

**FALL 2009 RAPTOR MIGRATION STUDIES
AT CHELAN RIDGE, WASHINGTON**



**This Report is Dedicated to the Memory of Christopher Street
Shown Above with a Special Friend at Chelan in 2008**

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



**Okanogan and Wenatchee National Forests
Winthrop, Washington**

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**FALL 2009 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. 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 2009 season marked the 12th consecutive, full-season count and the 11th consecutive season of banding at the site. This report summarizes the 2009 count and banding results.

The Chelan Ridge project was 1 of 10 long-term, annual migration counts and 1 of 5 migration-banding studies conducted or co-sponsored by HWI in North America during 2008. 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.

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 2009 follows Hoffman and Smith (2003). In comparing 2009 annual statistics against means and 95% confidence intervals for previous seasons, I equate significance with a 2009 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 entirely precluded 4 days of planned observations, including shutting down the project two days earlier than hoped for (27 October), and reduced observations to ≤ 4 hours on 3 other days (see Appendix C for daily weather records). The corresponding 1998–2008 averages are 4.5 and 1.9 days, respectively, indicating a slightly higher than average impact on observation effort. Otherwise, however, weather data collected on site during active observation periods indicated average sky conditions. Forty-seven percent of the active days featured predominantly fair skies, 35% transitional skies (i.e., changed from fair or partly cloudy to mostly cloudy or overcast during the day, or vice versa), and 18% mostly cloudy to overcast skies, compared to long-term averages of 48%, 31%, and 21%, respectively. In addition, 40% of the active days featured noteworthy levels of visibility reducing fog or haze and 15% featured some rain/snow showers, compared to averages of 40% and 14%, respectively.

The 2009 season also was fairly typical in terms of wind conditions. Light winds (< 12 kph) prevailed on 67% of the active observation days, moderate winds on 33%, and strong winds (≥ 29 kph) on no days, compared to 1998–2008 averages of 70%, 28%, and 2%, respectively. As usual, S-SW winds were most common, prevailing on 44% of the active days (average 48%); days featuring a definitive shift during the day from southwesterly to northeasterly winds, or vice versa, were second-most common (12% vs. average of 11%); and variable SE-SW winds, on average the third most common pattern, prevailed on 8% of the active days (average 9%). Relatively minor variations from the average pattern included the fact that days featuring some combination of SE-SW and NW-NE winds, which average fourth most common (5%), occurred twice as often as usual in 2009 (10%), and days where NW-NE winds prevailed throughout the day also were a bit more common than usual (7% vs. average of 4%).

The temperature during active observation periods averaged 12.4°C (the average of daily values, which in turn were averages of hourly readings), ranging from -2.4–25.1°C. The overall average nearly matched the long-term average of 12.5°C and the maximum daily average also ranked in the middle of the previous range of values; however, the minimum daily average was the second lowest to date. The barometric pressure during active observation periods averaged 30.02 in Hg, ranging from 29.38–30.44 in Hg, with all values ranking average to slightly below average. In 2009, 46% of the active days featured

predominantly good-to-excellent thermal-lift conditions, which is only slightly above average (43%) and terminates what had been a four-year increasing trend.

In summary, inclement weather kept our 2009 observers away from the site slightly more often than usual, including shutting down the project two days earlier than hoped for, but otherwise the weather and wind conditions generally ranked average for the site and past decade.

OBSERVATION EFFORT

Observations occurred on 60 of 65 possible days between the scheduled observation period of 24 August through 27 October. The number of observation days matched the 1998–2008 average of $60 \pm 95\%$ CI of 2.3 days and the number of observation hours (507.74) was a non-significant 3% above average (494.37 ± 27.50 hrs). The 2009 average of 2.2 observers per hour (including official and guest observers; value is mean of daily values, which are in turn means of hourly values) was a significant 11% higher than the 1998–2008 average of 2.0 ± 0.06 observers/hour.

FLIGHT SUMMARY AND TRENDS

The observers counted 2,325 migrating raptors of 16 species during the 2009 season (Table 1; see Appendix D for daily count records), which is a non-significant 11% above average (see Appendix E for annual count summaries). The flight consisted of 58% accipiters, 18% buteos, 6% falcons, 5% harriers, 4% eagles, 3% vultures, 2% Ospreys, and 4% unknown raptors (Figure 2). The proportion of vultures was significantly above average, whereas the proportions of eagles and Ospreys were significantly below average. The most common species seen in 2009 were the Sharp-shinned Hawk (37% of the total count), Red-tailed Hawk (15%), Cooper's Hawk (14%), Northern Harrier (6%), Golden Eagle (4%), and American Kestrel (3%). All other species each comprised less than 2% of the total count.

The count of 70 Turkey Vultures was a new record-high for the site; no record low or high species-specific counts occurred in 2009 (Appendix E). Adjusted passage rates were significantly above average for Turkey Vultures, Cooper's Hawks, Rough-legged Hawks, and Prairie Falcons, but were significantly below average for Swainson's Hawks and Golden Eagles (Table 1).

Population Trends.—Regression analyses of trends in adjusted passage rates updated through 2009 (after Hoffman and Smith 2003) indicated that what had been a significant declining trend for Northern Harriers is now best fit by a marginally significant ($P \leq 0.10$) trough-shaped, second-order, or quadratic, trend that reflects recent, overall stabilization of this species passage rates (Figure 3). Similar patterns and quadratic trends applied to Broad-winged Hawks (Figure 5), Sharp-shinned and Cooper's Hawks (Figure 4), and American Kestrels (Figure 5), with distinct upswings now evident for the latter three species and passage rates of Cooper's Hawks in record-high territory during 2 of the last 3 years. A highly significant ($P \leq 0.01$), quadratic trend also provided the best fit to data for adult Golden Eagles, but in this case tracking an increasing pattern through the early 2000s, but a declining trend after 2005 (Figure 6). No significant trend currently is indicated for non-adult Golden Eagles, but their passage rates also have been low for the past three seasons (Figure 6). Conversely, with a new record-high passage rate in 2009, a highly significant increasing trend is now indicated for Turkey Vultures (Figure 3). A significant long-term increasing trend is still indicated for Peregrine Falcons as well; however, passage rates of this species have now declined for three years in a row (Figure 7).

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. These analyses (hereafter called the Raptor Population Index or "RPI" analyses; see <http://www.rpi-project.org>) 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 2009. Among other refinements, this new approach both fits polynomial trajectories to the complete series of

annual count indices and allows for estimating rates of change between various periods, while also allowing for assessments of trend significance and precision. Note, however, that restrictions related to the mathematical assumptions behind the new approach precluded analyzing data for rare species, which in this case included all *buteos* except Red-tailed Hawk, and Prairie and Peregrine Falcons. Otherwise, with a few notable exceptions, the overall patterns of change and derived trend estimates suggested by the new modeling technique generally yielded similar inferences as those derived using the simpler methodology of Hoffman and Smith (2003) and presented herein to provide trend assessments updated through 2009.

Differences between the RPI results and those presented herein that clearly relate to addition of four more years of data include: a) replacement of no significant trend for Turkey Vultures in the RPI results with a highly significant increasing trend, primarily reflecting addition of the record-high passage rate in 2009; b) replacement of a significant decline for Northern Harriers in the RPI results with a marginally significant quadratic trend reflecting recent stabilization; c) replacement of at least marginally significant linear declines for Sharp-shinned and Cooper's Hawks in the RPI results with at least marginally significant quadratic trends illustrating sustained, recent recoveries; d) replacement of a marginally significant decline for Northern Goshawks in the RPI results with no significant overall trend, reflecting addition of four years of at least average passage rates since 2005; and e) replacement of a marginally significant linear decline for American Kestrels in the RPI results with a significant quadratic trend reflecting recent stabilization. No other noteworthy differences were apparent among the inferences generated by the RPI and updated Hoffman and Smith (2003) analyses.

At the 2007 joint meeting of the Raptor Research Foundation and Hawk Migration Association of North America in Allentown, Pennsylvania, a special symposium on American Kestrels was convened to draw attention to evidence of widespread declines of this otherwise common and ubiquitous species. The proceedings of this symposium will be published in the final 2009 issue of the *Journal of Raptor Research*, and will include another manuscript that specifically summarizes migration trend data for the species from across the continent, including Chelan Ridge (Farmer and Smith in press).

Age Ratios as Indicators of Regional Productivity.—Immature : adult ratios were significantly below average in 2009 for Cooper's Hawks and Bald Eagles, but were significantly above average for 5 of the remaining 8 species for which such comparisons were possible (Table 2). For Cooper's Hawks, the counts of identified adults and immature birds both were substantially above average, reflecting a combination of both higher overall flight volume and a significantly below-average proportion of unaged birds (Table 2). This suggests that productivity and especially adult survival both were strong in the Pacific Northwest for this species in 2009. For Bald Eagles and Peregrine Falcons, the overall counts were too low to warrant careful consideration of age ratios, but the complete absence of non-adult Bald Eagles was at least somewhat conspicuous. For Northern Harriers and Red-tailed Hawks, their above-average age ratios clearly reflected, at least partly, higher than average numbers of immature birds, suggesting good productivity; however, lower numbers of identified adults also contributed to the high ratios, especially for Red-tailed Hawks. Similarly, the high age ratios for Northern Goshawks and Golden Eagles clearly resulted from a dearth of adults rather than unusually high abundances of immature birds, suggesting that either low adult survival, delayed adult passage after our monitoring period, or perhaps simply limited adult movement (e.g., staying farther north) was the primary driver behind the low overall counts of these species in 2009.

Seasonal Timing.—The combined-species median passage date of 16 September was a significant 6 days earlier than the 1998–2008 average (Table 3) and the overall seasonal distribution differed from the average pattern in showing very high, early peak in activity during the 11-15 September five-day period, and then significantly below-average proportional activity levels during three of four five-day periods between late September and mid-October (Figure 8). The lull in activity beginning in late September corresponded to the first major cold snap of the season, with the first snow falling at the site on 2–3

October (Appendix C). The second major snow event of the season then hit on 12 October and resulted in the relative dearth of activity during the 11–15 October five-day period (Figure 8).

At the species level, only two species (Northern Goshawks and Broad-winged Hawks) showed significantly late median passage dates in 2009, whereas seven species showed significantly early timing (Turkey Vulture, Northern Harrier, Sharp-shinned Hawk, Cooper's Hawk, Red-tailed Hawk, Rough-legged Hawk, and Prairie Falcon (Table 3). Age- and sex-specific data revealed a few noteworthy clarifications (Table 4). Only adult Sharp-shinned and Cooper's Hawks showed early timing. No independent assessment of the passage timing of adult Northern Goshawks was possible because no birds were confidently identified as such; however, contrary to the species level showing of significantly late timing, the independent assessment showed immature birds as passing through significantly early. Similarly, the species-level assessment for Golden Eagles indicated non-significantly late timing; however, both age-specific assessments suggested early timing—strongly significant for adults and marginally so for non-adults. Overall, data for the latter two species suggest that the consistency of age-specific identification waned during the latter portion of the season and imparted a distinct bias to the age-specific data.

RESIDENT RAPTORS

Resident Turkey Vultures were present in the area through 22 September, seen both individually and in groups of up to five birds. Most often, they were seen either flying east across Mitchell Creek then stopping at Washington Butte or rising up at Washington Butte and then heading off to the north or west.

A probable resident, immature Northern Harrier was seen briefly on 25 August and 1 September in Black Canyon before it headed back north.

On three occasions, resident Sharp-Shinned Hawks were observed heading north into the woods in Black Canyon. The first was an immature bird seen on 24 August, which the observers thought probably migrated from the area soon thereafter. Resident adults were seen in the same general area on 4 and 12 September. The first sighting of a resident, immature Cooper's Hawk occurred on the first day of the count. For the next two weeks, the observers recorded several more sightings of immature birds flying north into the woods on the leeward side of the ridge just west of the upper owl. The last sighting of an immature bird occurred on 6 September, with an adult also seen exhibiting similar behavior on 7 September.

A family of light-morph Red-Tailed Hawks, two adults and one immature bird, resided in the area centered on Mitchell Creek canyon. They were often seen hunting low in the canyon, kiting over the saddle east of observation, perched in any of the many burnt snags in Mitchell Creek and on Cooper Mountain, or escorting other large raptors out of Mitchell Creek. The immature bird was last seen on 28 September, but both adults remained in the area until at least 24 October. A dark-morph individual of unknown age was seen on Cooper Mountain on 9 October, but it appeared that this bird was only a temporary, transient resident.

The observers believed that one sub-adult Golden Eagle occupied a home range that included the greater Mitchell Creek area. They first saw this bird on the first day of the count flying north over the upper owl, and saw it again several more times until 5 September when it apparently moved out of the area. This bird commonly lingered in Mitchell Creek before heading north, and was also seen escorting another Golden Eagle to the west of the observation point before heading back to the north. One adult Bald Eagle was seen on 3 October rising up near Mt. McLure and then heading off to the north.

A male/female pair of American Kestrels was first seen together in the Mitchell Creek area on 24 August, and then almost every day thereafter until the male was last seen on 2 September and the female on 6 September. This pair was frequently seen harassing the observation owl, hunting/kiting low in Mitchell

Creek, and over the ridge just east of the observation point. A single adult Prairie Falcon was seen on 25 August lingering in Mitchell Creek before flying off to the north.

This resident assemblage is fairly typical for the site.

TRAPPING EFFORT

Trapping occurred on 58 of 62 days between 24 August and 24 October, with effort totaling 632.76 station hours (see Appendix F for daily trapping records). The number of trapping days was significantly above the 2001–2008 average of $54 \pm 95\%$ CI of 2.9 days; however, due to a reduced crew the number of station hours was significantly below the long-term average of 769.9 ± 51.5 station hours (see Appendix G for annual trapping summaries).

TRAPPING AND BANDING RESULTS

The 2009 capture total of 664 newly banded birds and one foreign recapture, involved 11 typical species plus the first Broad-winged Hawk ever captured in the state of Washington—and a dark-morph bird to boot! The combined-species total was a non-significant 6% above the 2001–2008 average (Table 5, Appendix G). Capture totals were significantly above average for four commonly captured species (Northern Harrier, Red-tailed and Rough-legged Hawks, and Golden Eagle; Table 5), with 9 Rough-legged Hawks a new record high for the site (Appendix G). Capture totals were significantly below average only for the Northern Goshawk (Table 5). The species captured most frequently in 2009 were the Sharp-shinned Hawk (63% of captures), Cooper's Hawk (19%), Red-tailed Hawk (5%), Northern Harrier (4%), and Merlin (3%); all other species each comprised <2% of the total.

Capture rates were significantly above average in 2009 for seven species and were not significantly below average for any species, indicating a very efficient operation (Table 5). Similar to the situation for capture totals, capture success was significantly above average for Golden Eagles and Broad-winged, Red-tailed, and Rough-legged Hawks, and was significantly below average for Northern Goshawks, but unlike for capture totals also was significantly below average for Cooper's Hawks and Prairie Falcons (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 2009, the count-based immature : adult ratio of 3.2 was 15% below average (Table 2), whereas the banding age ratio of 5.2 was 51% above average (Table 6). Typically, the difference in magnitudes is much less pronounced and at this site the count age ratio averages higher than the capture age ratio. However, the latter is atypical compared to most western banding sites where higher capture age ratios typically suggest that immature birds are more susceptible to capture than adults. Therefore, similar to last year, the switch in the magnitude of the two values in 2009 suggests that immature birds were proportionately much more susceptible to capture than usual compared to adults. However, a closer look at the age-specific capture data revealed that this was only true for young females and that absolute reductions in the numbers of captured adults of both sexes contributed greatly to the elevated immature : adult capture ratio (Table 6).

For Cooper's Hawks, both the count (2.4) and capture (2.0) age ratios were below average in 2009 (51% and 21%, respectively) and, as usual (but again atypical compared to most other western sites), the count ratio was higher than the banding ratio (Table 6). This combination suggests that there were proportionately fewer immature birds in the flight (substantial reduction in count ratio) and that they were more susceptible to capture than usual compared to adults (lesser reduction in capture ratio). Again, a closer look at the age-specific capture data suggested that the latter was mostly true for immature females (Table 6).

The roughly estimated (no adults confirmed), count-based age ratio for Northern Goshawks in 2009 (17.0) was almost three times higher than the 2001–2008 average (6.1; Table 2), whereas the roughly

estimated (similar issue) capture age ratio (10.0) was 16% below average (11.9; Table 6). In this case, the changes reversed the usual arrangement (for this site as well as other western sites) whereby the capture ratio typically is much larger than the count ratio. Together these data suggest that adult goshawks were scarce this year and that the immature birds were much less susceptible to capture than usual.

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). For Sharp-shinned Hawks, these measures indicated a slight shift toward birds with fuller crops, but a much lower than average proportion of birds with healthy keels and a slight reduction in fat stores. These data match well the indication of immature birds being more susceptible to capture (hungrier) than usual. For Cooper's Hawks and Northern Goshawks, similar patterns applied except that the data for fat stores were more equivocal.

ENCOUNTERS WITH PREVIOUSLY BANDED BIRDS

Since HWI began banding at Chelan Ridge in 2001, we have recorded 59 foreign encounters of Chelan-banded birds. Nine new encounters occurred in 2009 and one additional encounter occurred in December 2008 that we did report in our last annual report (Table 8). These new encounters involved 1 Golden Eagle, 1 Red-tailed Hawk, 3 Cooper's Hawks, and 5 Sharp-shinned Hawks. The Golden Eagle (banded as a hatch-year [HY] male in 2007) recovery is particularly conspicuous because it is only the sixth band return HWI has ever received (since 1980) from a Golden Eagle banded on migration! Moreover, the bird was recovered in southwestern Wyoming very near HWI's Commissary Ridge Raptor Migration Project site (see Smith 2009), and is the second Golden Eagle that we have "tracked" from Chelan Ridge far to the southeast to the realm of northeastern Utah and southwestern Wyoming (the first tracked by satellite in 2003; see <http://www.hawkwatch.org/Research/Telemetry/crge37301b.jpg>). Unfortunately, the new encounter involved a lethal collision with a vehicle. Three of the six HWI band returns from Golden Eagles have involved vehicle collisions, with two fatal but one culminating in a successful rehabilitation and release in New Mexico earlier this year.

The Red-tailed Hawk was banded as a HY bird on 18 September 2009 and was found dead of unknown causes two months later ~611 km to the south near Medford, Oregon (Table 8). Similarly, one female Cooper's Hawk was banded as a second-year (SY) bird on 18 September 2008 and found dead of unknown causes only three months later, but in this case ~1,617 km to the south-southeast near Tempe, Arizona. The other two female Cooper's Hawks were banded as HY birds in 2008, with one found dead of unknown causes just under one year later ~340 km north near Canim Lake, British Columbia, and the other was taken to a rehabilitation center after colliding with some manner of "stationary object other than wires or towers" in April 2009 ~830 km to the south-southeast near Elko, Nevada. These latter two recoveries continue to paint an expanding picture of the geographic ranges of Chelan-banded accipiters traveling both west and east of the Sierra Nevada-Cascade Mountains chain. The five Sharp-shinned Hawks (four females and one male) were all banded as HY birds in 2008 or 2009 and recovered between 1–6.5 months later in south-central Washington, west-central Oregon, and northwestern and west-central California. Two were found dead of unknown causes, two were killed when they struck various stationary objects, and one was reported as caught by another raptor but then released again after a person apparently "rescued" it.

Our 2009 crew also secured the seventh foreign recapture at Chelan Ridge of a bird originally banded elsewhere. This HY female Sharp-shinned Hawk was banded by colleague Ted Swem of the U.S. Fish and Wildlife Service at his raptor-migration banding station in the Matanuska Valley of Alaska on 5 September 2009 and was recaptured at Chelan Ridge on 22 October 2009. The bird made the 3,396 km trip in 47 days, for an average travel pace of 72 km/day. Upon recapture, we found the bird in excellent health with an empty crop but a robust keel muscle and heavy fat stores.

VISITOR PARTICIPATION AND PUBLIC OUTREACH

The 2009 visitor logs recorded 134 individuals, with 30% returning after visiting in previous years. Visitation occurred on 26 days from 25 August through 24 October. The biggest visitation day was 20 September when 22 individuals visited the site. General adults, mostly avid birders, comprised ~75% of the visitors, college students 20%, and children of various ages the remainder. Most visitors came from surrounding Washington communities (primarily the Methow Valley and Seattle areas), but others originated in six other states (OR, OH, MT, WI, CA, and VT) as well as Ireland. Two organized groups of college students visited the site in 2009. The first group was led by Adam Dillon who organizes and leads customized wildlands field-study courses for college students in association with various universities. Mr. Dillon first visited the site last year to begin developing a plan for bringing his students here this year. Another group of ecology students led by Lisa Shipley visited from Washington State University and were treated to a special presentation on radio and satellite telemetry by long-time Chelan Ridge affiliate Jim Watson from the Washington Department of Fish and Wildlife. A third group of biology students from Evergreen State College in Washington had planned to visit in October, but unfortunately a snow storm intervened.

In 2009, 520 hourly assessments by the observers of visitor disturbance resulted in the following ratings: 89% none, 9% low, 2% moderate, and none high. This level of disturbance is slightly higher than most previous years because this year's limited trapping crew translated to the site interpreter spending proportionately more time than usual assisting them rather than the counters.

ACKNOWLEDGEMENTS

We dedicate this report to the memory of Christopher D. Street, who passed away on 12 November 2009 after an unsuccessful battle with cancer. Chris was a friend of the project and a key crewmember in 2007 and 2008. He will be missed by all who had the pleasure of knowing him, but we all are aware that his enthusiastic spirit will be present at Chelan Ridge in the years ahead. In his honor, we have now permanently renamed the south trapping blind as "C. Street."

Chris graduated from the University of Montana in 2005 and then worked as a wildlife biologist on a variety of projects for the U.S. Forest Service, U.S. Geological Survey, and University of Montana, and HWI. He was a kayaker, snowboarder, and mountain climber, and spent as much time as he could with good friends in wild places. He is survived by his parents, David and Sandy Street of Dousman, Wisconsin; his sister Elizabeth Dillon and brother Jeffrey Street; his partner Layla Dunlap of Missoula, Montana; his maternal grandparents, Jim and Onnie Weiss; and his paternal grandfather, Thomas Street. He was preceded in death by his paternal grandmother, Helen Street. At his and his parent's request, the Chris Street Memorial Fund was established at HWI to support the Chelan Ridge Raptor Migration Project, which has inspired so many, especially Chris (see <http://www.hawkwatch.org> for details).

Other financial and logistical support for this project in 2009 was provided by Okanogan and Wenatchee National Forests, the Fledgling Fund, the Kinsman Foundation, Kittitas Audubon 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 continued his tireless support of the project this year; for 13 years he has been the most dedicated volunteer that any project could hope to have! He started innocently enough in 1997 coming up to help support our lone observer and do some hawk watching. He now spends at least 40 hours of his own time before the project starts clearing trails, mowing trapping sets, and even getting large rocks out of the road. He brings food to the crew from his garden and squeezes his bees to make a little extra honey for sweetening the crew as the season wears on. Capturing sparrows in his yard for use as lure birds is another of his numerous contributions. Thank you Richard! We again thank former site coordinator and bander Ben Vang-Johnson for visiting and helping out with the banding operations on

several weekends. The crew also greatly appreciated the Pho soup his wife Friendly provided! We thank Washington Department of Fish Wildlife biologist Jim Watsion and his son Jesse for visiting the site again this year to help out with the banding operation, and especially for helping to enhance the educational experience of the students that visited from Washington State University. Brad Martin continued to whisper to his pigeon flock so they remained relaxed and eager to help us bring hawks, falcons, and eagles close enough for capture. Brad and his wife Norma patiently fit pigeon shuttling into work at the local glass blowing studio and hobby farm, all the while working construction and dentistry to pay the bills. Various members of the Forest Service staff have been an important element throughout the project's history, but none more so than Kathy Corrigan, who answers questions about the project at the District Office front desk, the phone, and even on the radio. She also hands out brochures and directs visitors to the ridge, and keeps the daily tally board at the visitor center up to date for all to see our successes. District staff member John Rohrer also has been an excellent, perennial supporter who has helped this partnership to succeed for the past 12 years. Lastly, new District Ranger, Mike Liu, visited the project with his family during the season and is the latest Forest Service leader to become a Chelan Ridge partnership enthusiast, and we greatly appreciate his support.

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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: 1998–2008 versus 2009.

SPECIES	COUNTS			RAPTORS/100 HOURS		
	1998–2008 ¹	2009	% Change	1998–2008 ¹	2009	% Change
Turkey Vulture	33 ± 16.2	70	+114	8.1 ± 1.83	16.3	+101
Osprey	41 ± 13.9	36	-13	14.7 ± 3.73	13.8	-7
Northern Harrier	107 ± 36.8	127	+19	31.2 ± 7.82	33.8	+8
White-tailed Kite	0.1 ± 0.3	0	-100	–	–	
Sharp-shinned Hawk	774 ± 239.6	852	+10	250.1 ± 45.32	252.5	+1
Cooper's Hawk	229 ± 59.2	332	+45	80.5 ± 10.56	112.7	+40
Northern Goshawk	33 ± 13.3	27	-17	7.9 ± 2.07	6.6	-17
Unknown small accipiter ²	44 ± 34.7	87	+99	–	–	
Unknown large accipiter ²	9 ± 6.6	12	+33	–	–	
Unknown accipiter	82 ± 88.9	38	-53	–	–	
TOTAL ACCIPITERS	1152 ± 297.2	1348	+17	–	–	
Broad-winged Hawk	5 ± 2.2	6	+29	3.8 ± 1.38	2.9	-23
Swainson's Hawk	6 ± 5.5	5	-10	3.8 ± 2.32	1.2	-68
Red-tailed Hawk	307 ± 97.7	341	+11	87.3 ± 15.57	76.8	-12
Ferruginous Hawk	0 ± 0.3	0	-100	0.2 ± 0.20	0.0	-100
Rough-legged Hawk	25 ± 15.3	48	+92	18.5 ± 5.05	39.5	+113
Unidentified buteo	60 ± 39.6	20	-67	–	–	
TOTAL BUTEOS	403 ± 133.1	420	+4	–	–	
Golden Eagle	122 ± 32.7	93	-24	32.9 ± 6.27	22.3	-32
Bald Eagle	6 ± 4.6	4	-34	1.6 ± 0.65	1.2	-25
Unidentified eagle	3 ± 4.0	1	-65	–	–	
TOTAL EAGLES	131 ± 36.1	98	-25	–	–	
American Kestrel	56 ± 25.9	59	+6	18.2 ± 5.25	20.2	+11
Merlin	37 ± 11.4	45	+23	10.9 ± 2.20	12.4	+14
Prairie Falcon	8 ± 5.2	14	+77	2.3 ± 0.68	3.9	+74
Peregrine Falcon	9 ± 6.1	7	-18	2.4 ± 0.83	2.7	+12
Unknown small falcon ²	3 ± 2.1	9	+177	–	–	
Unknown large falcon ²	2 ± 0.8	5	+167	–	–	
Unknown falcon	3 ± 3.3	2	-25	–	–	
TOTAL FALCONS	115 ± 32.5	141	+23	–	–	
Unidentified raptor	106 ± 75.8	85	-20	–	–	
GRAND TOTAL	2088 ± 466.4	2325	+11	–	–	

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: 1998–2008 versus 2009.

	TOTAL AND AGE-CLASSIFIED COUNTS						IMMATURE : ADULT			
	1998–2008 AVERAGE			2009			% UNKNOWN AGE		RATIO	
	TOTAL	IMM.	ADULT	TOTAL	IMM.	ADULT	1998–2008 ¹	2009	1998–2008 ¹	2009
Northern Harrier	106	36	25	127	53	20	43 ± 6.4	43	1.5 ± 0.37	2.7
Sharp-shinned Hawk	816	414	131	852	495	154	33 ± 6.2	24	3.7 ± 1.36	3.2
Cooper's Hawk	236	113	29	332	158	66	41 ± 6.6	33	4.4 ± 1.51	2.4
Northern Goshawk	32	16	5	27	17	0	37 ± 7.4	37	6.1 ± 3.69	17.0
Broad-winged Hawk	5	2	1	6	3	2	43 ± 14.1	17	1.1 ± 0.66	1.5
Red-tailed Hawk	322	69	137	341	93	89	35 ± 5.4	47	0.5 ± 0.12	1.0
Golden Eagle	124	59	27	93	46	15	30 ± 4.4	34	2.3 ± 0.37	3.1
Bald Eagle	6	2	5	4	0	4	7 ± 9.0	0	0.4 ± 0.27	0.0
Peregrine Falcon	9	3	2	7	4	1	46 ± 17.2	29	1.9 ± 0.99	4.0

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 2009, with a comparison of 2009 and 1998–2008 average median passage dates.

SPECIES	2009				1998–2008
	FIRST OBSERVED	LAST OBSERVED	BULK PASSAGE DATES ¹	MEDIAN PASSAGE DATE ²	MEDIAN PASSAGE DATE ^{2,3}
Turkey Vulture	23-Aug	29-Sep	26-Aug – 21-Sep	11-Sep	15-Sep ± 3.5
Osprey	25-Aug	29-Sep	4-Sep – 24-Sep	16-Sep	18-Sep ± 2.9
Northern Harrier	27-Aug	22-Oct	31-Aug – 4-Oct	16-Sep	22-Sep ± 2.4
Sharp-shinned Hawk	23-Aug	25-Oct	4-Sep – 7-Oct	17-Sep	20-Sep ± 1.8
Cooper's Hawk	24-Aug	15-Oct	1-Sep – 25-Sep	15-Sep	17-Sep ± 1.7
Northern Goshawk	28-Aug	25-Oct	9-Sep – 22-Oct	5-Oct	28-Sep ± 5.6
Broad-winged Hawk	12-Sep	28-Sep	12-Sep – 28-Sep	22-Sep	12-Sep ± 2.5
Swainson's Hawk	31-Aug	1-Oct	31-Aug – 1-Oct	14-Sep	15-Sep ± 5.3
Red-tailed Hawk	24-Aug	24-Oct	31-Aug – 11-Oct	15-Sep	25-Sep ± 1.9
Rough-legged Hawk	4-Oct	24-Oct	8-Oct – 22-Oct	11-Oct	15-Oct ± 2.8
Golden Eagle	24-Aug	24-Oct	10-Sep – 22-Oct	6-Oct	04-Oct ± 2.0
Bald Eagle	25-Sep	24-Oct	–	–	11-Oct ± 9.3
American Kestrel	25-Aug	24-Sep	28-Aug – 22-Sep	10-Sep	11-Sep ± 4.2
Merlin	29-Aug	24-Oct	10-Sep – 19-Oct	23-Sep	21-Sep ± 2.8
Prairie Falcon	28-Aug	9-Oct	30-Aug – 4-Oct	10-Sep	17-Sep ± 6.6
Peregrine Falcon	2-Sep	20-Oct	2-Sep – 20-Oct	15-Sep	16-Sep ± 6.8
Total	27-Aug	25-Oct	2-Sep – 10-Oct	16-Sep	22-Sep ± 1.4

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: 1998–2008 versus 2009.

SPECIES	ADULT		IMMATURE	
	1998–2008 ¹	2009	1998–2008 ¹	2009
Northern Harrier	20-Sep ± 3.4	16-Sep	22-Sep ± 2.7	16-Sep
Sharp-shinned Hawk	02-Oct ± 1.7	30-Sep	14-Sep ± 1.7	15-Sep
Cooper’s Hawk	26-Sep ± 2.2	22-Sep	12-Sep ± 1.6	12-Sep
Northern Goshawk	01-Oct ± 9.3	–	28-Sep ± 5.8	22-Sep
Red-tailed Hawk	29-Sep ± 2.1	25-Sep	17-Sep ± 3.3	12-Sep
Golden Eagle	05-Oct ± 2.4	18-Sep	03-Oct ± 1.9	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: 2001–2008 versus 2009.

	CAPTURE TOTALS		CAPTURE RATE ¹		CAPTURE SUCCESS ²	
	2001–2008 ³	2009	2001–2008 ³	2009	2001–2008 ³	2009
Northern Harrier	14 ± 4.6	24	1.8 ± 0.55	3.8	15.1 ± 3.9	18.9
Sharp-shinned Hawk	417 ± 68.7	419	53.9 ± 7.56	66.2	53.4 ± 9.6	44.5
Cooper's Hawk	113 ± 19.5	128	14.7 ± 2.39	20.2	44.1 ± 8.0	34.0
Northern Goshawk	16 ± 4.8	10	2.1 ± 0.57	1.6	57.6 ± 13.2	34.5
Broad-winged Hawk	0 ± 0.0	1	0.0 ± 0.00	0.2	0.0 ± 0.0	16.7
Red-tailed Hawk	25 ± 8.4	34	3.3 ± 1.07	5.4	6.8 ± 1.2	9.5
Rough-legged Hawk	2.3 ± 1.47	9	0.3 ± 0.18	1.4	8.5 ± 5.2	18.0
Golden Eagle	3 ± 1.4	5	0.4 ± 0.16	0.8	2.3 ± 1.0	5.3
American Kestrel	8.8 ± 3.14	9	1.1 ± 0.37	1.4	18.7 ± 9.4	13.8
Merlin	24 ± 8.3	21	3.1 ± 0.94	3.3	62.6 ± 20.7	42.0
Prairie Falcon	3 ± 1.2	3	0.4 ± 0.15	0.5	33.5 ± 15.6	17.6
Peregrine Falcon	1.6 ± 0.8	2	0.2 ± 0.10	0.3	19.1 ± 14.4	22.2
All species	628 ± 100.1	665	81.3 ± 10.97	105.1	34.3 ± 4.5	31.2

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: 2001–2008 versus 2009.

SPECIES	YEARS	FEMALE		MALE		FEMALE : MALE RATIO ¹	IMM. : ADULT RATIO ¹
		HY	AHY	HY	AHY		
Sharp-shinned Hawk	Avg. 2001–2008	162	62	158	35	1.2 ± 0.07	3.4 ± 0.42
	2009	199	41	152	27	1.3	5.2
Cooper's Hawk	Avg. 2001–2008	44	23	36	10	1.5 ± 0.15	2.5 ± 0.40
	2009	52	30	33	13	1.8	2.0
Northern Goshawk	Avg. 2001–2008	4	1	11	1	0.4 ± 0.10	11.9 ± 3.79
	2009	4	0	6	0	0.7	10.0

¹ Long-term values: mean ± 95% CI.

Table 7. Fall body condition indices for migrant accipiters captured at Chelan Ridge, WA: 2001–2008 versus 2009.

SPECIES	YEARS	CROP FULLNESS					KEEL MUSCLE ¹			WING-PIT FAT ²			
		E	1/4	1/2	3/4	F	0	1	2	0	1	2	3
Sharp-shinned Hawk	2001–2008 mean	60	16	11	5	8	13	66	21	19	58	19	4
	2009	62	8	11	8	11	44	48	8	21	66	12	2
Cooper's Hawk	2001–2008 mean	73	12	8	3	4	28	63	9	24	54	19	4
	2009	73	2	5	8	13	59	39	2	29	46	22	3
Northern Goshawk	2001–2008 mean	85	5	4	1	5	19	74	7	27	59	12	2
	2009	80	0	10	10	0	30	70	0	20	70	10	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 from December 2008 through November 2009 of raptors banded at the Chelan Ridge Raptor Migration Project.

BAND #	SPECIES ¹	SEX	BANDING DATE	BANDING AGE ²	ENCOUNTER LOCATION	ENCOUNTER DATE	ENCOUNTER AGE ²	DISTANCE (KM)	STATUS
1075 – 01350	CH	F	18-Sep-08	SY	Tempe, AZ	17-Dec-08	SY	1617	found dead – unknown cause
0629 – 51551	GE	M	24-Sep-07	HY	Kemmerer, WY	15-Feb-09	TY	1231	killed by vehicle collision
1232 – 39311	SS	M	09-Sep-08	HY	McKinleyville, CA	21-Feb-09	SY	783	killed when struck stationary object
1623 – 25083	SS	F	03-Oct-08	HY	Kennewick, WA	17-Mar-09	SY	208	caught by raptor – released
1075 – 01451	CH	F	06-Sep-08	HY	Elko, NV	10-Apr-09	SY	829	struck stationary object – rehab
1623 – 21241	SS	F	01-Sep-08	HY	Bend, OR	5-May-09	SY	382	killed when struck stationary object
1075 – 01454	CH	F	11-Sep-08	HY	Canim Lake, BC	24-Aug-09	SY	339	found dead – unknown cause
1623 – 25847	SS	F	04-Sep-09	HY	Benton City, WA	10-Oct-09	HY	180	found dead – unknown cause
1623 – 25886	SS	F	09-Sep-09	HY	Kenwood, CA	15-Nov-09	HY	913	found dead – unknown cause
1177 – 06062	RT	U	18-Sep-09	HY	Medford, OR	18-Nov-09	HY	611	found dead – unknown cause

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.

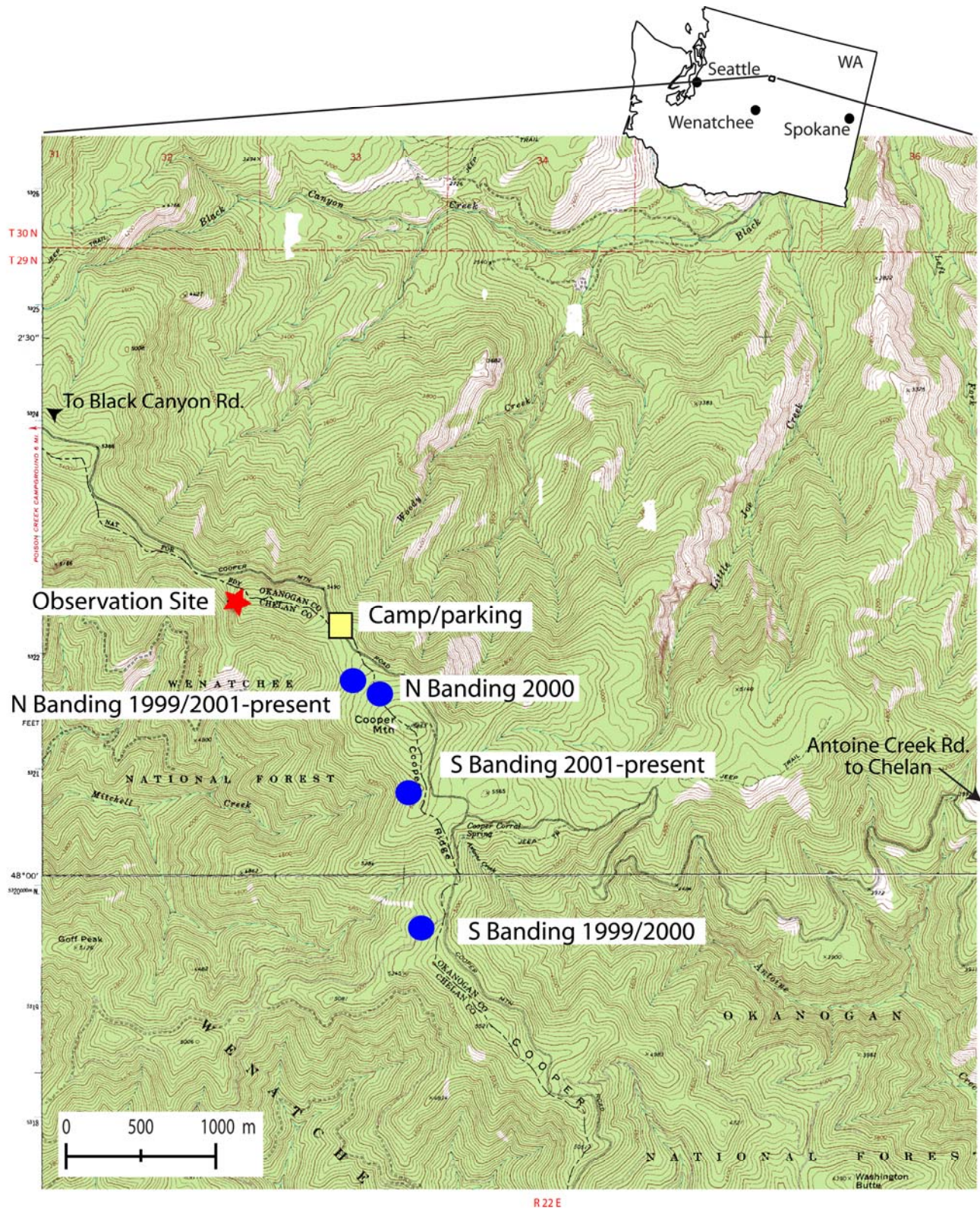


Figure 1. Location of the Chelan Ridge Raptor Migration Project count and banding sites in north-central Washington.

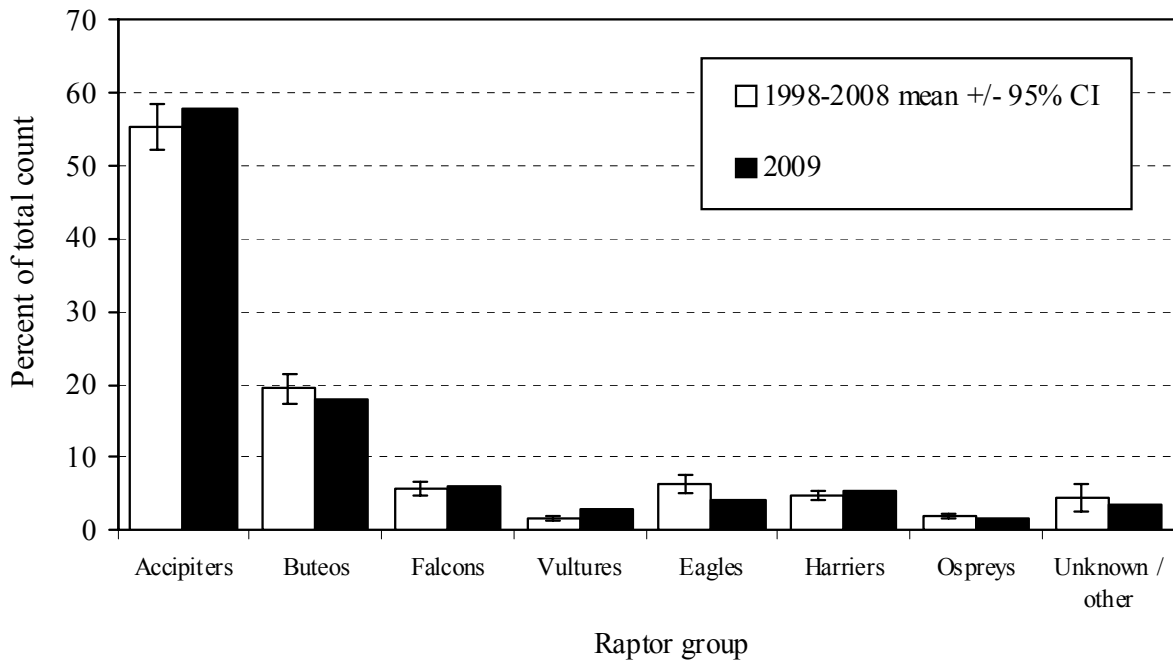


Figure 2. Fall raptor migration flight composition by major species groups at Chelan Ridge, WA: 1998–2008 versus 2009.

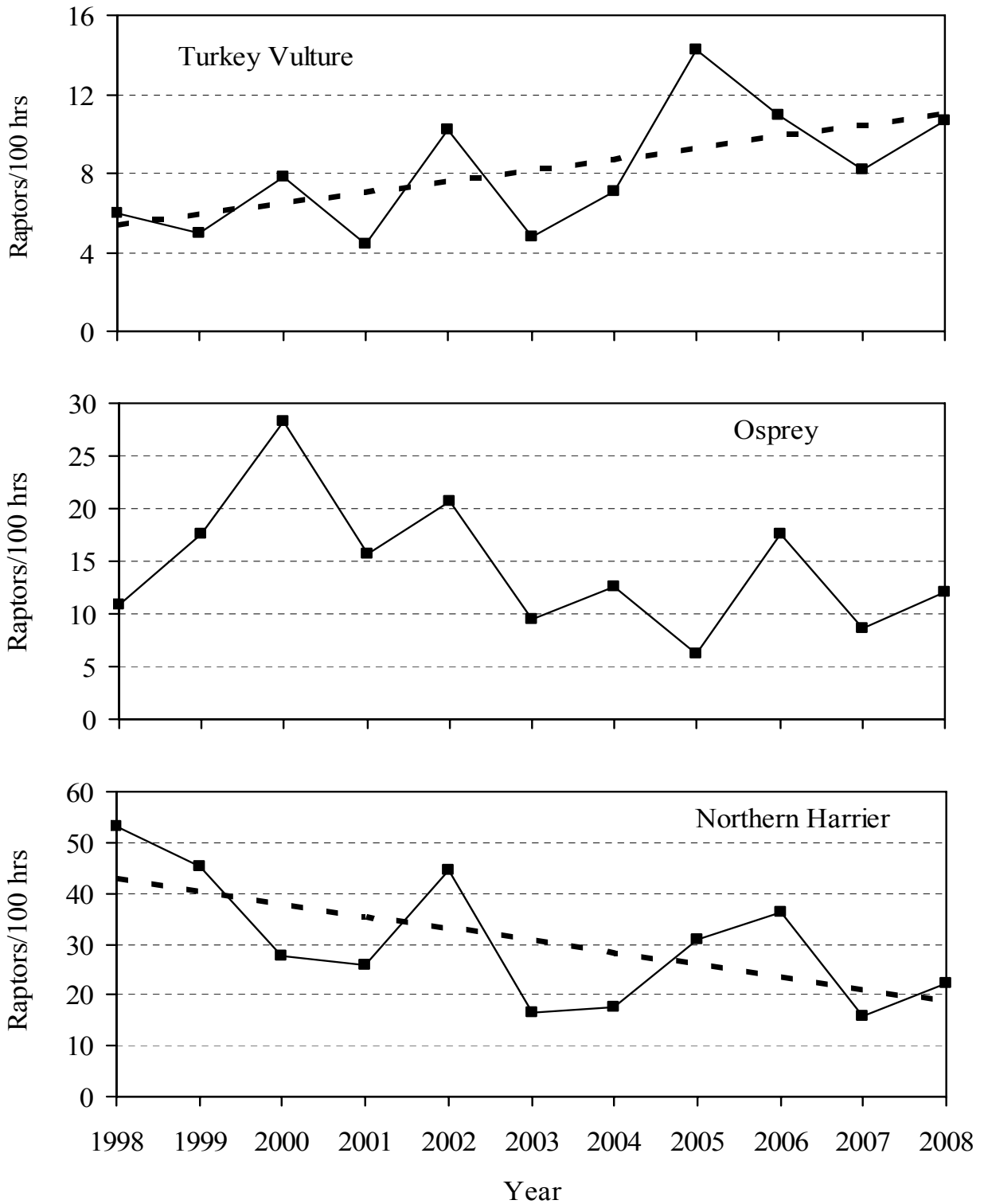


Figure 3. Adjusted fall-migration passage rates at Chelan Ridge, WA for Turkey Vultures, Ospreys, and Northern Harriers: 1998–2009. Dashed lines indicate significant linear or quadratic regressions.

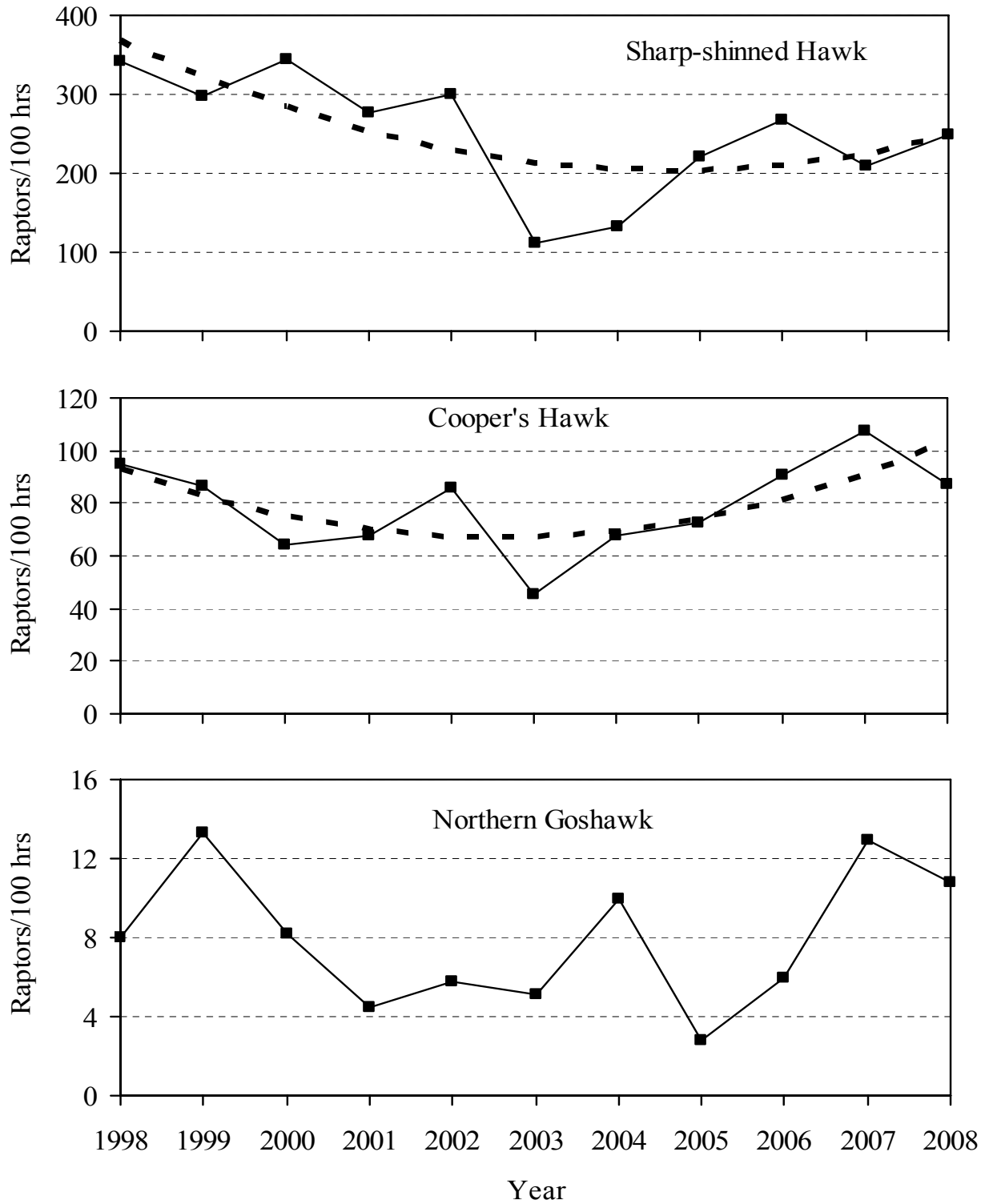


Figure 4. Adjusted fall-migration passage rates at Chelan Ridge, WA for Sharp-shinned Hawks, Cooper's Hawks, and Northern Goshawks: 1998–2009. Dashed lines indicate significant linear or quadratic regressions.

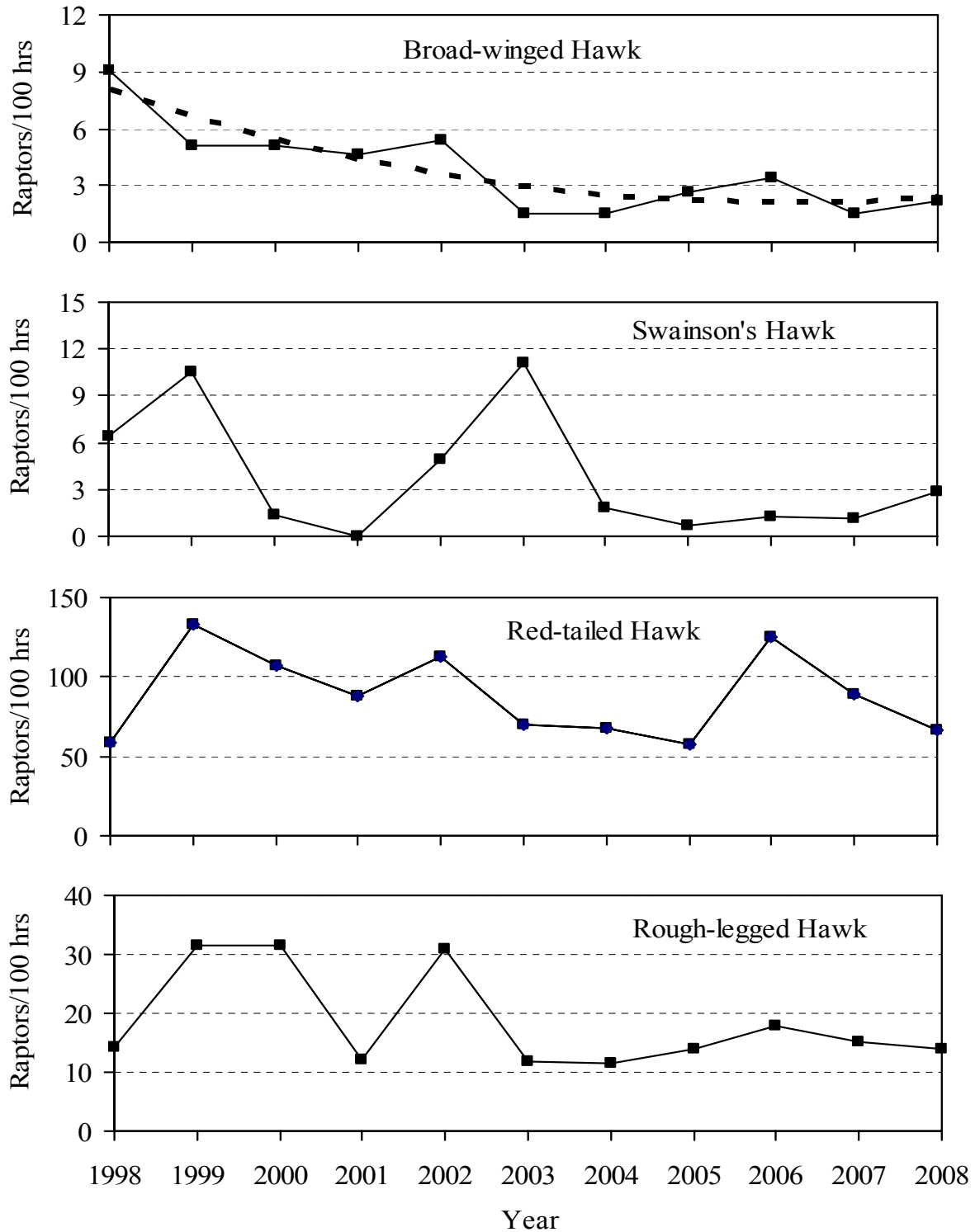


Figure 5. Adjusted fall-migration passage rates at Chelan Ridge, WA for Broad-winged, Swainson's, Red-tailed, and Rough-legged Hawks: 1998–2009. Dashed lines indicate significant linear or quadratic regressions.

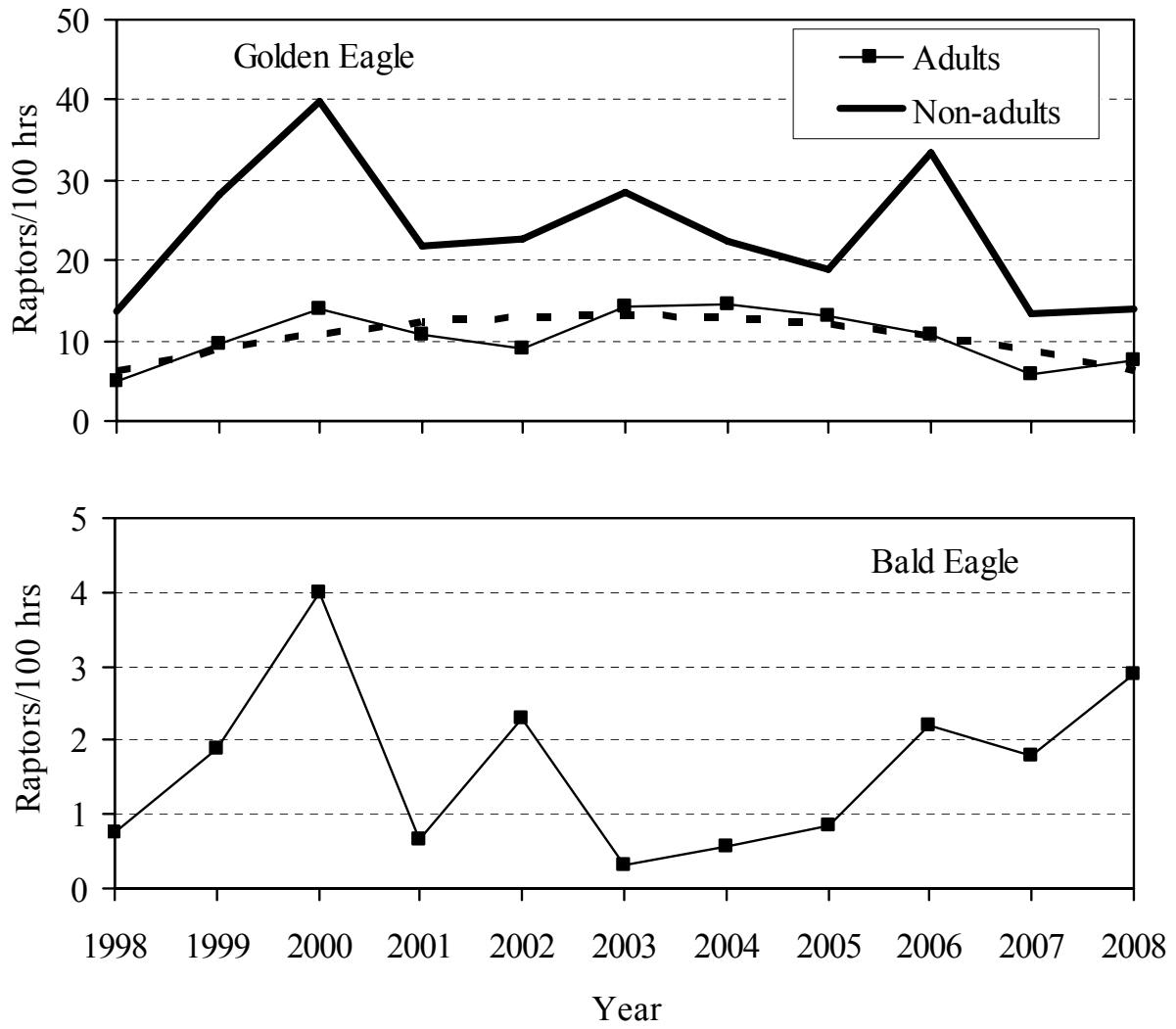


Figure 6. Adjusted fall-migration passage rates at Chelan Ridge, WA for Golden and Bald Eagles: 1998–2009. Dashed lines indicate significant linear or quadratic regressions.

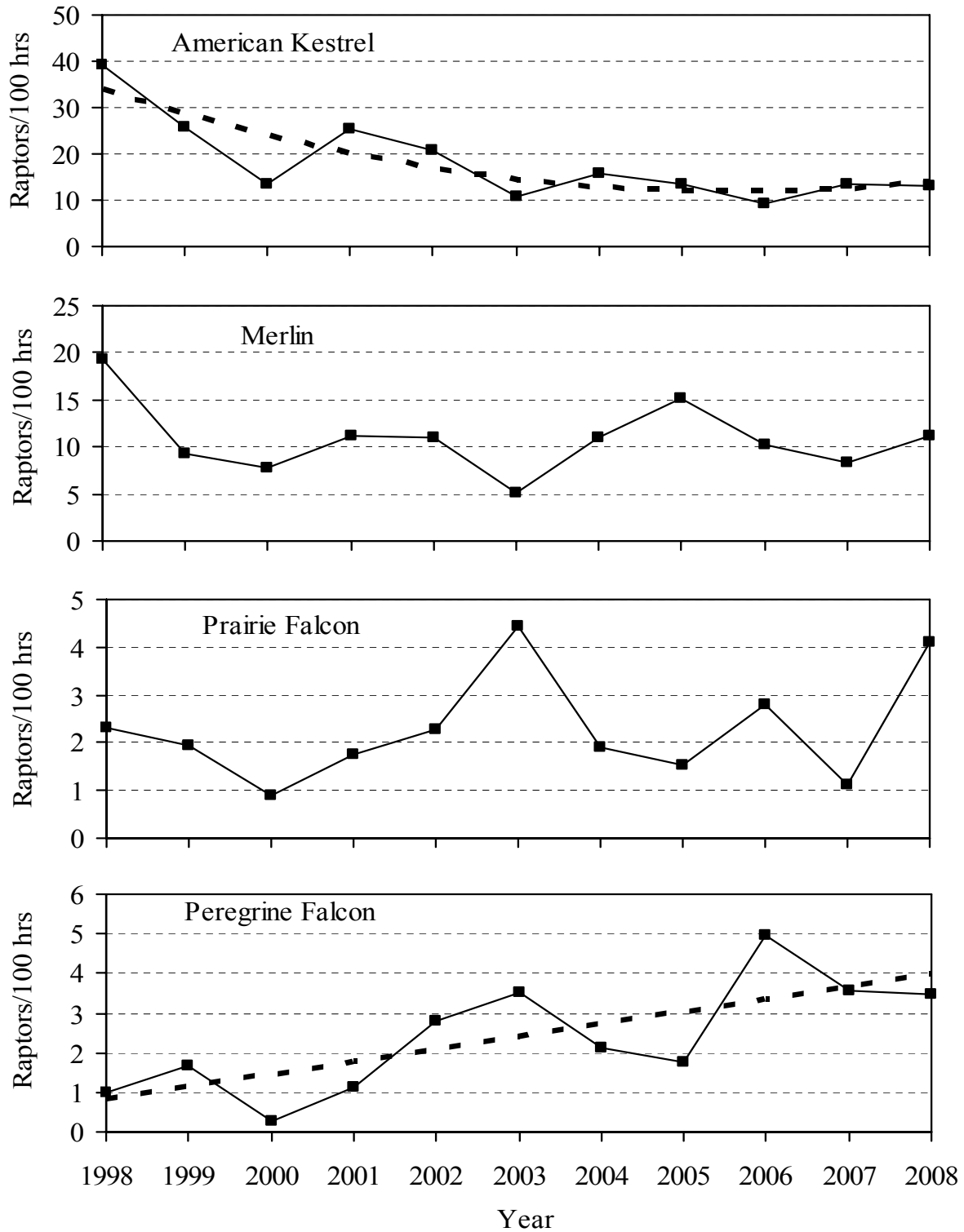


Figure 7. Adjusted fall-migration passage rates at Chelan Ridge, WA for American Kestrels, Merlins, Prairie Falcons, and Peregrine Falcons: 1998–2009. Dashed lines indicate significant linear or quadratic regressions.

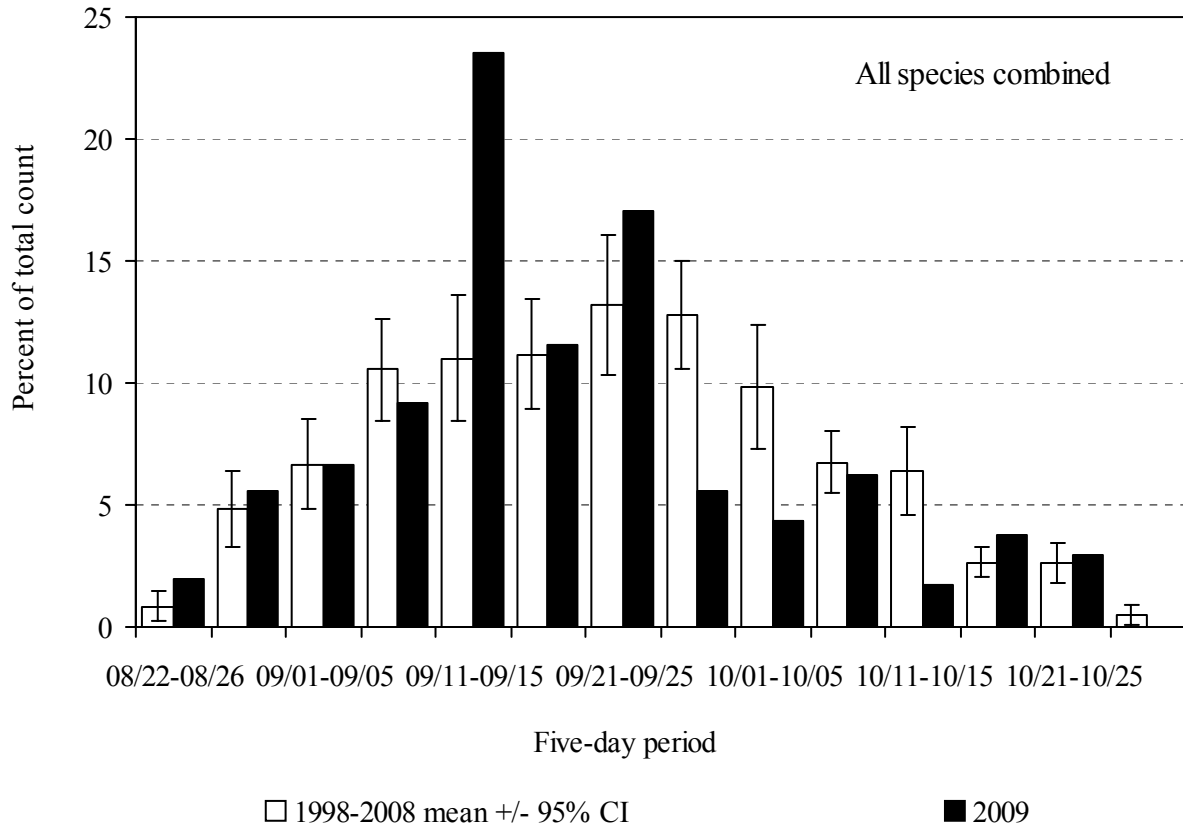


Figure 8. Combined-species passage volume by five-day periods for migrating raptors at Chelan Ridge, WA: 1998–2008 versus 2009.

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 (+).

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	<i>Cathartes aura</i>	TV	U	U	NA
Osprey	<i>Pandion haliaetus</i>	OS	U	U	NA
Northern Harrier	<i>Circus cyaneus</i>	NH	AM AF I Br U	AM AF U	NA
White-tailed Kite	<i>Elanus leucurus</i>	WK	A, I, U	U	NA
Sharp-shinned Hawk	<i>Accipiter striatus</i>	SS	A I U	U	NA
Cooper's Hawk	<i>Accipiter cooperii</i>	CH	A I U	U	NA
Northern Goshawk	<i>Accipiter gentilis</i>	NG	A I U	U	NA
Unknown small accipiter	<i>A. striatus</i> or <i>cooperii</i>	SA	U	U	NA
Unknown large accipiter	<i>A. cooperii</i> or <i>gentilis</i>	LA	U	U	NA
Unknown accipiter	<i>Accipiter</i> spp.	UA	U	U	NA
Broad-winged Hawk	<i>Buteo platypterus</i>	BW	A I U	U	D L U
Swanson's Hawk	<i>Buteo swainsoni</i>	SW	U	U	D L U
Red-tailed Hawk	<i>Buteo jamaicensis</i>	RT	A I U	U	D L U
Ferruginous Hawk	<i>Buteo regalis</i>	FH	A I U	U	D L U
Rough-legged Hawk	<i>Buteo lagopus</i>	RL	U	U	D L U
Unknown buteo	<i>Buteo</i> spp.	UB	U	U	D L U
Golden Eagle	<i>Aquila chrysaetos</i>	GE	I, S, NA, A, U ⁴	U	NA
Bald Eagle	<i>Haliaeetus leucocephalus</i>	BE	I, S1, S2, NA, A, U ⁵	U	NA
Unknown eagle	<i>Aquila</i> or <i>Haliaeetus</i> spp.	UE	U	U	NA
American Kestrel	<i>Falco sparverius</i>	AK	U	M F U	NA
Merlin	<i>Falco columbarius</i>	ML	AM Br U	AM Br U	NA
Prairie Falcon	<i>Falco mexicanus</i>	PR	U	U	NA
Peregrine Falcon	<i>Falco peregrinus</i>	PG	A I U	U	NA
Unknown small falcon	<i>F. sparverius</i> or <i>columbarius</i>	SF	U	U	NA
Unknown large falcon	<i>F. mexicanus</i> or <i>peregrinus</i>	LF	U	U	NA
Unknown falcon	<i>Falco</i> 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: 2009.

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 / HOUR	BIRDS / HOUR
23-Aug	9.00	2.0	0	clr	4.9	nw-n, ssw-sw	17.9	29.63	2	52	79	1	0.7
24-Aug	9.00	2.2	0	clr/haze	11.0	sse-sw	18.5	29.71	2	22	29	2	0.7
25-Aug	9.00	2.5	1	pc-ovc	18.5	s-sw	17.0	29.68	3	73	76	1	2.1
26-Aug	9.00	2.0	0	pc-ovc	12.7	ssw-sw	18.5	29.80	3	90	90	1	1.6
27-Aug	9.00	2.0	0	clr	2.9	sse-sw/calm	23.3	30.00	1	97	94	2	1.7
28-Aug	9.00	1.9	0	pc-ovc	6.6	n-ne, se-sw	25.1	30.24	2	83	86	2	1.8
29-Aug	9.00	2.0	0	ovc-pc, haze	11.8	nw-ne	17.5	30.19	4	59	75	2	2.0
30-Aug	9.00	2.9	0	clr	5.9	n-ene, var	23.6	30.07	2	66	70	2	3.3
31-Aug	10.00	2.0	0	clr	8.8	sw	23.5	29.97	2	69	76	2	5.0
01-Sep	9.17	1.9	0	clr-pc	8.2	sse-sw	23.3	30.04	2	85	82	2	5.7
02-Sep	9.00	2.6	0	clr-pc	13.0	se-ssw	20.4	30.14	2	72	95	1	4.3
03-Sep	9.00	2.0	0	pc-mc	22.7	ssw-sw	12.9	30.09	4	69	58	2	1.1
04-Sep	9.00	2.0	0	pc-ovc	6.2	s-sw	14.3	30.16	2	83	93	3	6.0
05-Sep	1.50	2.0	0	ovc, fog/rain	21.8	sw	13.3	29.94	4	63	20	-	0.0
06-Sep	5.25	2.6	0	ovc, fog/rain	21.4	ssw-sw	8.2	29.93	4	31	18	1	3.2
07-Sep	9.00	3.1	0	ovc-pc	10.7	s-sw	7.6	30.09	4	80	44	1	0.2
08-Sep	9.00	2.5	0	pc-ovc	6.0	sse-sw	10.8	30.14	2	93	92	2	3.9
09-Sep	9.00	3.0	1	pc-ovc	5.8	sw	14.1	30.15	3	68	61	2	9.0
10-Sep	9.00	2.1	0	clr	3.3	n, ssw-sw	16.0	30.31	1	94	90	3	8.7
11-Sep	9.00	2.1	1	clr	3.7	n-ne, ssw-sw	18.2	30.28	1	86	97	2	9.7
12-Sep	9.58	2.5	0	clr	3.6	ssw-sw	21.2	30.02	1	96	95	2	19.5
13-Sep	9.58	1.8	0	clr	3.0	s-sw	23.9	29.71	1	99	99	2	10.4
14-Sep	9.00	2.0	0	ovc-pc	6.9	nne, ssw-sw	20.7	29.89	2	86	97	2	11.6
15-Sep	9.00	1.9	0	mc-ovc	8.2	s-sw	18.0	30.22	3	90	92	2	7.8
16-Sep	9.00	2.0	0	pc/haze	7.0	se-sw	20.1	30.11	2	80	76	2	8.9
17-Sep	9.00	2.0	0	clr-pc	10.0	nnw-nne, ssw-sw	14.4	30.16	2	96	98	2	4.2
18-Sep	9.00	2.0	0	mc-pc	12.5	sw	16.5	30.10	2	100	93	2	8.4
19-Sep	9.00	2.2	0	pc-ovc, AM rain	18.4	sw	14.6	29.91	4	70	58	1	2.4
20-Sep	9.00	2.0	0	clr	6.9	nnw-ne, ssw	11.0	30.34	1	93	91	2	5.9
21-Sep	9.33	2.0	0	clr-pc	15.6	ssw-sw	14.4	30.44	4	98	100	1	7.2
22-Sep	9.00	2.0	0	clr	12.5	s-sw	16.8	30.40	2	94	95	1	14.9
23-Sep	9.00	2.0	1	clr-pc, haze	10.1	s-sw	20.6	30.28	2	78	77	2	7.2
24-Sep	9.00	2.0	0	clr-pc, haze	7.6	s-wsw	19.8	30.16	2	70	97	2	7.6
25-Sep	9.00	2.0	0	clr/haze	7.6	sw	18.7	30.25	1	86	97	2	6.9
26-Sep	9.08	2.6	0	clr-pc, blowing dust	10.7	ssw-sw	15.3	30.16	2	96	98	2	3.9
27-Sep	9.00	2.1	0	clr/haze	8.5	nnw-n, ssw-sw	9.1	30.21	3	85	86	3	2.2
28-Sep	8.83	2.0	0	clr-pc, haze	11.3	ssw-sw	12.1	29.61	3	89	88	2	4.3
29-Sep	9.00	2.0	0	pc-mc	14.6	ssw-sw	6.7	29.70	3	86	66	2	2.2
30-Sep	8.75	2.0	0	clr-mc	6.5	n, ssw-sw	6.7	30.05	2	85	70	2	1.6
01-Oct	8.75	2.0	0	mc-ovc, haze	8.8	ssw-w	8.0	30.17	3	72	57	2	1.8
02-Oct	6.75	2.0	0	pc-ovc, haze, snow	5.0	sse-sw, calm	7.1	29.90	3	53	44	1	1.0
03-Oct	8.75	2.2	0	pc-ovc, haze, PM snow	17.0	nw	3.2	29.79	4	79	63	2	1.9
04-Oct	8.67	2.0	0	clr-pc, haze	17.3	nw-n	5.1	29.84	3	87	99	3	3.5
05-Oct	8.75	2.0	0	clr/haze	5.6	n-ne, ssw-sw	5.3	30.07	3	80	82	3	3.5
06-Oct	8.75	2.9	0	clr-pc, haze	11.9	ssw-wsw	9.7	30.02	3	67	87	2	2.3
07-Oct	8.75	2.9	0	clr-pc, PM haze	12.3	nnw-nne	5.9	-	2	95	94	3	5.3
08-Oct	8.75	2.3	0	clr-ovc, haze	8.4	s-sw	6.4	30.01	3	79	89	1	1.9
09-Oct	8.75	1.9	0	pc	8.9	n, s-ssw	1.3	30.15	2	98	94	3	2.4
10-Oct	8.75	2.7	0	ovc-clr	4.2	nnw/calm, ssw-sw	0.9	30.04	4	89	65	2	4.7

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 / HOUR	BIRDS / HOUR
11-Oct	8.25	2.3	0	clr	13.3	s-ssw	-1.4	29.77	3	99	96	2	2.8
12-Oct	7.50	2.0	0	pc-ovc, haze, PM snow	6.3	ssw	-1.8	29.62	4	88	61	2	0.9
13-Oct	3.33	2.3	0	ovc, snow	21.0	n-nne	-2.4	29.38	4	22	36	-	0.0
14-Oct	0.00			Weather Day: snow									
15-Oct	8.50	2.2	0	ovc, fog	13.2	s-sw	6.3	30.15	4	59	49	1	1.3
16-Oct	0.00			Weather Day: snow									
17-Oct	4.50	2.0	0	ovc, fog/rain	22.8	ssw/var	9.7	29.81	4	33	37	2	0.9
18-Oct	7.92	2.0	0	mc-ovc, PM fog	6.3	ssw-sw	8.8	29.91	3	37	46	2	3.0
19-Oct	8.50	2.8	0	ovc, fog/haze	2.8	calm, sw	10.1	29.88	3	32	34	2	2.2
20-Oct	8.50	2.0	0	mc-ovc	9.8	ssw-sw	7.6	30.03	3	77	62	2	4.7
21-Oct	0.00			Weather Day: snow									
22-Oct	8.50	1.9	0	clr-ovc	11.6	n-nne, ssw-sw	5.2	30.12	3	52	91	2	3.4
23-Oct	0.00			Weather Day: snow									
24-Oct	8.58	3.5	0	pc-mc	6.2	ssw-sw	4.5	30.08	3	98	62	2	4.2
25-Oct	6.17	1.9	0	ovc, PM snow	21.8	ssw-sw	1.5	30.13	4	69	62	1	0.6
26-Oct	0.00			Weather Day: snow									
27-Oct	0.00			Weather Day: snow									

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: 2009.

DATE	OBS.		SPECIES ¹																								BIRDS			
	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	2	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0.7
24-Aug	9.00	1	0	0	0	0	1	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	6	0.7
25-Aug	9.00	3	1	0	0	5	3	0	0	0	1	0	0	5	0	0	0	0	0	0	1	0	0	0	0	0	0	19	2.1	
26-Aug	9.00	3	1	0	0	2	2	0	0	0	0	0	0	1	0	0	0	1	0	0	3	0	0	0	0	0	0	14	1.6	
27-Aug	9.00	1	0	1	0	3	4	0	0	1	0	0	0	4	0	0	0	0	0	0	1	0	0	0	0	0	0	15	1.7	
28-Aug	9.00	0	0	0	0	2	5	1	1	0	0	0	0	4	0	0	0	0	0	1	1	0	1	0	0	0	0	16	1.8	
29-Aug	9.00	0	1	2	0	2	3	0	1	0	0	0	0	4	0	0	0	1	0	0	1	1	0	0	0	1	0	18	2.0	
30-Aug	9.00	1	0	5	0	5	6	0	4	0	0	0	0	6	0	0	0	0	0	0	1	0	1	0	0	0	1	30	3.3	
31-Aug	10.00	2	0	6	0	11	6	0	5	0	0	0	1	10	0	0	0	0	0	0	6	1	1	0	0	0	1	50	5.0	
1-Sep	9.17	1	0	1	0	18	15	0	0	0	3	0	0	9	0	0	0	0	0	0	2	1	2	0	0	0	0	52	5.7	
2-Sep	9.00	0	0	5	0	13	6	0	3	0	0	0	0	5	0	0	0	0	0	0	6	0	0	1	0	0	0	39	4.3	
3-Sep	9.00	1	0	1	0	3	0	0	0	0	0	0	0	3	0	0	0	0	0	0	2	0	0	0	0	0	0	10	1.1	
4-Sep	9.00	1	1	1	0	22	6	0	6	0	0	0	0	11	0	0	0	1	0	0	2	0	1	0	1	0	1	54	6.0	
5-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	
6-Sep	5.25	0	1	1	0	6	1	1	0	1	1	0	0	3	0	0	0	2	0	0	0	0	0	0	0	0	0	17	3.2	
7-Sep	9.00	0	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	2	0.2	
8-Sep	9.00	2	0	0	0	13	6	0	0	0	1	0	0	11	0	0	0	0	0	0	1	0	0	0	0	0	1	35	3.9	
9-Sep	9.00	4	2	6	0	33	13	1	2	0	1	0	1	9	0	0	0	1	0	0	2	0	0	0	1	0	5	81	9.0	
10-Sep	9.00	9	0	4	0	28	11	1	0	1	0	0	0	12	0	0	0	2	0	0	4	2	1	0	1	0	2	78	8.7	
11-Sep	9.00	4	2	7	0	26	13	0	5	2	0	0	0	14	0	0	2	2	0	0	5	1	0	1	0	0	3	87	9.7	
12-Sep	9.58	9	0	12	0	69	32	1	13	1	5	1	0	25	0	0	0	2	0	0	6	3	0	1	2	1	4	187	19.5	
13-Sep	9.58	0	1	4	0	41	14	0	4	0	5	0	0	13	0	0	2	2	0	0	3	5	1	0	1	0	3	100	10.4	
14-Sep	9.00	14	6	0	0	43	14	0	11	0	1	0	1	7	0	0	1	2	0	0	0	0	0	0	1	0	2	104	11.6	
15-Sep	9.00	1	0	7	0	30	7	0	3	0	0	0	0	13	0	0	0	3	0	0	2	0	0	1	0	1	0	70	7.8	
16-Sep	9.00	2	4	9	0	34	8	0	4	0	0	0	0	10	0	0	0	2	0	0	2	2	0	1	0	0	2	80	8.9	
17-Sep	9.00	0	0	1	0	22	5	0	1	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	1	38	4.2	
18-Sep	9.00	0	1	2	0	37	18	2	2	1	1	0	0	6	0	0	0	3	0	0	0	0	0	0	0	0	3	76	8.4	
19-Sep	9.00	0	0	2	0	9	8	0	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	22	2.4	
20-Sep	9.00	1	3	3	0	12	14	0	1	1	0	0	0	6	0	0	0	1	0	0	1	3	0	0	1	1	0	53	5.9	
21-Sep	9.33	2	3	7	0	22	18	0	0	0	1	0	0	6	0	0	1	1	0	0	1	1	1	0	1	0	2	67	7.2	
22-Sep	9.00	0	2	2	0	78	26	3	5	0	0	3	0	5	0	0	0	1	0	0	5	1	0	0	0	0	3	134	14.9	
23-Sep	9.00	1	3	4	0	41	11	0	0	0	0	0	1	2	0	0	0	1	0	0	0	1	0	0	0	0	0	65	7.2	
24-Sep	9.00	0	1	2	0	24	10	0	4	1	4	1	0	9	0	0	1	1	0	0	1	2	0	0	0	0	7	68	7.6	
25-Sep	9.00	0	2	4	0	20	13	0	1	0	3	0	0	7	0	0	0	1	1	0	0	2	0	1	0	0	7	62	6.9	
26-Sep	9.08	1	0	2	0	18	3	1	0	0	0	0	0	4	0	0	1	1	0	0	0	1	1	0	0	0	2	35	3.9	

Appendix D. continued

DATE	OBS.		SPECIES ¹																								BIRDS			
	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
27-Sep	9.00	1	0	4	0	5	3	0	0	0	0	0	0	5	0	0	0	0	0	0	0	2	0	0	0	0	0	0	20	2.2
28-Sep	8.83	1	0	3	0	14	4	0	2	0	3	1	0	6	0	0	0	2	0	0	0	0	1	0	0	0	0	1	38	4.3
29-Sep	9.00	2	1	0	0	7	6	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	20	2.2	
30-Sep	8.75	0	0	0	0	3	2	0	0	0	1	0	0	5	0	0	0	1	0	0	0	2	0	0	0	0	0	14	1.6	
1-Oct	8.75	0	0	1	0	4	0	0	0	0	0	0	1	4	0	0	0	6	0	0	0	0	0	0	0	0	0	16	1.8	
2-Oct	6.75	0	0	1	0	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	1.0	
3-Oct	8.75	0	0	4	0	6	0	2	0	0	1	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	1	17	1.9	
4-Oct	8.67	0	0	3	0	6	2	0	4	0	0	0	0	6	0	2	0	0	0	0	0	1	2	0	0	0	4	30	3.5	
5-Oct	8.75	0	0	2	0	10	2	1	2	1	2	0	0	5	0	0	0	3	0	0	0	0	0	0	0	1	0	31	3.5	
6-Oct	8.75	0	0	2	0	6	1	0	0	0	0	0	0	6	0	1	1	2	0	0	0	1	0	0	0	0	0	20	2.3	
7-Oct	8.75	0	0	1	0	21	4	5	1	0	1	0	0	7	0	1	0	1	0	0	0	1	0	0	0	0	3	46	5.3	
8-Oct	8.75	0	0	1	0	11	0	1	0	0	0	0	0	1	0	2	0	1	0	0	0	0	0	0	0	0	0	17	1.9	
9-Oct	8.75	0	0	0	0	3	1	0	0	0	0	0	0	4	0	5	0	4	0	0	0	1	1	0	0	0	2	21	2.4	
10-Oct	8.75	0	0	0	0	2	0	2	1	1	1	0	0	12	0	7	1	8	0	0	0	1	0	0	0	0	5	41	4.7	
11-Oct	8.25	0	0	0	0	4	1	0	0	0	0	0	0	7	0	6	0	4	1	0	0	0	0	0	0	0	0	23	2.8	
12-Oct	7.50	0	0	0	0	2	0	1	0	0	0	0	0	1	0	1	0	2	0	0	0	0	0	0	0	0	0	7	0.9	
13-Oct	3.33	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	
14-Oct	0.00																													
15-Oct	8.50	0	0	0	0	9	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	11	1.3	
16-Oct	0.00																													
17-Oct	4.50	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	4	0.9	
18-Oct	7.92	0	0	1	0	11	0	1	0	0	0	0	0	5	0	2	1	2	0	0	0	1	0	0	0	0	0	24	3.0	
19-Oct	8.50	0	0	1	0	10	0	0	0	0	0	0	0	3	0	0	0	2	0	0	0	3	0	0	0	0	0	19	2.2	
20-Oct	8.50	0	0	1	0	5	0	0	0	0	0	0	0	14	0	5	5	3	0	0	0	3	0	1	0	0	3	40	4.7	
21-Oct	0.00																													
22-Oct	8.50	0	0	1	0	3	0	1	1	0	0	0	0	2	0	12	1	6	0	0	0	0	0	0	0	0	2	29	3.4	
23-Oct	0.00																													
24-Oct	8.58	0	0	0	0	6	0	1	0	0	2	0	0	5	0	4	3	9	2	0	0	1	0	0	0	0	3	36	4.2	
25-Oct	6.17	0	0	0	0	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0.6	
26-Oct	0.00																													
27-Oct	0.00																													
Total	507.74	70	36	127	0	852	332	27	87	12	38	6	5	341	0	48	20	93	4	1	59	45	14	7	9	5	2	85	2325	4.6

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: 1997–2009.

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	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	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	25-Oct
Observation days	29	53	61	67	55	62	59	59	62	64	62	64	60	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	495.48
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	441.8
SPECIES	RAPTOR COUNTS													
Turkey Vulture	4	29	21	26	14	46	30	25	58	50	42	48	70	38
Osprey	41	24	47	71	48	57	31	34	25	50	31	37	36	41
Northern Harrier	115	152	167	104	91	148	66	59	113	127	60	82	127	108
White-tailed Kite	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Sharp-shinned Hawk	311	949	932	1,050	878	937	421	468	730	854	880	875	852	819
Cooper's Hawk	150	247	232	198	198	234	136	220	228	270	363	269	332	244
Northern Goshawk	38	32	50	35	16	22	17	41	13	31	49	48	27	32
Unknown small accipiter ¹	–	–	–	–	98	85	40	1	48	97	45	33	87	48
Unknown large accipiter ¹	–	–	–	–	0	10	17	6	6	11	3	19	12	9
Unknown accipiter	182	221	248	98	0	49	36	10	9	12	8	8	38	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	1,207
Broad-winged Hawk	2	7	5	5	6	9	3	2	6	4	2	5	6	5
Swainson's Hawk	0	8	17	2	0	7	15	5	2	2	4	5	5	6
Red-tailed Hawk	145	182	450	364	263	386	263	277	233	441	378	304	341	324
Ferruginous Hawk	0	0	0	1	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	29
Unidentified buteo	75	58	148	97	83	82	39	15	29	57	29	10	20	56
TOTAL BUTEOS	223	268	664	522	365	529	334	319	292	532	435	349	420	419
Golden Eagle	105	55	141	174	105	135	142	130	130	157	82	111	93	121
Bald Eagle	2	2	7	15	2	8	1	2	4	8	10	12	4	6
Unidentified eagle	7	0	7	5	1	0	12	0	2	0	0	0	1	2
TOTAL EAGLES	114	57	155	194	108	143	155	132	136	165	92	123	98	130
American Kestrel	24	107	89	40	84	68	33	48	55	29	47	47	59	59
Merlin	17	55	36	26	36	38	21	39	53	34	40	44	45	39
Prairie Falcon	2	10	7	5	5	6	19	5	4	9	6	17	14	9
Peregrine Falcon	5	2	9	1	3	9	14	7	4	20	16	13	7	9
Unknown small falcon ¹	–	–	–	–	6	4	6	5	1	3	0	2	9	4
Unknown large falcon ¹	–	–	–	–	1	2	2	2	3	3	1	1	5	2
Unknown falcon	10	6	6	2	2	0	0	4	0	0	1	0	2	2
TOTAL FALCONS	58	180	147	74	137	127	95	110	120	98	111	124	141	122
Unidentified Raptor	178	216	218	62	112	178	134	27	48	52	30	22	85	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	2,164

¹ Designations used for the first time in 2001.

Appendix F. Daily capture totals of migrating raptors at Chelan Ridge, WA: 2009.

DATE	STN	SPECIES ¹												CAPTURES	
	HOURS	NH	SS	CH	NG	BW	RT	RL	GE	AK	ML	PR	PG	TOTAL	/STN HR
24-Aug	7.75	0	3	1	0	0	1	0	0	1	0	0	1	7	0.9
25-Aug	7.75	0	1	1	0	0	0	0	0	0	0	0	0	2	0.3
26-Aug	16.67	0	2	1	0	0	0	0	0	1	0	0	0	4	0.2
27-Aug	8.75	0	2	3	1	0	0	0	0	1	0	0	0	7	0.8
28-Aug	8.83	0	2	0	0	0	0	0	0	1	0	0	0	3	0.3
29-Aug	17.75	0	3	0	0	0	3	0	0	1	0	0	0	7	0.4
30-Aug	17.67	0	0	2	0	0	0	0	0	0	0	0	0	2	0.1
31-Aug	9.42	0	7	4	0	0	1	0	0	0	1	1	0	14	1.5
1-Sep	8.83	0	18	1	0	0	1	0	0	0	0	0	0	20	2.3
2-Sep	8.75	0	11	3	0	0	1	0	0	0	1	0	0	16	1.8
3-Sep	8.50	0	4	1	1	0	0	0	0	0	0	0	0	6	0.7
4-Sep	8.42	0	9	2	0	0	0	0	0	1	0	1	0	13	1.5
5-Sep	1.17	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
6-Sep	7.75	0	3	4	0	0	0	0	0	0	0	0	0	7	0.9
7-Sep	8.33	0	2	1	0	0	0	0	0	0	0	0	0	3	0.4
8-Sep	9.08	0	9	4	0	0	2	0	0	0	0	0	0	15	1.7
9-Sep	8.83	0	11	5	0	0	0	0	0	0	0	0	0	16	1.8
10-Sep	12.92	1	14	2	0	0	3	0	0	1	2	0	0	23	1.8
11-Sep	8.92	2	11	3	0	0	1	0	0	0	0	0	0	17	1.9
12-Sep	18.50	4	34	8	0	0	2	0	0	1	2	0	0	51	2.8
13-Sep	18.83	1	30	3	0	0	1	0	0	0	2	0	0	37	2.0
14-Sep	8.42	0	21	8	0	0	0	0	0	0	0	0	0	29	3.4
15-Sep	8.92	0	22	7	0	0	1	0	0	0	0	0	0	30	3.4
16-Sep	8.75	1	12	4	0	0	0	0	0	0	0	0	1	18	2.1
17-Sep	8.83	0	6	4	0	0	0	0	0	0	1	0	0	11	1.2
18-Sep	9.08	2	20	14	0	0	1	0	0	0	0	0	0	37	4.1
19-Sep	16.84	0	2	4	1	0	0	0	0	0	0	0	0	7	0.4
20-Sep	16.83	0	13	1	0	0	0	0	1	0	2	0	0	17	1.0
21-Sep	9.00	2	17	4	0	0	2	0	0	0	1	0	0	26	2.9
22-Sep	8.75	0	18	5	0	0	0	0	0	0	1	0	0	24	2.7
23-Sep	8.58	1	8	2	0	0	1	0	0	0	0	0	0	12	1.4
24-Sep	8.92	0	3	4	0	0	1	0	0	0	0	0	0	8	0.9
25-Sep	9.00	1	15	5	0	0	1	0	0	0	1	0	0	23	2.6
26-Sep	16.75	1	10	2	0	0	1	0	0	1	1	0	0	16	1.0
27-Sep	17.83	0	5	3	0	0	0	0	0	0	1	0	0	9	0.5
28-Sep	15.84	0	7	2	0	1	0	0	0	0	0	0	0	10	0.6
29-Sep	8.50	0	2	4	0	0	2	0	0	0	0	0	0	8	0.9
30-Sep	8.50	0	4	2	0	0	0	0	0	0	0	0	0	6	0.7

Appendix F. continued

DATE	STN	SPECIES ¹												CAPTURES	
	HOURS	NH	SS	CH	NG	BW	RT	RL	GE	AK	ML	PR	PG	TOTAL	/ STN HR
1-Oct	8.58	1	1	0	0	0	0	0	0	0	0	0	0	2	0.2
2-Oct	6.50	0	4	0	0	0	0	0	0	0	0	0	0	4	0.6
3-Oct	17.17	1	2	0	1	0	1	0	0	0	1	0	0	6	0.3
4-Oct	15.75	0	7	2	0	0	0	1	0	0	0	1	0	11	0.7
5-Oct	8.67	0	5	0	0	0	0	0	0	0	1	0	0	6	0.7
6-Oct	8.75	1	2	0	0	0	2	1	0	0	0	0	0	6	0.7
7-Oct	12.00	0	4	0	1	0	2	0	0	0	0	0	0	7	0.6
8-Oct	16.42	1	5	0	1	0	0	1	1	0	0	0	0	9	0.5
9-Oct	7.17	0	2	0	1	0	0	1	2	0	0	0	0	6	0.8
10-Oct	16.75	1	2	0	2	0	0	2	0	0	0	0	0	7	0.4
11-Oct	15.67	1	3	0	0	0	1	1	0	0	0	0	0	6	0.4
12-Oct	7.33	1	2	2	0	0	0	0	0	0	0	0	0	5	0.7
13-Oct	2.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
14-Oct	0.00														
15-Oct	3.75	0	2	0	0	0	0	0	0	0	0	0	0	2	0.5
16-Oct	0.00														
17-Oct	9.33	0	0	0	0	0	1	0	0	0	0	0	0	1	0.1
18-Oct	16.09	0	9	0	0	0	0	0	0	0	0	0	0	9	0.6
19-Oct	7.92	0	2	0	0	0	0	0	0	0	0	0	0	2	0.3
20-Oct	15.82	1	2	0	0	0	1	0	1	0	2	0	0	7	0.4
21-Oct	0.00														
22-Oct	8.08	0	3	0	1	0	0	2	0	0	0	0	0	6	0.7
23-Oct	0.00														
24-Oct	15.75	0	1	0	0	0	0	0	0	0	1	0	0	2	0.1
Total	632.76	24	419	128	10	1	34	9	5	9	21	3	2	665	1.1

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: 1999–2009.

	1999 ¹	2000 ¹	2001	2002	2003	2004	2005	2006	2007	2008	2009	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		
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		
Number of stations	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	54.4	
Station hours	388	?	612.8	837.3	803.3	699.6	828.2	797.33	716.12	836.48	632.76	754.67	
Captures / stn. hour	5.7	?	8.6	8.1	7.3	5.0	7.5	10.2	9.4	9.1	10.5	8.4	
SPECIES	RAPTOR CAPTURES												
Northern Harrier	4	3	10	13	11	6	12	28	12	18	24	14.9	141
Sharp-shinned Hawk	139	125	341	459	394	237	389	556	450	503	419	417	4018
Cooper's Hawk	42	46	107	127	100	58	137	100	138	140	128	115	1123
Northern Goshawk	14	10	12	13	9	16	11	24	16	29	10	16	164
Broad-winged Hawk										0	1	0	1
Red-tailed Hawk	11	8	22	29	20	16	11	50	33	22	34	26	256
Rough-legged Hawk	0	1	1	2	1	0	5	6	1	2	9	3.0	28
Golden Eagle	0	1	2	0	4	2	2	6	2	5	5	3	29
American Kestrel	3	0	8	10	17	5	6	8	3	13	9	9	82
Merlin	6	4	17	21	25	10	49	31	15	25	21	24	224
Prairie Falcon	1	1	3	4	4	1	0	3	4	5	3	3	29
Peregrine Falcon	0	0	2	0	4	1	1	2	1	2	2	2	15
All species	220	199	525	678	589	352	623	814	675	764	665	632	6110
Recaptures ²	0	0	0	0	0	0	0	0	1	0	0	0	1
Foreign Recaptures ³	0	0	0	1	0	0	0	2	2	0	1	0.8	7
Foreign Encounters ⁴	0	1	5	2	1	1	4	15	12	7	9	6.4	59

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.