FALL 2010 RAPTOR MIGRATION STUDIES AT CHELAN RIDGE, WASHINGTON

April 2011

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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. In cooperation with HWI and OWNF, the Falcon Research Group (FRG) initiated a trapping and banding program at the site in 1999 and 2000, but HWI and OWNF took over coordinating the banding program in 2001. To date, our observers have recorded 18 species of migratory diurnal raptors at the site, with counts ranging between ~1,500–2,900 migrants per season. The 2010 season marked the 13th consecutive, full-season count and the 12th consecutive season of banding at the site. This report summarizes the 2010 count and banding results.

The Chelan Ridge project was 1 of 9 long-term, annual migration counts and 1 of 4 migration-banding studies conducted or co-sponsored by HWI in North America during 2010. The primary objective of these efforts is to track long-term population trends of diurnal raptors in western North America and around the Gulf Coast region (Hoffman and Smith 2003; Smith et al. 2001, 2008 a, b). Raptors serve as important biological indicators of ecosystem health (Bildstein 2001) and long-term migration counts are one of the most cost effective and efficient methods for monitoring the regional status and trends of multiple raptor species (Zalles and Bildstein 2000).

The intensive counting and banding operations, along with related research activities such as satellite tracking of migrants, also provide valuable information about species' ranges, migratory routes and behaviors, and population demographics (e.g., Hoffman et al. 2002, Lott and Smith 2006, Goodrich and Smith 2008), as well as affording rich opportunities for a variety of other biological assessments and studies (e.g., DeLong and Hoffman 2004, McBride et al. 2004). This information helps us understand the life histories, ecology, status, and conservation needs of raptor populations in North America. In addition, these migration studies offer unique opportunities for the public to learn about raptors and the natural environment, and providing such opportunities is another important component of the missions of HWI and OWNF. Accordingly, besides ensuring efficient local coordination of the overall project, OWNF personnel and volunteers, working in tandem with the seasonal observers, banders, and on-site interpreter, play a critical role in coordinating environmental education opportunities at the site.

STUDY SITE

Chelan Ridge is located approximately 21 km north–northwest of the village of Chelan on the Chelan County / Okanogan County and Okanogan National Forest / Wenatchee National Forest borders (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, then Black Canyon Road (USFS Road 4010) west–southwest until it ends, then 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. The view to the south extends across Lake Chelan and into the Wenatchee National Forest. The view to the west follows the ridgeline (known as Cooper Ridge) and extends into the Sawtooth Wilderness. The view to the north extends across the Methow Valley and into the Pasayten Wilderness. The view to the east extends across the Columbia River and the Waterville Plateau. The lookout's southwestern slope is a cliff face with a 70–80° slope that drops about 65 m into the Mitchell Creek Basin. This cliff face creates excellent updrafts on days of moderate to strong south winds. On such days, migrants using the updrafts fly extremely close to the observation point. There are also unobstructed views of the regions to the south (the basin) and west where thermals frequently form.

Mitchell Creek Basin fills the east–west view and is a common place to spot raptors. This basin is approximately 3.5 km wide, with Goff Peak the major landmark on the southern side of the basin. In 1970, a major forest fire cleared Mitchell Creek Basin and today it is filled with snags, lots of exposed rocks, and young, regenerating vegetation consisting mainly of Scouler willow (*Salix scouleri*), big basin sagebrush (*Artemisia tridentata*), and some lodgepole pine (*Pinus contorta*). 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. Looking north into Black Canyon, it is difficult to spot migrants against the dark-green backdrop lodgepole and Ponderosa pine (*Pinus ponderosa*) forest. Although the view of the northern horizon is unobstructed, one cannot see all of Black Canyon from the lookout. To the southeast, migrant raptors often fly through another gap between the lookout and Cooper Mountain. Some migrants pass the lookout undetected but are later seen rising above the horizon on thermals near Cooper Mountain.

Two trapping and banding stations were located approximately 1 and 2.25 km southeast of the count site (Figure 1). The North station was 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 was located in a saddle on the southwest flanks of Cooper Mountain in an area used regularly since 2001. Because the stations were located sufficiently "downstream" of the count site, the trapping operations did not affect the behavior of migrants in ways that might have produced a biased count.

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 second season of raptor migration counting at Chelan Ridge for official observer Brian Connely and the first season of experience for official observer Craig Waythomas (see Appendix A for a complete history of observer participation); however, Craig previously gained relevant experience working as bander for HWI in Nevada. Multi-purpose crewmember Marie-Catherine Fournier also routinely assisted with the counts and previously served in a similar capacity for HWI in Nevada. Other crewmembers, HWI and USFS staff, and visitors also occasionally assisted with the counts.

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.

Smith et al. (2008a) present trend analyses of data collected through 2005 for most of the long-term, on-going, autumn migration studies in western North America, including Chelan Ridge for the first time (hereafter called the Raptor Population Index or "RPI" analyses; see http://www.rpi-project.org). 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 2010 are based on a more complex analytical approach (also see Farmer et al. 2007) than that represented in Hoffman and Smith (2003) and used herein to present analyses updated through 2010. In comparing 2010 annual statistics against means and 95% confidence intervals for previous seasons, we equate significance with a 2010 value falling outside the bounds of the confidence interval for the associated mean.

TRAPPING AND BANDING

Weather permitting the trappers operated the two traditional banding stations daily 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 much quicker.

RESULTS AND DISCUSSION

WEATHER

Inclement weather forced the site to close on 23 October, which is on par with the average close date from the last thirteen years (see Appendix C for daily weather records, as well as Appendix E for comparisons of annual start and end dates). Four additional days were also precluded, and three days were shortend (reduced observation time to ≤ 4 hours) due to weather (Appendix C). For comparison, weather, on an average seasonal basis (i.e., 1997-2009) has demonstrated to preclude 4.3, and severely hamper 1.8 days of observations in a given season.

During active observation periods, skies were recorded as predominantly fair 38% of the times, 29% as transitional (i.e., changed from fair or partly cloudy to mostly cloudy or overcast during the day, or vice versa), and 32% as mostly cloudy to overcast. In comparison, the averages for the site are 47% fair, 32% transitional, and 21% as mostly cloudy or overcast, suggesting that the predominant skies in 2010 were mostly cloudy or overcast and less than predominantly fair. Similarily, the season's visibility was affected by fog and/or haze on 48% of active observational days (vs. average of 40% in previous years), and the proportion of days affected by rain and/or snow was 13 % (vs. 14% average). Despite these conditions however, the season's visibility estimates were rated higher than average facing both the east (76 km in 2010 vs. 60.0 km for the average, 1997 - 2009), as well as the west (75 km vs. the mean of 56.9 km). Observers rated the thermal lift as good to excellent 30% of the active days, which is slightly below the 1997-2009 average of 43%.

The prevalent winds that occurred during the 2010 migration season were light (< 12 kph), occurring 57% of the active observation days (vs 70% on average), to moderate (12-29 kph , occurring 41% of the active observation days vs. on average, 29%). Only 2% of the active observation days produced strong winds (≥ 29 kph), which is on par with the long term average, of 2 %. The direction was primarily out of the S-SW (72%), but also calm/variable (16%). Winds were also recorded from the SW-NW (3%), N-E (3%), S-W (2%), NW-NE (2%), and SE-SW (2%). In comparison, winds on average (1997-2009) blow primarily from the S-SW (46%), S-W/ N-E (11%), SE-SW (9%), S-W/Calm and Variable (7%), and Calm /Variable (5%). Thus, the light to moderate winds prevailing out of the S-SW, with calm or variable occasional winds from other directions, seem to conform to past years fairly well.

In summary, inclement weather kept the 2010 observers away from the observation posts just slightly more often than average only with regard to shortend days. On average, a light S-SW wind is prevalent for this site. This past season, the winds were moderately stronger and more persistent out of this direction. In addition, with poor thermal lift coupled with a higher prevalence of cloudy and overcast conditions, raptors probably had to work harder for migrating through this corridor. Thus, some raptors may have chosen a different pathway that was less strenuous.

OBSERVATION EFFORT

During the 2010 season, observers were able to count on 58 of 65 possible days between 23 August and 26 October, which is slightly below the long term average (60 ± 95% CI of 2.2 days, Appendix E). In addition, the number of observation hours (477.17) was also below average (495.5 ± 26.32 hrs). The 2010 average of 2.1 observers per hour (including official and guest observers; value is mean of daily values, which are in turn means of hourly values) was slightly (+5%) higher than the 1998–2009 average of 2.0 ± 0.06 observers/hour.

FLIGHT SUMMARY AND TRENDS

Observers counted 2,132 migrating raptors of 16 species during the 2010 season (Table 1; see Appendix D for daily count records), which is only a slight 1% above the long term 1998-2009 average (Table 1; see Appendix E for annual count summaries). The highlight of the season was the record count of 63 Merlins, which was significantly above the long term overage of 37 ± 11.2 birds (Table 1, Appendix E). The counts of most other species were non-significantly above average (Table 1, Appendix E). However, the 2010 counts of Ospreys, Northern Goshawks, Golden Eagles, and American Kestrels were non-significantly below average (Table 1, Appendix E). The observers also counted four Broad-winged and five Swainson's Hawks, and although these two species represent the more uncommon species, they are normally observed on an annual basis (see Appendix E).

The flight consisted of 57% accipiters, 18% buteos, 6% falcons, 6% eagles, 5% harriers, 2% vultures, 2% Ospreys, and 4% unknown raptors (Table 1). The proportion of vultures was significantly above average, whereas the proportions of eagles and Ospreys were significantly below average (Figure 2). As usual, the most common species seen in 2010 were the Sharp-shinned Hawk (39% of the total count), Red-tailed Hawk (15%), Cooper's Hawk (12%), Northern Harrier (5%), Golden Eagle (5%), and Merlin (3%). Otherwise, all other species each comprised of 2% of the total count, or less.

Population Trends.—Regression analyses of the adjusted passage rates through 2010 revealed a significant ($P \leq 0.10$) quadratic downward decline for adult Golden Eagles only (Figure 6). However, different shapes in quadratic patterns are demonstrating that Northern Harriers (Figure 3), Sharp-shinned, Cooper's (Figure 4), Broad-winged Hawks (Figure 5), and American Kestrels (Figure 7) are either leveling off from early downward indications, or have already leveled off and are now noticeably beginning to trend upward, such as the patterns displayed by Northern Harriers (Figure 3), Sharp-

shinned, and Cooper's Hawks (Figure 4). In contrast, Turkey Vultures and Peregrine Falcons have been steadily increasing in numbers (Figures 3 and 7, respectively).

In western North America, Golden Eagles have recently been showing steady declines (Smith et al. 2008a). Thus, it is important to be able to contrast whether adults, non-adults, or both age groups are declining to understand what age-specific group may be decreasing. For this site, current data suggests that the adults are declining (see above and Figure 6) and that the non-adult birds are showing a wave-like pattern of remaining stable. At this time, it is unknown whether if something is causing a negative affect on adult survivorship or if adult Golden Eagles are changing migratory patterns. Smith et al. (2008a) concluded that western trends from Northern Harriers, Sharp-shinned Hawks, Cooper's Hawks, American Kestrels were variable. Current data from Chelan Ridge suggest similar results. However, widespread American Kestrel populations throughout North America have been decreasing at alarming rates (Farmer et al. 2008, Farmer and Smith 2009), and in 2007 at a joint meeting of the Raptor Research Foundation and Hawk Migration Association of North America a special symposium was held to discuss evidence to their widespread decline (see Journal of Raptor Research 2009, Vol. 43, No. 4). The Broad-winged Hawk is a species that is found more numerous in eastern North America, and recent analyses of counts in the West are of mixed results (Smith et al. 2008). Thus, in addition to the the low numbers observed migrating through Chelan Ridge on an annual basis (Table 1, Appendix E), interpreting anything meaningfull from the current Broad-wing Hawk trend (Figure 5) is equivocal. Lastly, Smith et al. (2008a) concluded that Turkey Vultures were stable to increasing throughout western North America, except for a decline in New Mexico since 1998. Although the Chelan Ridge data at the time was included in that paper, current data indicate that the trend is still increasing. Peregrine Falcons, like the nationwide trend (see Farmer et al. 2008), are increasing at this site as well.

Age Ratios as Indicators of Regional Productivity.—Immature : adult ratios were significantly below average in 2010 for Cooper's Hawks, Sharp-shinned Hawks, and Peregrine Falcons, but above average for Northern Harriers, Golden Eagles, and Bald Eagles among the remaining species for which such comparisons were possible (Table 2). For Cooper's Hawks, the count of identified adults was significantly higher than the average, but below for immature birds. Adult birds outnumbered immature ones for a change (Table 2). The overall Cooper's Hawk count stayed close the average experienced at Chelan Ridge. For Bald Eagles and Peregrine Falcons, the overall counts were too low to warrant careful consideration of age ratios, and the absence of adult Northern Goshawks continued last years trends of very high immature : adult ratios in the species. The above-average age ratio for Northern Harriers suggests good productivity. The lack of age ratio determination for Northern Goshawks due to missing adults in the count and the higher than usual ratio in Golden Eagles may have resulted from low adult survival, delayed adult passage after our monitoring period, or perhaps simply limited adult movement (e.g., staying farther north).

Seasonal Timing.—The combined-species median passage date of 26 September was four days later this past season compared to the long-term average (Table 3). The volume of migration usually peaks around late September, then begins to rapidly deline and levels off to lower numbers in mid-October; whereas, this past season a major movement of migrants was seen during the five-day period between 11-15 September, followed by a five-day period of low observations, then coming to a peak again during the latter part of September and into early October (Figure 8). Both peaks observed this year represent shifts in front of and later than the normal peak, but the shift into the beginning of October is more pronounced (Figure 8). Similarily, most species median-level passage dates also shifted anywhere from 1 to 18 days later this past season, accept for Bald Eagles which were 13 days early (Table 3). The Peregrine Falcon showed consistency, reflecting median dates of no change (Table 3). The age-specific median dates generally followed the same pattern accept that immature Sharp-shinned Hawks and Golden Eagles were significantly earilier (Table 4).

RESIDENT RAPTORS

Resident Red-tailed Hawks were present from the beginning of observations to closing (23 August – 23 October). Six individuals were identified as residents. Throughout the entire observation period, a pair of light morph adults were seen almost daily, frequenting Mitchel Creek and the surrounding area often observed kiting, hunting, perched, and escorting other Red-tailed Hawks and eagles away. Along with this pair, a light morph juvenile was also observed. The juvenile was first observed on 24 August, and was last seen 03 October. Another pair was observed to inhabit a territory east of Cooper Mountain. One of the pair was a dark morph adult, but there remained uncertainty about plumage coloration of the other individual. Lastly, a dark morph juvenile was observed only once on 04 September flying from the east.

Three resident Turkey Vultures were observed from 23 August through 16 September. They were seen commonly in all directions from the observation location but more frequently towards the east, over Cooper Mountain, between the mountain and Washington Butte. Another bird documented as a resident was seen on the 17th of September.

A pair of resident American Kestrels was often observed kiting, hunting, and perching along various snags on Cooper Ridge, as well as in the Gap. The male was observed from 23 August to 12 September, while the female was active from 24 August through 17 September. Both were seen together on 25 August and 03 September.

A resident adult Sharp-shinned Hawk was seen daily from 23 August through 06 October hunting along Cooper Ridge and Mitchel Creek, often heading north through the gaps and over the education area. This adult (whether the same bird or a different one is unknown) appeared frequently and multiple times a day. On 25 August, a pair of adults was observed together near Cooper Mountain, and on 06 September a resident juvenile was seen several times throughout the day hunting along Cooper Ridge and over Mitchel Creek. This was the only day a resident juvenile was observed throughout the whole season.

On 05 October, an unknown-aged Golden Eagle was recorded as non-migratory after being observed several times hunting to the west of the observation location. This bird was never seen again after that initial appearance and thought to have migrated resulting in an additional migration point count.

TRAPPING EFFORT

Trapping occurred on 54 of 59 days between 25 August and 22 October, with effort totaling 520.66 station hours (see Appendix F for daily trapping records). The number of trapping days was near the 2001–2009 average of 54.4 ± 95% CI of 2.9 days; however, due to a reduced crew the number of station hours was significantly below the long-term average of 754.67 ± 57.7 station hours (see Appendix G for annual trapping summaries).

TRAPPING AND BANDING RESULTS

The 2010 capture total of 631 newly banded birds, seven recaptures and one foreign recapture, involved 11 typical species. The combined-species total very close to the 2001–2009 average (Table 5, Appendix G). Capture totals were significantly above average for two commonly captured species (Northern Harrier and Red-tailed Hawk; Table 5), with 29 Northern Harriers a new record high for the site (Appendix G). Also high total captures were achieved in Golden Eagles and Peregrine Falcons. Capture totals were significantly below average for the Rough-legged Hawk, American Kestrel, and the Prairie Falcon (Table 5). The species captured most frequently in 2010 were the Sharp-shinned Hawk (62.8% of captures), Cooper's Hawk (17.9%), Red-tailed Hawk (5.5%), Merlin (4.8%), Northern Harrier (4.6%), and Northern Goshawk (2.4%); all other species each comprised <2% of the total.

Capture rates were significantly above average in 2010 for nine species and were significantly below average for two species (American Kestrel and Prairie Falcon) (Table 5). Similar to the situation for

capture totals, capture success was significantly above average for the Norhern Harrier, Red-tailed Hawk, and Golden Eagle, and was significantly below average for the Sharp-shinned Hawk, Rough-legged Hawk, Prairie Falcon, and the American Kestrel (Table 5).

Compared to the counts, banding at this site yields unique and substantial sex-age specific data only for the three accipiters. For Sharp-shinned Hawks in 2010, the count-based immature : adult ratio of 2.4 was 35% below average (Table 2), which is in the range of the banding age ratio at 2.8 (22% below average) (Table 6). The latter was less pronounced compared to past seasons, but it still confirmed the trend that immature birds are more susceptible to capture than adults. Female Sharp-shinned Hawks were trapped more frequently than males in 2010 (1.7 female : male ratio), a pattern that usually holds true, but at a lower average ratio (1.2 ± 0.07, Table 6). However, both genders in the species followed the trend of high immature : adult ratios.

For Cooper's Hawks, we observed a strong discrepancy between the count and capture age ratios. For the count data, this species averages at 4.3 more immatures compared to adult birds at this location, but in 2010 more adults (89 compared to 80 immatures, Table 2) were encountered when age class identification was possible. As is expected, Cooper's Hawks trapped on site consisted of 1.9 times more immature specimen compared to adult birds, a value significantly lower than in the past (average of 2.5 ± 0.43). During trapping, more than twice (2.1x) as many female Cooper's Hawks were captured confirming the site average, but at a higher ratio than expected (1.6 ± 0.13). For trapping, both genders showed a similar bias towards hatch year birds among capture totals (Table 6).

No count- or capture-based age ratios for Northern Goshawks in 2010 were calculated due to the lack of identification or trapping of adult birds at the site. Usually the capture ratio is much larger than the count ratio, but both are clearly favoring immature birds over adults. Once again adult goshawks are scarce during observation and trapping at Chelan Ridge.

Another way to assess the relative condition of the three accipiter species is examining measures of body condition collected during banding; i.e., crop fullness, keel muscle condition, and wing-pit fat ratings (Table 7). In contrast to last year, Sharp-shinned Hawks showed clear indications of lower relative condition with a large proportion of birds featuring empty crops, underdeveloped keel muscles and low levels of wing-pit fat. These data match well the indication of immature birds being more susceptible to capture (hungrier) than usual. Similar patterns were seen in Cooper's Hawks, but they were less pronounced in Northern Goshawks.

ENCOUNTERS WITH PREVIOUSLY BANDED BIRDS

To date, 67 raptors banded at Chelan Ridge have subsequently been encountered elsewhere as foreign encounters. In 2010, we received notification of eight new recoveries: 4 Sharp-shinned Hawks, 2 Red-tailed Hawks, 1 Cooper's Hawk, and 1 Merlin (Table 8). One female hatch-year Sharp-shinned Hawk died after being captured due to unknown injury while wintering in Mexico. Likewise, another female hatch-year Sharp-shinned Hawk was shot, and an adult female Cooper's Hawk was found dead of unknown causes, both on wintering grounds in Mexico. Recoveries indicate that raptors banded at Chelan Ridge use both the Pacific and the Intermountain Flyways (unpublished data, HWI). One male hatch-year Sharp-shinned Hawk was recovered 16 March, 2010 near Bruneau, Idaho within the Intermountain Flyway, while another female Sharp-shinned Hawk, the two Red-tailed Hawks, and the Merlin were all recovered within the Pacific Flyway. According to recovery reports, the hatch-year male Sharp-shinned Hawk recovered in Idaho was likely killed by another raptor. The Merlin was initially found in an injured state and later died. As is the case with many band recoveries, most birds are being found dead of unknown causes. For a detailed list of encounters with previously banded birds see Table 8.

The only “foreign recapture” encountered was an adult AHY Red-tailed Hawk originally banded at an airport in western Washington and released away from the airport approximately 177 km to the southwest from the Chelan Ridge site. Local airport biologists banded the bird using an alpha-numeric black and yellow plastic band. Not all airport biologists are authorized to use USGS-Bird Banding Lab issued bands to band birds under their federal authorization but there is agreement between the BBL and airport biologists to mark birds using plastic or other auxiliary markers to keep track of individual problem animals that continuously return. Our crew captured this bird on 27 September and placed a HWI authorized federal aluminum USGS-BBL band on the opposite leg and subsequently contacted the airport biologist, as well as the Bird Banding Lab to report the capture. In addition, the crew recaptured 3 Cooper’s Hawks and 4 Sharp-shinned Hawks that were previously banded at the site. These records are important to understand that raptors are using the same migratory pathways, and it helps provide information on longevity and survivorship.

VISITOR PARTICIPATION AND PUBLIC OUTREACH

In 2010, a total of 140 individuals visited the site during the season outside of any organized event. In addition, the largest single visitation day happened on 25 September as part of the Chelan Ridge Hawk Migration Festival. Multiple local groups and individual from various western states interested in hawks came to Chelan Ridge on that day to engage in on-site education of raptor migration, including an opportunity to see raptors up close and in hand prior to their release back into the wild. 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 Oregon, California, Nevada, and Montana.

Primary observers assess the disturbance level of visitors every hour. In 2010, 498 hourly assessments of visitor disturbance resulted in the following disturbance ratings: 90% of the time no disturbance was observed, 8% the crew had to deal with low, 1% moderate, and 1% with high levels of disturbance during observation hours. This level of disturbance is slightly higher than previous years because high levels of disturbance may not have been recorded adequately in the past. After reviewing the visitor log list in association with the few days where visitor disturbance was ranked high, it became apparent that even smaller groups of visitors can cause relatively high levels of disturbance.

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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: 1998–2009 versus 2010.

	COUNTS			RAPTORS/100 HOURS		
SPECIES	1998–2009[1]	2010	% Change	1998–2009[1]	2010	% Change
Turkey Vulture	36 ± 18.6	44	+24	8.8 ± 2.14	11.8	+35
Osprey	41 ± 13.4	36	-12	14.7 ± 3.40	15.1	+3
Northern Harrier	109 ± 35.6	114	+5	31.4 ± 7.15	36.9	+18
White-tailed Kite	0.1 ± 0.3	0	-100	–	–	
Sharp-shinned Hawk	780 ± 230.4	841	+8	253.5 ± 41.96	291.4	+15
Cooper's Hawk	237 ± 63.5	249	+5	83.2 ± 10.98	97.0	+17
Northern Goshawk	32 ± 12.8	30	-7	7.9 ± 1.88	7.8	-1
Unknown small accipiter[2]	48 ± 35.5	59	+22	–	–	
Unknown large accipiter[2]	9 ± 6.2	7	-25	–	–	
Unknown accipiter	78 ± 86.0	26	-67	–	–	
TOTAL ACCIPITERS	1167 ± 289.7	1212	+4	–	–	
Broad-winged Hawk	5 ± 2.1	4	-16	3.7 ± 1.27	2.8	-24
Swainson's Hawk	6 ± 5.3	5	-10	3.5 ± 2.03	1.5	-58
Red-tailed Hawk	310 ± 94.0	315	+2	87.6 ± 14.73	90.8	+4
Ferruginous Hawk	0 ± 0.3	0	-100	0.1 ± 0.19	0.0	-100
Rough-legged Hawk	27 ± 16.0	37	+38	21.1 ± 6.28	29.6	+40
Unidentified buteo	57 ± 39.5	14	-75	–	–	
TOTAL BUTEOS	404 ± 127.5	375	-7	–	–	
Golden Eagle	120 ± 32.4	109	-9	32.7 ± 6.25	32.0	-2
Bald Eagle	6 ± 4.5	10	+69	1.5 ± 0.59	2.4	+56
Unidentified eagle	3 ± 3.9	0	-100	–	–	
TOTAL EAGLES	129 ± 35.8	119	-7	–	–	
American Kestrel	56 ± 24.8	47	-16	18.4 ± 4.80	15.0	-19
Merlin	37 ± 11.2	63	+69	11.0 ± 2.02	22.1	+101
Prairie Falcon	8 ± 5.2	11	+31	2.4 ± 0.65	3.2	+34
Peregrine Falcon	8 ± 5.8	10	+18	2.4 ± 0.76	2.9	+18
Unknown small falcon[2]	4 ± 2.8	4	+3	–	–	
Unknown large falcon[2]	2 ± 1.3	0	-100	–	–	
Unknown falcon	3 ± 3.1	1	-62	–	–	
TOTAL FALCONS	117 ± 32.0	136	+16	–	–	
Unidentified raptor	105 ± 72.8	96	-8	–	–	
GRAND TOTAL	2107 ± 451.3	2132	+1	–	–	

[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: 1998–2009 versus 2010.

	Total and Age-classified Counts								Immature : Adult	
	1998–2009 Average			2010			% Unknown Age		Ratio	
	Total	Imm.	Adult	Total	Imm.	Adult	1998–2009[1]	2010	1998–2009[1]	2010
Northern Harrier	108	36	25	114	53	20	43 ± 5.8	36	1.6 ± 0.39	2.7
Sharp-shinned Hawk	819	421	133	841	393	166	32 ± 5.8	34	3.7 ± 1.24	2.4
Cooper's Hawk	244	117	32	249	80	89	40 ± 6.2	32	4.3 ± 1.42	0.9
Northern Goshawk	32	16	4	30	25	0	37 ± 6.8	17	6.1 ± 3.69	N/A
Broad-winged Hawk	5	2	1	4	2	0	41 ± 13.6	50	1.2 ± 0.60	N/A
Red-tailed Hawk	324	71	133	315	67	112	36 ± 5.3	43	0.6 ± 0.14	0.6
Golden Eagle	121	58	26	109	71	22	30 ± 4.0	15	2.3 ± 0.36	3.2
Bald Eagle	6	2	5	10	4	4	6 ± 8.3	20	0.3 ± 0.26	1.0
Peregrine Falcon	9	3	2	10	3	3	45 ± 16.0	40	2.1 ± 0.99	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 2010, with a comparison of 2010 and 1998–2009 average median passage dates.

	2010				1998–2009
Species	First Observed	Last Observed	Bulk Passage Dates[1]	Median Passage Date[2]	Median Passage Date[2, 3]
Turkey Vulture	27-Aug	4-Oct	3-Sep – 27-Sep	17-Sep	15-Sep ± 3.3
Osprey	24-Aug	16-Oct	14-Sep – 7-Oct	23-Sep	19-Sep ± 2.7
Northern Harrier	24-Aug	17-Oct	6-Sep – 6-Oct	23-Sep	22-Sep ± 2.4
Sharp-shinned Hawk	24-Aug	23-Oct	5-Sep – 7-Oct	26-Sep	21-Sep ± 1.7
Cooper's Hawk	24-Aug	16-Oct	3-Sep – 2-Oct	22-Sep	17-Sep ± 1.6
Northern Goshawk	26-Aug	23-Oct	15-Sep – 22-Oct	17-Oct	29-Sep ± 5.2
Broad-winged Hawk	30-Aug	2-Oct	–		14-Sep ± 3.2
Swainson's Hawk	11-Sep	2-Oct	22-Sep – 2-Oct	3-Oct	15-Sep ± 4.5
Red-tailed Hawk	23-Aug	23-Oct	10-Sep – 16-Oct	2-Oct	25-Sep ± 2.5
Rough-legged Hawk	2-Oct	17-Oct	14-Oct – 17-Oct	17-Oct	15-Oct ± 2.6
Golden Eagle	25-Aug	22-Oct	20-Sep – 17-Oct	7-Oct	5-Oct ± 1.9
Bald Eagle	2-Sep	23-Oct	9-Sep – 20-Oct	30-Sep	12-Oct ± 9.3
American Kestrel	25-Aug	13-Oct	30-Aug – 3-Oct	15-Sep	11-Sep ± 3.9
Merlin	4-Sep	22-Oct	14-Sep – 14-Oct	30-Sep	21-Sep ± 2.6
Prairie Falcon	2-Sep	17-Oct	2-Sep – 17-Oct	3-Oct	16-Sep ± 6.1
Peregrine Falcon	24-Aug	26-Sep	14-Sep – 28-Oct	16-Sep	16-Sep ± 5.9
Total	27-Aug	23-Oct	5-Sep – 13-Oct	26-Sep	22-Sep ± 1.6

[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: 1998–2009 versus 2010.

	ADULT		IMMATURE	
SPECIES	1998–2009[1]	2010	1998–2009[1]	2010
Northern Harrier	21-Sep ± 3.2	16-Sep	22-Sep ± 2.7	16-Sep
Sharp-shinned Hawk	02-Oct ± 1.6	30-Sep	14-Sep ± 1.5	15-Sep
Cooper's Hawk	26-Sep ± 2.2	22-Sep	13-Sep ± 1.4	12-Sep
Northern Goshawk	01-Oct ± 9.3	–	27-Sep ± 5.4	22-Sep
Red-tailed Hawk	29-Sep ± 2.1	25-Sep	17-Sep ± 3.2	12-Sep
Golden Eagle	04-Oct ± 3.6	18-Sep	04-Oct ± 1.7	5-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: 2001–2009 versus 2010.

	Capture Totals		Capture Rate[1]		Capture Success[2]	
	2001–2009[3]	2010	2001–2009[3]	2010	2001–2009[3]	2010
Northern Harrier	14.9 ± 4.9	29	2.0 ± 0.55	5.6	15.1 ± 3.9	25.4
Sharp-shinned Hawk	417.1 ± 64.2	396	55.3 ± 7.56	76.1	53.4 ± 9.6	43.7
Cooper's Hawk	115.0 ± 18.5	113	15.3 ± 2.39	21.7	44.1 ± 8.0	41.2
Northern Goshawk	15.6 ± 4.7	15	2.1 ± 0.57	2.9	57.6 ± 13.2	46.9
Broad-winged Hawk	0.1 ± 0.2	0	0.0 ± 0.00	0.0	0.0 ± 0.0	0.0
Red-tailed Hawk	26.3 ± 8.1	35	3.5 ± 1.07	6.7	6.8 ± 1.2	10.7
Rough-legged Hawk	3.0 ± 2.1	1	0.4 ± 0.18	0.2	8.5 ± 5.2	2.6
Golden Eagle	3.1 ± 1.4	5	0.4 ± 0.16	1.0	2.3 ± 1.0	4.6
American Kestrel	8.8 ± 2.9	3	1.2 ± 0.37	0.6	18.7 ± 9.4	6.1
Merlin	23.8 ± 7.8	30	3.1 ± 0.94	5.8	62.6 ± 20.7	46.2
Prairie Falcon	3.0 ± 1.1	1	0.4 ± 0.15	0.2	33.5 ± 15.6	9.1
Peregrine Falcon	1.7 ± 0.8	3	0.2 ± 0.10	0.6	19.1 ± 14.4	30.0
All species	632.3 ± 94.0	631	83.9 ± 10.97	121.2	34.3 ± 4.5	32.2

[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: 2001–2009 versus 2010.

		Female		Male			
Species	Years	HY	AHY	HY	AHY	Female : Male Ratio[1]	Imm. : Adult Ratio[1]
Sharp-shinned Hawk	Avg. 2001–2009	166	59	157	34	1.2 ± 0.07	3.6 ± 0.43
	2010	178	73	115	30	1.7	2.8
Cooper's Hawk	Avg. 2001–2009	45	24	36	10	1.6 ± 0.13	2.5 ± 0.36
	2010	48	28	26	11	2.1	1.9
Northern Goshawk	Avg. 2001–2009	4	1	10	1	0.5 ± 0.09	9.7 ± 4.38
	2010	3	0	12	0	0.3	

[1] Long-term values: mean ± 95% CI.

Table 7. Fall body condition indices for migrant accipiters captured at Chelan Ridge, WA: 2001–2009 versus 2010.

		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	2001–2009mean	60.1	15.3	11.2	5.1	8.2	16	64	19	19	59	18	4
Hawk	2010	78	7	8	3	5	54	37	9	43	48	8	1
Cooper's	2001–2009mean	72.6	10.7	8.0	3.8	4.9	31	61	8	24	53	19	4
Hawk	2010	77	5	11	2	5	81	19	0	54	35	8	4
Northern	2001–2009mean	84.7	4.0	4.4	2.2	4.6	20	73	6	27	60	11	2
Goshawk	2010	100	0	0	0	0	47	53	0	20	60	20	0

[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 2010.

BAND #	SPECIES[1]	SEX	BANDING DATE	BANDING AGE[2]	ENCOUNTER LOCATION	ENCOUNTER DATE	ENCOUNTER AGE[2]	DISTANCE (KM)	STATUS
1483 – 55865	SS	F	08-Sep-04	HY	Cashmere, WA	04-Mar-10	ATY	54	found dead – unknown cause
1573 – 85254	SS	M	08-Oct-09	HY	Bruneau, ID	16-Mar-10	HY	684	killed by a raptor
1623 – 25827	SS	F	01-Sep-09	HY	Guadalupe Coronado, Mexico	14-Jan-10	HY	2331	Caught due to injury – died
1623 – 25851	SS	F	04-Sep-09	HY	Cuauhtemoc, Mexico	31-Jan-10	HY	2319	found dead – shot
1807 – 94027	RT	U	11-Oct-06	AHY	Oregon City, OR	Apr-10	ATY	364	found dead – unknown cause
1005 – 24368	CH	F	14-Sep-09	ASY	Buena Vista, Mexico	Feb-10	ASY	3350	found dead – unknown cause
1177 – 06574	RT	U	25-Sep-06	HY	Springfield, OR	06-Jun-10	ATY	488	found dead – unknown cause
0804 – 31126	ML	F	28-Sep-06	HY	Rock Island, WA	Apr-10	ATY	63	found injured – died

[1] SS = Sharp-shinned Hawk; CH = Cooper's Hawk; GE = Golden Eagle; RT = Red-tailed Hawk.

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

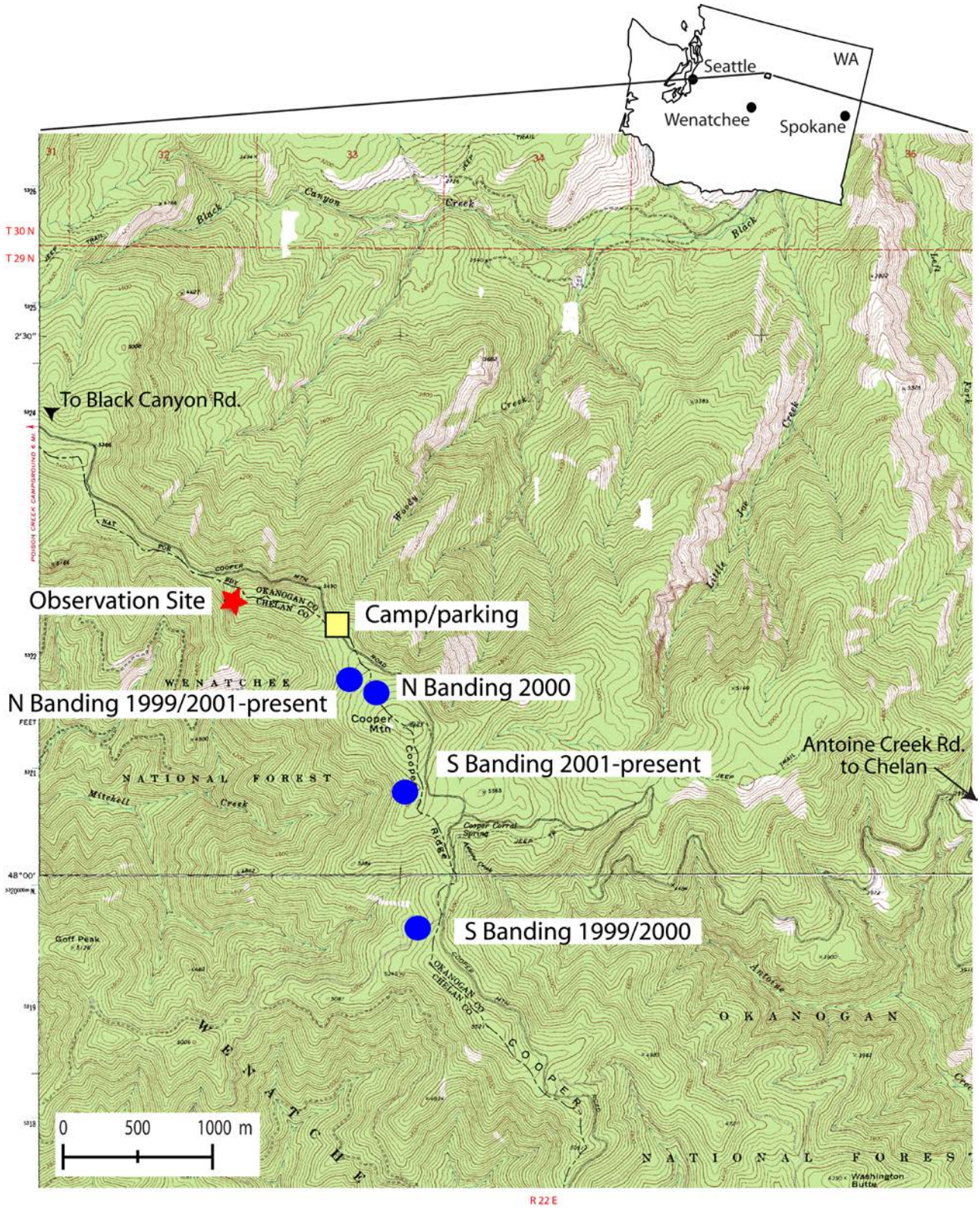

Figure 1. Location of the Chelan Ridge Raptor Migration Project count and banding sites in north-central Washington.

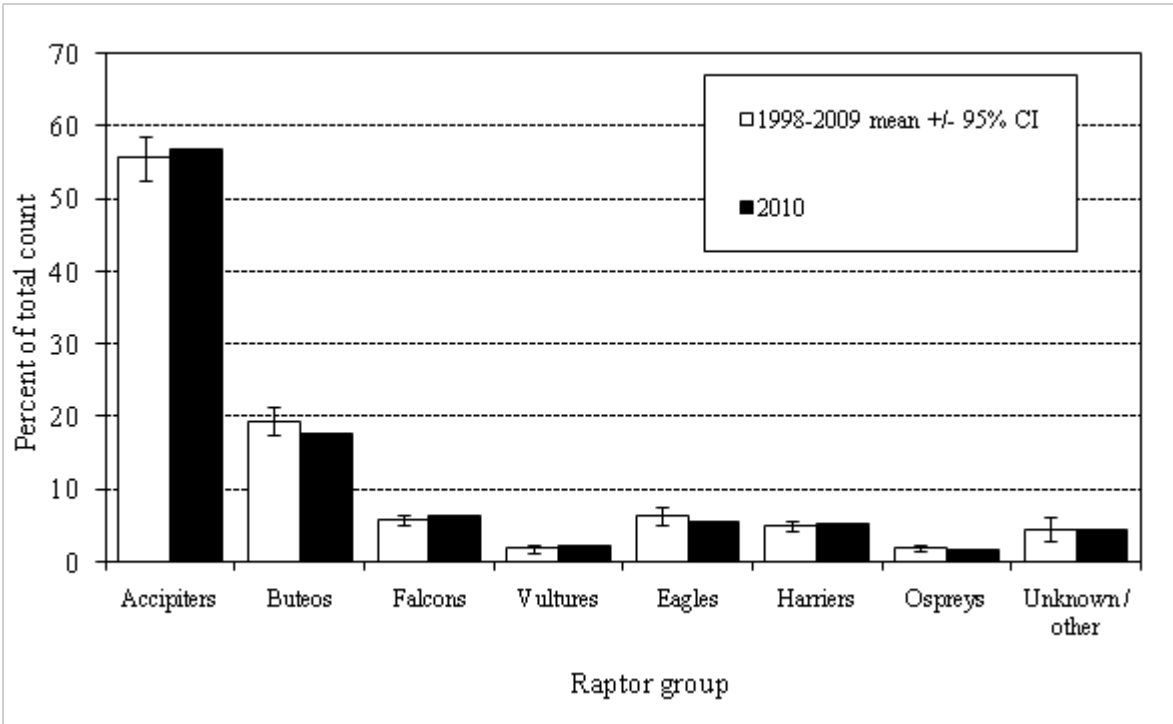

Figure 2. Fall raptor migration flight composition by major species groups at Chelan Ridge, WA: 1998–2009 versus 2010.

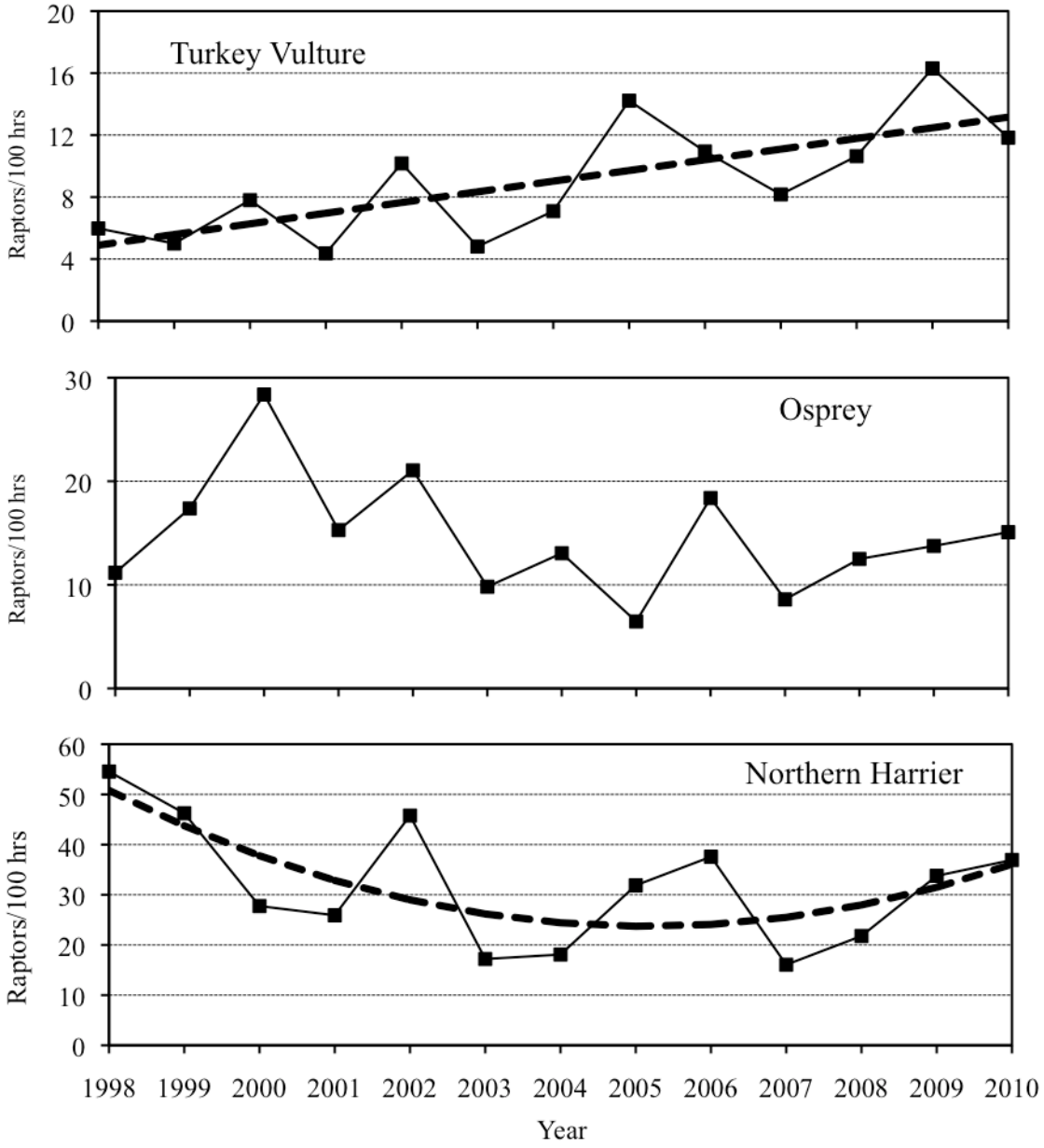

Figure 3. Adjusted fall-migration passage rates at Chelan Ridge, WA for Turkey Vultures, Ospreys, and Northern Harriers: 1998–2010. Dashed lines indicate significant linear or quadratic regressions.

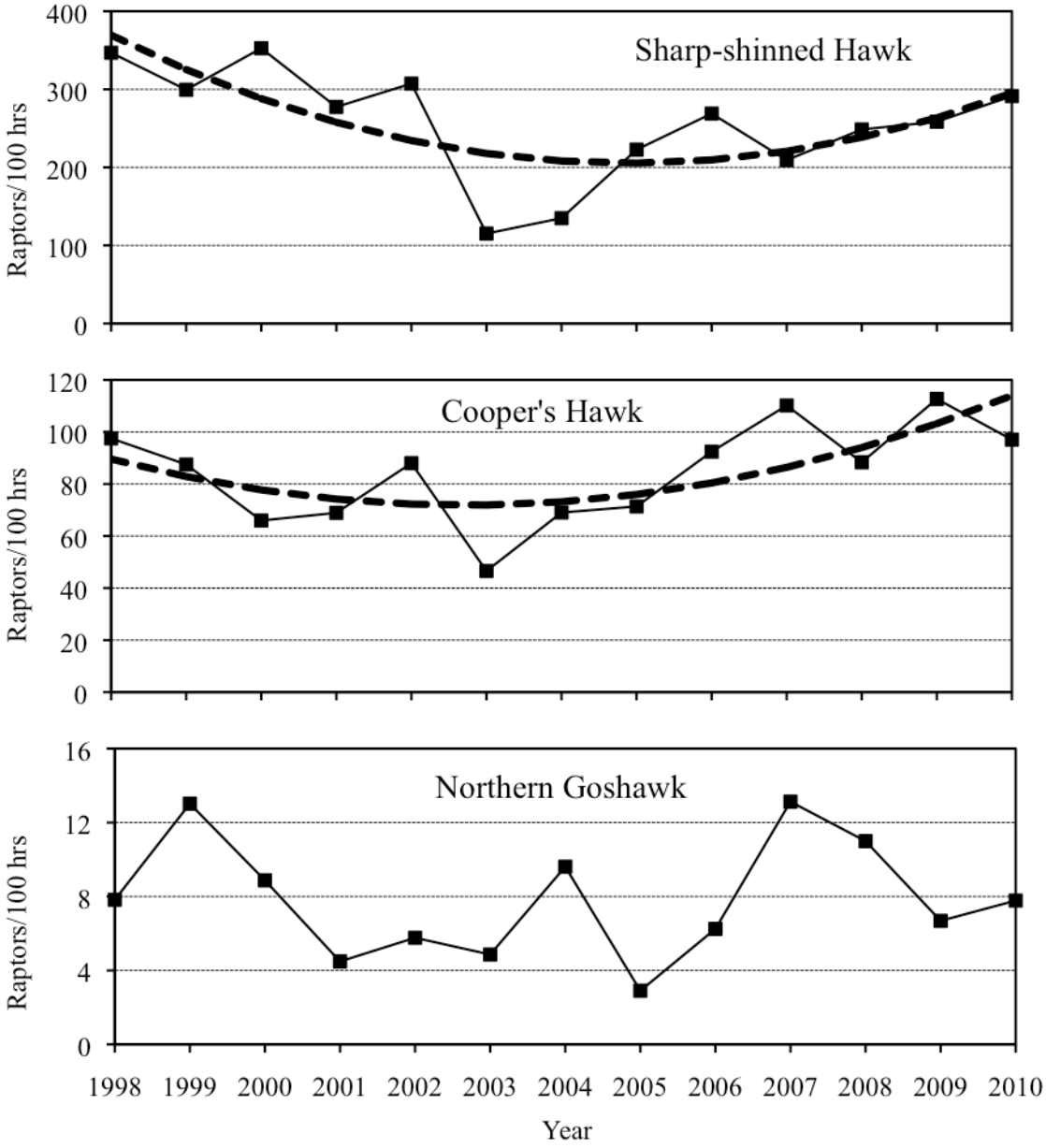

Figure 4. Adjusted fall-migration passage rates at Chelan Ridge, WA for Sharp-shinned Hawks, Cooper's Hawks, and Northern Goshawks: 1998–2010. Dashed lines indicate significant linear or quadratic regressions.

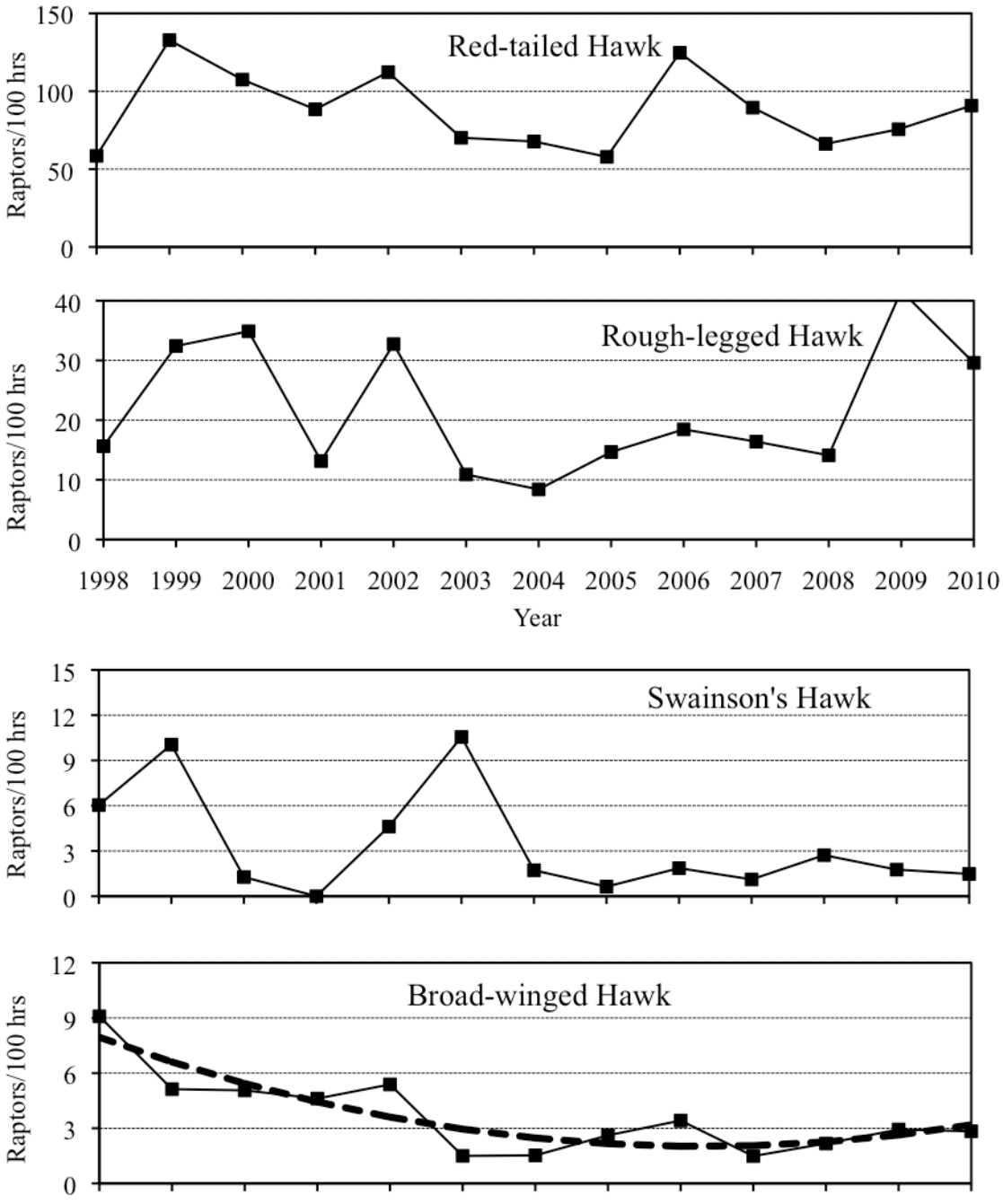

Figure 5. Adjusted fall-migration passage rates at Chelan Ridge, WA for Broad-winged, Swainson's, Red-tailed, and Rough-legged Hawks: 1998–2010. Dashed lines indicate significant linear or quadratic regressions.

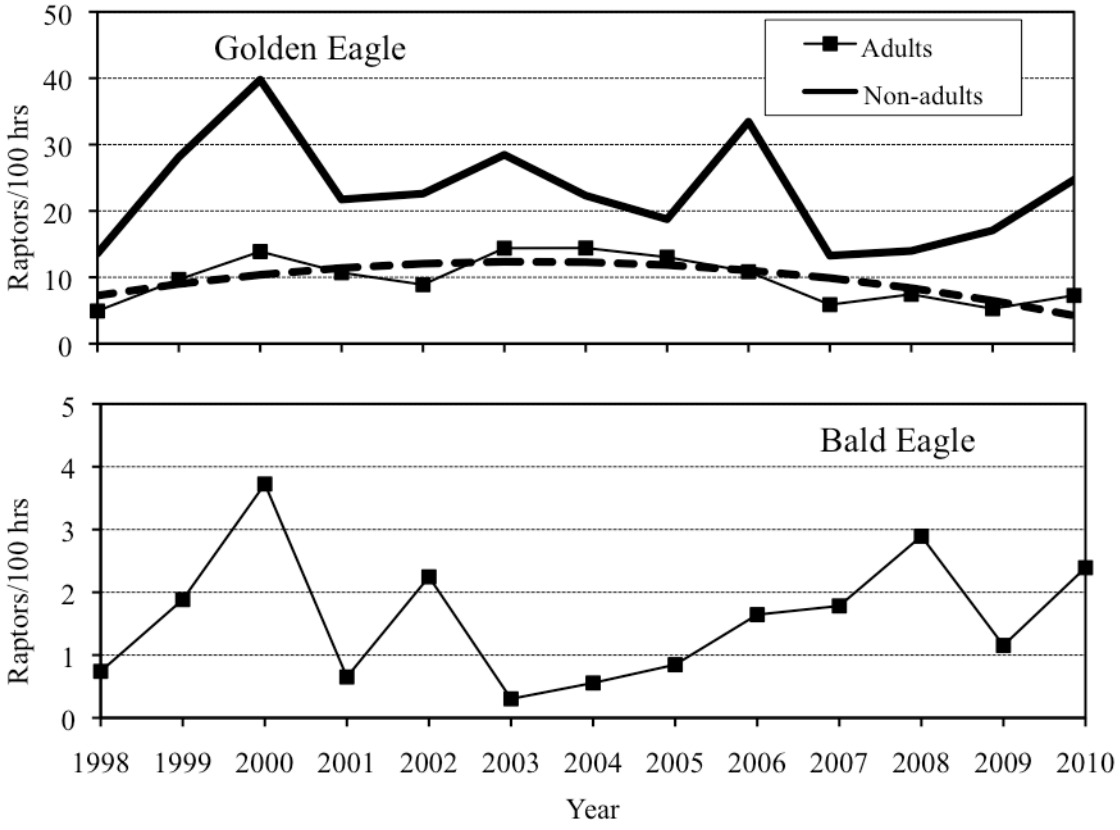

Figure 6. Adjusted fall-migration passage rates at Chelan Ridge, WA for Golden and Bald Eagles: 1998–2010. Dashed lines indicate significant linear or quadratic regressions.

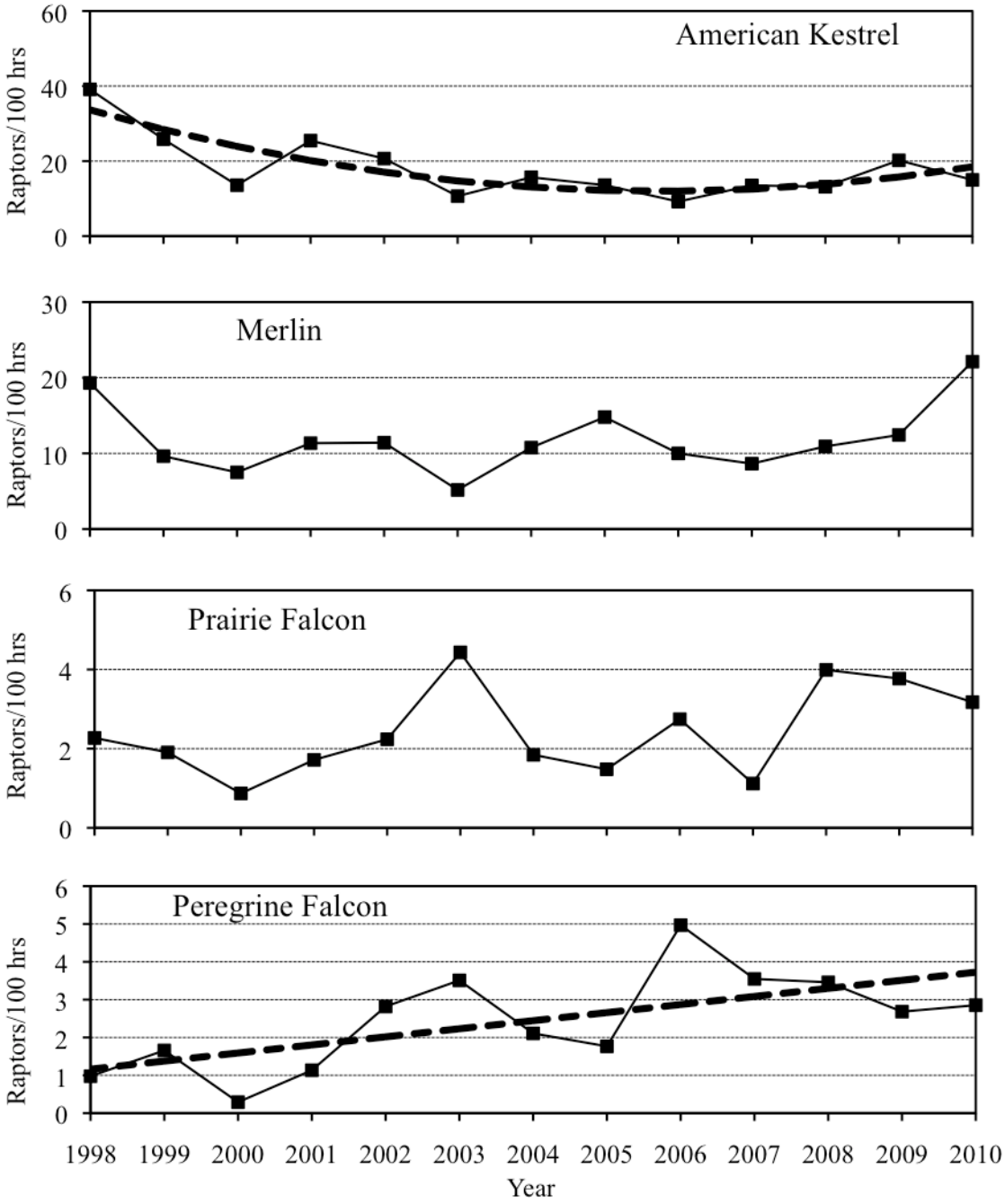

Figure 7. Adjusted fall-migration passage rates at Chelan Ridge, WA for American Kestrels, Merlins, Prairie Falcons, and Peregrine Falcons: 1998–2010. Dashed lines indicate significant linear or quadratic regressions.

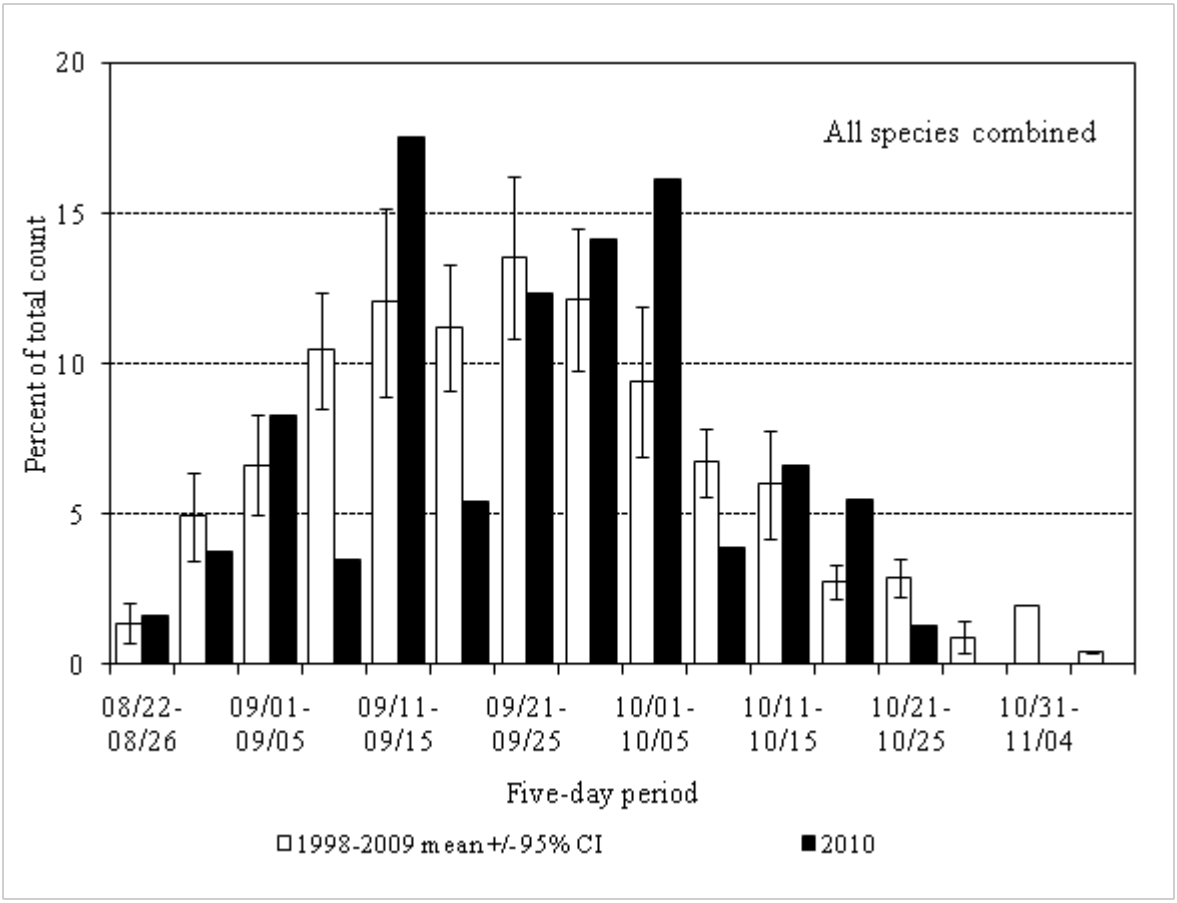

Figure 8. Combined-species passage volume by five-day periods for migrating raptors at Chelan Ridge, WA: 1998–2009 versus 2010.

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 (+), and Marie-Catherine Fournier (+).

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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: 2010.

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
23-Aug	9.00	2.0	0	clr,haze	9.8	ssw	13.9	-	3	98	95	0	0.2
24-Aug	9.00	2.8	0	clr,haze	11.8	s,ssw	15.4	30.29	3	87	86	0	0.8
25-Aug	9.00	2.0	0	clr,haze	15.8	s,ssw	19.3	30.13	3	89	72	1	0.6
26-Aug	9.00	2.0	0	clr,pc,mc,haze,dust	32.8	ssw,sw	14.7	29.88	3	67	72	0	1.3
27-Aug	9.00	2.0	0	pc,mc	11.2	ssw	9.3	29.98	4	75	100	0	1.0
28-Aug	9.00	2.0	0	pc,mc,ovc,haze	10.2	nnw,n	8.7	29.86	2	78	88	1	2.0
29-Aug	9.00	2.0	0	clr,mc,ovc	11.0	ssw,sw	9.7	29.86	3	78	100	1	1.1
30-Aug	9.00	2.0	0	mc,ovc	10.1	n,wsw,w,n	8.2	29.95	3	56	84	1	2.8
31-Aug	0.67	2.0	0	ovc,rain	14.3	s	5.0	30.00	4	47	45	0	0.0
01-Sep	9.17	2.3	0	clr,pc	10.4	ssw,sw	10.9	30.08	2	95	100	1	4.2
02-Sep	9.00	2.0	0	pc	8.3	sse,s,ssw	13.5	30.28	2	97	100	1	3.4
03-Sep	9.00	2.5	0	pc,mc	11.7	ssw,sw	15.5	30.12	1	97	95	1	6.0
04-Sep	9.17	2.5	0	clr,pc,mc	15.6	sw,wsw,w	11.8	29.98	3	86	95	2	2.4
05-Sep	9.00	2.7	0	mc,ovc	5.2	sw,nw	7.5	30.04	3	60	96	1	2.2
06-Sep	5.83	2.4	0	mc,ovc,rain	9.5	ssw,sw	7.3	30.00	4	39	81	1	1.2
07-Sep	0.00			Weather Day									
08-Sep	1.00	1.7	0	ovc,fog,rain	3.7	ssw	8.0	29.84	4	2	13	0	0.0
09-Sep	9.00	2.0	0	pc,ovc	8.4	ssw,sw,nw,n	8.0	29.90	3	49	98	3	2.4
10-Sep	9.00	2.5	0	clr,pc,haze	13.0	s,ssw	9.3	30.05	2	70	93	2	3.7
11-Sep	9.25	2.5	0	pc,mc	14.9	ssw	18.5	30.07	2	93	96	2	7.4
12-Sep	9.00	2.8	0	ovc	23.9	ssw,sw	10.3	30.06	4	60	96	1	5.3
13-Sep	9.42	2.1	0	clr,pc	8.4	s,sw	13.5	30.11	2	89	100	2	12.3
14-Sep	9.17	2.6	0	clr,pc	7.1	sw,n	13.9	30.10	2	100	100	3	9.2
15-Sep	8.42	2.0	0	mc,ovc	16.2	s,ssw,sw	13.3	30.04	3	77	88	1	10.7
16-Sep	9.00	2.0	0	ovc	5.3	s,ssw	11.8	30.04	3	76	75	2	7.9
17-Sep	8.67	1.9	0	ovc,haze	11.8	n,nne	8.9	30.02	4	16	35	2	3.0
18-Sep	0.00			Weather Day									
19-Sep	0.25	2.0	0	ovc,fog	14.5	ssw,sw	8.0	29.82	4	0	0	1	8.0
20-Sep	5.58	1.9	0	pc,mc,ovc,rain	27.6	ssw,sw	5.8	29.83	4	27	57	1	4.1
21-Sep	9.00	2.0	1	pc,mc,ovc,snow	4.5	n,nne	2.6	29.90	3	64	92	3	3.7
22-Sep	9.00	2.2	1	clr,haze	9.1	ssw,sw	4.5	29.88	2	97	100	1	14.4
23-Sep	5.50	2.0	0	ovc,fog,rain	20.0	ssw,sw	2.6	29.93	4	26	36	1	2.7
24-Sep	9.00	2.0	0	mc,ovc	13.2	ssw,sw	5.6	30.19	4	65	74	1	2.1
25-Sep	9.75	2.2	0	clr,haze	16.3	s,ssw	8.6	30.13	3	100	91	1	8.9
26-Sep	9.00	2.0	0	mc,ovc,rain,snow	17.8	ssw,sw	10.3	30.06	3	56	85	1	5.3
27-Sep	9.00	2.0	0	clr,pc,mc,ovc,snow	20.7	ssw,sw	10.8	30.15	3	64	96	1	11.1
28-Sep	9.00	2.0	0	clr,pc	21.2	ssw,sw	11.7	30.09	3	76	99	3	6.4
29-Sep	9.00	2.0	0	clr	7.5	nnw,n,ssw	8.3	30.18	2	95	98	3	6.0
30-Sep	9.00	2.0	0	clr,haze	13.4	n,ene	9.8	30.12	3	100	100	3	5.6
01-Oct	9.08	2.0	0	clr,haze	11.5	s,ssw,sw	15.3	30.16	2	92	89	1	12.6
02-Oct	9.42	1.9	0	clr,haze	10.1	s,ssw	16.2	30.11	2	95	40	2	13.0
03-Oct	8.75	2.0	0	ovc,haze	14.5	s,ssw,sw	13.8	29.96	3	93	29	1	5.5
04-Oct	8.75	2.0	0	mc,haze	7.5	ssw,n	10.2	30.02	3	57	39	1	6.9
05-Oct	8.75	2.0	0	clr,haze	9.5	n,ene,sw	7.8	30.34	2	95	90	2	3.4
06-Oct	8.75	2.0	0	clr,haze	5.2	sw,ssw,n,ene	12.8	30.19	3	100	95	1	1.9
07-Oct	8.75	2.0	0	pc,ovc,haze	5.3	s,ssw	12.8	30.02	3	85	51	0	2.6
08-Oct	8.75	3.0	0	mc,ovc,haze	6.4	s,ssw,sw	11.3	30.14	3	64	33	2	4.6
09-Oct	0.00			Weather Day									
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	8.75	2.3	0	clr	8.6	s,ssw	3.6	30.27	2	92	100	1	3.7
12-Oct	8.50	2.0	0	ovc,haze	15.4	ssw,sw	5.1	30.33	4	90	96	1	4.0
13-Oct	8.50	2.0	0	clr,pc,mc,haze	13.5	s,ssw,sw	7.9	30.25	3	81	45	1	2.0
14-Oct	8.50	1.4	0	pc,ovc,haze	21.0	s,ssw	10.5	30.09	3	82	33	1	1.6
15-Oct	8.50	2.0	0	clr,pc	2.4	var	1.7	30.18	1	94	99	2	2.8
16-Oct	8.50	2.0	0	clr,pc	11.9	s,ssw	2.8	30.09	3	100	100	1	5.1
17-Oct	8.50	2.0	0	clr	5.1	ssw,sw	4.6	30.16	2	95	85	2	4.4
18-Oct	8.25	2.0	0	ovc	7.4	ssw,sw	7.4	30.20	4	79	90	0	0.1
19-Oct	8.25	2.1	0	pc,mc	8.6	ssw,sw	9.4	30.18	3	97	70	1	0.6
20-Oct	8.25	2.0	0	pc,haze	14.8	s,ssw,sw	9.1	30.08	4	90	45	1	1.7
21-Oct	8.25	2.0	0	clr,pc,haze	8.6	s,ssw,sw	10.5	-	3	93	59	0	0.5
22-Oct	8.25	2.0	0	pc,ovc,haze	16.7	ssw,sw	6.3	-	3	69	69	0	1.3
23-Oct	6.50	2.0	0	ovc,fog	6.8	ssw,sw	3.5	-	4	24	31	1	0.8
24-Oct	0.00			Weather Day									

[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: 2010.

	OBS.	SPECIES[1]																											BIRDS
DATE	HOURS	TV	OS	NH	WK	SS	CH	NG	SA	LA	UA	BW	SW	RT	FH	RL	UB	GE	BE	UE	AK	ML	PR	PG	SF	LF	UF	UU	TOTAL	/HOUR
23-Aug	9.00	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0.2
24-Aug	9.00	0	1	1	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	7	0.8
25-Aug	9.00	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	0	5	0.6
26-Aug	9.00	0	0	0	0	4	0	1	0	0	2	0	0	1	0	0	1	0	0	0	2	0	0	0	0	0	0	1	12	1.3
27-Aug	9.00	1	0	0	0	3	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	9	1.0
28-Aug	9.00	1	0	1	0	6	2	0	1	0	1	0	0	2	0	0	0	0	0	0	2	0	0	0	0	0	0	2	18	2.0
29-Aug	9.00	0	0	2	0	4	2	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	10	1.1
30-Aug	9.00	0	0	3	0	8	6	0	0	0	0	1	0	4	0	0	0	0	0	0	2	0	0	0	0	0	0	1	25	2.8
31-Aug	0.67	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
1-Sep	9.00	1	0	2	0	21	7	0	2	0	0	0	0	2	0	0	0	0	0	0	2	0	0	0	0	0	0	1	38	4.2
2-Sep	9.00	1	0	1	0	12	4	0	2	0	1	0	0	3	0	0	0	1	1	0	3	0	1	0	0	0	0	1	31	3.4
3-Sep	9.00	5	0	2	0	21	10	2	0	0	1	0	0	6	0	0	0	1	0	0	5	0	0	1	0	0	0	0	54	6.0
4-Sep	9.17	0	0	1	0	10	1	0	0	0	0	0	0	4	0	0	0	0	0	0	3	2	1	0	0	0	0	0	22	2.4
5-Sep	9.00	1	0	0	0	10	4	0	0	1	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	1	20	2.2
6-Sep	5.83	1	0	2	0	2	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	1.2
7-Sep	0.00																													
8-Sep	1.00	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
9-Sep	9.00	0	0	1	0	9	3	0	5	0	0	1	0	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0	22	2.4
10-Sep	9.00	2	0	2	0	12	3	0	0	1	0	0	0	8	0	0	0	4	0	0	0	0	0	0	0	0	0	1	33	3.7
11-Sep	9.25	2	0	0	0	20	17	1	2	0	1	0	1	12	0	0	2	2	0	0	0	2	0	1	0	0	0	5	68	7.4
12-Sep	9.00	2	1	1	0	18	10	0	3	0	0	0	0	4	0	0	2	0	0	0	1	1	0	0	0	0	0	5	48	5.3
13-Sep	9.42	4	3	2	0	44	21	0	7	1	5	0	0	10	0	0	1	2	2	0	4	2	0	0	0	0	0	8	116	12.3
14-Sep	9.17	0	1	12	0	29	9	0	4	1	1	0	0	14	0	0	0	0	0	0	2	5	0	1	0	0	0	5	84	9.2
15-Sep	8.42	1	2	7	0	45	12	3	0	1	5	0	0	5	0	0	1	1	0	0	1	1	0	3	0	0	0	2	90	10.7
16-Sep	9.00	2	3	2	0	39	11	1	3	0	0	0	0	1	0	0	0	2	0	0	2	0	0	0	0	0	0	5	71	7.9
17-Sep	8.67	2	4	3	0	8	1	1	3	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26	3.0
18-Sep	0.00																													
19-Sep	0.25	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	8.0

Appendix D. continued

DATE	OBS. HOURS	SPECIES[1] TV	OS	NH	WK	SS	CH	NG	SA	LA	UA	BW	SW	RT	FH	RL	UB	GE	BE	UE	AK	ML	PR	PG	SF	LF	UF	UU	TOTAL	BIRDS /HOUR
20-Sep	5.58	0	0	0	0	13	4	0	1	0	0	1	0	2	0	0	0	1	0	0	0	0	0	1	0	0	0	0	23	4.1
21-Sep	9.00	0	1	2	0	18	3	0	3	0	0	0	0	3	0	0	1	0	0	0	0	1	0	0	0	0	0	1	33	3.7
22-Sep	9.00	5	10	13	0	43	19	1	3	0	1	0	1	17	0	0	0	1	0	0	2	4	0	1	0	0	0	9	130	14.4
23-Sep	5.50	2	0	1	0	4	1	0	0	0	0	0	0	0	0	0	1	2	0	0	0	1	0	0	0	0	0	3	15	2.7
24-Sep	9.00	0	0	0	0	10	4	0	0	0	0	0	0	4	0	0	1	0	0	0	0	0	0	0	0	0	0	0	19	2.1
25-Sep	9.75	4	0	7	0	44	10	0	2	0	1	0	1	6	0	0	1	3	1	0	0	2	0	0	0	0	0	5	87	8.9
26-Sep	9.00	0	0	0	0	28	8	0	0	0	1	0	0	1	0	0	0	4	0	0	1	2	1	1	0	0	0	1	48	5.3
27-Sep	9.00	5	0	3	0	49	17	0	0	0	0	0	0	12	0	0	0	2	0	0	1	4	1	0	2	0	0	4	100	11.1
28-Sep	9.00	0	1	2	0	27	6	0	4	0	1	0	0	9	0	0	0	0	0	0	1	4	0	0	0	0	0	3	58	6.4
29-Sep	9.00	0	0	1	0	23	5	0	4	0	2	0	0	3	0	0	0	3	2	0	3	4	0	0	0	0	0	4	54	6.0
30-Sep	9.00	0	1	2	0	24	2	0	2	0	0	0	0	6	0	0	0	5	0	0	2	2	0	0	0	0	0	4	50	5.6
1-Oct	9.08	1	3	14	0	47	14	0	0	0	1	0	0	23	0	0	0	5	0	0	3	2	0	0	0	0	0	1	114	12.6
2-Oct	9.42	0	1	11	0	50	12	2	3	0	0	1	2	18	0	1	0	4	0	0	1	7	1	0	1	0	0	7	122	13.0
3-Oct	8.75	0	0	2	0	21	4	1	0	0	0	0	0	8	0	0	0	4	0	0	1	5	1	0	0	0	0	1	48	5.5
4-Oct	8.75	1	1	1	0	27	5	0	2	0	1	0	0	16	0	0	0	2	0	0	0	0	0	0	0	0	1	3	60	6.9
5-Oct	8.75	0	0	0	0	9	1	1	3	1	0	0	0	6	0	0	0	6	1	0	0	0	1	0	0	0	0	1	30	3.4
6-Oct	8.75	0	0	2	0	5	2	0	0	0	0	0	0	4	0	0	0	2	0	0	0	1	0	0	1	0	0	0	17	1.9
7-Oct	8.75	0	1	0	0	6	0	0	0	0	0	0	0	8	0	0	0	7	0	0	0	1	0	0	0	0	0	0	23	2.6
8-Oct	8.75	0	0	0	0	15	0	0	0	0	0	0	0	13	0	0	1	9	0	0	0	0	0	0	0	0	0	2	40	4.6
9-Oct	0.00																													
10-Oct	0.00																													
11-Oct	8.75	0	0	0	0	4	0	0	0	0	0	0	0	18	0	2	0	5	0	0	0	0	0	0	0	0	0	3	32	3.7
12-Oct	8.50	0	0	0	0	14	1	1	0	0	0	0	0	11	0	1	0	2	0	0	0	1	3	0	0	0	0	0	34	4.0
13-Oct	8.50	0	0	2	0	9	0	0	0	0	0	0	0	0	0	2	1	2	0	0	1	0	0	0	0	0	0	0	17	2.0
14-Oct	8.50	0	0	0	0	4	0	0	0	0	0	0	0	1	0	2	0	2	0	0	0	5	0	0	0	0	0	0	14	1.6
15-Oct	8.50	0	1	2	0	5	0	1	0	0	0	0	0	8	0	0	0	6	0	0	0	0	0	0	0	0	0	1	24	2.8
16-Oct	8.50	0	1	2	0	3	1	5	0	0	0	0	0	10	0	16	0	3	0	0	0	0	0	0	0	0	0	2	43	5.1
17-Oct	8.50	0	0	2	0	3	0	0	0	0	0	0	0	12	0	13	0	3	0	0	0	1	1	0	0	0	0	2	37	4.4

Appendix D. continued

	OBS.	SPECIES[1]																											BIRDS
DATE	HOURS	TV	OS	NH	WK	SS	CH	NG	SA	LA	UA	BW	SW	RT	FH	RL	UB	GE	BE	UE	AK	ML	PR	PG	SF	LF	UF	UU	TOTAL	/HOUR
18-Oct	8.25	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.1
19-Oct	8.25	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	1	0	0	0	0	0	0	5	0.6
20-Oct	8.25	0	0	0	0	3	0	1	0	0	0	0	0	4	0	0	0	5	1	0	0	0	0	0	0	0	0	0	14	1.7
21-Oct	8.25	0	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	4	0.5
22-Oct	8.25	0	0	0	0	2	0	4	0	1	0	0	0	1	0	0	0	2	0	0	0	1	0	0	0	0	0	0	11	1.3
23-Oct	6.50	0	0	0	0	1	0	2	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	5	0.8
24-Oct	0.00																													
25-Oct	0.00																													
26-Oct	0.00																													
Total	477.17	44	36	114	0	841	249	30	59	7	26	4	5	315	0	37	14	109	10	0	47	63	11	10	4	0	1	96	2132	4.5

[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: 1997–2010.

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	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	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	23-Oct
Observation days	29	53	61	67	55	62	59	59	62	64	62	64	60	58	60
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	495.5
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	441.8
Species	Raptor Counts														
Turkey Vulture	4	29	21	26	14	46	30	25	58	50	42	48	70	44	38
Osprey	41	24	47	71	48	57	31	34	25	50	31	37	36	36	41
Northern Harrier	115	152	167	104	91	148	66	59	113	127	60	82	127	114	108
White-tailed Kite	0	0	0	0	0	0	1	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	819
Cooper's Hawk	150	247	232	198	198	234	136	220	228	270	363	269	332	249	244
Northern Goshawk	38	32	50	35	16	22	17	41	13	31	49	48	27	30	32
Unknown small accipiter[1]	–	–	–	–	98	85	40	1	48	97	45	33	87	59	48
Unknown large accipiter[1]	–	–	–	–	0	10	17	6	6	11	3	19	12	7	9
Unknown accipiter	182	221	248	98	0	49	36	10	9	12	8	8	38	26	70
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	1,308
Broad-winged Hawk	2	7	5	5	6	9	3	2	6	4	2	5	6	4	5
Swainson's Hawk	0	8	17	2	0	7	15	5	2	2	4	5	5	5	6
Red-tailed Hawk	145	182	450	364	263	386	263	277	233	441	378	304	341	315	324
Ferruginous Hawk	0	0	0	1	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	29
Unidentified buteo	75	58	148	97	83	82	39	15	29	57	29	10	20	14	56
Total Buteos	223	268	664	522	365	529	334	319	292	532	435	349	420	375	450
Golden Eagle	105	55	141	174	105	135	142	130	130	157	82	111	93	109	121
Bald Eagle	2	2	7	15	2	8	1	2	4	8	10	12	4	10	6
Unidentified eagle	7	0	7	5	1	0	12	0	2	0	0	0	1	0	2
Total Eagles	114	57	155	194	108	143	155	132	136	165	92	123	98	119	140
American Kestrel	24	107	89	40	84	68	33	48	55	29	47	47	59	47	59
Merlin	17	55	36	26	36	38	21	39	53	34	40	44	45	63	39
Prairie Falcon	2	10	7	5	5	6	19	5	4	9	6	17	14	11	9
Peregrine Falcon	5	2	9	1	3	9	14	7	4	20	16	13	7	10	9
Unknown small falcon[1]	–	–	–	–	6	4	6	5	1	3	0	2	9	4	4
Unknown large falcon[1]	–	–	–	–	1	2	2	2	3	3	1	1	5	0	2
Unknown falcon	10	6	6	2	2	0	0	4	0	0	1	0	2	1	2
Total Falcons	58	180	147	74	137	127	95	110	120	98	111	124	141	136	133
Unidentified Raptor	178	216	218	62	112	178	134	27	48	52	30	22	85	96	99
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	2,164

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

Appendix F. Daily capture totals of migrating raptors at Chelan Ridge, WA: 2010.

	STN	SPECIES[1]													CAPTURES
DATE	HOURS	NH	SS	CH	NG	BW	RT	RL	GE	AK	ML	PR	PG	TOTAL	/STN HR
25-Aug	7.50	0	3	3	0	0	0	0	0	0	0	0	0	6	0.8
26-Aug	8.00	0	0	2	0	0	0	0	0	0	0	0	0	2	0.3
27-Aug	8.75	0	0	0	0	0	0	0	0	1	0	0	0	1	0.1
28-Aug	8.75	0	1	3	0	0	0	0	0	0	0	0	0	4	0.5
29-Aug	8.50	0	2	1	0	0	1	0	0	0	0	0	0	4	0.5
30-Aug	8.50	0	2	0	0	0	0	0	0	0	0	0	0	2	0.2
31-Aug	1.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
1-Sep	9.00	0	7	6	0	0	0	0	0	0	0	0	0	13	1.4
2-Sep	9.00	0	7	2	0	0	0	0	0	0	0	0	0	9	1.0
3-Sep	9.00	2	9	1	1	0	2	0	0	0	1	0	1	17	1.9
4-Sep	11.16	0	7	3	0	0	0	0	0	0	0	0	0	10	0.9
5-Sep	17.75	0	13	3	0	0	1	0	0	0	0	0	0	17	1.0
6-Sep	6.00	1	2	1	0	0	1	0	0	0	0	0	0	5	0.8
7-Sep	0.00														
8-Sep	0.00														
9-Sep	17.75	1	5	1	0	0	1	0	0	0	0	0	0	8	0.5
10-Sep	9.00	0	6	0	0	0	1	0	0	0	3	0	0	10	1.1
11-Sep	16.84	0	16	13	0	0	2	0	0	0	0	0	0	31	1.8
12-Sep	9.00	0	8	9	0	0	2	0	0	0	0	0	1	20	2.2
13-Sep	9.00	0	21	10	0	0	0	0	0	0	2	0	0	33	3.7
14-Sep	9.00	4	16	1	0	0	1	0	0	0	3	0	0	25	2.8
15-Sep	8.50	2	19	7	1	0	4	0	0	0	1	0	1	35	4.1
16-Sep	15.50	1	19	4	0	0	0	0	0	0	1	0	0	25	1.6
17-Sep	15.91	0	9	1	0	0	1	0	0	0	1	0	0	12	0.8
18-Sep	0.00														
19-Sep	3.00	0	3	1	0	0	1	0	0	0	0	0	0	5	1.7
20-Sep	5.50	0	1	1	0	0	0	0	0	0	0	0	0	2	0.4
21-Sep	17.75	1	9	1	0	0	0	0	0	1	2	0	0	14	0.8
22-Sep	8.75	3	13	6	0	0	0	0	0	0	0	0	0	22	2.5
23-Sep	4.00	0	4	1	0	0	0	0	0	0	0	0	0	5	1.3
24-Sep	9.00	0	6	3	0	0	2	0	0	0	1	0	0	12	1.3

Appendix F. continued

Date	Stn Hours	Species[1] NH	SS	CH	NG	BW	RT	RL	GE	AK	ML	PR	PG	Total	Captures / Stn Hr
25-Sep	17.91	3	21	5	0	0	2	0	0	0	1	0	0	32	1.8
26-Sep	8.50	1	5	4	1	0	0	0	0	0	2	0	0	13	1.5
27-Sep	8.75	0	30	3	0	0	5	0	0	0	0	0	0	38	4.3
28-Sep	8.75	1	13	0	0	0	0	0	0	0	0	0	0	14	1.6
29-Sep	17.92	0	10	6	0	0	0	0	0	0	3	0	0	19	1.1
30-Sep	9.00	1	4	0	0	0	0	0	0	0	0	0	0	5	0.6
1-Oct	8.00	2	22	2	0	0	2	0	1	0	1	0	0	30	3.8
2-Oct	17.67	2	22	1	1	0	0	0	0	1	1	0	0	28	1.6
3-Oct	8.50	0	10	4	2	0	1	0	0	0	1	0	0	18	2.1
4-Oct	8.25	0	10	0	0	0	0	0	0	0	0	0	0	10	1.2
5-Oct	3.50	0	3	0	0	0	0	0	2	0	0	0	0	5	1.4
6-Oct	8.50	2	6	0	0	0	0	0	0	0	0	0	0	8	0.9
7-Oct	8.00	0	4	1	0	0	1	0	1	0	2	0	0	9	1.1
8-Oct	8.50	1	5	1	1	0	0	0	0	0	1	0	0	9	1.1
9-Oct	0.00														
10-Oct	0.00														
11-Oct	8.50	0	2	2	0	0	2	0	0	0	0	0	0	6	0.7
12-Oct	8.00	0	5	0	0	0	0	0	0	0	1	0	0	6	0.8
13-Oct	8.00	1	4	0	0	0	0	0	0	0	0	0	0	5	0.6
14-Oct	11.75	0	3	0	0	0	0	0	0	0	0	0	0	3	0.3
15-Oct	8.00	0	2	0	1	0	0	0	0	0	1	0	0	4	0.5
16-Oct	8.00	0	0	0	3	0	0	0	0	0	0	0	0	3	0.4
17-Oct	16.25	0	1	0	1	0	1	1	0	0	1	1	0	6	0.4
18-Oct	8.00	0	0	0	1	0	0	0	0	0	0	0	0	1	0.1
19-Oct	7.75	0	1	0	0	0	0	0	0	0	0	0	0	1	0.1
20-Oct	7.00	0	3	0	1	0	1	0	1	0	0	0	0	6	0.9
21-Oct	8.00	0	1	0	0	0	0	0	0	0	0	0	0	1	0.1
22-Oct	7.75	0	1	0	1	0	0	0	0	0	0	0	0	2	0.3
Total	520.66	29	396	113	15	0	35	1	5	3	30	1	3	631	1.2 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: 1999–2010.

	1999[1]	2000[1]	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	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		
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		
Number of stations	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	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	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	8.8	
SPECIES	RAPTOR CAPTURES													
Northern Harrier	4	3	10	13	11	6	12	28	12	18	24	29	16.3	170
Sharp-shinned Hawk	139	125	341	459	394	237	389	556	450	503	419	396	415	4414
Cooper's Hawk	42	46	107	127	100	58	137	100	138	140	128	113	115	1236
Northern Goshawk	14	10	12	13	9	16	11	24	16	29	10	15	16	179
Broad-winged Hawk											1			1
Red-tailed Hawk	11	8	22	29	20	16	11	50	33	22	34	27	27	291
Rough-legged Hawk	0	1	1	2	1	0	5	6	1	2	9	1	2.8	29
Golden Eagle	0	1	2	0	4	2	2	6	2	5	5	3	3	34
American Kestrel	3	0	8	10	17	5	6	8	3	13	9	8	8	85
Merlin	6	4	17	21	25	10	49	31	15	25	21	30	24	254
Prairie Falcon	1	1	3	4	4	1	0	3	4	5	3	1	3	30
Peregrine Falcon	0	0	2	0	4	1	1	2	1	2	2	3	2	18
All species	220	199	525	678	589	352	623	814	675	764	665	631	632	6741
Recaptures[2]	0	0	0	0	0	0	0	0	1	0	0	7	1	8
Foreign Recaptures[3]	0	0	0	1	0	0	0	2	2	0	1	1	0.8	8
Foreign Encounters[4]	0	1	5	2	1	1	4	15	12	7	9	9	6.7	68

[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.