridge Raptor Migration Project.

STUDY SITE

Chelan Ridge is located approximately 21 km north–northwest of the village of Chelan, on the Chelan / Okanogan County border, as well as on the border between the Okanogan and the Wenatchee National Forests (48°01'12.8"N, 120°05'38.4"W; Figure 1). The study 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° 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. And, although the northern view is unobstructed, Black Canyon does have blind spots that are invisible from the lookout where raptors can be 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. Thus, allowing some migrants to pass the lookout undetected but are later 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 they fly nearby.

Two trapping and banding stations are located approximately 1 and 2.25 km southeast of the count site (Figure 1). 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 official or designated observers, relieved or supplemented by other trained staff and volunteers, conducted standardized daily counts of migrating raptors from a single traditional observation site. This was the first season of raptor migration counting at Chelan Ridge for both official observers, Chadette Pfaff and Michael Oliveira, but Chadette had four seasons prior experience as a counter at other HWI sites (see Appendix A for a complete history of observer participation). Multi-purpose crewmember Kathryn Walpole also routinely assisted with the counts, while other crewmembers, USFS staff, and visitors assisted on occasion as well.

Weather permitting, observations usually began at 0800 H and ended between 1600 and 1700 H Pacific Standard Time (PST). 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 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 or 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.
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 updated through 2011 follows Farmer et al. (2007). In comparing 2011 annual statistics against means and 95% confidence intervals for previous seasons, we equate significance with a 2011 value falling outside the bounds of the confidence interval for the associated mean.

TRAPPING AND BANDING

The trappers operated the two traditional 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, all captured birds were fitted with a uniquely numbered USGS Biological Resources Division aluminum leg band. Data gathering and recording followed standardized protocols used at all HWI migration-banding sites (Hoffman et al. 2002). All birds were released within 45 minutes, usually quicker.

RESULTS AND DISCUSSION

WEATHER

Inclement weather forced the site to close on 25 October. (See Appendix C for daily weather records, as well as Appendix E for comparisons of annual start and end dates.) Six additional days were also precluded, and two days were shortend (reduced observation time to ≤ 4 hours) due to weather (Appendix C). For comparison, weather, on an average seasonal basis (i.e., 1997-2010) has demonstrated to preclude 4.5, and severely hamper 1.8 days of observations in a given season.

During active observation periods, skies were recorded as predominantly fair 66% of the times, 18% as transitional (i.e., changed from fair or partly cloudy to mostly cloudy or overcast during the day, or vice versa), and 16% as mostly cloudy to overcast. In comparison, the averages for the site are 47% fair, 31% transitional, and 22% as mostly cloudy or overcast, suggesting that the predominant skies in 2011 were mostly fair with some transition and overcast. Similarily, the season's visibility was also ranked very high; visibility looking towards both the east and west were ranked at 93% (vs. on average of 61% and 58% looking east and west, respectively). Fog and/or haze affected the season's visibility on 16% of active observational days (vs. on average of 40%), and the proportion of days affected by rain and/or snow was 4 % (vs. 14% average). Although the season's daily average temperature was no different from the long-term average (i.e., 12.6 ^{o}C vs. 12.3 ^{o}C, respectively), observers rated a good to excellent thermal lift very high, occurring on 61% of the active days, which is considerably above the long term average of 43%. Thermal lift is often favorable for raptors to gain altitude and conserve energy during migration. Thus, thermal lift conditions were favorable for raptors to gain extremely high altitudes, and without background sky conditions (e.g., clouds) to help detect those high birds, raptors could have gone undetected but that is unknown without some way to check for observer bias (e.g., radar).

Similar to previous years, the season's wind conditions were again primarily light (< 12 kph), occurring on 57 % of the active observation days (vs. 69%, on average). Moderate (12-29 kph) and high winds (≥ 29 kph), however, both exceeded average, occurring on 41% and 5% of the active observation days, vs. 30%, and 2% on average, respectively. Wind direction, on average, often blow out of the S-SW (48.0%), S-W for a major part of the day then switching to N-E for another major part of the day (10.4%), and SE-SW (8.7%) as primary patterns. This past season, winds blew from the S-W (47% vs. 1.9% on average), S-SW (33%), and S-W for a major part of the day then switching to N-E for another major part of the day (12%) as the primary directions. Winds were also recorded from the N-E (3%); SE-SW (2%); S-W, calm and variable (2%); and SW-NW, calm and variable (2%). Thus, although still relatively comparable with previous wind speed and direction, winds were a little less light, more moderate, and slightly stronger, and blew considerably more from the S-W direction.

In summary, the considerable increase in thermal lift, coupled with fewer cloudy days to help detect birds could have caused raptors to be missed. In addition, the season's prevalent S-W winds vs. the normal S-SW conditions could have caused raptors to behave differently and follow a different flight line, also escaping detection. Thus, with new inexperienced crewmembers to the site, coupled with thermal lift that

had the potential to cause raptors to escape, the count could have been underestimated. However, with the seemingly minor S-W wind switch from a primarily S-SW direction, birds could have behaved differently and chosen a different pathway. But these scenarios are unknown without a more thorough analysis of weather, as well as how weather influences detection probability.

OBSERVATION EFFORT

During this past season, observers were able to count on 58 of 65 possible days between 23 August and 26 October, which is slightly below the 1998-2010 long term average (60.2 ± 95% CI of 2.0 days, Appendix E). The number of observation hours (484.92) was also below average (494.1 ± 23.35 hrs). However, the 2011 average of 2.4 observers per hour (including official and guest observers; value is mean of daily values, which are in turn means of hourly values) was slightly higher than the long-term average (2.01 ± 0.06 observers/hour).

FLIGHT SUMMARY AND TRENDS

Observers counted 1,270 migrating raptors of 17 species during the 2011 season (Table 1; see Appendix D for daily count records), which is a 40% decrease from the long term average (Table 1; see Appendix E for annual count summaries). The highlight of the season was that of an immature Red-shouldered Hawk seen on 14 September, which is a first for this species at the site (Appendix E). In addition, a tied record count of 15 Bald Eagles was also recorded (Appendix E). The counts of two other uncommon species (Broad-winged and Swainson's Hawks) were also recorded above average (Table 1, Appendix E). However, counts of all the other species were below average (Table 1), and even more dismally, observers recorded record low counts for Cooper's Hawks, Red-tailed Hawks, Golden Eagles, and American Kestrels (Appendix E).

The flight consisted of 62% accipiters, 17% buteos, 5% falcons, 5% eagles, 4% harriers, 3% Ospreys, 2% vultures, and 2% unknown raptors (Table 1). The proportions of accipiters, vultures, and Ospreys were above average; whereas, the proportions of buteos, falcons, eagles, and harriers were below average (Figure 2). With 46% of the total count, the Sharp-shinned Hawk, as per usual was the most common species observed, followed by the Red-tailed Hawk (11%), Cooper's Hawk (10%), Northern Harriers (4%) Golden Eagles (4%), and Ospreys and Merlins (at 3% each). Otherwise, all of the other species each comprised of only 2% or less of the total count.

Population Trends.—Regression analyses of the adjusted passage rates through 2011 continue to reveal a significant ($P \leq 0.10$) quadratic downward decline for adult Golden Eagles (Figure 6). Northern Harriers (Fig. 3), Broad-winged Hawks (Fig. 5), and American Kestrels (Fig. 7) also continue to reveal trends of decline. With Northern Harriers, however, the significant decline is marginal ($p = 0.079$), with little information explained by the model ($r^2 = 0.235$). Thus, inferring significance should be done with caution due to the likelihood of a Type I error. The Broad-winged Hawk is a relatively uncommon species at this site (Appendix E) and throughout the West, so inferencing a population level decline from this site at this time is rather non-sequitur, since most of the population breeds and migrates through the eastern half of North America. Golden Eagles have (Farmer et al. 2008) and continue to demonstrate declines but data from Chelan Ridge (Fig. 6) and Bonney Butte (another HWI site in Oregon) are both indicating declines from the adult age classes. Thus, demonstrating the potential importance to be able to contrast whether adults, non-adults, or both age groups are declining to understand what age-specific group may be most affected. Likewise, widespread North American Kestrel populations have also shown alarming rates of deline (Farmer et al. 2008, Farmer and Smith 2009), and although much discussion has ensued (Journal of Raptor Research 2009, Vol. 43, No. 4), an exact causal effect has yet to be pinpointed.

Age Ratios

Although it can be difficult to correctly identify immature vs. adult migrating raptors in many species (Table 2), as indicated above it is still important to distinguish as best as possible to determine if a certain age class of a given species is in decline over time (adults vs. juveniles), as this information may help

focus further research attention. However, from a year-to-year basis, using this data to extract annual reproductive effort can be misleading because of large year-to-year variation of unknown aged birds, as well as not understanding how weather effects migration and observer detectability at a particular site and the error surrounding those estimates. Regardless, immature : adult ratios from this past season were below average for most species where ages could be separated: Sharp-shinned Hawks, Cooper's Hawks, Northern Goshawks, Broad-winged Hawks, Red-tailed Hawks, and Peregrine Falcons; but were above average for Northern Harriers, Golden and Bald Eagles (Table 2). Red-tailed Hawks and Bald Eagles are typically the two species where more adults are counted than juveniles; whereas, with most of the other raptor species, immatures are seen in greater numbers. In 2011, two species deviated from this norm; the Broad-winged Hawk and Peregrine Falcon. With Broad-wings, low numbers are counted but usually equal proportions of immatures to adults migrate through. This past season, observers counted six total Broad-winged Hawks and only three could be identified; two adults and one immature (Table 2). Thus, any inferences drawn from these data concerning changes in population structure of sex ratios or age-related migration behavior are equivocal. With Peregrine Falcons, immature migrants typically outnumber adults, but this past season showed an equal proportion of immature to adults migrating through based on those identified. Again, low sample sizes and a quarter of the birds unidentified limit the relevance of this particular result.

Seasonal Timing

The combined-species median passage date of 25 September was a day earlier compared to last year but was still three days after the long-term average (Table 3). Looking at long-term averages, migration volume usually peaks around mid to late September, then dips slightly during the five-day period between 16 through 20 September, peaks again near the end of September, then declines steadily through 06 October when migration remains relatively stable for ten days. It finally drops off rapidly after 15 October ending out the season (Fig. 8). This past season showed an initial rapid increase up to the normal mid-September peak, then dropped significantly during the next five-day period but increased steadily for a second peak at the end of September. In October, a huge five-day break was observed only to be followed by a third major migration push lasting only during the second five-day period of the month, which then steadily declined after mid October to end out the season (Fig. 8).

Most species-specific median-level passage dates shifted anywhere from 1 to 11 days later, while three species (e.g., Swainson's Hawks, Rough-legged Hawks, and Merlins) moved three to seven days early compared to previous averages (Table 3). Passage dates for Turkey Vultures, Northern Goshawks, and Golden Eagles stayed consistent, reflecting no particular shift (Table 3). The age-specific median dates generally followed the same pattern except that immature Sharp-shinned, Cooper's and Red-tailed Hawks moved up by one to three (Table 4). Interestingly, median passage dates for both immature and adult Golden Eagles happened six and twelve days later than usual, respectively (Table 4). This contrasts the overall timing of Golden Eagles not shifting away from the norm (see above and Table 3) but the discrepancy does not factor in the percentage of Golden Eagles that were impossible to age (Table 2).

RESIDENT RAPTORS

Two pairs of resident Red-tailed Hawks (1 pair adult light morphs & 1 pair with a light and dark morph) were present from the beginning of observations to closing (23 August – 25 October). At least one immature light morph was seen throughout the season as well. A male American Kestrel was seen on twelve separate days between 23 August and 22 September. On 27 and 29 August, a female was also seen, and on 08 September a total of two males were observed. A resident Merlin of unknown age and gender was seen on 30 August, 24 September, and 12 October, and on 18 September two Merlins were observed and classified as resident. Local Peregrine's also frequented the site as an immature was observed on six separate occasions during the period between 23 August and 23 September. On 26 August, an adult was observed, and two unknown aged local Peregrines were counted on 04 September.

Although uncommon, a single Prairie Falcon of unknown age and an immature bird was seen on 26 and 29 August, as well as 14 September, respectively.

At least one resident immature Sharp-shinned Hawk was seen regularly on at least fourteen days between 24 August and 16 September, and on at least eight days, another immature was observed as well. During three days in August, as well as on 09 October, an adult was also observed. An immature Cooper's Hawk was observed on six separate days between 26 August and 14 September, and on the same last day, an adult female was also observed and classified as resident. A resident immature Northern Goshawk was passed the site on 30 August, as well as on 02 and 11 September.

On 29 August, three Golden Eagles were observed (2 adults & 1 immature). Thereafter, two immatures were recorded on 04 September and single immatures on 16 and 23 September. In addition, single adult Golden Eagles were observed again on 09 and 29 September, as well as on 09 October. Single Golden Eagles of unknown age were also seen on 24 and 25 September. On two separate days (04 and 06 September), a single immature Bald Eagle was recorded and classified as resident.

Lastly, on 24 August a single Turkey Vulture was observed, but on 14 September, the crew counted ten of the species as resident birds. Also, an immature Northern Harrier was seen on 27 August, as well as a brown specimen of the same species on 13 October. Often, resident birds displaying territorial behavior can be seen flying in non-migratory northerly directions, as well as hunting and/or kiting in the same area for multiple days throughout the season, thus distinguishing themselves from migrants.

TRAPPING EFFORT

Trapping occurred on 52 of 60 days between 22 August and 20 October, with effort totaling 496.08 station hours (Appendix G, as well as Appendix F for daily trapping results). For the last few years, the number of trapping days has remained near the long term average, but the reduction of crew sizes have significantly shortened the number of station hours (Appendix G).

TRAPPING AND BANDING RESULTS

A total of 550 raptors of ten species were captured and newly banded (Table 5, Appendix G). The species captured most frequently were the Sharp-shinned Hawk (67.8% of captures), Cooper's Hawk (17.5%), Red-tailed Hawk (4.7%), Merlin (3.5%), and Northern Goshawk (2.7%); all other species each comprised <2% of the total. Although this past season's capture totals were well below average, both the capture rate and success were well above average (Table5), concluding that trapper efficiency and overall success is still being maintained and that the lower numbers reflect also the lower numbers counted this past season (Appendix E). However, the capture success of a few species did go down (e.g., Northern Harriers, Rough-legged Hawks, and Merlins), but those results could be linked to birds being less interested in additional feeding opportunities through lure birds, as well as trapping inexperience with those particular species.

Through counts, it is not only difficult sometimes to separate age classes (Table 2), but with many species it is even more difficult to separate gender. One of the purposes of banding is being able to better differentiate those age and gender classes, although for many species (e.g., buteos) differentiating gender is still difficult and genetic samples are essential to do so. With accipiters, however, both gender and ages can accurately be determined and many banding sites capture enough birds to compare age and gender related ratios to see how they differ annually, as well as to monitor for the possibility of major changes over time. For both Sharp-shinned and Cooper's Hawks the number of females and immatures captured typically outnumber the number of males and adults, respectively (Table 6). This past season, in contrast, a greater number of male Sharp-shinned Hawks were captured; otherwise, the ratio patterns stayed consistent (Table 6). As per usual, few Northern Goshawks were captured and all were immature. The numbers of males that are captured typically outnumber females, and this past season was no exception (Table 6). Again, tracking deviations in annual sex and age ratios, and especially monitoring long term through banding helps better track changes in reproductive effort (e.g., major changes in sex ratios, or the

lack of young being produced) or migratory behavior (e.g., major changes in adult gender being captured or observed).

Often banders assess measures of body condition by ranking the fullness of the crop, tactile assessment of keel muscle, and visual assessment of fat in the wing-pit. Again, with accipiters being the bread-and-butter of the raptor species captured at many migration monitoring sites, they can be used to assess annual variations of these body condition indices, as well as monitor to assess if these indices are drastically changing over the long term, especially in association with poorer health. This past season, Cooper's Hawks showed clear indications of lower relative condition with a large proportion of birds having poor keel muscle mass and little to no fat (Table 7). Similarily, a high proportion of Northern Goshawks captured appeared also to be skinny with no fat. Indices of crop fullness and size indicated that individuals from these two species are capturing food and are maybe in good health, but a higher than normal proportion of birds captured this past season appeared to be food deprived (Table 7). Sharp-shinned Hawks, in relative contrast, appeared to be foraging with better success and maintaining better body condition (Table 7).

ENCOUNTERS WITH PREVIOUSLY BANDED BIRDS

Throughout this past year, we received notification of nine recoveries: 1 Merlin, 1 Cooper's Hawk, 1 Golden Eagle, 5 Sharp-shinned Hawks, and 1 Peregrine Falcon (Table 8). Four birds (the Merlin, Cooper's Hawk and two adult female Sharp-shinns) were found dead of unknown causes (Table 8). These types of encounters are often the norm. Two birds (both Sharp-shinned Hawks) were found after collisions (Table 8). The adult female was reported to have been injured due to striking hog wire. Fortunately, she was able to return back to the wild. An immature male however, wasn't so lucky as it collided with a different kind of stationary object causing mortality. Reporting on another injury, a young female Peregrine Falcon that was banded this past field season was recovered with a broken right wing near Point Mugu Naval Base in California, just over a month after it was banded. That bird is still in rehab at this time and the folks down there indicated that they will let us know the status of the bird and if a release is eminent or even possible. Another bird that was banded this past season, an immature female Sharp-shinned Hawk, was encountered just over a month and half later only 62 miles away. It was reportedly shot! Although raptors are protected by federal and state laws, unfortunately they are still unlawfully shot in some instances. The last bird to report among previously banded indiviuals was a hatch-year male Golden Eagle that was banded in October 2010 at Chelan Ridge, and encountered during the winter months near Malad City, Idaho. Communication was made to the person who reported the encounter. The bird was found dead in an open field next to a dead deer carcass with a very sharp (skinny) keel and full crop. No necropsy was performed as the bird was left in the field, but messy feathers near the cloaca likely caused by diarrhea-like symptoms were reported. We concluded possible starvation but it is unknown if contaminants were also involved.

No "foreign recaptures" were encountered during the season but the crew did recapture three birds previously banded birds that returned to the site; two females and one male Sharp-shinned Hawk. The two females were both adults, one was originally banded on 30 September 2011 and recaptured again on 21 October. The other bird caused a bit of confusion as the band number was recorded in the database as missing. Going back to the original data sheets we deduced that the bird was originally banded on 21 September, 2009. It was recaptured again this past season on 21 October. The male (hatch-year) that returned was originally banded on 26 August 2011, and was recaptured again on 01 September, six days later. These records are important to learn about local landscape use by raptor, migratory stop-over potential, or repeat usage of migratory pathways, in addition to information on longevity and survivorship.

VISITOR PARTICIPATION AND PUBLIC OUTREACH

In 2011, a total of 114 individuals visited the site during the season outside of any organized event. In addition, the largest single visitation day happened on 17 September as part of the Chelan Ridge Hawk

Migration Festival. Multiple local groups and individuals from various western states interested in hawks came to Chelan Ridge on that day to engage in education activities of on-site raptor migration. Activities included an opportunity to see raptors up close and in hand prior to their release back into the wild after being banded. The festival was sponsored by Methow Valley Ranger District of the US Forest Service, North Central Washington Audubon Society, and HawkWatch International. Most visitors came from the surrounding Washington communities, but others came from Idaho, New York, British Columbia, Canada, and even Jamaica.

Primary observers assess the disturbance level of visitors every hour. In 2011, 481 hourly assessments of visitor disturbance resulted in the following disturbance ratings: 97.2% of the time the observers ranked their efforts as not being disturbed at all, 2.6% the crew had to deal with low, and 0.2% as moderate disturbance. Thus, with various levels of visitation, anywhere from individuals to bigger groups, visitor disturbance this past season was relatively negligible.

ACKNOWLEDGEMENTS

Christopher D. Street was a key crewmember in 2007 and 2008, and a true friend of the project. Chris, like many others, has been tremendously inspired by this project, but unfortunately due to an unsuccessful battle with cancer, Chris passed away on 12 November 2009. The Chris Street Memorial Fund was established at HWI to support the Chelan Ridge Raptor Migration Project. For details, see http://www.hawkwatch.org for details.

Other financial and logistical support for this project in 2011 was provided by Okanogan and Wenatchee National Forests (Methow Vallley Ranger District), Washington Department of Fish and Wildlife, The Fledgling Fund, The Icicle Fund, Kittitas Audubon Society, North Central Washington Audubun Society, and HWI private donors and members. As usual, numerous individuals were essential in helping us achieve successful promotion and implementation of this season's effort and we heartily thank them for their assistance. Richard Hendrick, who has been with us since we started in 1997, has done everything from lending support to the counting and banding efforts, to clearing trails and often brings fresh garden produce and honey to the site for which we, and field crews, are especially grateful. Thanks also to Brad Martin and his wife Norma for their continuous supply of lure birds through the years. Long time biologist Jim Watson of the Washington Department of Fish and Wildlife has also encouraged and helped us in various ways with our research and monitorinig efforts. That support and encouragement doesn't go unnoticed, so thanks! Likewise, similar support and encouragement is often performend by Forest Service staff, so a tremoundous thanks goes to Kathy Corrigan, John Rohrer, and District Ranger, Mike Liu, especially for their support for Kent and all his wonderful support of the project!

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Table 1. Fall counts and adjusted passage rates (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) by species for migrating raptors at Chelan Ridge, WA: 1998–2010 versus 2011.

	COUNTS			RAPTORS/100 HOURS		
SPECIES	1998–2010[1]	2011	% Change	1998–2010[1]	2011	% Change
Turkey Vulture	36 ± 18.0	31	-14	7.8 ± 1.66	6.4	-18
Osprey	41 ± 12.9	33	-19	8.2 ± 1.45	6.8	-17
Northern Harrier	109 ± 34.3	56	-49	22.4 ± 4.62	11.5	-48
White-tailed Kite	0.1 ± 0.3	0	-100	–	–	
Sharp-shinned Hawk	784 ± 232.0	587	-25	168.2 ± 24.09	121.1	-28
Cooper's Hawk	238 ± 61.1	130	-45	49.7 ± 6.45	26.8	-46
Northern Goshawk	32 ± 12.3	25	-22	6.4 ± 1.33	5.2	-19
Unknown small accipiter[2]	35 ± 36.4	16	-55	–	–	
Unknown large accipiter[2]	7 ± 6.5	5	-23	–	–	
Unknown accipiter	75 ± 83.8	22	-70	–	–	
TOTAL ACCIPITERS	1170 ± 278.6	785	-33	–	–	
Red-shouldered Hawk	0 ± 0.0	1	-	0.0 ± 0.00	0.2	-
Broad-winged Hawk	5 ± 2.1	6	+27	1.0 ± 0.25	1.2	+21
Swainson's Hawk	6 ± 5.0	13	+136	1.2 ± 0.55	2.7	+122
Red-tailed Hawk	310 ± 90.4	135	-56	65.0 ± 7.56	27.8	-57
Ferruginous Hawk	0 ± 0.3	0	-100	0.0 ± 0.03	0.0	-100
Rough-legged Hawk	28 ± 15.6	22	-20	5.9 ± 1.50	4.5	-23
Unidentified buteo	54 ± 39.7	40	-26	–	–	
TOTAL BUTEOS	402 ± 122.8	217	-46	–	–	
Golden Eagle	119 ± 31.2	45	-62	24.2 ± 3.11	9.3	-62
Bald Eagle	6 ± 4.4	15	+141	1.3 ± 0.46	3.1	+139
Unidentified eagle	3 ± 3.8	3	+20	–	–	
TOTAL EAGLES	128 ± 34.4	63	-51	–	–	
American Kestrel	56 ± 24.0	15	-73	12.2 ± 3.37	3.1	-75
Merlin	39 ± 12.7	37	-5	8.4 ± 1.56	7.6	-9
Prairie Falcon	9 ± 5.1	4	-53	1.8 ± 0.51	0.8	-55
Peregrine Falcon	9 ± 5.6	8	-7	1.7 ± 0.58	1.6	-5
Unknown small falcon[2]	3 ± 2.8	0	-100	–	–	
Unknown large falcon[2]	1 ± 1.5	0	-100	–	–	
Unknown falcon	3 ± 3.0	1	-60	–	–	
TOTAL FALCONS	118 ± 31.1	65	-45	–	–	
Unidentified raptor	104 ± 70.0	20	-81	–	–	
GRAND TOTAL	2108 ± 433.7	1270	-40	–	–	

[1] Mean ± 95% confidence interval.

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

Table 2. Fall counts by age class and immature : adult ratios for selected species of migrating raptors at Chelan Ridge, WA: 1998–2010 versus 2011.

	Total and Age-classified Counts						% Unknown Age		Immature : Adult Ratio	
	1998–2010 Average			2011						
	Total	Imm.	Adult	Total	Imm.	Adult	1998–2010[1]	2011	1998–2010[1]	2011
Northern Harrier	109	38	25	56	12	20	43 ± 6.3	43	1.7 ± 0.43	2.7
Sharp-shinned Hawk	821	419	136	587	299	106	33 ± 4.5	31	3.2 ± 0.81	2.8
Cooper's Hawk	244	114	37	130	58	28	40 ± 4.8	34	4.0 ± 1.57	2.1
Northern Goshawk	32	17	4	25	13	7	33 ± 7.2	20	4.9 ± 2.73	1.9
Broad-winged Hawk	5	2	1	6	1	2	38 ± 12.4	50	1.0 ± 0.59	0.5
Red-tailed Hawk	323	71	131	135	29	68	40 ± 4.0	28	0.5 ± 0.13	0.4
Golden Eagle	120	59	25	45	28	10	31 ± 4.4	16	2.4 ± 0.42	2.8
Bald Eagle	7	2	4	15	6	7	9 ± 9.1	13	0.5 ± 0.31	0.9
Peregrine Falcon	9	3	2	8	3	3	38 ± 13.4	25	1.3 ± 0.85	1.0

[1] Mean ± 95% confidence interval. For age ratios, note that long-term mean immature : adult ratios are averages of annual ratios and may differ from values obtained by dividing average numbers of immatures and adults. Discrepancies in the two values reflect high annual variability in the observed age ratio.

Table 3. First and last observed, bulk-passage, and median-passage dates by species for migrating raptors at Chelan Ridge, WA in 2011, with a comparison of 2011 and 1998–2010 average median passage dates.

	2011				1998–2010
Species	First Observed	Last Observed	Bulk Passage Dates[1]	Median Passage Date[2]	Median Passage Date[2, 3]
Turkey Vulture	24-Aug	2-Oct	6-Sep – 30-Sep	15-Sep	15-Sep ± 3.1
Osprey	24-Aug	21-Oct	10-Sep – 16-Oct	21-Sep	19-Sep ± 2.8
Northern Harrier	28-Aug	22-Oct	3-Sep – 11-Oct	25-Sep	22-Sep ± 2.4
Sharp-shinned Hawk	24-Aug	25-Oct	5-Sep – 9-Oct	22-Sep	21-Sep ± 2.0
Cooper's Hawk	23-Aug	16-Oct	30-Aug – 7-Oct	20-Sep	18-Sep ± 1.9
Northern Goshawk	31-Aug	16-Oct	2-Sep – 13-Oct	1-Oct	1-Oct ± 5.7
Broad-winged Hawk	3-Sep	21-Sep	3-Sep – 21-Sep	20-Sep	14-Sep ± 3.2
Swainson's Hawk	4-Sep	28-Sep	13-Sep – 28-Sep	15-Sep	18-Sep ± 6.7
Red-tailed Hawk	24-Aug	23-Oct	10-Sep – 15-Oct	7-Oct	26-Sep ± 2.8
Rough-legged Hawk	29-Sep	22-Oct	13-Oct – 22-Oct	10-Oct	15-Oct ± 2.6
Golden Eagle	27-Aug	25-Oct	9-Sep – 18-Oct	10-Oct	10-Oct ± 1.9
Bald Eagle	24-Sep	25-Oct	29-Sep – 20-Oct	14-Oct	10-Oct ± 3.7
American Kestrel	28-Aug	9-Oct	30-Aug – 6-Oct	21-Sep	12-Sep ± 3.7
Merlin	30-Aug	20-Oct	3-Sep – 6-Oct	15-Sep	22-Sep ± 3.0
Prairie Falcon	26-Aug	20-Sep	–		18-Sep ± 6.5
Peregrine Falcon	23-Aug	9-Oct	–	22-Sep	17-Sep ± 5.2
Total	27-Aug	25-Oct	5-Sep – 13-Oct	25-Sep	22-Sep ± 1.9

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

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

[3] Mean of annual values ± 95% confidence interval in days; unless otherwise indicated, values are given only for species with annual counts ≥5 birds for ≥3 years.

Table 4. Median passage dates by age for selected species of migrating raptors at Chelan Ridge, WA: 1998–2010 versus 2011.

	ADULT		IMMATURE	
SPECIES	1998–2010[1]	2011	1998–2010[1]	2011
Northern Harrier	21-Sep ± 3.1	30-Sep	22-Sep ± 2.6	30-Sep
Sharp-shinned Hawk	02-Oct ± 1.5	07-Oct	15-Sep ± 1.8	14-Sep
Cooper's Hawk	26-Sep ± 2.1	30-Sep	13-Sep ± 1.6	12-Sep
Northern Goshawk	01-Oct ± 9.3	–	29-Sep ± 5.3	01-Oct
Red-tailed Hawk	30-Sep ± 2.2	07-Oct	18-Sep ± 3.3	15-Sep
Golden Eagle	05-Oct ± 3.9	17-Oct	04-Oct ± 2.0	10-Oct

Note: Median passage dates are dates by which 50% of species/age-specific flights had passed; values are based only on annual counts ≥5 birds.

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

Table 5. Fall capture totals, rates, and successes by species for migrating raptors at Chelan Ridge, WA: 2001–2010 versus 2011.

	Capture Totals		Capture Rate[1]		Capture Success[2]	
	2001–2010[3]	2011	2001–2010[3]	2011	2001–2010[3]	2011
Northern Harrier	16 ± 5.0	8	2.3 ± 0.91	1.6	16.5 ± 3.7	14.3
Sharp-shinned Hawk	415 ± 54.3	373	57.4 ± 7.61	75.2	51.5 ± 7.9	60.5
Cooper's Hawk	115 ± 15.6	96	16.0 ± 2.51	19.4	42.8 ± 6.6	68.1
Northern Goshawk	16 ± 4.0	15	2.1 ± 0.49	3.0	54.2 ± 11.5	55.6
Broad-winged Hawk	0 ± 0.2	0	0.0 ± 0.03	0.0	1.7 ± 3.3	0.0
Red-tailed Hawk	27 ± 7.0	26	3.9 ± 1.12	5.2	7.5 ± 1.3	15.7
Rough-legged Hawk	2.8 ± 1.8	1	0.4 ± 0.27	0.2	8.9 ± 4.7	3.7
Golden Eagle	3 ± 1.2	5	0.5 ± 0.19	1.0	2.8 ± 1.0	10.6
American Kestrel	8.2 ± 2.72	4	1.1 ± 0.32	0.8	16.9 ± 7.8	26.7
Merlin	24 ± 6.7	19	3.4 ± 0.91	3.8	58.9 ± 17.0	50.0
Prairie Falcon	3 ± 1.0	0	0.4 ± 0.12	0.0	29.5 ± 13.5	0.0
Peregrine Falcon	1.8 ± 0.7	3	0.3 ± 0.11	0.6	20.5 ± 11.6	37.5
All species	632 ± 79.3	550	87.6 ± 12.24	110.9	33.8 ± 3.6	46.4

[1] Captures / 100 station hours.

[2] Number of birds captured / number of birds observed. The combined-species value was calculated excluding Ospreys, Turkey Vultures, and unknown raptors from the count totals. Species-specific values were calculated after birds identified only to genus were allocated across possible species in proportion to the relative abundance of birds identified to those species.

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

Table 6. Fall capture totals by sex and age (HY = hatching year; AHY = after hatching year), female : male capture ratios, and immature : adult capture ratios for selected species of migrating raptors at Chelan Ridge, WA: 2001–2010 versus 2011.

		Female		Male			
Species	Years	HY	AHY	HY	AHY	Female : Male Ratio[1]	Imm. : Adult Ratio[1]
Sharp-shinned Hawk	Avg. 2001–2010	168	61	153	34	1.3 ± 0.08	3.5 ± 0.39
	2011	121	60	165	27	0.9	3.3
Cooper's Hawk	Avg. 2001–2010	45	24	35	10	1.6 ± 0.13	2.4 ± 0.32
	2011	39	19	25	13	1.5	2.0
Northern Goshawk	Avg. 2001–2010	4	1	10	1	0.5 ± 0.08	9.7 ± 4.38
	2011	7	0	8	0	0.3	0.0

[1] Long-term values: mean ± 95% CI.

Table 7. Fall body condition indices for migrant accipiters captured at Chelan Ridge, WA: 2001–2010 versus 2011.

		Crop Fullness					Keel Muscle[1]			Wing-pit Fat[2]			
Species	Years	E	1/4	1/2	3/4	F	0	1	2	0	1	2	3
Sharp-shinned	2001–2010mean	61.9	14.5	10.8	4.9	7.9	20	62	18	22	58	17	3
Hawk	2011	62	11	9	0	18	35	60	6	29	49	18	5
Cooper's	2001–2010mean	73.0	10.1	8.3	3.6	5.0	36	56	7	27	51	18	4
Hawk	2011	79	4	4	1	11	79	20	1	45	33	17	5
Northern	2001–2010mean	86.3	3.6	4.0	2.0	4.2	23	71	6	26	60	12	2
Goshawk	2011	87	7	7	0	0	40	53	7	33	47	13	7

[1] Subjective rating based on visual and tactile assessment of keel muscle mass, with 0 indicating a skinny bird, 1 indicating a moderately healthy bird, and 2 indicating a bird with a robust keel muscle.

[2] Subjective rating based on visual assessment of fat deposit in the "wing-pit" hollow directly under the wing, with 0 indicating no fat, 1 indicating a modest fat deposit, 2 indicating a deposit that mostly fills the wing-pit, and 3 indicating a bulging deposit.

Table 8. Foreign encounters of raptors banded at the Chelan Ridge Raptor Migration Project from records obtained in 2011.

BAND #	SPECIES[1]	SEX	BANDING DATE	BANDING AGE[2]	ENCOUNTER LOCATION	ENCOUNTER DATE	ENCOUNTER AGE[2]	DISTANCE (KM)	STATUS
1623 – 24125	ML	F	13-Sep-10	HY	Phelan, CA	01-Jan-11	HY	1266	Found dead – unknown cause
2206 – 66461	CH	F	28-Sep-08	ASY	Lovelock, NV	25-Jan-11	ATY	734	Found dead – unknown cause
0679 – 03461	GE	M	05-Oct-10	HY	Malad City, ID	25-Jan-11	HY	1038	Found dead – possible starvation
1623 – 21075	SS	F	27-Sep-06	HY	Montague, CA	17-Feb-11	ATY	633	Injured due to striking hog wire – released
1623 – 24159	SS	F	16-Sep-10	HY	Escondido, CA	21-Mar-11	SY	1396	Found dead – unknown cause
1623 – 21087	SS	F	01-Oct-06	AHY	Levermore, CA	20-Apr-11	ATY	963	Found dead – unknown cause
1232 – 35996	SS	M	24-Sep-11	HY	Wellington, NV	10-Nov-11	HY	846	Found dead – collision of unknown object, not wire
1613 – 04942	SS	F	09-Oct-11	HY	Wenache, WA	24-Nov-11	HY	62	Found dead – shot
1807 – 93852	PG	F	21-Sep-11	HY	Point Mugu Naval Base, CA	26-Oct-11	HY	1268	Found injured with broken Rt. wing – in rehab

[1] ML = Merlin; CH = Cooper's Hawk; GE = Golden Eagle; SS = Sharp-shinned Hawk; PG = Peregrine Falcon.

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

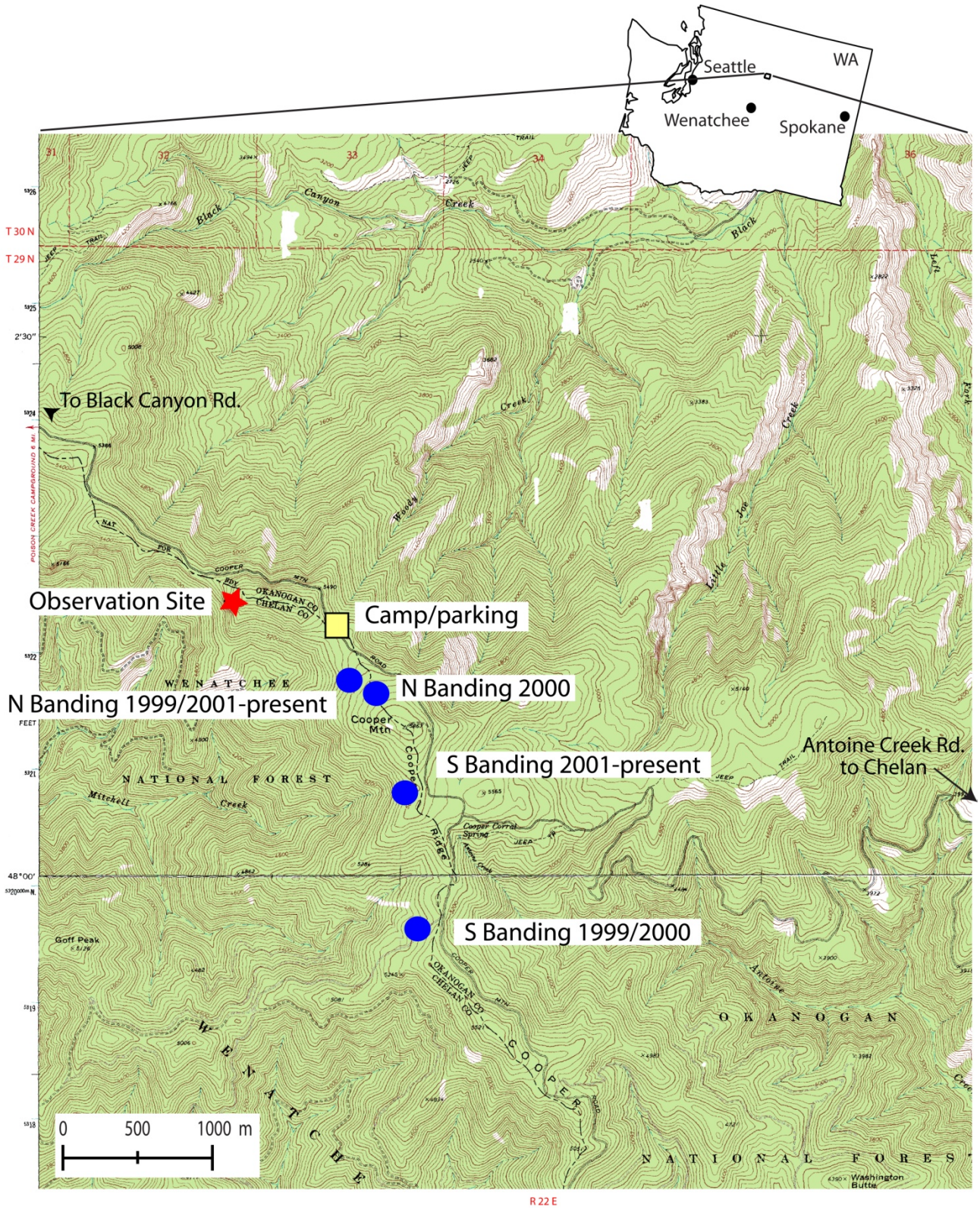

Figure 1. Location of the Chelan Ridge Raptor Migration Project count and banding sites in north-central Washington.

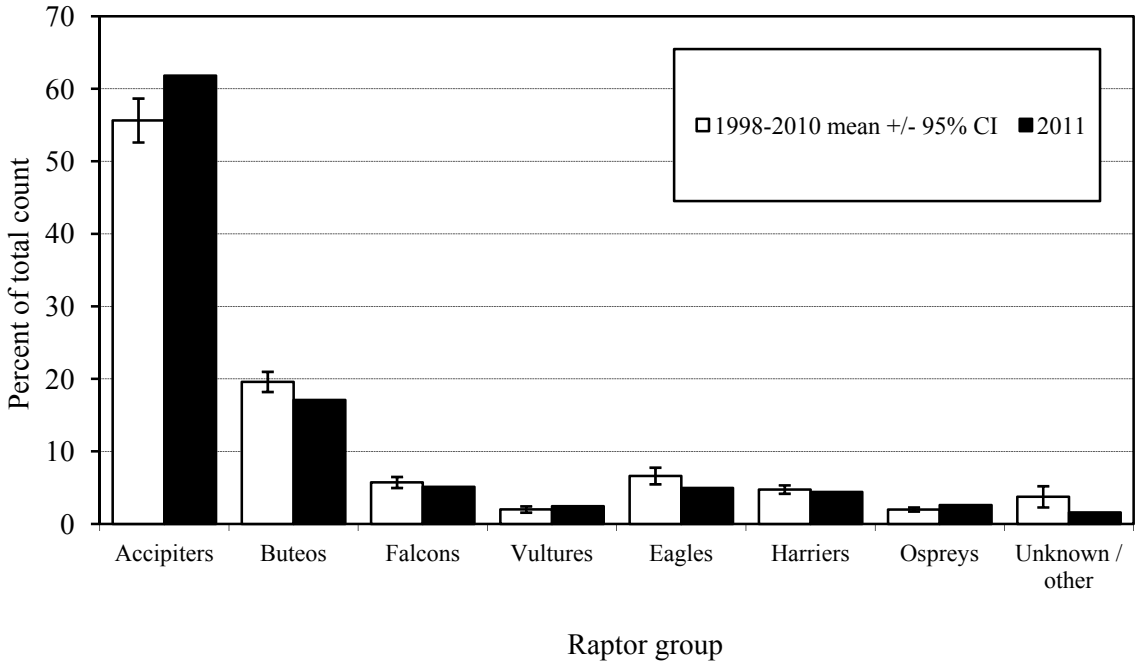

Figure 2. Fall raptor migration flight composition by major species groups at Chelan Ridge, WA: 1998–2010 versus 2011.

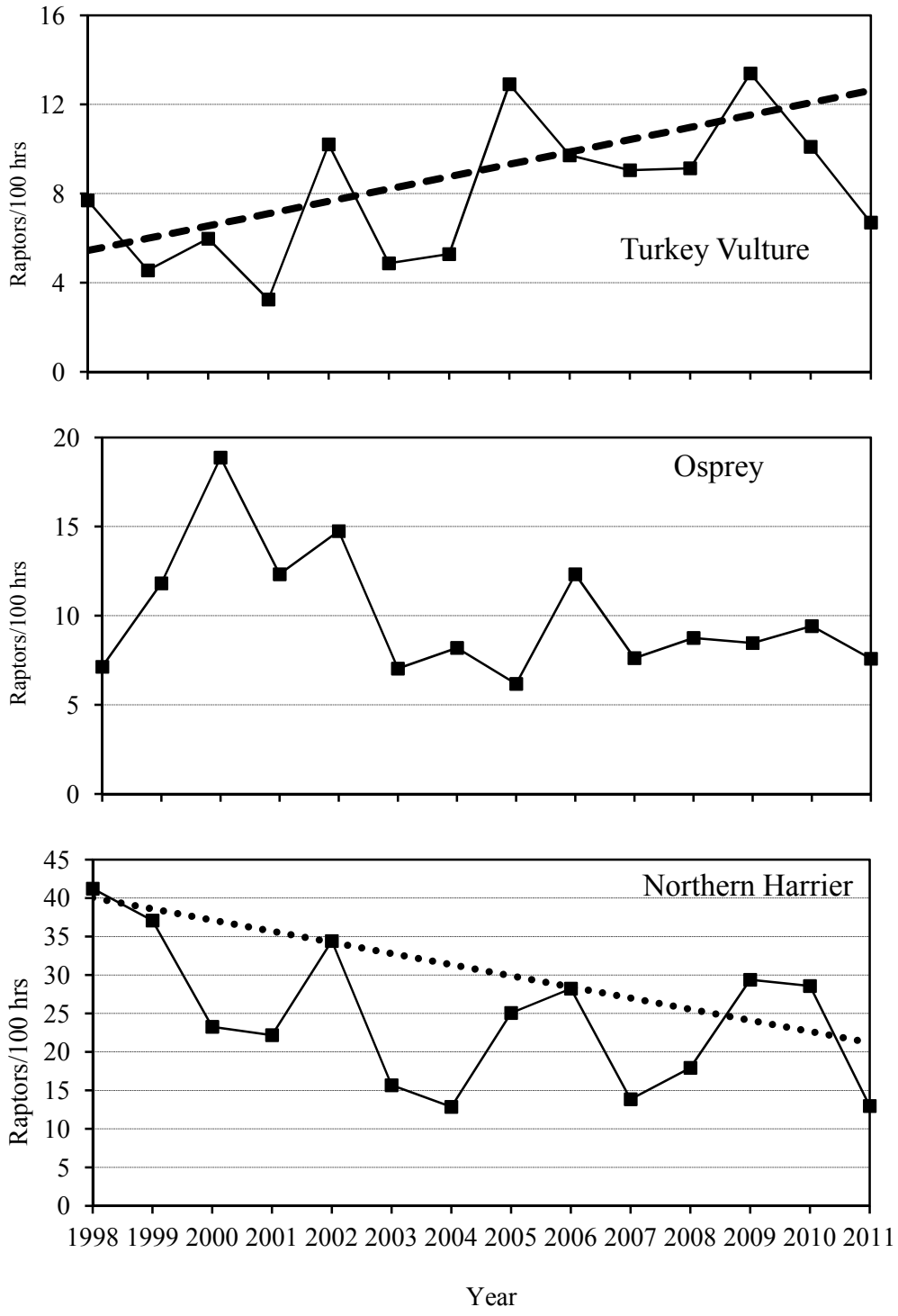

Figure 3. Adjusted fall-migration passage rates at Chelan Ridge, WA for Turkey Vultures, Ospreys, and Northern Harriers: 1998–2011. Dashed lines indicate significant linear or quadratic regressions.

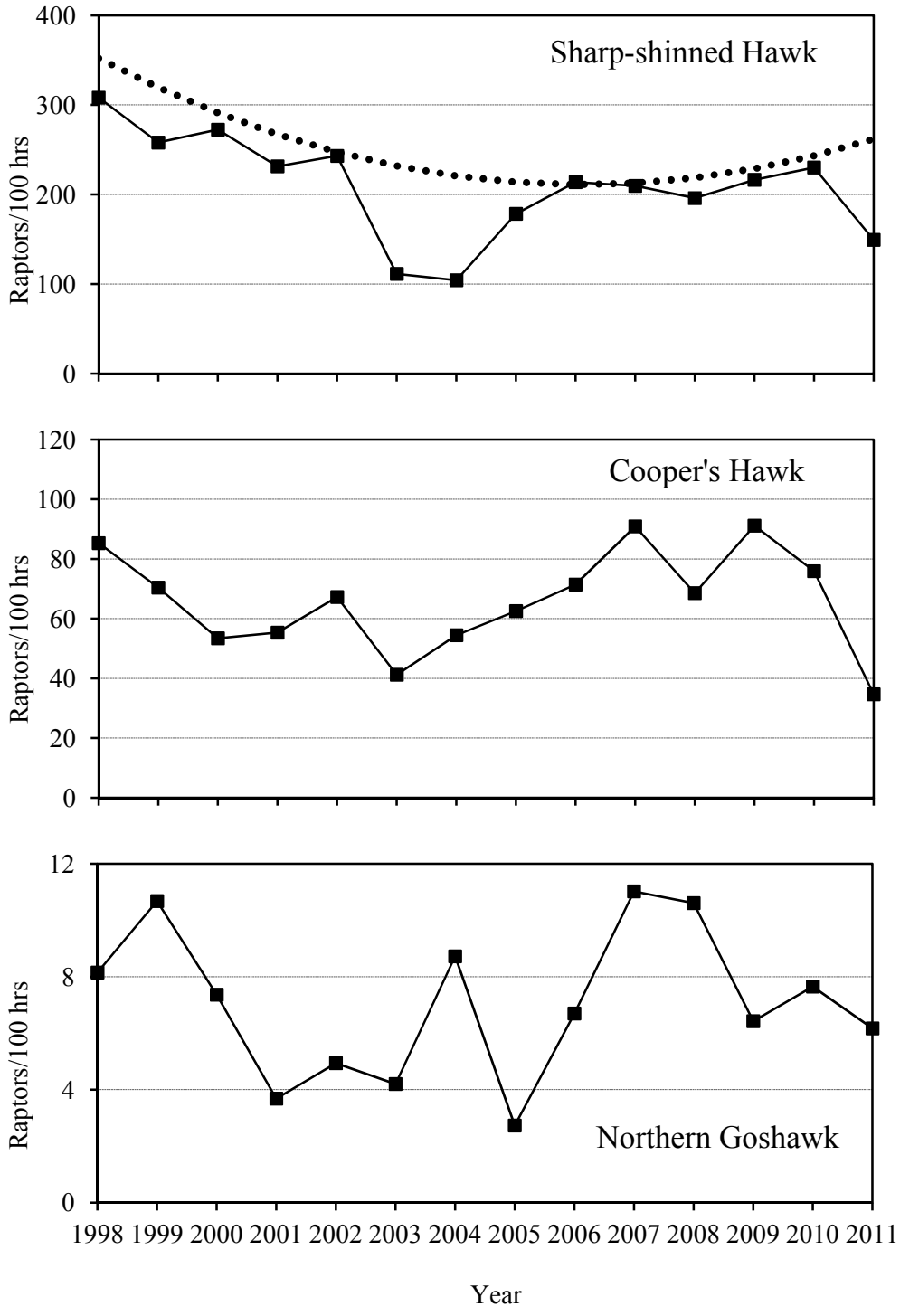

Figure 4. Adjusted fall-migration passage rates at Chelan Ridge, WA for Sharp-shinned Hawks, Cooper's Hawks, and Northern Goshawks: 1998–2011. Dashed lines indicate significant linear or quadratic regressions.

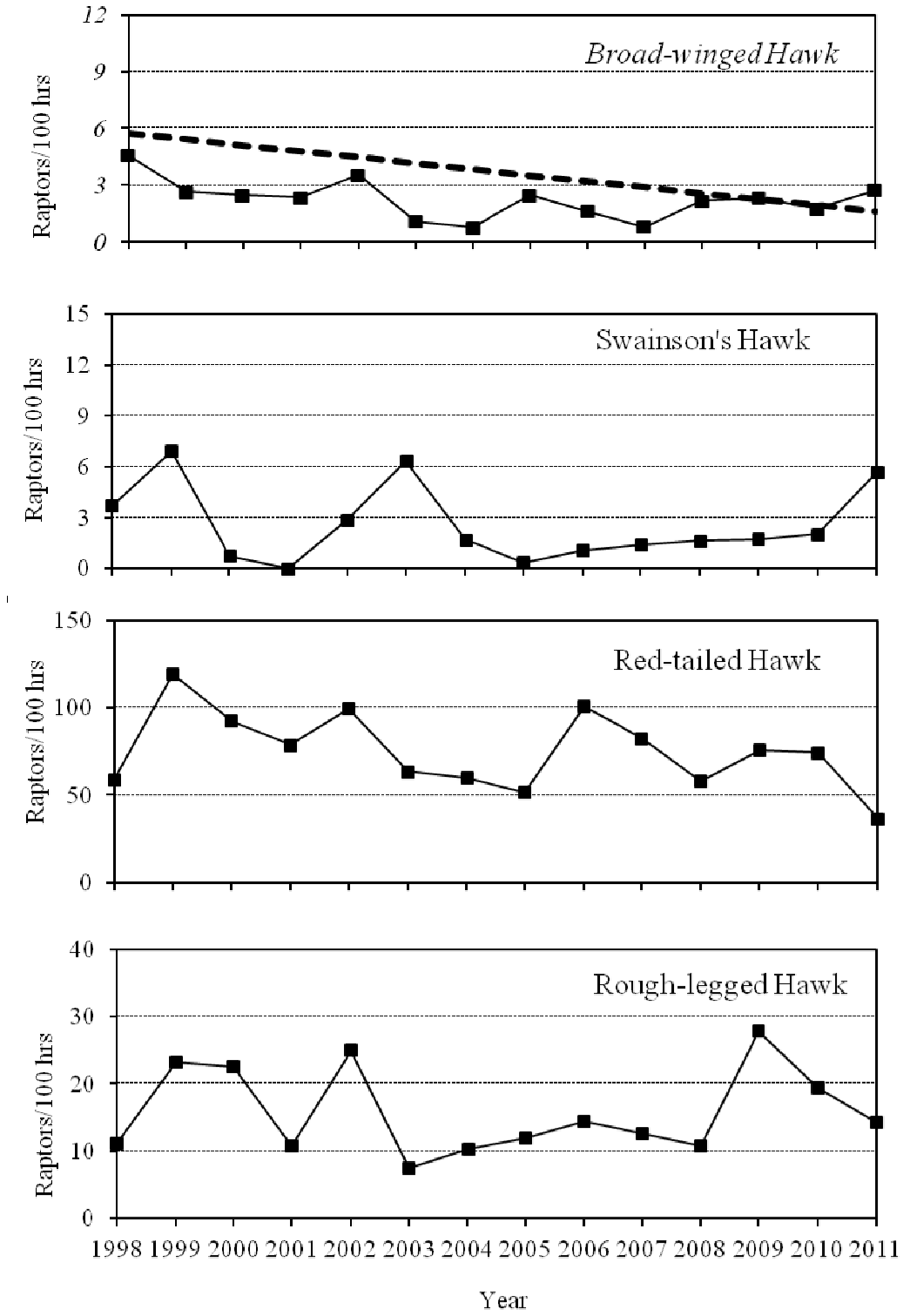

Figure 5. Adjusted fall-migration passage rates at Chelan Ridge, WA for Broad-winged, Swainson's, Red-tailed, and Rough-legged Hawks: 1998–2011. Dashed lines indicate significant linear or quadratic regressions.

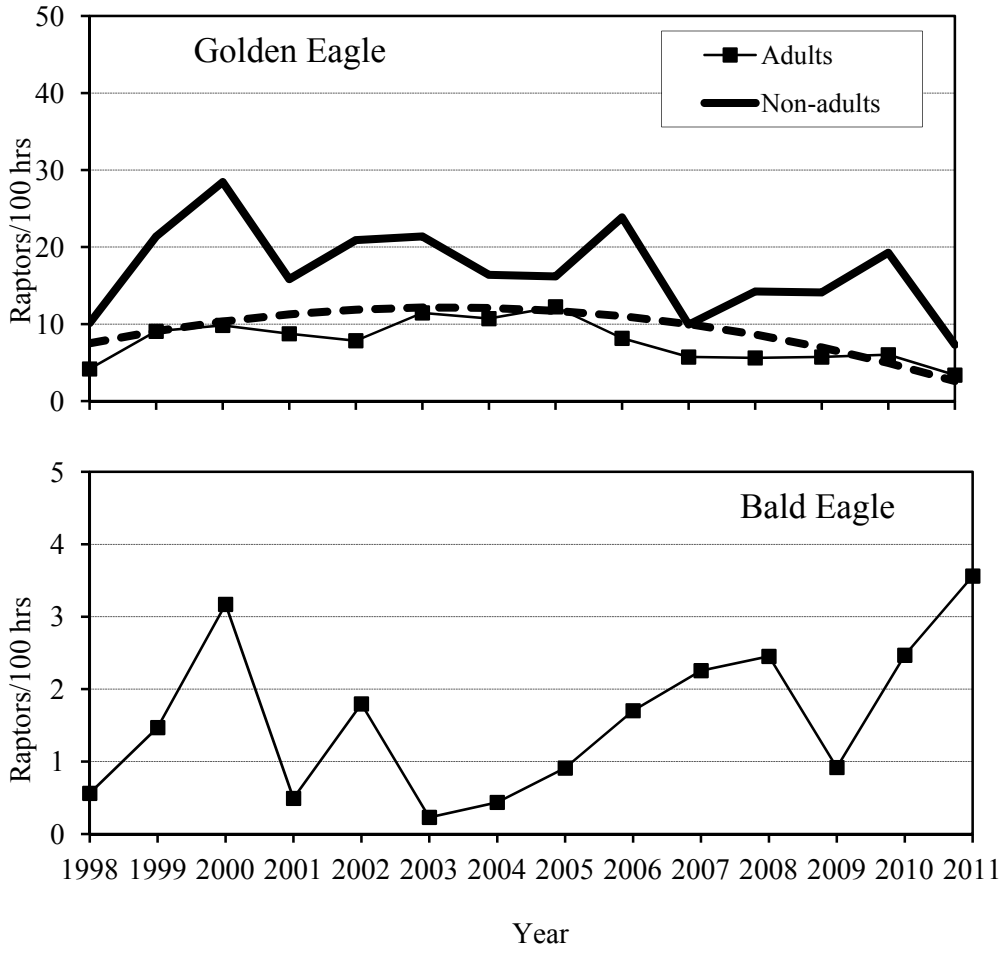

Figure 6. Adjusted fall-migration passage rates at Chelan Ridge, WA for Golden and Bald Eagles: 1998–2011. Dashed lines indicate significant linear or quadratic regressions.

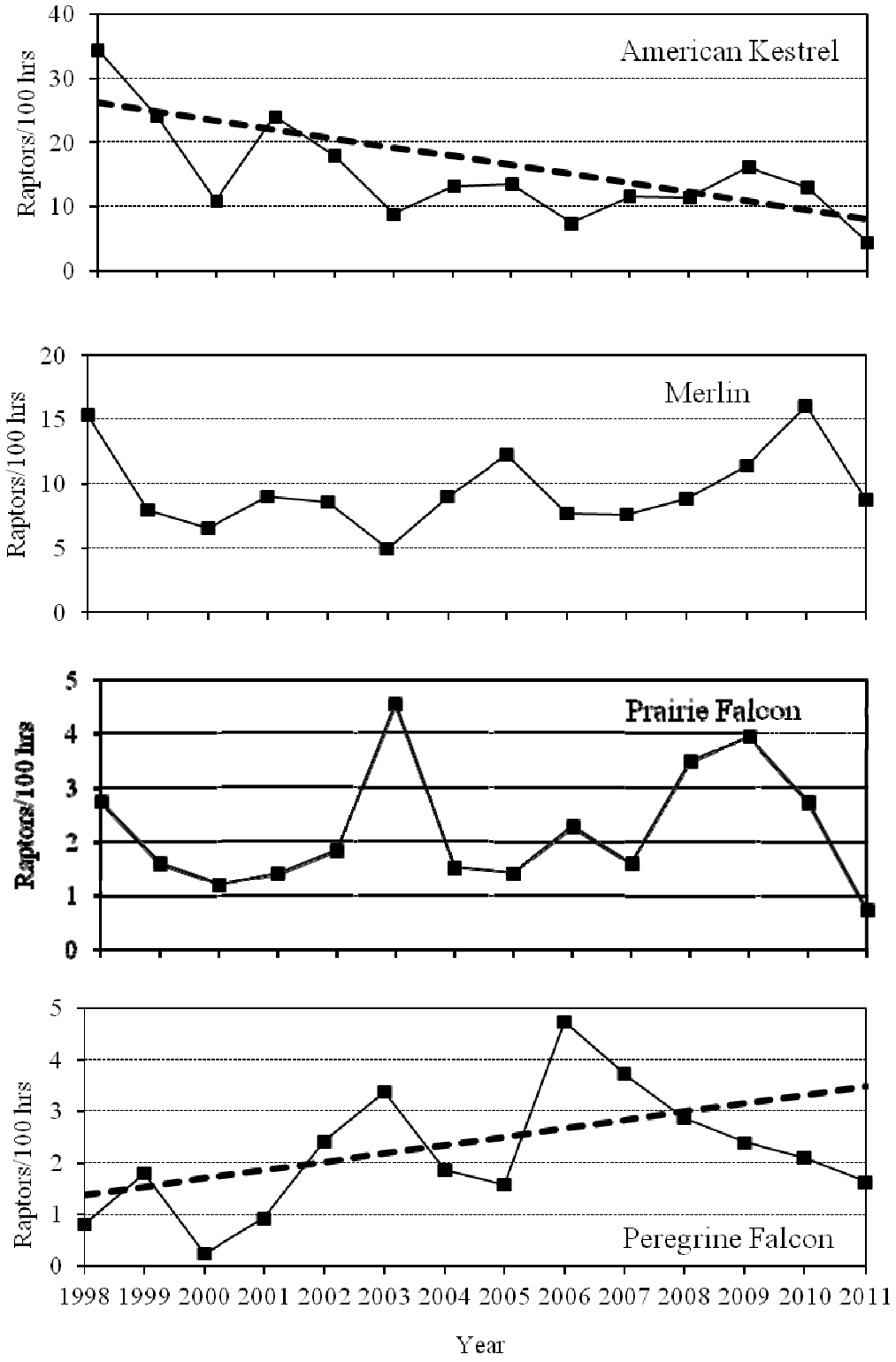

Figure 7. Adjusted fall-migration passage rates at Chelan Ridge, WA for American Kestrels, Merlins, Prairie Falcons, and Peregrine Falcons: 1998–2011. Dashed lines indicate significant linear or quadratic regressions.

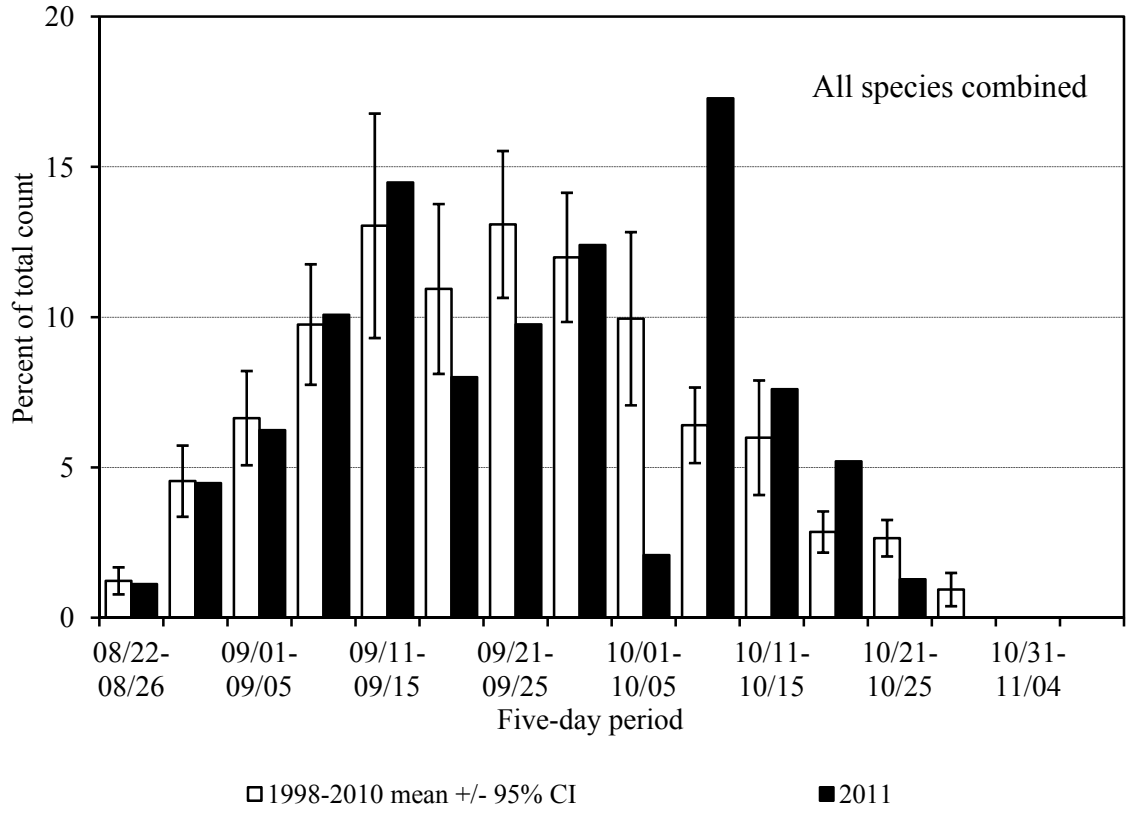

Figure 8. Combined-species passage volume by five-day periods for migrating raptors at Chelan Ridge, WA: 1998–2010 versus 2011.

Appendix A. History of official observer participation in the Chelan Ridge Raptor Migration Project.

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 (~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).

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[1] Numbers in parentheses indicate the number of years 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 Chelan Ridge, WA.

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	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
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. Daily observation effort, visitor disturbance ratings, weather records, and flight summaries for the Chelan Ridge Raptor Migration Project: 2011.

Date	Observ Hours	Obsrvrs / Hour[1]	Visitor Distur b[2]	Predominant Weather[3]	Wind Speed (kph)[1]	Wind Direction	Temp (°C)[1]	Baro. Press. (in Hg)[1]	Thermal Lift[4]	Visib. West (km)[1]	Visib. East (km)[1]	Flight Distance[5]	Birds / Hour
23-Aug	10.00	2.1	0	cl	15.7	s-sw	18.4	-	2	100	100	0	0.4
24-Aug	8.67	2.0	0	clr	8.2	s-w	17.4	-	1	100	100	0	0.5
25-Aug	0.00			Weather Day									
26-Aug	9.00	3.1	0	clr	12.7	s-sw	23.0	-	1	100	100	2	0.7
27-Aug	9.00	3.3	0	clr	10.9	se-sw	21.8	-	1	100	100	1	0.9
28-Aug	9.00	2.8	0	clr-pc	10.1	s-sw	25.4	-	1	100	100	2	3.2
29-Aug	9.00	2.3	0	clr, haze	12.2	s-w	20.6	-	1	70	78	0	0.2
30-Aug	9.00	2.0	0	clr-pc	9.8	s-w	19.3	-	1	100	60	2	1.2
31-Aug	9.00	2.4	0	mc-clr	11.4	s-w, n-e	10.2	-	3	99	100	0	0.8
01-Sep	9.00	1.9	0	clr-pc-ovc	17.0	s-w	11.9	-	2	100	100	2	1.0
02-Sep	9.00	3.2	0	clr	4.2	s-w, calm/var	16.5	-	2	100	100	0	0.8
03-Sep	9.25	2.6	0	clr	11.1	n-e	10.8	-	1	100	100	2	1.6
04-Sep	9.00	3.0	0	clr	13.9	s-w	18.9	-	1	100	100	2	1.8
05-Sep	9.00	1.9	0	clr	10.0	s-sw	17.4	-	1	100	100	2	3.6
06-Sep	9.00	2.0	0	clr	12.7	s-w, n-e	20.8	-	1	100	100	2	2.7
07-Sep	9.00	2.0	0	clr	8.4	s-w	18.6	-	1	100	100	2	3.9
08-Sep	8.50	2.3	0	clr	8.5	s-w	23.6	-	1	95	99	2	2.4
09-Sep	9.00	3.3	0	clr	8.1	s-w, n-e	22.1	-	1	60	60	2	2.7
10-Sep	9.00	2.7	0	clr	8.7	s-w, n-e	20.7	-	1	90	90	2	2.7
11-Sep	9.00	3.0	0	clr	11.4	s-sw	24.8	-	1	60	60	2	4.8
12-Sep	9.00	2.0	0	clr	13.2	s-sw	23.3	-	1	20	47	2	3.8
13-Sep	9.00	3.0	0	mc	11.0	s-w	20.9	-	2	100	100	2	2.9
14-Sep	9.00	3.0	0	clr	10.5	s-w	19.4	-	1	100	100	2	7.3
15-Sep	9.00	2.0	0	ovc-pc-mc	11.7	s-w	14.6	-	3	100	100	0	1.4
16-Sep	9.00	2.5	0	clr-pc-mc-ovc	11.5	s-w	9.8	-	3	100	100	2	0.9
17-Sep	9.00	3.0	0	ovc-mc-ovc	20.4	s-w	6.7	-	4	100	100	0	0.8
18-Sep	7.50	2.8	0	fog-mc-pc	32.6	s-w	11.4	-	2	82	83	2	1.7
19-Sep	8.00	1.6	0	pc-clr-pc	8.3	s-w, n-e	11.6	-	3	100	100	2	4.5
20-Sep	9.00	2.0	0	clr	15.1	s-w	11.5	-	2	100	100	2	4.0
21-Sep	9.00	2.0	0	mc	16.5	s-sw	14.6	-	3	100	100	2	4.7
22-Sep	9.00	2.0	0	ovc	2.3	s-w	14.7	-	3	100	100	0	1.1
23-Sep	9.00	3.0	0	clr	21.3	s-sw	17.7	-	2	100	100	2	2.3
24-Sep	9.00	2.8	0	clr-pc	13.5	s-sw	19.6	-	2	100	100	2	5.3
25-Sep	8.50	2.0	0	ovc-mc	35.9	s-w	11.4	-	4	97	76	0	0.2
26-Sep	1.50	2.0	0	ovc, blowing snow/dust, fog	22.0	s-sw	2.6	-	4	40	40	0	0.0
27-Sep	4.25	2.0	0	mc-pc	20.3	s-sw	8.1	-	3	100	100	2	2.1
28-Sep	9.25	2.2	0	clr	7.7	n-e	5.8	-	1	100	100	3	5.0
29-Sep	9.00	2.0	0	clr-pc	7.2	s-sw	9.5	-	1	100	100	2	7.3
30-Sep	9.00	3.1	0	clr-pc	15.2	s-w	13.7	-	3	100	100	2	4.7
01-Oct	8.17	2.7	0	ovc	12.3	s-w	12.1	-	4	100	100	0	0.4
02-Oct	9.00	3.0	0	clr-blowing snow/dust	12.6	s-sw	9.0	-	3	100	100	0	2.6
03-Oct	0.00			Weather Day									
04-Oct	1.50	3.0	0	ovc, fog	11.5	s-w	4.9	-	4	0	0	0	0.0
05-Oct	0.00			Weather Day									
06-Oct	7.00	4.0	0	pc	8.8	sw-nw, calm/var	8.5	-	2	100	100	3	13.6
07-Oct	9.00	3.6	0	clr-ovc-pc	8.3	s-w	7.7	-	2	100	100	3	4.4
08-Oct	9.00	2.0	0	clr	17.6	s-w	5.9	-	3	100	100	2	2.9
09-Oct	8.50	1.9	0	mc-ovc-pc, fog	8.7	s-w	7.2	-	2	100	100	2	6.6
10-Oct	0.00			Weather Day									

Appendix C. continued

Date	Observ Hours	Obsrvrs / Hour[1]	Visitor Disturb[2]	Predominant Weather[3]	Wind Speed (kph)[1]	Wind Direction	Temp (°C)[1]	Baro. Press. (in Hg)[1]	Thermal Lift[4]	Visib. West (km)[1]	Visib. East (km)[1]	Flight Distance[5]	Birds / Hour
11-Oct	8.17	2.0	0	clr	38.0	s-sw	4.4	-	4	96	100	2	1.1
12-Oct	9.00	2.7	0	pc	15.6	s-sw	3.3	-	4	100	100	2	1.2
13-Oct	9.00	3.0	0	clr-pc, haze	7.3	s-w, n-e	2.6	-	2	100	100	3	6.1
14-Oct	0.00			Weather Day									
15-Oct	9.00	1.9	0	clr, fog	7.7	s-sw	3.6	-	2	100	100	2	2.7
16-Oct	6.00	2.0	0	clr	8.9	s-w	6.7	-	1	100	100	3	4.0
17-Oct	8.83	1.9	0	clr	6.4	s-w	7.4	-	2	100	100	2	2.2
18-Oct	9.00	1.9	0	clr, haze	9.5	s-sw	7.0	-	3	100	100	1	1.3
19-Oct	8.00	3.0	0	pc	14.0	s-sw	8.3	-	3	100	100	2	0.9
20-Oct	8.50	2.0	0	clr-pc-ovc	12.0	s-w	6.9	-	3	97	98	0	0.6
21-Oct	8.50	2.0	0	ovc	18.0	s-w	5.8	-	4	100	100	0	0.6
22-Oct	6.00	2.0	0	pc-mc	29.6	s-sw	6.6	-	3	84	80	1	0.5
23-Oct	8.83	1.3	0	pc-ovc-pc	10.5	s-w	3.2	-	4	100	100	0	0.2
24-Oct	0.00			Weather Day									
25-Oct	6.50	1.0	0	clr	8.9	s-w, n-e	0.0	-	1	100	100	0	0.9

[1] Average of hourly records.

[2] Median hourly visitor-disturbance rating (subjective assessment by observers): 0 = none, 1 = low, 2 = moderate, 3 = high.

[3] Predominant sky condition during day: clr = clear (0-15% cloud cover); pc = partly cloudy (16-50% cover); mc = mostly cloudy (51-75% cover); ovc = overcast (76-100% cover); ts = thunderstorms.

[4] Median hourly rating concerning prevalence of lift-generating thermals, based on subjective assessments of solar intensity, wind speeds, and migrant behavior: 1 = excellent, 2 = good, 3 = fair, 4 = poor.

[5] Median hourly rating concerning line-of-sight distance of flight from observation site: 1 = close, detection and identification possible with naked eye; 2 = moderate, detection possible with naked eye, but binoculars needed for identification; 3 = far, binoculars needed for both detection and identification; 4 = distant, birds detected and identified only with excellent binoculars or spotting scope and by experienced observers.

Appendix D. Daily observation effort and fall raptor migration counts by species at Chelan Ridge, WA: 2011.

	OBS.	SPECIES[1]																												BIRDS
DATE	HOURS	TV	OS	NH	WK	SS	CH	NG	SA	LA	UA	RS	BW	SW	RT	FH	RL	UB	GE	BE	UE	AK	ML	PR	PG	SF	LF	UF	UU	TOTAL	/HOUR
23-Aug	10.00	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	4	0.4
24-Aug	8.67	1	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0.5
25-Aug	0.00																														
26-Aug	9.00	0	0	0	0	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	6	0.7
27-Aug	9.00	1	0	0	0	3	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	8	0.9
28-Aug	9.00	1	1	3	0	19	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	29	3.2
29-Aug	9.00	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0.2
30-Aug	9.00	0	0	0	0	3	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	3	0	0	0	0	0	0	11	1.2
31-Aug	9.00	0	0	1	0	3	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0.8
1-Sep	9.00	0	0	0	0	5	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	1.0
2-Sep	9.00	0	0	0	0	1	3	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	7	0.8
3-Sep	9.25	0	0	3	0	3	2	1	0	0	0	0	2	0	0	0	0	0	1	0	0	0	3	0	0	0	0	0	0	15	1.6
4-Sep	9.00	0	0	0	0	8	2	1	0	0	0	0	0	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	1.8
5-Sep	9.00	0	0	1	0	20	2	1	0	0	0	0	0	0	2	0	0	0	0	0	0	1	2	1	1	0	0	0	1	32	3.6
6-Sep	9.00	1	0	1	0	18	0	0	1	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0	24	2.7
7-Sep	9.00	0	0	1	0	25	5	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	1	35	3.9
8-Sep	8.50	0	0	0	0	16	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	20	2.4
9-Sep	9.00	0	0	1	0	14	2	0	0	0	2	0	0	0	1	0	0	2	1	0	0	0	1	0	0	0	0	0	0	24	2.7
10-Sep	9.00	0	4	2	0	9	3	0	0	0	1	0	0	0	3	0	0	0	0	0	0	0	2	0	0	0	0	0	0	24	2.7
11-Sep	9.00	0	2	2	0	25	4	2	0	0	1	0	0	0	4	0	0	0	0	0	0	0	3	0	0	0	0	0	0	43	4.8
12-Sep	9.00	0	0	3	0	16	5	0	0	0	0	0	0	0	3	0	0	0	2	0	0	0	4	1	0	0	0	0	0	34	3.8
13-Sep	9.00	3	0	1	0	8	1	2	0	0	1	0	1	5	2	0	0	1	1	0	0	0	0	0	0	0	0	0	0	26	2.9
14-Sep	9.00	14	3	0	0	25	10	0	1	0	0	1	0	1	8	0	0	0	1	0	0	0	1	0	0	0	0	0	1	66	7.3
15-Sep	9.00	0	0	0	0	7	4	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	1.4
16-Sep	9.00	0	1	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0	8	0.9
17-Sep	9.00	0	0	0	0	3	0	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	7	0.8
18-Sep	7.50	1	1	0	0	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	13	1.7
19-Sep	8.00	0	3	1	0	15	5	0	0	0	1	0	2	0	3	0	0	2	1	0	0	1	2	0	0	0	0	0	0	36	4.5

Appendix D. continued

DATE	OBS. HOURS	SPECIES[1]																												BIRDS /HOUR
		TV	OS	NH	WK	SS	CH	NG	SA	LA	UA	RS	BW	SW	RT	FH	RL	UB	GE	BE	UE	AK	ML	PR	PG	SF	LF	UF	UU	TOTAL	
20-Sep	9.00	0	1	4	0	22	3	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3	1	1	0	0	0	0	0	36	4.0
21-Sep	9.00	0	0	3	0	29	6	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	42	4.7
22-Sep	9.00	0	1	0	0	7	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	10	1.1
23-Sep	9.00	1	1	0	0	13	2	0	1	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	21	2.3
24-Sep	9.00	4	2	1	0	30	4	0	1	0	0	0	0	0	3	0	0	0	1	1	0	0	0	0	1	0	0	0	0	48	5.3
25-Sep	8.50	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0.2
26-Sep	1.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
27-Sep	4.25	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	2.1
28-Sep	9.25	0	2	0	0	7	2	0	0	1	3	0	0	6	11	0	0	7	2	0	0	0	0	0	0	0	0	0	5	46	5.0
29-Sep	9.00	0	2	3	0	34	10	0	0	0	0	0	0	0	6	0	1	0	1	2	0	3	1	0	0	0	0	1	2	66	7.3
30-Sep	9.00	2	1	4	0	23	2	3	2	0	0	0	0	0	3	0	0	0	0	0	0	0	1	0	0	0	0	0	1	42	4.7
1-Oct	8.17	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0.4
2-Oct	9.00	2	0	1	0	8	4	4	0	0	0	0	0	0	3	0	0	0	0	1	0	0	0	0	0	0	0	0	0	23	2.6
3-Oct	0.00																														
4-Oct	1.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
5-Oct	0.00																														
6-Oct	7.00	0	0	3	0	46	8	1	4	1	2	0	0	0	18	0	0	6	1	0	0	2	3	0	0	0	0	0	0	95	13.6
7-Oct	9.00	0	1	1	0	12	6	2	3	0	1	0	0	0	9	0	0	2	0	1	0	0	1	0	0	0	0	0	1	40	4.4
8-Oct	9.00	0	0	2	0	13	2	2	0	0	0	0	0	0	2	0	0	0	2	3	0	0	0	0	0	0	0	0	0	26	2.9
9-Oct	8.50	0	0	6	0	16	3	0	1	1	2	0	0	0	12	0	1	2	9	0	1	1	0	0	1	0	0	0	0	56	6.6
10-Oct	0.00																														
11-Oct	8.17	0	0	2	0	3	1	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	9	1.1
12-Oct	9.00	0	0	1	0	7	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	11	1.2
13-Oct	9.00	0	2	2	0	22	3	2	1	1	3	0	0	0	7	0	1	4	4	1	1	0	0	0	0	0	0	0	1	55	6.1
14-Oct	0.00																														
15-Oct	9.00	0	0	1	0	8	0	0	0	0	0	0	0	0	7	0	2	2	1	0	0	0	0	0	0	0	0	0	3	24	2.7
16-Oct	6.00	0	3	0	0	2	1	1	0	1	4	0	0	0	3	0	3	0	2	2	0	0	0	0	0	0	0	0	2	24	4.0
17-Oct	8.83	0	0	0	0	3	0	0	0	0	0	0	0	0	4	0	7	1	2	1	1	0	0	0	0	0	0	0	0	19	2.2

Appendix D. continued

	OBS.	SPECIES[1]																											BIRDS
DATE	HOURS	TV	OS	NH	WK	SS	CH	NG	SA	LA	UA	RS	BW	SW	RT	FH	RL	UB	GE	BE	UE	AK	ML	PR	PG	SF	LF	UF	UU	TOTAL	/HOUR
18-Oct	9.00	0	0	0	0	5	0	0	0	0	0	0	0	0	2	0	0	2	2	1	0	0	0	0	0	0	0	0	0	12	1.3
19-Oct	8.00	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	4	1	1	0	0	0	0	0	0	0	0	0	0	7	0.9
20-Oct	8.50	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	2	0	0	0	0	0	0	5	0.6
21-Oct	8.50	0	1	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	5	0.6
22-Oct	6.00	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	3	0.5
23-Oct	8.83	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0.2
24-Oct	0.00																														
25-Oct	6.50	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	6	0.9
Total	484.92	31	33	56	0	587	130	25	16	5	22	1	6	13	135	0	22	40	45	15	3	15	37	4	8	0	0	1	20	1270	2.6

[1] See Appendix B for full names associated with species codes.

Appendix E. Annual observation effort and fall raptor migration counts by species at Chelan Ridge, WA: 1997–2011.

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Mean
Start Date	5-Sep	27-Aug	27-Aug	27-Aug	27-Aug	25-Aug	23-Aug	24-Aug	24-Aug	24-Aug	24-Aug	24-Aug	23-Aug	23-Aug	23-Aug	24-Aug
End Date	11-Oct	21-Oct	27-Oct	5-Nov	22-Oct	25-Oct	26-Oct	23-Oct	25-Oct	26-Oct	27-Oct	27-Oct	25-Oct	23-Oct	25-Oct	23-Oct
Observation days	29	53	61	67	55	62	59	59	62	64	62	64	60	58	58	60.2
Observation hours	204.60	382.92	504.33	505.75	439.00	491.28	509.24	507.50	502.50	512.00	520.00	557.85	507.74	477.17	484.92	494.1
Raptors / 100 hours	691.1	620.2	571.2	481.3	470.4	522.1	297.1	286.1	363.4	458.8	413.3	365.2	457.9	446.8	261.9	442.2
Species									Raptor Counts							
Turkey Vulture	4	29	21	26	14	46	30	25	58	50	42	48	70	44	31	39
Osprey	41	24	47	71	48	57	31	34	25	50	31	37	36	36	33	41
Northern Harrier	115	152	167	104	91	148	66	59	113	127	60	82	127	114	56	109
White-tailed Kite	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Sharp-shinned Hawk	311	949	932	1,050	878	937	421	468	730	854	880	875	852	841	587	821
Cooper's Hawk	150	247	232	198	198	234	136	220	228	270	363	269	332	249	130	244
Northern Goshawk	38	32	50	35	16	22	17	41	13	31	49	48	27	30	25	32
Unknown small accipiter[1]	–	–	–	–	98	85	40	1	48	97	45	33	87	59	16	50
Unknown large accipiter[1]	–	–	–	–	0	10	17	6	6	11	3	19	12	7	5	9
Unknown accipiter	182	221	248	98	0	49	36	10	9	12	8	8	38	26	22	66
Total Accipiters	681	1,449	1,462	1,381	1,190	1,337	667	746	1,034	1,275	1,348	1,252	1,348	1,212	785	1,301
Red-shouldered Hawk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Broad-winged Hawk	2	7	5	5	6	9	3	2	6	4	2	5	6	4	6	5
Swainson's Hawk	0	8	17	2	0	7	15	5	2	2	4	5	5	5	13	6
Red-tailed Hawk	145	182	450	364	263	386	263	277	233	441	378	304	341	315	135	323
Ferruginous Hawk	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Rough-legged Hawk	1	13	44	53	13	45	14	20	22	28	22	25	48	37	22	30
Unidentified buteo	75	58	148	97	83	82	39	15	29	57	29	10	20	14	40	52
Total Buteos	223	268	664	522	365	529	334	319	292	532	435	349	420	375	216	445
Golden Eagle	105	55	141	174	105	135	142	130	130	157	82	111	93	109	45	120
Bald Eagle	2	2	7	15	2	8	1	2	4	8	10	12	4	10	15	7
Unidentified eagle	7	0	7	5	1	0	12	0	2	0	0	0	1	0	3	2
Total Eagles	114	57	155	194	108	143	155	132	136	165	92	123	98	119	63	138
American Kestrel	24	107	89	40	84	68	33	48	55	29	47	47	59	47	15	58
Merlin	17	55	36	26	36	38	21	39	53	34	40	44	45	63	37	41
Prairie Falcon	2	10	7	5	5	6	19	5	4	9	6	17	14	11	4	9
Peregrine Falcon	5	2	9	1	3	9	14	7	4	20	16	13	7	10	8	9
Unknown small falcon[1]	–	–	–	–	6	4	6	5	1	3	0	2	9	4	0	4
Unknown large falcon[1]	–	–	–	–	1	2	2	2	3	3	1	1	5	0	0	2
Unknown falcon	10	6	6	2	2	0	0	4	0	0	1	0	2	1	1	2
Total Falcons	58	180	147	74	137	127	95	110	120	98	111	124	141	136	65	134
Unidentified Raptor	178	216	218	62	112	178	134	27	48	52	30	22	85	96	20	98
Grand Total	1,414	2,375	2,881	2,434	2,065	2,565	1,513	1,452	1,826	2,349	2,149	2,037	2,325	2,132	1,270	2,162

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

Appendix F. Daily capture totals of migrating raptors at Chelan Ridge, WA: 2011.

	STN	SPECIES[1]													CAPTURES
DATE	HOURS	NH	SS	CH	NG	BW	RT	RL	GE	AK	ML	PR	PG	TOTAL	/STN HR
22-Aug	6.00	0	2	1	0	0	0	0	0	0	0	0	0	3	0.5
23-Aug	8.75	0	0	1	0	0	0	0	0	0	0	0	0	1	0.1
24-Aug	8.33	0	1	0	0	0	1	0	0	2	0	0	0	4	0.5
25-Aug	0.00														
26-Aug	8.58	0	4	2	0	0	1	0	0	0	0	0	0	7	0.8
27-Aug	9.00	0	4	3	0	0	0	0	0	0	0	0	0	7	0.8
28-Aug	9.16	0	4	1	0	0	0	0	0	0	0	0	0	5	0.5
29-Aug	10.00	0	1	2	0	0	1	0	0	1	1	0	0	6	0.6
30-Aug	9.50	0	5	3	0	0	1	0	0	0	0	0	0	9	0.9
31-Aug	0.00														
1-Sep	9.00	0	3	2	0	0	2	0	0	0	1	0	0	8	0.9
2-Sep	8.66	0	8	2	1	0	0	0	0	0	0	0	0	11	1.3
3-Sep	9.00	0	8	2	0	0	1	0	0	0	0	0	0	11	1.2
4-Sep	9.00	0	10	2	0	0	1	0	0	0	0	0	0	13	1.4
5-Sep	8.50	0	11	2	0	0	1	0	0	0	0	0	0	14	1.6
6-Sep	9.33	0	7	5	0	0	2	0	0	0	0	0	0	14	1.5
7-Sep	8.33	0	8	6	0	0	1	0	0	0	0	0	0	15	1.8
8-Sep	8.00	0	13	5	0	0	1	0	0	1	0	0	0	20	2.5
9-Sep	6.16	0	5	0	0	0	0	0	0	0	0	0	0	5	0.8
10-Sep	9.25	0	12	0	0	0	0	0	0	0	0	0	0	12	1.3
11-Sep	9.30	0	16	4	0	0	1	0	0	0	0	0	0	21	2.3
12-Sep	9.00	0	14	6	0	0	0	0	0	0	1	0	0	21	2.3
13-Sep	9.50	0	11	1	0	0	1	0	0	0	0	0	0	13	1.4
14-Sep	9.00	0	9	2	1	0	0	0	0	0	0	0	1	13	1.4
15-Sep	17.00	1	15	6	0	0	1	0	0	0	0	0	0	23	1.4
16-Sep	16.75	0	8	2	0	0	0	0	0	0	1	0	0	11	0.7
17-Sep	15.42	0	7	0	0	0	0	0	0	0	0	0	0	7	0.5
18-Sep	7.25	0	4	3	0	0	0	0	0	0	0	0	0	7	1.0
19-Sep	7.91	0	8	3	0	0	0	0	0	0	1	0	0	12	1.5
20-Sep	8.91	0	15	5	0	0	1	0	0	0	1	0	0	22	2.5
21-Sep	9.00	0	5	2	0	0	0	0	0	0	0	0	1	8	0.9
22-Sep	9.00	2	11	4	0	0	1	0	0	0	1	0	0	19	2.1

Appendix F. continued

Date	Stn Hours	Species[1] NH	SS	CH	NG	BW	RT	RL	GE	AK	ML	PR	PG	Captures Total	/ Stn Hr
23-Sep	9.00	0	11	2	0	0	0	0	0	0	1	0	1	15	1.7
24-Sep	9.00	0	18	3	1	0	0	0	0	0	1	0	0	23	2.6
25-Sep	17.00	0	1	0	1	0	0	0	0	0	1	0	0	3	0.2
26-Sep	1.50	0	1	0	0	0	0	0	0	0	0	0	0	1	0.7
27-Sep	0.00														
28-Sep	9.00	0	1	2	0	0	0	0	0	0	0	0	0	3	0.3
29-Sep	9.00	2	16	1	0	0	0	0	0	0	1	0	0	20	2.2
30-Sep	18.00	1	19	1	1	0	1	0	0	0	1	0	0	24	1.3
1-Oct	12.50	1	2	3	0	0	0	0	0	0	0	0	0	6	0.5
2-Oct	8.33	1	8	2	0	0	0	0	1	0	1	0	0	13	1.6
3-Oct	0.00														
4-Oct	0.00														
5-Oct	0.00														
6-Oct	6.50	0	13	1	0	0	0	0	0	0	2	0	0	16	2.5
7-Oct	17.00	0	8	2	3	0	2	0	0	0	2	0	0	17	1.0
8-Oct	16.75	0	5	1	3	0	0	0	1	0	1	0	0	11	0.7
9-Oct	8.50	0	20	0	1	0	0	0	3	0	0	0	0	24	2.8
10-Oct	0.00														
11-Oct	7.75	0	0	1	0	0	0	0	0	0	0	0	0	1	0.1
12-Oct	8.33	0	3	0	0	0	1	0	0	0	0	0	0	4	0.5
13-Oct	8.33	0	3	0	1	0	1	0	0	0	0	0	0	5	0.6
14-Oct	0.00														
15-Oct	8.00	0	7	0	0	0	1	0	0	0	1	0	0	9	1.1
16-Oct	5.00	0	1	0	0	0	0	0	0	0	0	0	0	1	0.2
17-Oct	8.50	0	2	0	1	0	1	0	0	0	0	0	0	4	0.5
18-Oct	8.50	0	4	0	0	0	1	0	0	0	0	0	0	5	0.6
19-Oct	8.50	0	0	0	0	0	0	1	0	0	0	0	0	1	0.1
20-Oct	8.50	0	1	0	1	0	0	0	0	0	0	0	0	2	0.2
Total	496.08	8	373	96	15	0	26	1	5	4	19	0	3	550	1.1 Avg

[1] See Appendix B for full names associated with species codes.

Appendix G. Annual trapping effort and capture totals by species for migrating raptors at Chelan Ridge, WA: 1999–2011.

	1999[1]	2000[1]	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	MEAN	TOTAL
First trapping day	28-Aug	2-Sep	30-Aug	27-Aug	23-Aug	25-Aug	25-Aug	25-Aug	25-Aug	24-Aug	24-Aug	25-Aug	22-Aug	24-Aug	
Last trapping day	16-Oct	14-Oct	17-Oct	19-Oct	25-Oct	18-Oct	22-Oct	22-Oct	16-Oct	23-Oct	24-Oct	22-Oct	20-Oct	19-Oct	
Number of stations	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
Trapping days	47	42	44	54	56	53	56	56	51	60	58	54	52	54.4	
Station hours	388	?	612.8	837.3	803.3	699.6	828.2	797.33	716.12	836.48	632.76	520.66	496.08	731.27	
Captures / stn. hour	5.7	?	8.6	8.1	7.3	5.0	7.5	10.2	9.4	9.1	10.5	12.1	11.1	8.8	
SPECIES	RAPTOR CAPTURES														
Northern Harrier	4	3	10	13	11	6	12	28	12	18	24	29	8	16.3	178
Sharp-shinned Hawk	139	125	341	459	394	237	389	556	450	503	419	396	373	415.0	4787
Cooper's Hawk	42	46	107	127	100	58	137	100	138	140	128	113	96	114.8	1332
Northern Goshawk	14	10	12	13	9	16	11	24	16	29	10	15	15	15.5	174
Broad-winged Hawk											1		0	0.1	1
Red-tailed Hawk	11	8	22	29	20	16	11	50	33	22	34	27	26	27.2	317
Rough-legged Hawk	0	1	1	2	1	0	5	6	1	2	9	1	1	2.8	30
Golden Eagle	0	1	2	0	4	2	2	6	2	5	5	3	5	3.3	39
American Kestrel	3	0	8	10	17	5	6	8	3	13	9	8	4	8.2	89
Merlin	6	4	17	21	25	10	49	31	15	25	21	30	19	24.4	273
Prairie Falcon	1	1	3	4	4	1	0	3	4	5	3	1	0	2.8	30
Peregrine Falcon	0	0	2	0	4	1	1	2	1	2	2	3	3	1.8	21
All species	220	199	525	678	589	352	623	814	675	764	665	631	550	632.2	7291
Recaptures[2]	0	0	0	0	0	0	0	0	1	0	0	7	3	0.8	11
Foreign Recaptures[3]	0	0	0	1	0	0	0	2	2	0	1	1	0	0.8	8
Foreign Encounters[4]	0	1	5	2	1	1	4	15	12	7	9	9	9	6.7	77

[1] Data collected by the Falcon Research Group.

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

[3] Recaptures at Chelan Ridge of birds originally banded elsewhere.

[4] Birds originally banded at Chelan Ridge and subsequently encountered elsewhere.