

**FALL 2008 RAPTOR MIGRATION STUDIES
AT CHELAN RIDGE, WASHINGTON**



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



**Okanogan and Wenatchee National Forests
Winthrop, 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. HWI took over coordinating the banding program in 2001. To date, HWI observers have recorded 18 species of migratory diurnal raptors at the site, with counts ranging between ~1,500–2,900 migrants per season. The 2008 season marked the 11th consecutive, full-season count and the 10th consecutive season of banding at the site. This report summarizes the 2008 count and banding results.

The Chelan project was 1 of 14 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 educator, play a critical role in coordinating educational 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 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 first season of raptor migration counting for both official observers, Grace Eger and Brian Connely (see Appendix A for a complete history of observer participation). Former full-time observer and current seasonal crew leader/bander, Rob Spaul, provided on-site training and assistance throughout the season. On-site Interpreter, Leif Baierl, also routinely assisted with the count and participated in pre-season training in Utah. Other crewmembers, HWI and USFS staff, and visitors also occasionally assisted with the counts.

Weather permitting, observations usually began between 0700 and 0800 H and ended between 1500 and 1600 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 2008 follows Hoffman and Smith (2003). In comparing 2008 annual statistics against means and 95% confidence intervals for previous seasons, I equate significance with a 2008 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 0900–1700 H PST. Capture devices included mist nets, dhogaza 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 one day of planned observations and reduced observations to ≤ 4 hours on one other day (see Appendix C for daily weather records). The corresponding 1998–2007 averages are 2.5 and 1.8 days, respectively. Weather data collected on site during active observation periods indicated that 36% of the active days featured predominantly fair skies, 44% transitional skies (i.e., changed from fair or partly cloudy to mostly cloudy or overcast during the day, or vice versa), and 20% mostly cloudy to overcast skies. The comparable long-term averages are 49% fair, 30% transitional, and 21% mostly cloudy to overcast. The proportion of active observation days that featured noteworthy levels of visibility reducing fog and especially haze (47%) was above the long-term average of 39% and similar to last year, but was much less pronounced than during 2002 and 2003, in particular, when wildfires were very prevalent due to drought conditions. This year, there were still a number of fires and prescribed burns that occurred throughout the season creating hazy conditions. In particular, there was significant haze throughout the visible area from 16–21 September due to fires to the east, and prescribed burns occurred to the north from 29 September through 1 October and from 16–18 October. The proportion of active observation days that featured some rain and/or snow during active observation periods (19%) also was above average (13%) in 2008.

In 2008, light winds (< 12 kph) prevailed on 83% of the active observation days, moderate winds on 17%, and strong winds (≥ 29 kph) on none of the active days (1998–2007 averages: 69%, 29%, and 2%). In terms of wind directions, 2008 was similar to most years in that S-SW winds were the most common pattern, prevailing on a near average 45% of the active days (average 46%). Days when SE-SW winds prevailed throughout the day were only slightly more common than usual (11% vs. average of 9%); however, days that featured such winds for a substantial portion of the day but then the pattern switched to NW-NE winds (or vice versa) were much more common than usual and for the first time since the

project began (17% vs. average of 4% of the active days). Otherwise, the prevalence of most other typically seen patterns was slightly below average in 2008.

The temperature during active observation periods averaged 11.5°C (the average of daily values, which in turn were averages of hourly readings), ranging from 1.2–22.4°C. The overall average was slightly below the long-term average of 12.6°C and the minimum was the third lowest for the project, both very similar to last year; however, unlike last year when the maximum ranked as the third highest to date, this year's maximum ranked third lowest. The barometric pressure during active observation periods averaged 29.98 in Hg, ranging from 29.77 to 30.55 in Hg, with all values ranking slightly above average. In 2008, 56% of the active days featured predominantly good-to-excellent thermal-lift conditions, which is substantially higher than the long-term average of 41%. These ratings have increased each of the past five years.

In summary, inclement weather kept our 2008 observers away from the site less often than usual, but cool temperatures, cloudy skies, fog/haze, and rain/snow showers all were more prevalent than average during active observation periods. The wind conditions were atypical in being much lighter than usual, which likely contributed to a high proportion of days with good thermal lift, and in featuring a record-high proportion of days when a mix of SE-SW and NW-NE winds prevailed.

OBSERVATION EFFORT

Observations occurred on 64 of 65 possible days between the scheduled observation period of 24 August through 27 October. The number of observation days and hours (557.85) were 6% and 14% above the 1998–2007 averages of $60 \pm 95\%$ CI of 2.4 days and 488.02 ± 27.12 hours. The number of active days was the second highest to date but not a significant difference, whereas the difference in hours was significant and the 2008 value comprised a new record high (Appendix E). The 2008 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 a non-significant 7% higher than the 1998–2007 average of 2.0 ± 0.07 observers/hour.

FLIGHT SUMMARY AND TRENDS

The observers counted 2,037 migrating raptors of 16 species during the 2008 season (Table 1; see Appendix D for daily count records), which is a non-significant 6% lower than the 1998–2007 average (see Appendix E for annual count summaries). The flight consisted of 62% accipiters, 17% buteos, 6% eagles, 4% harriers, 6% falcons, 2% vultures, 2% Ospreys, and 1% unknown raptors (Figure 2). The proportions of buteos, harriers, and unknown raptors were significantly below average, whereas the proportions of accipiters and vultures were significantly above average. The most common species seen in 2008 were the Sharp-shinned Hawk (43% of the total count), Red-tailed Hawk (15%), Cooper's Hawk (13%), Golden Eagle (5%), and Northern Harrier (4%). All other species each comprised less than 3% of the total count.

No record low or high species-specific counts occurred in 2008 (Appendix E). Adjusted passage rates were significantly above average for Turkey Vultures, Northern Goshawks, Bald Eagles, Prairie Falcons, and Peregrine Falcons, whereas passage rates were significantly below average for Northern Harriers, Red-tailed Hawks, and Golden Eagles (Table 1).

Population Trends.—Regression analyses of trends in adjusted passage rates updated through 2008 (after Hoffman and Smith 2003) indicated continuation of a significant ($P \leq 0.05$) linear declining trend for Northern Harriers (Figure 3) and marginally significant ($P \leq 0.10$) to highly significant ($P \leq 0.01$) overall declines best modeled with quadratic trends for Sharp-shinned and Cooper's Hawks (Figure 4), Broad-winged Hawks (Figure 5), adult Golden Eagles (Figure 6), and American Kestrels (Figure 7).

Conversely, continuations of a significant linear increasing trend for Turkey Vultures (Figure 3) and a highly significant linear increasing trend for Peregrine Falcons (Figure 7) were indicated. After showing a sharp decline between 1998 and 2003, Sharp-shinned Hawk passage rates have since shown a strong increasing trend, which for the first time in 2008 was modeled by a marginally significant, trough-shaped, quadratic trend (Figure 4). Cooper's Hawks have shown a similar pattern, except that passage rates of this species have been among the highest to date for the past three seasons, whereas recent Sharp-shinned Hawk passage rates have remained below those seen between 1998 and 2002 (Figure 4). The Broad-winged Hawk and American Kestrel regressions tracked similar patterns of decline through 2003, but then relatively stable patterns thereafter (Figures 5 and 7). Lastly, a significant quadratic regression continued to track a hill-shaped pattern in passage rates of adult Golden Eagles, with an increasing pattern evident during the first three years of the project but a decreasing pattern of similar magnitude evident since 2004 (Figure 6). A similar pattern is evident for non-adult Golden Eagles, except that high peaks in 2000 and 2006 precluded a significant quadratic model fit (Figure 6).

Smith et al. (2008a) present trend analyses of data collected through 2005 for most of the long-term, ongoing, 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 2008. 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 2008.

Differences between the RPI results and those presented herein that clearly relate to addition of three more years of data include: a) replacement of marginally significant to significant linear declines for Sharp-shinned and Cooper's Hawks in the RPI results with marginally significant to significant quadratic trends illustrating sustained, recent recoveries; b) replacement of a marginally significant decline for Northern Goshawks in the RPI results with no significant overall trend, reflecting three years of improved counts from 2006–2008; and c) replacement of a marginally significant linear decline for American Kestrels in the RPI results with a significant quadratic trend reflecting a stabilizing pattern since 2003. 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 are expected to be published in the *Journal of Raptor Research* later this year, 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 review).

Age Ratios as Indicators of Regional Productivity.—Immature : adult ratios were significantly below average in 2008 for Sharp-shinned and Cooper's Hawks, significantly above average for Northern Harriers, Bald Eagles, and Peregrine Falcons, and did not differ significantly from the long-term averages for four other species for which such comparisons were possible (Table 2). Note, however, that the overall count of Broad-winged Hawks was too low to attach much value to the comparison. For Northern Harriers, the high 2008 age ratio clearly was due to a dearth of adults rather than high abundance of

immature birds. In contrast, for both Bald Eagles and Peregrine Falcons, relatively high abundance of immature birds contributed to the high age ratios for these species. For Sharp-shinned and Cooper's Hawks, high adult abundance clearly contributed to the low age ratios for these species, especially for Cooper's Hawks for which the abundance of immature birds also was above average.

Seasonal Timing.—The combined-species median passage date of 19 September was a significant 3 days earlier than the 1998–2007 average (Table 3) and the overall seasonal distribution differed from the average pattern in showing mostly above-average proportional activity levels during the first three weeks of September but then significantly below average activity during the 21–25 September and 1–5 October five-day periods (Figure 8). Both of the latter periods featured relatively unsettled conditions and rain/snow events, particularly in early October when the only missed day of observations occurred due to the weather (Appendix C). Activity also was significantly above-average during the latter half of October, reflecting higher than average late-season activity of eagles, goshawks, and Red-tailed and Rough-legged Hawks.

At the species level, five species showed significantly late median passage dates (Osprey, Northern Harrier, Northern Goshawk, Red-tailed Hawk, and Golden Eagle) and four species showed significantly early timing (Sharp-shinned Hawk, Broad-winged Hawk, Merlin, and Peregrine Falcon, with Cooper's Hawks also marginally late; Table 3). Note that all four falcon species showed at least slightly early timing in 2008. Age- and sex-specific data revealed several noteworthy clarifications: 1) although both the species-level data and data for “brown” birds (i.e., a combination of unidentified immatures and adult females) indicated significantly late passage for harriers, identified adults showed significantly early timing, especially adult males, and the median passage date for identified immature birds matched the long-term average for this group; 2) the species-level data indicated significantly late passage for goshawks, and the age-specific data for immature birds indicated the same, but identified adults showed significantly early timing; 3) the species-level data for Red-tailed Hawks and Golden Eagles indicated late timing, but the age-specific data were mixed and at most indicated only marginally significant variation; and 4) at the species level the timing of Bald Eagle passage matched the long-term average, but the age-specific data for both identified adults and non-adults suggested early timing (Table 4).

RESIDENT RAPTORS

One resident Turkey Vulture was seen one to two times per week on the north side of Cooper Mountain and over the saddle east of the observation point. The observers thought that the observation point was probably on the far southern edges of the bird's territory, as they saw it only infrequently, it always seemed to be passing through rather than lingering in the area, and it typically returned north after passing through.

Occasionally during September, the observers recorded Sharp-shinned and Cooper's Hawks hunting in the Mitchell Creek area late in the afternoon, but their impression was that these may not have been truly resident birds, but rather transient locals.

Resident Red-tailed hawks were first seen on 24 September and included three light-morph adults and one light-morph juvenile. All four birds were seen most frequently in Mitchell Creek hunting low in the canyon, kiting over the saddle east of observation, flying west toward Twin Peaks up to 20 km away, and occasionally in Black Canyon just north of observation. The adults often were seen escorting other large raptors that entered their territory from the west. The juvenile was last seen on 26 September. One of the adults was presumed to have migrated in early October, with only two adults seen after 7 October and for the remainder of the season.

One adult Golden Eagle was believed to have a territory about 20 km west of the observation point. It was seen on 8 and 26 September and 5 and 25 October. On two occasions the eagle was seen escorting

another Golden Eagle from the Twin Peaks area south and out of its territory. On the other two occasions the eagle was seen flying north in the Twin Peaks area.

One adult Bald Eagle was seen on three occasions between early September and early October traveling from the southeast over Mitchell Creek and continuing on to the northwest. The observers assumed that this eagle was not local to the observation area, but rather utilized both Lake Chelan south of the observation site and the Methow River north of observation site as hunting territories. One non-adult Bald Eagle was seen on 5 September traveling northwest from Lake Chelan.

One adult male American Kestrel resided in the area and was seen almost daily from 24 August through 17 September. It frequently buzzed the observation owl and hunted low in the Mitchell Creek basin and over the ridge just east of the observation point. One adult female was seen acting non-migratory on 26 August, but was not seen again and was assumed to have migrated early.

This resident assemblage differs from past years in that local Northern Harriers, Sharp-shinned and Cooper's Hawks, and Prairie Falcons often have been more apparent in the past, and typically more than one local Turkey Vulture is often apparent.

TRAPPING EFFORT

Trapping occurred on 60 of 61 days between 24 August and 23 October, with effort totaling 836.48 station hours (see Appendix F for daily trapping records). The number of trapping days and station hours were both significantly above their respective 2001–2007 averages of $53 \pm 95\%$ CI of 3.2 days and 756.4 ± 61.3 station hours, with number of days a new record high (see Appendix G for annual trapping summaries).

TRAPPING AND BANDING RESULTS

The 2008 capture total of 764 newly banded birds, involving 11 typical species, was the second highest total since HWI took over the banding program in 2001 and was a significant 25% higher than the 2001–2007 average (Table 5, Appendix G). Capture totals were significantly above average for six species and were not significantly below average for any species (Table 5), and the totals for Cooper's Hawks, Northern Goshawks, and Prairie Falcons rose to new record highs (Appendix G). The species captured most frequently in 2008 were the Sharp-shinned Hawk (66% of captures), Cooper's Hawk (18%), Northern Goshawk (4%), Red-tailed Hawk (3%), Merlin (3%), and Northern Harrier (2%); all other species each comprised <2% of the total.

Similar patterns applied to estimates of capture totals, capture rates (birds captured per 100 station hours), and capture success (capture proportions of observed, trappable species), in that no values were significantly below average; however, capture rates were significantly above average for only four species and capture success was significantly above average only for Northern Harriers and Golden Eagles (Table 5). Most notably, despite substantial increases in the total numbers caught and the capture rates, capture success for Northern Goshawks and Prairie Falcons was slightly below average, indicating that the trappers simply were unable to keep pace the well-above average flight volume of these species.

Compared to the counts, banding at this site yields unique and substantial sex-age specific data only for the three accipiters (Table 6). For Sharp-shinned Hawks, both the count and banding data indicated reduced immature : adult ratios in 2008 (51% and 36% below average, respectively), with both estimates of similar magnitude (2.1 and 2.4, respectively), which is typical for the site. However, at this site the count age ratio averages higher than the capture age ratio, which 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, the switch in the magnitude of the two values in 2008 suggests that immature birds were more susceptible to capture than usual compared to adults in 2008. Both datasets

also indicated similarly below-average (52–59%) age ratios for Northern Goshawks. The magnitude of the two estimates differed more (3.4 count; 4.3 capture) for this species, but again in typical fashion for the site and, in this case, suggesting no substantial variation in susceptibility to capture. In contrast, for Cooper's Hawks, the two datasets suggested very different patterns in both direction and magnitude, with the count age ratio of 2.9 a significant 40% below average and the banding age ratio of 4.5 a significant 95% above average. Moreover, the count-based age ratios for this species typically average roughly twice as high as the capture-based ratios (again, an atypical pattern compared to most other western sites), but the opposite was true in 2008. Accordingly, similar to the case for Sharp-shinned Hawks, the 2008 pattern at Chelan Ridge was more typical for our western banding sites, in general, and suggests that immature Cooper's Hawks were much more susceptible to capture than usual at this site compared to adults in 2008. The capture data also uniquely indicated that the female : male ratios of captured Sharp-shinned and Cooper's Hawks were both above average in 2008, significantly so for Sharp-shinned Hawks, whereas the sex ratio of captured Northern Goshawks was substantially below average (Table 6).

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, and wing-pit fat ratings (Table 7). For Sharp-shinned Hawks, these measures indicated a typical pattern for crop fullness and wing-pit fat, but an above-average proportion of birds with thin keel muscles. For Cooper's Hawks, there was a slight increase in the proportion of birds with empty crops, a substantial increase in the proportion of birds with thin keels, and marked increase in the proportion of birds with no wing-pit fat; however, the proportion of birds with heavy wing-pit fat also was above average, albeit still comprising a relatively small fraction of the total number of birds captured. The same pattern applied to Northern Goshawks in terms of keel-muscle mass and fat storage; however, a considerably above-average proportion of the goshawks had full or nearly full crops when captured. Thus, the body condition data seem to support the age ratio inferences in suggesting that below-average body condition may have contributed to higher susceptibility to capture of immature Sharp-shinned and Cooper's Hawks in 2008. In contrast, for Northern Goshawks, perhaps the higher proportion of birds with food in their crops offset other indicators of below-average body condition and resulted in a typical pattern of capture susceptibility.

ENCOUNTERS WITH PREVIOUSLY BANDED BIRDS

Since banding began at Chelan Ridge in 1999, 40 foreign encounters with Chelan-banded birds have been recorded. Six new encounters occurred in 2008, involving 2 Red-tailed Hawks, 3 Sharp-shinned Hawks, and 1 Cooper's Hawk (Table 8). All were banded as hatch-year (HY) birds between 2003 and 2008. The Cooper's Hawk was banded in 2007 and encountered dead of unknown causes 7 months later during April 1,768 km to the southeast near Tucson, Arizona. One Sharp-shinned Hawk was banded in 2007 and two in 2008, with all three encountered again within less than 4 months. Two were found dead of unknown causes, one in early January 1,245 km south in southern California and the other in late November 808 km south in northern California. The third bird was recaptured 287 km south at our Bonney Butte migration site in northern Oregon 12 days later. This was the fifth exchange of banded birds between the two sites (3 Sharp-shinned Hawks, 1 Cooper's Hawk, and 1 Red-tailed Hawk). One Red-tailed Hawk banded in 2007 was encountered dead of unknown causes in early January 165 km south near Yakima, Washington. The other was banded in 2003 and found dead in March 2008 along a highway, presumably having been hit by a vehicle, 836 km south in northern California.

The Cooper's Hawk recovered in Arizona is the eleventh Chelan-banded bird that has ended up east of the Sierra–Cascade range. Others include four Sharp-shinned Hawks recovered or recaptured in Arizona, Idaho, and Nevada; 2 other Cooper's Hawks encountered in central Arizona and northeastern Nevada; 2 Merlins encountered in west-central Oregon and southeastern Washington; 1 Golden Eagle tracked by satellite to a winter range in southern New Mexico; and 1 Northern Harrier tracked by satellite to southern California then east to southern Arizona. This suggests that although the majority of Chelan

Ridge migrants follow the Pacific Coast Flyway (*sensu* Hoffman et al. 2002) into western Oregon and California for the winter, thus far roughly 20% of those tracked or re-encountered have diverted east and southeast from Chelan Ridge to travel through the Intermountain corridor into Idaho, Nevada, Arizona, and New Mexico.

VISITOR PARTICIPATION AND PUBLIC OUTREACH

The 2008 visitor logs recorded 165 individuals—similar to last year—mostly from surrounding Washington communities (primarily the Methow Valley and Seattle areas), with an estimated 30–40% returning after visiting in previous years. Visitation occurred from 24 August through 18 October on a total of 20 days, with most guests remaining for 2–3 hours. The typical age range of general guests was 45–65 years, with retirees a common constituent. Organized groups included a church group and 10th grade class from Entiat, Washington; a Leavenworth Home School group, ages 2–15 years; and a Chelan Valley Independent school group, ages kindergarten to 7th grade.

In 2008, 572 hourly assessments by the observers of visitor disturbance resulted in the following ratings: 92% none, 7% low, and <1% moderate or high. This typical low level of disturbance testifies to the advantages of having a full-time educator and other dedicated volunteers available to ensure enjoyable and informative visits for all guests without unnecessarily distracting the observers from their primary task of documenting the migration.

ACKNOWLEDGEMENTS

Financial and logistical support for this project in 2008 was provided by Okanogan and Wenatchee National Forests, Washington Department of Fish and Wildlife (WDFW), Arthur and Elaine Johnson Foundation, Fledgling Fund, Kinsman Foundation, 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. The Chelan Ridge project continues to encourage local interns to participate, learn, and help out. This year, Madeleine Eckmann, Lindsay Welfelt, Jaime Welfelt, and Alexis Monetta were our interns and we hope they will all return again in 2009. Teri Peiper shared her professional photographer expertise by shooting images during the season; her talent is obvious. Forest Supervisor Becki Heath, Group Leader for Administration and Recreation Maureen Hanson, Chelan District Ranger Bob Sheehan, and Methow Valley District Ranger John Newcom made a point to visit this year and their support and encouragement was well received by the crew. Richard Hendrick and his birding buddy Meredith Spencer are certainly the most dedicated volunteers that any project could hope to have. They continuously see things that the project could use, and then make it happen. We all appreciate Richard and Meredith! We thank former site coordinator and bander Ben Vang-Johnson for visiting and helping out with the banding operations. Brad Martin whispered to his pigeon flock over the winter so they would again be relaxed and eager to help us bring hawks, falcons, and eagles close enough for capture. Brad and his wife Norma patiently cope with the challenges of getting the work done at the Ridge and then fitting pigeon trades into the short time before dark. We value their essential role in the success of our capture effort. Kathy Corrigan was her tireless self at the Forest Service front desk, taking radio calls from the ridge, answering phone calls, handing out brochures, and directing visitors to the ridge. She also keeps the tally board up to date every day. Finally, the continuing, dependable support from District Staff John Rohrer has been an important foundation to allow this partnership to succeed for the past 12 years.

LITERATURE CITED

- Bildstein, K. L. 2001. Why migratory birds of prey make great biological indicators. Pages 169–179 in K. L. Bildstein and D. Klem (Editors). Hawkwatching in the Americas. Hawk Migration Association of North America, North Wales, Pennsylvania, USA.
- DeLong, J. P., and S. W. Hoffman. 2004. Fat stores of migrating Sharp-shinned and Cooper's Hawks in New Mexico. *Journal of Raptor Research* 38:163–168.
- Farmer, C. J., D. J. T. Hussell, and D. Mizrahi. 2007. Detecting population trends in migratory birds of prey. *Auk* 124:1047–1062.
- Farmer, C. J., and J. P. Smith. In review. Migration counts indicate widespread declines of American Kestrels (*Falco sparverius*) in North America. *Journal of Raptor Research*, 2009 Special Issue on American Kestrels.
- Goodrich, L. J., and J. P. Smith. 2008. Raptor migration in North America. Pages 37–150 in K. L. Bildstein, J. P. Smith, E. Ruelas Inzunza, and R. R. Veit (Editors), State of North America's birds of prey. Series in Ornithology No. 3. Nuttall Ornithological Club, Cambridge, Massachusetts, and American Ornithologists' Union, Washington, DC.
- Hoffman, S. W., and J. P. Smith. 2003. Population trends of migratory raptors in western North America, 1977–2001. *Condor* 105:397–419.
- Hoffman, S. W., J. P. Smith, and T. D. Meehan. 2002. Breeding grounds, winter ranges, and migratory routes of raptors in the Mountain West. *Journal of Raptor Research* 36:97–110.
- Lott, C. A., and J. P. Smith. 2006. A geographic-information-system approach to estimating the origin of migratory raptors in North America using hydrogen stable isotope ratios in feathers. *The Auk* 123:822–835.
- McBride, T. J., J. P. Smith, H. P. Gross, and M. Hooper. 2004. Blood-lead and ALAD activity levels of Cooper's Hawks (*Accipiter cooperii*) migrating through the southern Rocky Mountains. *Journal of Raptor Research* 38:118–124.
- Smith, J. P., C. J. Farmer, S. W. Hoffman, G. S. Kaltenecker, K. Z. Woodruff, and P. Sherrington. 2008. Trends in autumn counts of migratory raptors in western North America. Pages 217–252 in K. L. Bildstein, J. P. Smith, E. Ruelas Inzunza, and R. R. Veit (Editors), State of North America's birds of prey. Series in Ornithology No. 3. Nuttall Ornithological Club, Cambridge, Massachusetts, and American Ornithologists' Union, Washington, DC.
- Smith, J. P., C. J. Farmer, S. W. Hoffman, C. A. Lott, L. J. Goodrich, J. Simon, C. Riley, and E. Ruelas Inzunza. 2008b. Trends in autumn counts of migratory raptors around the Gulf of Mexico, 1995–2005. Pages 253–278 in K. L. Bildstein, J. P. Smith, E. Ruelas Inzunza, and R. R. Veit (Editors), State of North America's birds of prey. Series in Ornithology No. 3. Nuttall Ornithological Club, Cambridge, Massachusetts, and American Ornithologists' Union, Washington, DC.
- Smith, J. P., P. Grindrod, and S. W. Hoffman. 2001. Migration counts indicate Broad-winged Hawks are increasing in the West: evidence of breeding range expansion? Pages 93–106 in K. L. Bildstein and D. Klem (Editors), Hawkwatching in the Americas. Hawk Migration Association of North America, North Wales, Pennsylvania, USA.
- Zalles, J. I., and K. L. Bildstein (Editors). 2000. Raptor watch: a global directory of raptor migration sites. BirdLife Conservation Series No. 9. BirdLife International, Cambridge, United Kingdom, and Hawk Mountain Sanctuary Association, Kempton, Pennsylvania, USA.

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: 1998–2007 versus 2008.

SPECIES	COUNTS			RAPTORS/100 HOURS		
	1998–2006 ¹	2007	% Change	1998–2006 ¹	2007	% Change
Turkey Vulture	34 ± 8.8	48	+41	7.9 ± 1.95	10.6	+35
Osprey	42 ± 9.5	37	-11	14.7 ± 4.10	12.1	-18
Northern Harrier	109 ± 24.6	82	-25	31.4 ± 8.17	22.1	-30
White-tailed Kite	0 ± 0.2	0	-100	–	–	
Sharp-shinned Hawk	810 ± 129.7	875	+8	250.3 ± 50.10	247.9	-1
Cooper's Hawk	233 ± 36.1	269	+16	78.3 ± 11.29	87.1	+11
Northern Goshawk	31 ± 8.3	48	+57	7.6 ± 2.20	10.8	+42
Unknown small accipiter ²	45 ± 27.6	33	-27	–	–	
Unknown large accipiter ²	8 ± 4.2	19	+151	–	–	
Unknown accipiter	79 ± 55.2	8	-90	–	–	
TOTAL ACCIPITERS	1189 ± 176.1	1252	+5	–	–	
Broad-winged Hawk	5 ± 1.4	5	+2	4.0 ± 1.48	2.2	-45
Swainson's Hawk	6 ± 3.6	5	-19	3.9 ± 2.56	2.9	-27
Red-tailed Hawk	324 ± 57.0	304	-6	90.9 ± 16.97	66.2	-27
Ferruginous Hawk	0 ± 0.2	0	-100	0.2 ± 0.22	0.0	-100
Rough-legged Hawk	27 ± 9.1	25	-9	19.0 ± 5.35	13.8	-27
Unidentified buteo	64 ± 24.8	10	-84	–	–	
TOTAL BUTEOS	426 ± 81.2	349	-18	–	–	
Golden Eagle	125 ± 21.9	111	-11	34.9 ± 6.72	21.4	-39
Bald Eagle	6 ± 2.8	12	+103	1.5 ± 0.70	2.9	+89
Unidentified eagle	3 ± 2.5	0	-100	–	–	
TOTAL EAGLES	134 ± 24.4	123	-8	–	–	
American Kestrel	60 ± 16.2	47	-22	18.7 ± 5.70	13.2	-30
Merlin	38 ± 6.5	44	+16	10.9 ± 2.45	11.2	+3
Prairie Falcon	8 ± 2.7	17	+124	2.1 ± 0.62	4.1	+95
Peregrine Falcon	9 ± 4.0	13	+53	2.3 ± 0.88	3.5	+52
Unknown small falcon ²	3 ± 1.6	2	-42	–	–	
Unknown large falcon ²	2 ± 0.6	1	-50	–	–	
Unknown falcon	2 ± 1.5	0	-100	–	–	
TOTAL FALCONS	120 ± 18.6	124	+3	–	–	
Unidentified raptor	108 ± 46.6	22	-80	–	–	
GRAND TOTAL	2161 ± 283.4	2037	-6	–	–	

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: 1998–2007 versus 2008.

	TOTAL AND AGE-CLASSIFIED COUNTS						IMMATURE : ADULT			
	1998–2007 AVERAGE			2008			% UNKNOWN AGE		RATIO	
	TOTAL	IMM.	ADULT	TOTAL	IMM.	ADULT	1998–2007 ¹	2008	1998–2007 ¹	2008
Northern Harrier	109	36	26	82	36	14	43 ± 7.0	39	1.4 ± 0.33	2.6
Sharp-shinned Hawk	810	417	126	875	391	188	33 ± 6.8	34	3.9 ± 1.46	2.1
Cooper's Hawk	233	112	28	269	128	44	41 ± 7.2	36	4.6 ± 1.64	2.9
Northern Goshawk	31	15	4	48	27	8	38 ± 7.9	27	6.4 ± 4.03	3.4
Broad-winged Hawk	5	2	1	5	1	1	42 ± 15.2	60	1.1 ± 0.74	1.0
Red-tailed Hawk	324	71	139	304	50	115	34 ± 5.5	46	0.5 ± 0.13	0.4
Golden Eagle	125	60	27	111	55	21	30 ± 4.8	32	2.2 ± 0.40	2.6
Bald Eagle	6	1	5	12	7	5	8 ± 9.8	0	0.3 ± 0.20	1.4
Peregrine Falcon	9	3	2	13	4	1	45 ± 18.7	62	1.6 ± 0.92	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 2008, with a comparison of 2008 and 1998–2007 average median passage dates.

SPECIES	2008				1998–2007
	FIRST OBSERVED	LAST OBSERVED	BULK PASSAGE DATES ¹	MEDIAN PASSAGE DATE ²	MEDIAN PASSAGE DATE ^{2,3}
Turkey Vulture	24-Aug	27-Sep	27-Aug – 25-Sep	13-Sep	15-Sep ± 3.8
Osprey	24-Aug	9-Oct	30-Aug – 29-Sep	22-Sep	18-Sep ± 3.1
Northern Harrier	3-Sep	26-Oct	7-Sep – 10-Oct	26-Sep	22-Sep ± 2.5
Sharp-shinned Hawk	25-Aug	26-Oct	5-Sep – 9-Oct	17-Sep	21-Sep ± 1.9
Cooper's Hawk	24-Aug	22-Oct	3-Sep – 29-Sep	15-Sep	17-Sep ± 1.9
Northern Goshawk	27-Aug	25-Oct	8-Sep – 22-Oct	11-Oct	27-Sep ± 5.5
Broad-winged Hawk	3-Sep	15-Sep	3-Sep – 15-Sep	8-Sep	12-Sep ± 2.7
Swainson's Hawk	8-Sep	18-Sep	8-Sep – 18-Sep	15-Sep	14-Sep ± 6.5
Red-tailed Hawk	24-Aug	26-Oct	6-Sep – 21-Oct	29-Sep	25-Sep ± 1.9
Rough-legged Hawk	8-Oct	27-Oct	8-Oct – 25-Oct	15-Oct	14-Oct ± 3.1
Golden Eagle	26-Aug	25-Oct	10-Sep – 23-Oct	9-Oct	04-Oct ± 1.9
Bald Eagle	7-Sep	18-Oct	14-Sep – 17-Oct	11-Oct	11-Oct ± 11.4
American Kestrel	24-Aug	16-Oct	29-Aug – 29-Sep	10-Sep	11-Sep ± 4.7
Merlin	26-Aug	24-Oct	5-Sep – 3-Oct	14-Sep	21-Sep ± 2.8
Prairie Falcon	30-Aug	23-Oct	5-Sep – 21-Oct	10-Sep	17-Sep ± 7.2
Peregrine Falcon	29-Aug	13-Oct	29-Aug – 28-Sep	7-Sep	17-Sep ± 7.3
Total	27-Aug	27-Oct	4-Sep – 15-Oct	19-Sep	22-Sep ± 1.5

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: 1998–2007 versus 2008.

SPECIES	ADULT		IMMATURE	
	1998–2007 ¹	2008	1998–2007 ¹	2008
Northern Harrier	22-Sep ± 2.8	8-Sep	22-Sep ± 3.0	22-Sep
Sharp-shinned Hawk	02-Oct ± 1.9	1-Oct	14-Sep ± 1.8	12-Sep
Cooper’s Hawk	26-Sep ± 2.4	24-Sep	12-Sep ± 1.7	12-Sep
Northern Goshawk	04-Oct ± 8.4	17-Sep	26-Sep ± 5.6	11-Oct
Red-tailed Hawk	29-Sep ± 2.3	30-Sep	17-Sep ± 3.7	17-Sep
Golden Eagle	05-Oct ± 2.6	8-Oct	03-Oct ± 2.1	1-Oct
Bald Eagle	15-Oct ± 5.9	8-Oct	23-Oct ± 0.0	16-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: 2001–2007 versus 2008.

	CAPTURE TOTALS		CAPTURE RATE ¹		CAPTURE SUCCESS ²	
	2001–2007 ³	2008	2001–2007 ³	2008	2001–2007 ³	2008
Northern Harrier	13 ± 5.1	18	1.7 ± 0.62	2.2	14.2 ± 4.0	22.0
Sharp-shinned Hawk	405 ± 74.3	503	53.4 ± 8.53	60.1	53.1 ± 11.0	55.5
Cooper's Hawk	110 ± 20.8	140	14.5 ± 2.75	16.7	43.6 ± 9.2	47.5
Northern Goshawk	14 ± 3.7	29	1.9 ± 0.48	3.5	57.7 ± 15.3	56.9
Red-tailed Hawk	26 ± 9.6	22	3.4 ± 1.21	2.6	6.8 ± 1.4	7.0
Rough-legged Hawk	2.3 ± 1.70	2	0.3 ± 0.21	0.2	8.6 ± 6.0	7.7
Golden Eagle	3 ± 1.4	5	0.3 ± 0.17	0.6	2.0 ± 0.9	4.5
American Kestrel	8.1 ± 3.35	13	1.1 ± 0.41	1.6	17.5 ± 10.5	27.1
Merlin	24 ± 9.6	25	3.1 ± 1.08	3.0	63.6 ± 23.8	55.6
Prairie Falcon	3 ± 1.2	5	0.4 ± 0.16	0.6	34.4 ± 18.0	27.8
Peregrine Falcon	1.6 ± 0.9	2	0.2 ± 0.12	0.2	19.6 ± 16.6	15.4
All species	609 ± 106.9	764	80.4 ± 12.34	91.3	33.6 ± 4.9	39.6

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: 2001–2007 versus 2008.

SPECIES	YEARS	FEMALE		MALE		FEMALE : MALE RATIO ¹	IMM. : ADULT RATIO ¹
		HY	AHY	HY	AHY		
Sharp-shinned Hawk	Avg. 2001–2007	164	52	149	32	1.2 ± 0.07	3.7 ± 0.47
	2008	166	92	151	41	1.3	2.4
Cooper's Hawk	Avg. 2001–2007	40	23	34	9	1.6 ± 0.19	2.3 ± 0.28
	2008	66	19	47	6	1.6	4.5
Northern Goshawk	Avg. 2001–2007	4	1	9	1	0.5 ± 0.11	10.5 ± 3.49
	2008	1	1	12	2	0.1	4.3

¹ Long-term values: mean ± 95% CI.

Table 7. Fall body condition indices for migrant accipiters captured at Chelan Ridge, WA: 2001–2007 versus 2008.

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	2001–2007 mean	61	17	12	4	7	8	66	25	19	57	20	5
	2008	60	15	11	4	10	26	66	9	24	56	18	2
Cooper's Hawk	2001–2007 mean	72	13	9	3	3	22	67	11	23	54	19	4
	2008	80	7	5	3	5	58	40	2	31	46	16	7
Northern Goshawk	2001–2007 mean	90	6	1	0	3	9	81	9	26	60	13	1
	2008	63	0	19	6	13	56	44	0	38	50	6	6

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 in 2008 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
1177 - 25151	RT	U	21-Sep-07	HY	Yakima Co., WA	2-Jan-08	SY	165	found dead – unknown cause
1593 - 60947	SS	F	07-Sep-07	HY	Santa Clarita, CA	4-Jan-08	SY	1,245	found dead – unknown cause
1177 - 06469	RT	U	05-Oct-03	HY	Laytonville, CA	12-Mar-08	ATY	836	killed on highway
1075 - 00175	CH	M	18-Sep-07	HY	Tucson, AZ	16-Apr-08	SY	1,768	found dead – unknown cause
1232 - 39489	SS	M	14-Sep-08	HY	Bonney Butte, OR	26-Sep-08	HY	287	captured / released
1232 - 39425	SS	M	06-Sep-08	HY	Fortuna, CA	28-Nov-08	HY	808	found dead – unknown cause

¹ SS = Sharp-shinned Hawk; CH = Cooper's Hawk; 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.

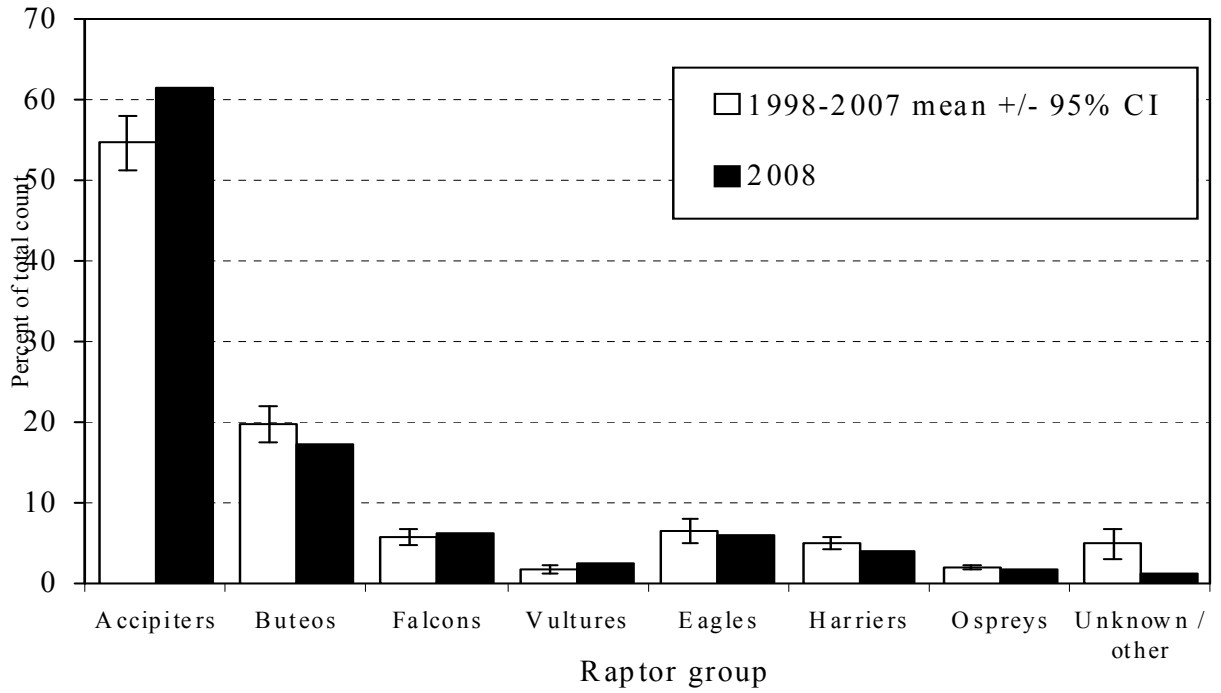


Figure 2. Fall raptor migration flight composition by major species groups at Chelan Ridge, WA: 1998–2007 versus 2008.

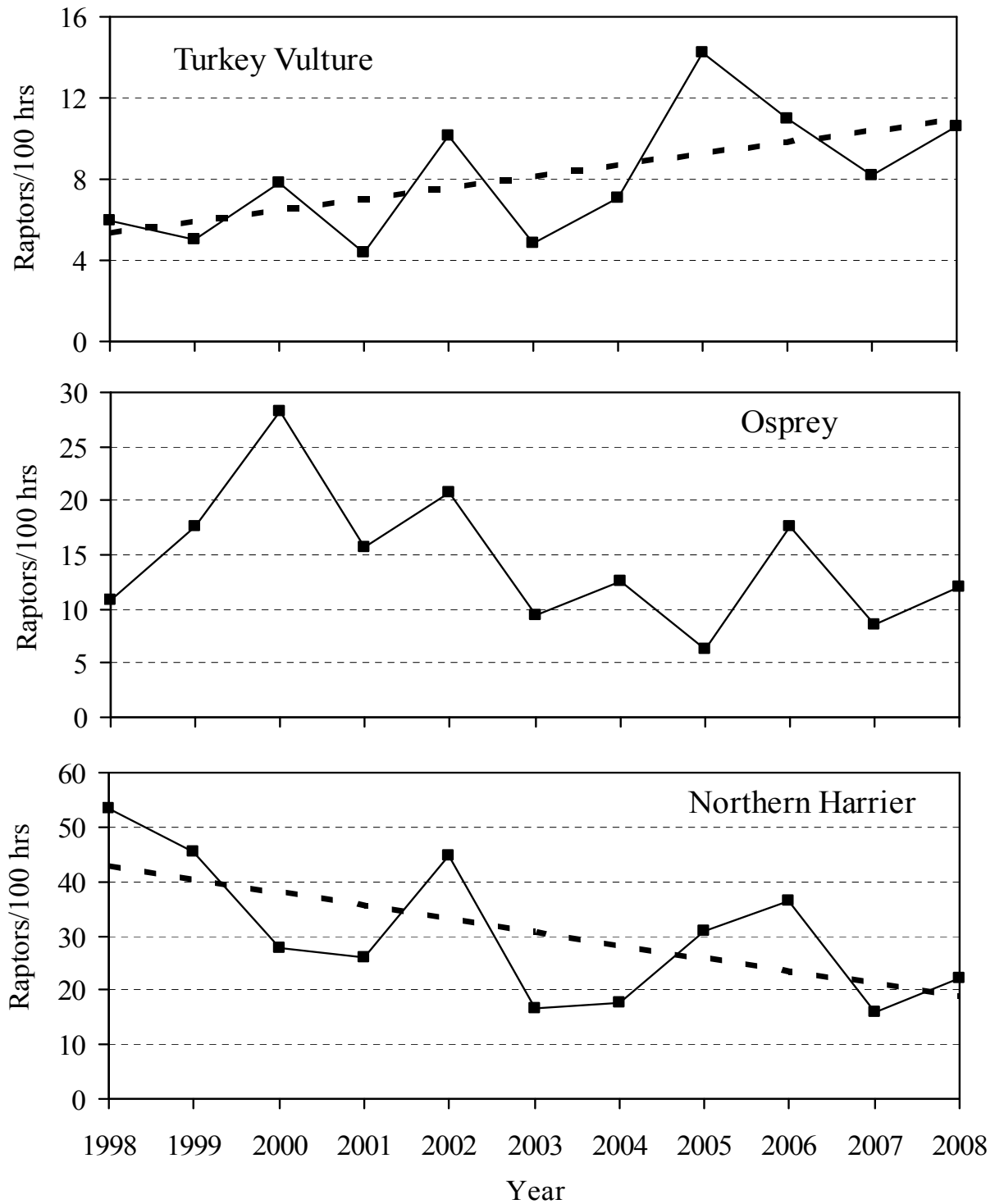


Figure 3. Adjusted fall-migration passage rates at Chelan Ridge, WA for Turkey Vultures, Ospreys, and Northern Harriers: 1998–2008. Dashed lines indicate significant linear or quadratic regressions.

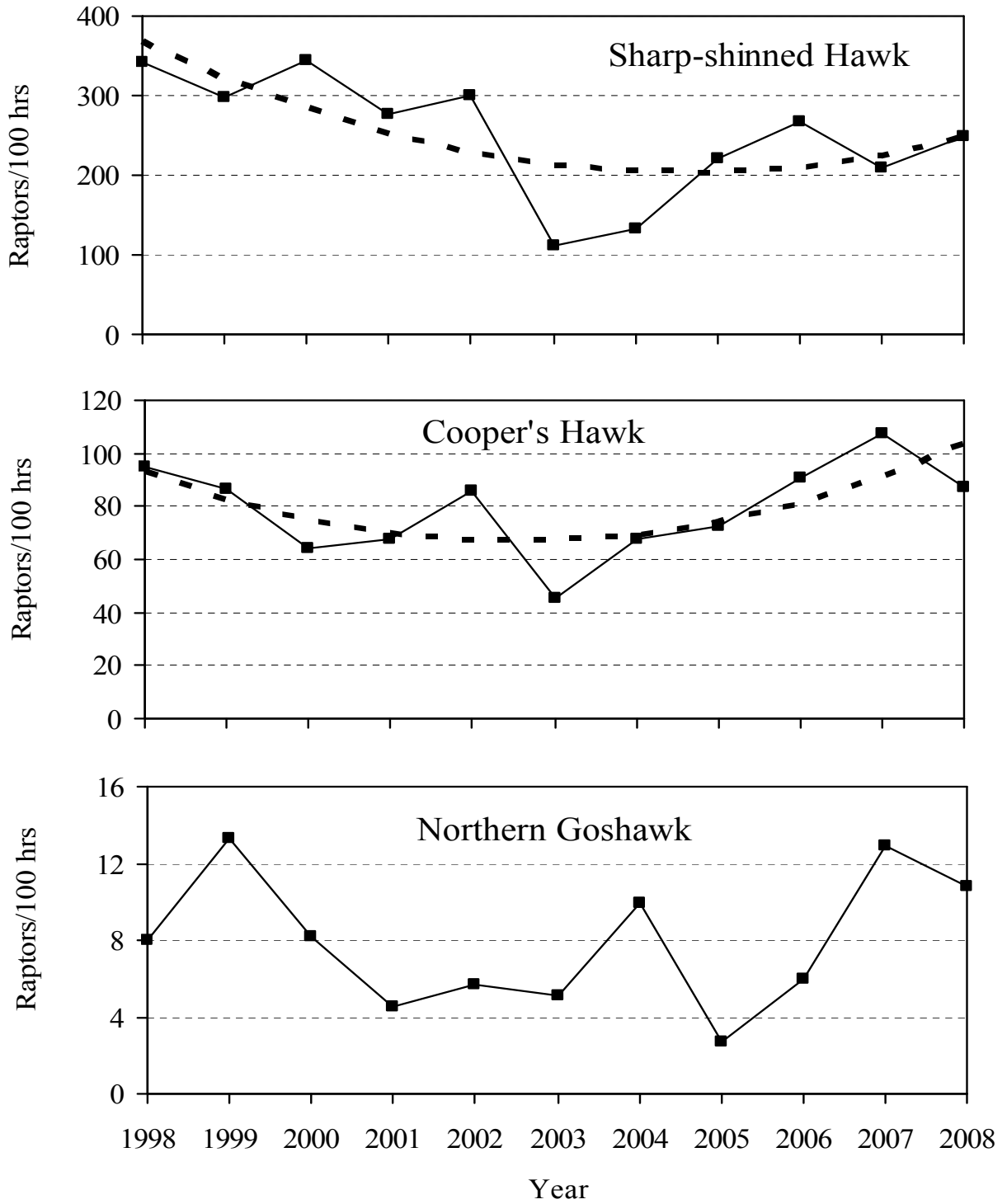


Figure 4. Adjusted fall-migration passage rates at Chelan Ridge, WA for Sharp-shinned Hawks, Cooper's Hawks, and Northern Goshawks: 1998–2008. Dashed lines indicate significant linear or quadratic regressions.

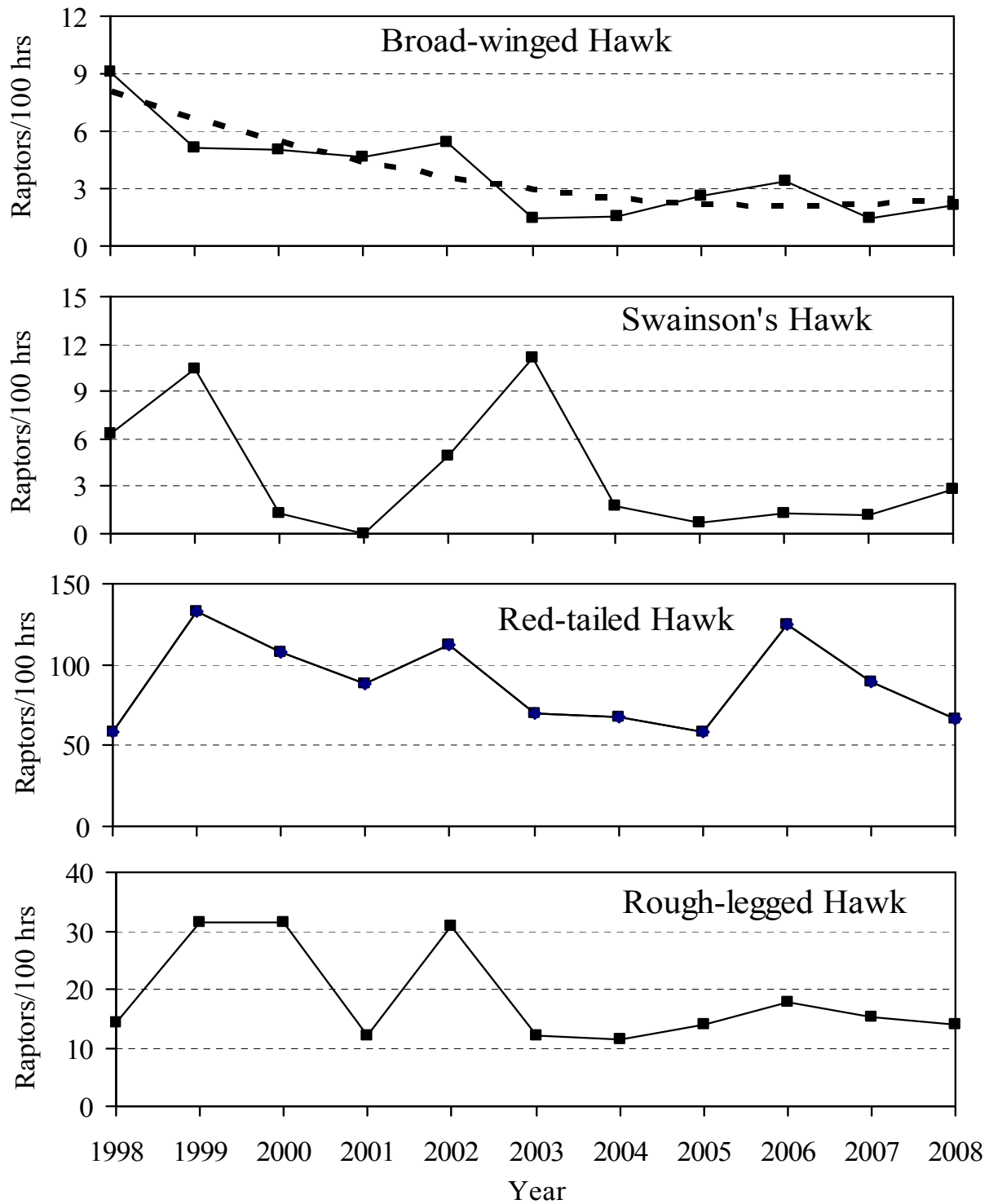


Figure 5. Adjusted fall-migration passage rates at Chelan Ridge, WA for Broad-winged, Swainson's, Red-tailed, and Rough-legged Hawks: 1998–2008. Dashed lines indicate significant linear or quadratic regressions.

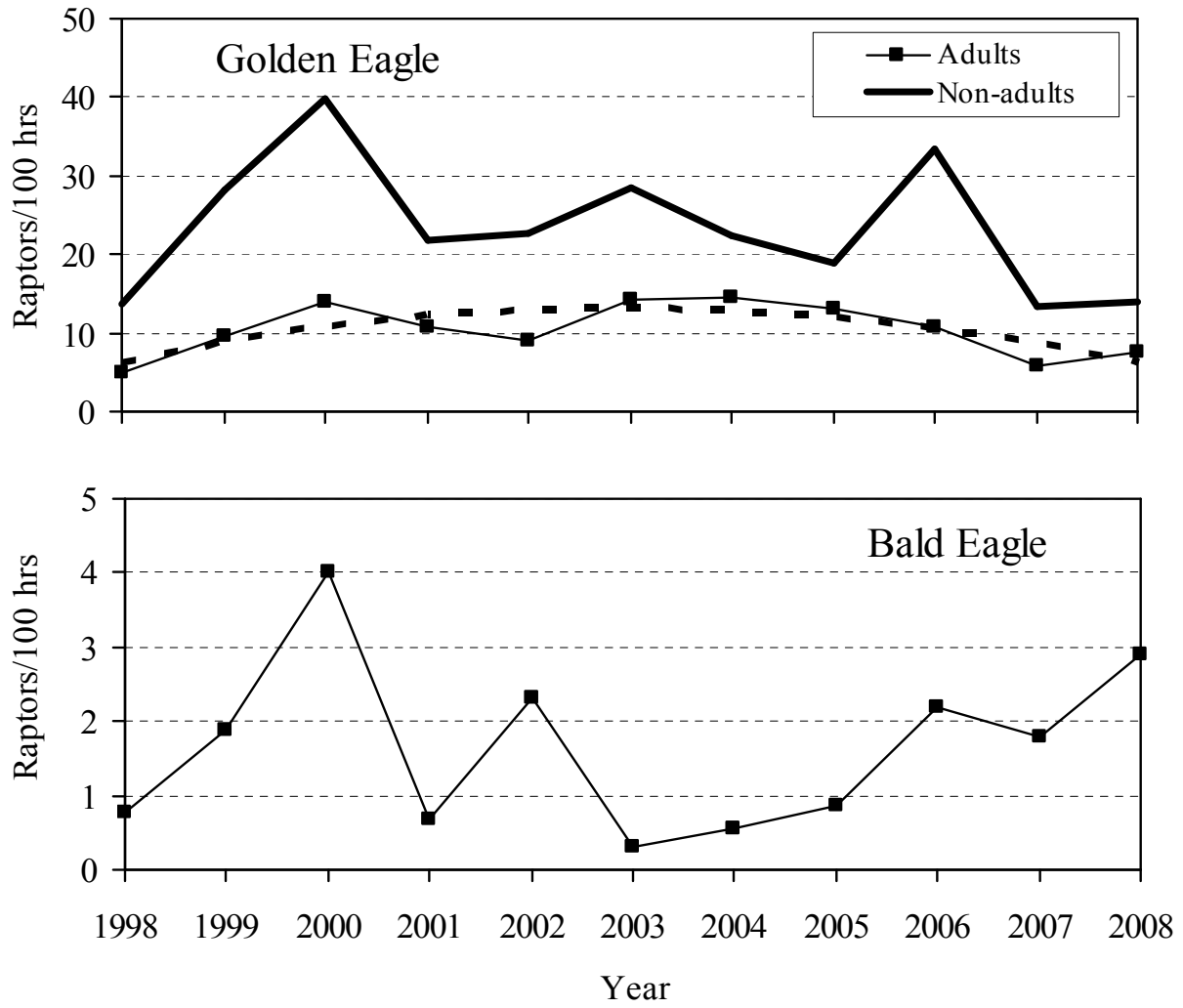


Figure 6. Adjusted fall-migration passage rates at Chelan Ridge, WA for Golden and Bald Eagles: 1998–2008. Dashed lines indicate significant linear or quadratic regressions.

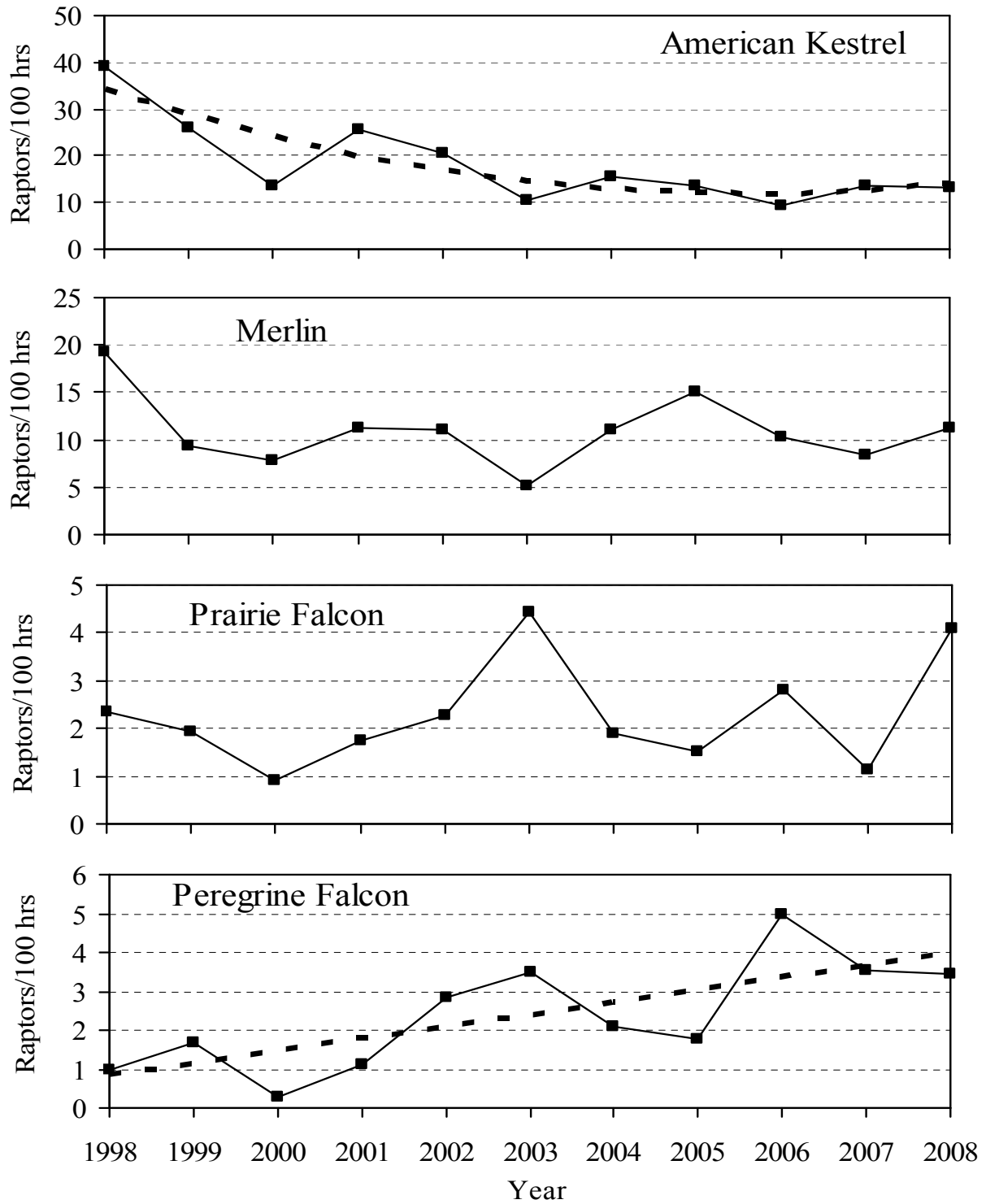


Figure 7. Adjusted fall-migration passage rates at Chelan Ridge, WA for American Kestrels, Merlins, Prairie Falcons, and Peregrine Falcons: 1998–2008. Dashed lines indicate significant linear or quadratic regressions.

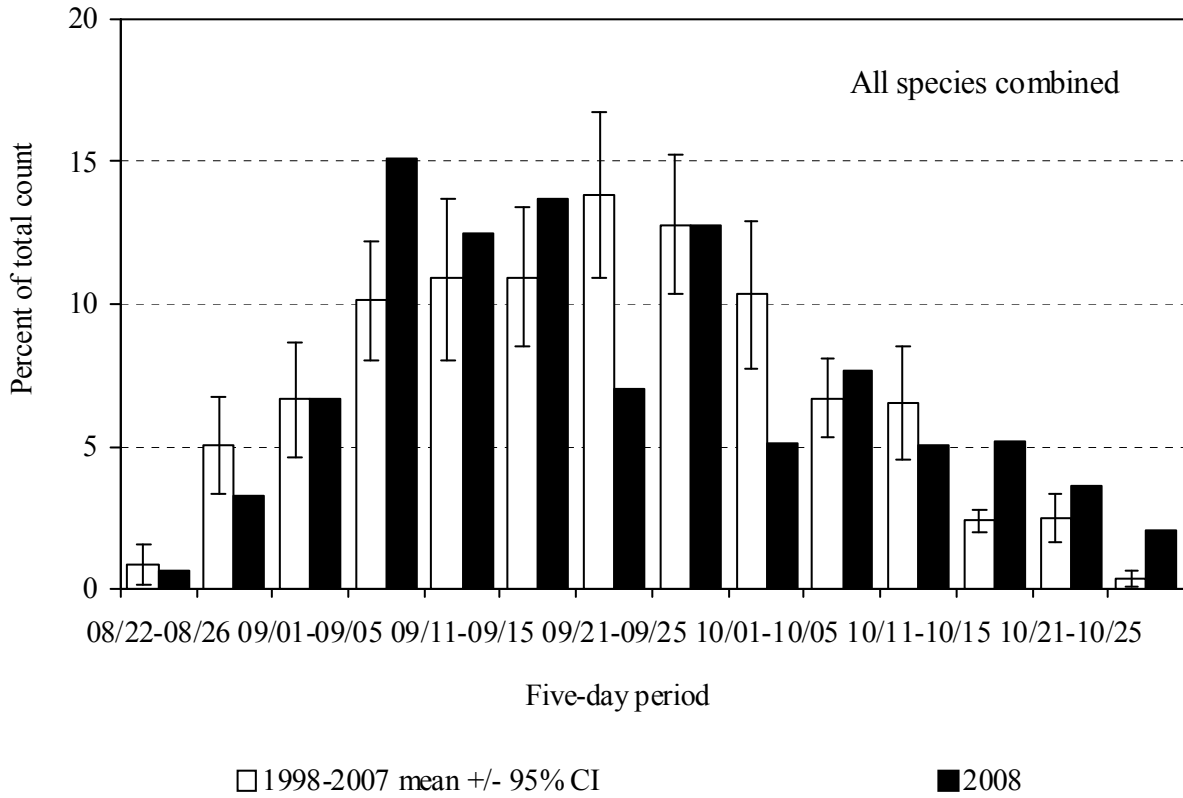


Figure 8. Combined-species passage volume by five-day periods for migrating raptors at Chelan Ridge, WA: 1998–2007 versus 2008.

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 Look (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 Sjollem (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 Sjollem (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 Baiert (0), with assistance from Rob Spaul (2+).

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: 2008.

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
24-Aug	8.83	1.8	0	mc-ovc, PM rain	12.0	ssw, sse	19.7		3	81	59	1	1.1
25-Aug	9.00	2.8	0	ovc-pc	12.3	ssw-sw	14.2	29.90	3	87	82	1	0.3
26-Aug	8.67	2.9	0	clr-pc	11.2	sw-wsw	12.4	30.10	2	100	100	2	1.5
27-Aug	8.50	3.0	0	pc-mc	9.7	ssw-sw	12.7	30.02	2	73	59	2	2.5
28-Aug	9.00	3.0	0	mc-ovc, AM haze	11.5	ssw-sw	15.3	30.20	3	64	20	3	0.6
29-Aug	9.00	2.7	0	clr-pc	23.9	ssw-sw	16.8	29.97	3	59	48	2	1.6
30-Aug	9.50	2.0	0	clr-mc, AM haze	5.4	nne, ssw	11.9	29.88	2	80	74	2	1.5
31-Aug	9.00	2.0	0	clr-ovc, PM fog/rain/snow	5.9	nw-nne, sw	11.0	29.92	3	75	60	3	1.6
1-Sep	9.50	1.9	0	clr-mc	5.3	nw, ssw-sw	12.5	30.19	2	75	65	2	1.3
2-Sep	9.00	2.0	0	pc-ovc, haze	9.5	ssw-sw	12.6	30.25	3	70	70	2	2.4
3-Sep	9.00	2.2	0	clr-pc, haze	5.6	nw-n, ssw-sw, nw	13.5	30.23	1	100	95	2	3.3
4-Sep	9.00	2.0	0	clr-mc, haze	7.9	nw, s-sw	14.9	30.26	2	95	94	2	6.3
5-Sep	9.17	2.0	0	mc-ovc, haze	4.3	ssw-sw	16.3	30.19	3	75	57	1	6.4
6-Sep	9.00	2.1	0	pc-ovc, AM haze	3.3	sw/calm, nw	16.3	30.24	3	80	72	2	2.7
7-Sep	9.00	2.0	0	clr/haze	6.4	nw-n, calm/var	12.6	30.30	2	100	100	2	3.8
8-Sep	9.50	2.7	0	pc/haze	5.7	s-sw	17.1	30.13	2	87	87	2	11.8
9-Sep	9.00	2.0	0	clr-pc, haze	8.0	ssw-sw, n-ne	16.3	29.92	2	75	88	2	8.7
10-Sep	9.00	2.0	0	clr/haze	8.8	nnw-n, ssw-sw	14.5	30.26	2	95	90	2	6.6
11-Sep	9.00	2.0	0	clr/haze	14.3	ssw-sw	17.5	30.22	3	75	79	2	3.2
12-Sep	9.75	2.7	0	pc	10.3	sw	19.8	30.09	2	79	76	2	6.7
13-Sep	9.00	1.9	0	clr-pc	7.4	nw-n, sw	13.4	30.27	2	82	80	2	5.0
14-Sep	9.50	1.9	0	clr	5.3	ssw	19.0	30.36	2	88	90	2	5.9
15-Sep	9.67	1.8	0	clr	11.7	ssw-sw	18.0	30.33	3	73	78	2	6.4
16-Sep	9.00	2.0	0	clr/haze	8.0	s-sw	21.3	30.27	2	55	79	2	4.4
17-Sep	9.00	2.0	0	pc-mc, haze	8.3	se-sw	21.8	30.23	2	36	35	2	8.1
18-Sep	9.17	2.0	0	pc/haze	4.6	calm, ssw-sw/var	22.4	30.15	1	30	37	2	6.0
19-Sep	9.50	2.8	0	pc-mc, haze	4.0	se-sw	22.0	30.12	2	30	35	2	5.1
20-Sep	9.00	2.0	0	ovc, haze, PM rain	3.7	nw-n/calm/var	16.7	29.96	4	25	25	2	1.2
21-Sep	9.00	1.6	0	ovc	8.8	nw/calm, ssw-sw	12.0	29.96	4	54	53	2	6.4
22-Sep	9.50	1.9	0	ovc-pc	13.9	ssw-sw	7.9	30.04	3	63	38	2	2.0
23-Sep	9.00	1.9	0	clr-ovc	9.3	ssw	7.4	30.23	3	95	93	2	3.0
24-Sep	9.25	2.0	0	ovc, AM rain/snow	10.6	ssw	7.5	30.01	4	59	54	2	3.0
25-Sep	9.00	2.0	0	clr-ovc	12.5	ssw-sw	10.3	30.03	3	74	55	2	3.3
26-Sep	9.50	2.0	0	mc-ovc	8.4	calm/nw, ssw-sw	10.0	30.20	3	71	76	2	3.2
27-Sep	9.00	1.9	0	pc-mc	11.5	ssw-sw	13.6	30.23	2	85	86	2	6.3
28-Sep	9.25	1.9	0	clr	5.7	calm, ssw	13.3	30.41	2	96	93	2	8.1
29-Sep	9.25	1.9	0	clr	7.1	ssw-sw	15.2	30.35	1	94	93	2	7.2
30-Sep	9.00	2.0	1	clr-ovc, haze	5.3	ssw-sw, calm	18.5	30.33	2	69	67	2	4.9
1-Oct	8.67	2.9	0	clr-ovc, haze	7.7	sse-ssw	17.1	30.23	2	56	55	2	5.0
2-Oct	9.00	2.0	0	ovc, scat rain/snow	11.8	sse-ssw	14.0	29.95	4	38	39	2	0.7
3-Oct	4.17	2.0	0	ovc, fog/rain	13.8	se-ssw	9.8	29.77	4	28	18	0	2.6
4-Oct	0.00			Weather Day: fog/rain		s							
5-Oct	9.00	1.9	0	ovc-pc	8.7	w, ssw-sw/var	6.5	29.88	4	84	37	2	3.8
6-Oct	6.00	2.0	1	ovc, scat fog/rain	11.5	sse-ssw	6.5	30.12	4	37	13	1	1.8
7-Oct	9.00	2.7	0	pc-mc, scat fog/snow	23.5	sw	4.7	30.09	3	78	31	2	2.4
8-Oct	9.00	2.1	0	clr-ovc	5.1	s-sw	3.4	30.28	2	70	60	2	3.9
9-Oct	9.00	2.0	0	pc-ovc, scat snow	4.9	ne, ssw-sw	3.4	30.03	3	72	39	3	5.9
10-Oct	9.00	1.9	0	clr-pc	9.2	nw-ne	1.8	30.21	2	83	88	3	3.8

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	9.00	2.0	0	clr-mc	6.6	nw-ne	1.2	30.23	1	94	85	3	3.9
12-Oct	9.00	1.8	0	ovc/rain-clr	3.5	nw-n/calm/var	7.5	30.28	3	67	62	2	0.9
13-Oct	9.00	1.9	0	pc-mc, haze	15.5	ssw-sw	10.6	30.33	2	77	47	2	1.4
14-Oct	8.75	1.9	0	pc-mc, haze	6.1	var	4.6	30.34	2	73	56	3	1.4
15-Oct	8.75	2.0	0	clr-ovc, haze	11.8	s-ssw	3.2	30.20	2	66	57	2	3.4
16-Oct	4.75	2.0	0	mc-ovc, haze	11.3	ssw-sw	6.7	30.23	4	43	33	2	4.2
17-Oct	8.75	2.0	0	pc-mc, haze	14.8	ssw-sw	10.3	30.17	3	64	59	2	2.5
18-Oct	8.75	1.9	0	ovc-clr, PM haze	6.4	nw-nne, ssw, calm	7.7	30.09	2	72	87	3	1.7
19-Oct	8.75	1.9	0	clr-mc	5.2	ne, sse-ssw	6.3	30.23	2	81	77	2	2.1
20-Oct	4.00	2.0	0	ovc, scat snow	14.8	ssw-sw	4.0	29.89	4	31	14	2	0.5
21-Oct	8.75	2.0	0	clr-pc	8.4	s-ssw	2.8	30.47	2	91	92	2	1.8
22-Oct	8.75	2.0	0	clr	17.4	ssw-sw	4.4	30.47	2	80	85	2	3.5
23-Oct	8.50	2.0	0	clr-pc	8.3	nw-nne, sw	5.2	30.20	2	72	72	3	2.2
24-Oct	8.50	2.2	0	mc-ovc, scat rain	10.0	ssw-sw	8.0	30.21	3	64	53	2	0.7
25-Oct	8.50	2.1	0	clr	7.0	nne, ssw-sw	5.8	30.33	2	95	91	3	4.1
26-Oct	7.00	2.0	0	pc	5.3	ne, ssw	4.8	30.55	1	78	78	2	0.7
27-Oct	8.50	2.0	0	clr-pc, PM haze	5.7	se-ssw, nw-nne	8.7	30.41	1	84	88	2	0.1

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: 2008.

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
24-Aug	8.83	2	1	0	0	0	1	0	1	0	0	0	0	3	0	0	0	0	0	0	2	0	0	0	0	0	0	0	10	1.1
25-Aug	9.00	1	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	3	0.3
26-Aug	8.67	1	0	0	0	5	2	0	0	0	0	0	0	2	0	0	0	1	0	0	1	1	0	0	0	0	0	0	13	1.5
27-Aug	8.50	1	2	0	0	4	5	1	0	0	0	0	0	4	0	0	0	1	0	0	1	1	0	0	0	0	0	1	21	2.5
28-Aug	9.00	2	0	0	0	1	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0.6
29-Aug	9.00	1	0	0	0	2	1	0	0	1	0	0	0	1	0	0	0	2	0	0	1	1	0	2	0	0	0	2	14	1.6
30-Aug	9.50	1	1	0	0	4	4	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	1	0	0	0	14	1.5	
31-Aug	9.00	0	0	0	0	6	0	0	0	2	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	3	14	1.6
1-Sep	9.50	2	0	0	0	5	3	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	12	1.3	
2-Sep	9.00	0	0	0	0	11	8	0	1	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	22	2.4	
3-Sep	9.00	0	0	3	0	8	5	1	0	1	1	2	0	4	0	0	2	0	0	0	3	0	0	0	0	0	0	30	3.3	
4-Sep	9.00	0	0	3	0	25	9	0	0	1	0	0	0	4	0	0	5	1	0	0	4	1	0	2	1	0	0	1	57	6.3
5-Sep	9.17	2	1	0	0	28	8	2	5	0	0	0	0	5	0	0	0	0	0	0	3	1	3	1	0	0	0	59	6.4	
6-Sep	9.00	2	1	2	0	8	4	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	24	2.7	
7-Sep	9.00	1	0	4	0	8	4	0	3	3	0	0	0	3	0	0	0	1	1	0	1	2	1	1	0	0	0	1	34	3.8
8-Sep	9.50	2	1	3	0	52	20	2	3	0	0	2	2	17	0	0	0	0	0	0	1	5	1	1	0	0	0	112	11.8	
9-Sep	9.00	0	0	2	0	50	14	1	0	0	0	0	0	4	0	0	0	0	0	0	2	4	1	0	0	0	0	78	8.7	
10-Sep	9.00	2	0	3	0	30	8	0	0	0	0	0	0	6	0	0	0	5	0	0	1	2	2	0	0	0	0	59	6.6	
11-Sep	9.00	0	0	1	0	14	5	0	0	0	0	0	0	0	0	0	0	2	0	0	5	1	1	0	0	0	0	29	3.2	
12-Sep	9.75	0	0	0	0	43	11	0	2	0	0	0	0	3	0	0	0	1	0	0	2	2	1	0	0	0	0	65	6.7	
13-Sep	9.00	4	2	2	0	21	8	0	0	2	0	0	0	3	0	0	0	1	0	0	1	0	1	0	0	0	0	45	5.0	
14-Sep	9.50	2	1	0	0	34	10	0	0	1	0	0	0	3	0	0	0	1	1	0	1	2	0	0	0	0	0	56	5.9	
15-Sep	9.67	5	2	2	0	32	6	0	0	0	0	1	1	9	0	0	0	2	0	0	0	2	0	0	0	0	0	62	6.4	
16-Sep	9.00	1	0	1	0	25	8	0	0	0	0	0	0	4	0	0	0	0	0	0	0	1	0	0	0	0	0	40	4.4	
17-Sep	9.00	2	0	3	0	45	12	3	1	0	0	0	0	5	0	0	0	0	0	0	1	0	0	1	0	0	0	73	8.1	
18-Sep	9.17	3	2	2	0	26	13	1	0	0	0	0	2	6	0	0	0	0	0	0	0	0	0	0	0	0	0	55	6.0	
19-Sep	9.50	2	0	1	0	19	12	0	0	0	0	0	0	10	0	0	0	3	0	0	0	1	0	0	0	0	0	48	5.1	
20-Sep	9.00	0	2	2	0	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	1.2	
21-Sep	9.00	3	2	0	0	33	9	0	0	0	0	0	0	7	0	0	0	1	0	0	1	2	0	0	0	0	0	58	6.4	
22-Sep	9.50	0	2	2	0	10	0	0	0	0	0	0	0	3	0	0	0	1	0	0	0	0	1	0	0	0	0	19	2.0	
23-Sep	9.00	1	4	2	0	8	7	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	27	3.0	
24-Sep	9.25	0	0	1	0	16	6	0	0	0	0	0	0	1	0	0	0	3	0	0	0	1	0	0	0	0	0	28	3.0	
25-Sep	9.00	4	1	1	0	12	4	1	0	0	0	0	0	5	0	0	0	1	0	0	0	1	0	0	0	0	0	30	3.3	
26-Sep	9.50	0	0	1	0	16	3	1	0	0	0	0	0	7	0	0	0	1	0	0	0	1	0	0	0	0	0	30	3.2	
27-Sep	9.00	1	3	3	0	22	12	1	0	0	1	0	0	7	0	0	0	1	0	0	3	2	0	1	0	0	0	57	6.3	

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
28-Sep	9.25	0	3	6	0	25	15	1	4	0	0	0	0	8	0	0	0	4	0	0	4	2	1	2	0	0	0	0	75	8.1
29-Sep	9.25	0	3	5	0	29	13	2	1	0	0	0	0	8	0	0	0	3	0	0	1	2	0	0	0	0	0	67	7.2	
30-Sep	9.00	0	1	6	0	19	4	0	0	0	0	0	0	9	0	0	0	4	0	0	0	0	0	0	1	0	0	44	4.9	
1-Oct	8.67	0	0	6	0	22	3	1	1	1	0	0	0	3	0	0	0	3	0	0	2	1	0	0	0	0	0	43	5.0	
2-Oct	9.00	0	0	1	0	2	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	6	0.7	
3-Oct	4.17	0	0	0	0	7	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	1	11	2.6	
4-Oct	0.00																													
5-Oct	9.00	0	0	0	0	21	4	1	1	2	0	0	0	4	0	0	0	1	0	0	0	0	0	0	0	0	0	34	3.8	
6-Oct	6.00	0	0	1	0	8	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	11	1.8	
7-Oct	9.00	0	0	1	0	10	0	0	0	1	0	0	0	4	0	0	0	4	1	0	0	1	0	0	0	0	0	22	2.4	
8-Oct	9.00	0	0	0	0	7	1	1	2	1	0	0	0	11	0	5	0	4	1	0	0	0	0	0	0	0	2	35	3.9	
9-Oct	9.00	0	2	3	0	13	1	0	5	0	3	0	0	16	0	1	1	5	1	0	0	0	0	0	0	0	2	53	5.9	
10-Oct	9.00	0	0	1	0	14	0	2	0	0	0	0	0	12	0	0	0	3	0	0	1	0	0	0	0	0	1	34	3.8	
11-Oct	9.00	0	0	0	0	6	0	7	3	1	0	0	0	12	0	1	0	4	1	0	0	0	0	0	0	0	0	35	3.9	
12-Oct	9.00	0	0	0	0	3	0	0	0	0	0	0	0	4	0	0	0	1	0	0	0	0	0	0	0	0	0	8	0.9	
13-Oct	9.00	0	0	4	0	5	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	13	1.4	
14-Oct	8.75	0	0	1	0	4	0	2	0	0	0	0	0	4	0	0	0	1	0	0	0	0	0	0	0	0	0	12	1.4	
15-Oct	8.75	0	0	0	0	7	1	1	0	0	1	0	0	8	0	6	0	4	2	0	0	0	0	0	0	0	0	30	3.4	
16-Oct	4.75	0	0	2	0	4	0	1	0	0	0	0	0	6	0	2	0	2	2	0	1	0	0	0	0	0	0	20	4.2	
17-Oct	8.75	0	0	0	0	8	1	2	0	0	0	0	0	4	0	1	0	2	1	0	0	1	1	0	0	0	1	22	2.5	
18-Oct	8.75	0	0	0	0	1	0	1	0	1	1	0	0	4	0	0	0	2	1	0	0	1	0	0	1	0	2	15	1.7	
19-Oct	8.75	0	0	0	0	4	0	3	0	0	0	0	0	5	0	1	0	4	0	0	0	0	0	0	0	0	1	18	2.1	
20-Oct	4.00	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0.5	
21-Oct	8.75	0	0	0	0	5	1	2	0	0	0	0	0	5	0	0	0	2	0	0	0	0	1	0	0	0	0	16	1.8	
22-Oct	8.75	0	0	0	0	5	1	3	0	0	0	0	0	8	0	4	0	9	0	0	0	0	0	0	0	0	1	31	3.5	
23-Oct	8.50	0	0	0	0	3	0	1	0	0	0	0	0	4	0	1	0	6	0	0	0	0	1	0	0	0	3	19	2.2	
24-Oct	8.50	0	0	0	0	2	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	1	0	0	0	0	0	6	0.7	
25-Oct	8.50	0	0	0	0	9	0	1	0	1	0	0	0	12	0	2	0	10	0	0	0	0	0	0	0	0	0	35	4.1	
26-Oct	7.00	0	0	1	0	1	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	5	0.7	
27-Oct	8.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0.1	
Total	557.85	48	37	82	0	875	269	48	33	19	8	5	5	304	0	25	10	111	12	0	47	44	17	13	2	1	0	2037	228.6	

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: 1997–2008.

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	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	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
Observation days	29	53	61	67	55	62	59	59	62	64	62	64	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	494.37
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	440.3
Species													
Turkey Vulture	4	29	21	26	14	46	30	25	58	50	42	48	35
Osprey	41	24	47	71	48	57	31	34	25	50	31	37	41
Northern Harrier	115	152	167	104	91	148	66	59	113	127	60	82	106
White-tailed Kite	0	0	0	0	0	0	1	0	0	0	0	0	0
Sharp-shinned Hawk	311	949	932	1,050	878	937	421	468	730	854	880	875	816
Cooper's Hawk	150	247	232	198	198	234	136	220	228	270	363	269	236
Northern Goshawk	38	32	50	35	16	22	17	41	13	31	49	48	32
Unknown small accipiter ¹	–	–	–	–	98	85	40	1	48	97	45	33	44
Unknown large accipiter ¹	–	–	–	–	0	10	17	6	6	11	3	19	9
Unknown accipiter	182	221	248	98	0	49	36	10	9	12	8	8	72
TOTAL ACCIPITERS	681	1,449	1,462	1,381	1,190	1,337	667	746	1,034	1,275	1,348	1,252	1,195
Broad-winged Hawk	2	7	5	5	6	9	3	2	6	4	2	5	5
Swainson's Hawk	0	8	17	2	0	7	15	5	2	2	4	5	6
Red-tailed Hawk	145	182	450	364	263	386	263	277	233	441	378	304	322
Ferruginous Hawk	0	0	0	1	0	0	0	0	0	0	0	0	0
Rough-legged Hawk	1	13	44	53	13	45	14	20	22	28	22	25	27
Unidentified buteo	75	58	148	97	83	82	39	15	29	57	29	10	59
TOTAL BUTEOS	223	268	664	522	365	529	334	319	292	532	435	349	419
Golden Eagle	105	55	141	174	105	135	142	130	130	157	82	111	124
Bald Eagle	2	2	7	15	2	8	1	2	4	8	10	12	6
Unidentified eagle	7	0	7	5	1	0	12	0	2	0	0	0	2
TOTAL EAGLES	114	57	155	194	108	143	155	132	136	165	92	123	133
American Kestrel	24	107	89	40	84	68	33	48	55	29	47	47	59
Merlin	17	55	36	26	36	38	21	39	53	34	40	44	38
Prairie Falcon	2	10	7	5	5	6	19	5	4	9	6	17	8
Peregrine Falcon	5	2	9	1	3	9	14	7	4	20	16	13	9
Unknown small falcon ¹	–	–	–	–	6	4	6	5	1	3	0	2	3
Unknown large falcon ¹	–	–	–	–	1	2	2	2	3	3	1	1	2
Unknown falcon	10	6	6	2	2	0	0	4	0	0	1	0	2
TOTAL FALCONS	58	180	147	74	137	127	95	110	120	98	111	124	120
Unidentified Raptor	178	216	218	62	112	178	134	27	48	52	30	22	100
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	2,150

¹ Designations used for the first time in 2001.

Appendix F. Daily capture totals of migrating raptors at Chelan Ridge, WA: 2008.

DATE	STN.	SPECIES ¹											CAPTURES	
	HOURS	NH	SS	CH	NG	RT	RL	GE	AK	ML	PR	PG	TOTAL	/ STN HR
24-Aug	6.91	0	1	1	0	0	0	0	0	0	0	0	2	0.3
25-Aug	4.17	0	0	0	0	0	0	0	0	0	0	0	0	0.0
26-Aug	16.00	0	3	0	0	0	0	0	0	0	0	0	3	0.2
27-Aug	8.75	0	0	4	0	1	0	0	2	0	0	0	7	0.8
28-Aug	8.75	0	1	2	0	0	0	0	0	0	0	0	3	0.3
29-Aug	9.00	0	1	1	0	0	0	0	1	0	0	0	3	0.3
30-Aug	18.00	0	3	8	0	0	0	0	2	0	1	0	14	0.8
31-Aug	18.25	0	6	1	0	0	0	0	0	0	0	0	7	0.4
1-Sep	17.16	1	7	5	0	0	0	0	0	0	0	0	13	0.8
2-Sep	17.66	0	6	3	0	2	0	0	1	0	0	0	12	0.7
3-Sep	14.75	0	17	0	0	0	0	0	1	2	0	0	20	1.4
4-Sep	9.50	1	9	5	0	0	0	0	0	0	0	0	15	1.6
5-Sep	13.92	1	17	10	0	1	0	0	0	0	0	0	29	2.1
6-Sep	17.58	0	12	4	1	0	0	0	0	0	0	0	17	1.0
7-Sep	18.41	0	10	2	0	2	0	0	0	2	0	0	16	0.9
8-Sep	9.16	0	13	5	1	1	0	0	0	2	0	0	22	2.4
9-Sep	17.25	0	36	9	0	0	0	0	0	7	0	0	52	3.0
10-Sep	8.66	1	7	3	0	0	0	0	0	0	1	0	12	1.4
11-Sep	17.25	0	17	6	0	0	0	0	3	1	0	0	27	1.6
12-Sep	9.66	0	19	8	1	1	0	0	0	0	1	0	30	3.1
13-Sep	17.50	1	20	4	0	1	0	0	0	0	0	0	26	1.5
14-Sep	18.00	0	23	8	0	2	0	0	1	1	0	0	35	1.9
15-Sep	18.25	1	18	5	0	1	0	0	0	0	0	0	25	1.4
16-Sep	17.83	0	15	2	0	0	0	0	0	2	0	0	19	1.1
17-Sep	14.93	0	20	4	0	0	0	0	0	0	0	0	24	1.6
18-Sep	9.25	0	14	3	1	0	0	0	0	0	0	0	18	1.9
19-Sep	9.08	2	10	2	0	2	0	0	0	0	0	0	16	1.8
20-Sep	17.00	1	8	1	1	0	0	0	0	0	0	0	11	0.6
21-Sep	9.41	1	11	0	0	0	0	0	0	0	0	0	12	1.3
22-Sep	17.83	0	4	1	0	0	0	0	0	1	0	0	6	0.3
23-Sep	17.75	0	9	6	1	1	0	0	0	0	0	0	17	1.0
24-Sep	7.83	0	2	0	0	0	0	1	0	0	0	0	3	0.4
25-Sep	12.25	0	15	0	0	1	0	0	0	1	0	0	17	1.4
26-Sep	17.08	2	10	3	0	2	0	0	1	1	0	0	19	1.1
27-Sep	17.83	0	18	3	1	0	0	0	0	2	0	0	24	1.3

Appendix F. continued

DATE	STN.	SPECIES ¹											CAPTURES	
	HOURS	NH	SS	CH	NG	RT	RL	GE	AK	ML	PR	PG	TOTAL	/ STN HR
28-Sep	17.75	1	23	7	0	0	0	0	0	1	0	1	33	1.9
29-Sep	17.91	1	16	1	1	1	0	0	0	1	0	0	21	1.2
30-Sep	17.75	1	10	4	0	1	0	0	0	0	0	0	16	0.9
1-Oct	12.92	0	8	5	1	0	0	0	0	0	1	0	15	1.2
2-Oct	17.16	0	4	1	1	0	0	0	0	0	0	0	6	0.3
3-Oct	8.91	0	8	0	0	0	0	1	1	0	0	0	10	1.1
4-Oct	0.00													
5-Oct	17.58	0	18	0	0	0	0	0	0	0	0	0	18	1.0
6-Oct	11.83	1	4	0	1	0	0	0	0	1	0	0	7	0.6
7-Oct	16.91	0	1	0	1	0	0	0	0	0	0	1	3	0.2
8-Oct	14.33	0	8	1	1	0	1	0	0	0	0	0	11	0.8
9-Oct	8.50	0	1	0	1	0	0	0	0	0	0	0	2	0.2
10-Oct	13.50	0	0	0	2	0	0	0	0	0	0	0	2	0.1
11-Oct	16.83	0	0	0	1	0	0	0	0	0	0	0	1	0.1
12-Oct	16.36	0	2	0	0	1	0	1	0	0	0	0	4	0.2
13-Oct	16.82	1	3	0	1	0	0	0	0	0	0	0	5	0.3
14-Oct	17.08	0	2	0	1	0	0	0	0	0	0	0	3	0.2
15-Oct	8.25	0	1	0	0	1	1	1	0	0	0	0	4	0.5
16-Oct	5.75	1	2	0	0	0	0	0	0	0	0	0	3	0.5
17-Oct	7.58	0	2	1	2	0	0	1	0	0	0	0	6	0.8
18-Oct	16.75	0	2	0	1	0	0	0	0	0	0	0	3	0.2
19-Oct	16.83	0	1	0	2	0	0	0	0	0	0	0	3	0.2
20-Oct	11.00	0	0	0	0	0	0	0	0	0	0	0	0	0.0
21-Oct	16.41	0	2	1	2	0	0	0	0	0	0	0	5	0.3
22-Oct	14.00	0	1	0	2	0	0	0	0	0	0	0	3	0.2
23-Oct	15.16	0	2	0	1	0	0	0	0	0	1	0	4	0.3
24-Oct	6.83	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Total	843.31	18	503	140	29	22	2	5	13	25	5	2	764	0.9

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: 1999–2008.

	1999 ¹	2000 ¹	2001	2002	2003	2004	2005	2006	2007	2008	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		
Last trapping day	16-Oct	14-Oct	17-Oct	19-Oct	25-Oct	18-Oct	22-Oct	22-Oct	16-Oct	23-Oct		
Number of stations	2	2	2	2	2	2	2	2	2	2	2	
Trapping days	47	42	44	54	56	53	56	56	51	60	53.8	
Station hours	388	?	612.8	837.3	803.3	699.6	828.2	797.33	716.12	836.48	766.37	
Captures / stn. hour	5.7	?	8.6	8.1	7.3	5.0	7.5	10.2	9.4	9.1	8.2	
SPECIES	RAPTOR CAPTURES											
Northern Harrier	4	3	10	13	11	6	12	28	12	18	13.8	117
Sharp-shinned Hawk	139	125	341	459	394	237	389	556	450	503	417	3599
Cooper's Hawk	42	46	107	127	100	58	137	100	138	140	113	995
Northern Goshawk	14	10	12	13	9	16	11	24	16	29	16	154
Red-tailed Hawk	11	8	22	29	20	16	11	50	33	22	25	222
Rough-legged Hawk	0	1	1	2	1	0	5	6	1	2	2.3	19
Golden Eagle	0	1	2	0	4	2	2	6	2	5	3	24
American Kestrel	3	0	8	10	17	5	6	8	3	13	9	73
Merlin	6	4	17	21	25	10	49	31	15	25	24	203
Prairie Falcon	1	1	3	4	4	1	0	3	4	5	3	26
Peregrine Falcon	0	0	2	0	4	1	1	2	1	2	2	13
All species	220	199	525	678	589	352	623	814	675	764	628	5445
Recaptures ²	0	0	0	0	0	0	0	0	1	0	0	1
Foreign Recaptures ³	0	0	0	1	0	0	0	2	2	0	0.8	6
Foreign Encounters ⁴	0	1	5	2	1	1	4	15	12	5	5.9	48

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.