

**FALL 2007 RAPTOR MIGRATION STUDIES
AT CHELAN RIDGE, WASHINGTON**



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Salt Lake City, Utah**



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Winthrop, Washington**

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TABLE OF CONTENTS

List of Tables	iii
List of Figures	iii
Introduction.....	1
Study Site.....	1
Methods	2
Standardized Counts.....	2
Trapping and Banding.....	3
Results and Discussion	3
Weather	3
Observation Effort.....	4
Flight Summary and Trends.....	4
Resident Raptors	6
Trapping Effort.....	6
Trapping and Banding Results	6
Encounters with Previously Banded Birds.....	7
Visitor Participation and Public Outreach	8
Acknowledgements.....	8
Literature Cited.....	9
Tables.....	10
Figures	17
Appendix A. History of official observer participation in the Chelan Ridge Raptor Migration Project.....	25
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.	26
Appendix C. Daily observation effort, visitor disturbance ratings, weather records, and flight summaries for the Chelan Ridge Raptor Migration Project: 2007.....	27
Appendix D. Daily observation effort and fall raptor migration counts by species at Chelan Ridge, WA: 2007.....	29
Appendix E. Annual observation effort and fall raptor migration counts by species at Chelan Ridge, WA: 1997–2007.....	31
Appendix F. Daily capture totals of migrating raptors at Chelan Ridge, WA: 2007.	32
Appendix G. Annual trapping effort and capture totals by species for migrating raptors at Chelan Ridge, WA: 1999–2007.	34

LIST OF TABLES

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: 1998–2006 versus 2007.	10
Table 2.	Fall counts by age class and immature : adult ratios for selected species of migrating raptors at Chelan Ridge, WA: 1998–2006 versus 2007.	11
Table 3.	First and last observed, bulk-passage, and median-passage dates by species for migrating raptors at Chelan Ridge, WA in 2006, with a comparison of 2007 and 1998–2006 average median passage dates.	12
Table 4.	Median passage dates by age for selected species of migrating raptors at Chelan Ridge, WA: 1998–2006 versus 2007.	13
Table 5.	Fall capture totals, rates, and successes by species for migrating raptors at Chelan Ridge, WA: 2001–2006 versus 2007.	14
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: 2001–2006 versus 2007.	15
Table 7.	Foreign encounters in 2007 of raptors banded at the Chelan Ridge Raptor Migration Project.	16

LIST OF FIGURES

Figure 1.	Location of the Chelan Ridge Raptor Migration Project count and banding sites in north-central Washington.	17
Figure 2.	Fall raptor migration flight composition by major species groups at Chelan Ridge, WA: 1998–2006 versus 2007.	18
Figure 3.	Adjusted fall-migration passage rates at Chelan Ridge, WA for Turkey Vultures, Ospreys, and Northern Harriers: 1998–2007. Dashed lines indicate significant linear or quadratic regressions.	19
Figure 4.	Adjusted fall-migration passage rates at Chelan Ridge, WA for Sharp-shinned Hawks, Cooper’s Hawks, and Northern Goshawks: 1998–2007. Dashed lines indicate significant linear or quadratic regressions.	20
Figure 5.	Adjusted fall-migration passage rates at Chelan Ridge, WA for Broad-winged, Swainson’s, Red-tailed, and Rough-legged Hawks: 1998–2007. Dashed lines indicate significant linear or quadratic regressions.	21
Figure 6.	Adjusted fall-migration passage rates at Chelan Ridge, WA for Golden and Bald Eagles: 1998–2007. Dashed lines indicate significant linear or quadratic regressions.	22
Figure 7.	Adjusted fall-migration passage rates at Chelan Ridge, WA for American Kestrels, Merlins, Prairie Falcons, and Peregrine Falcons: 1998–2006. Dashed lines indicate significant linear or quadratic regressions.	23
Figure 8.	Combined-species passage volume by five-day periods for migrating raptors at Chelan Ridge, WA: 1998–2006 versus 2007.	24

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. 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 2007 season marked the 10th consecutive, full-season count and the 9th consecutive season of banding at the site. This report summarizes the 2007 count and banding results.

The Chelan project was 1 of 14 long-term, annual migration counts and 1 of 6 migration-banding studies conducted or co-sponsored by HWI in North America during 2007. 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. 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 breeding and wintering distributions, migratory routes and timing, migratory behavior, population demographics, mortality factors and longevity, morphometric variation, molt timing and sequences, and health assessments (Hoffman et al. 2002, Goodrich and Smith 2008). 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 other trained staff and volunteers, conducted standardized daily counts of migrating raptors from a single traditional observation site. Official observer Dayna Hawes had one prior season of migration counting experience, whereas this was the first season of experience for official observer Shaun Hyland (see Appendix A for a complete history of observer participation). Long-time project affiliate and former full-time Chelan observer Richard Hendrick, former HWI observer Rob Spaul of this year’s banding crew, other USFS and HWI crewmembers, and occasionally other visitors 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 2007 follows Hoffman and Smith (2003). In comparing 2007 annual statistics against means and 95% confidence intervals for previous seasons, we equate significance with a 2007 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 mid-October, generally between 0900–1700 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 four days of planned observations and reduced observations to ≤ 4 hours on three other days (see Appendix C for daily weather records). The corresponding 1998–2006 averages are 2.3 and 1.7 days, respectively. Weather data collected on site during active observation periods indicated that 41% of the active days featured predominantly fair skies, 33% transitional skies (i.e., changed from fair or partly cloudy to mostly cloudy or overcast during the day, or vice versa), and 26% 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/or haze (48%) was substantially above the long-term average of 38%. In contrast, the proportion of active observation days that featured some rain and/or snow (5%) was below average (14%). The increased prevalence of fog and haze did not translate, however, to reduced observer estimates of average visibility, which were among the highest recorded for the project in 2007 (85 km to the east; 74 km to the west).

In 2007, light winds (< 12 kph) prevailed on 67% of the active observation days, moderate winds on 28%, and strong winds (≥ 29 kph) on 5% of the active days (1998–2006 averages: 69%, 29%, and 2%). In terms of wind directions, 2007 was similar to most years in that S-SW winds were the most common pattern, prevailing on 41% of the active days; however, their prevalence was slightly below the long-term average of 47%. SW-NW winds also were noticeably less common than usual (0% vs. average of 5%), whereas patterns that were noticeably more common than usual included mixes of NE-E and calm/variable winds (7% vs. average of 1%) and mixes of S-W and calm/variable winds (15% vs. average of 6%).

The temperature during active observation periods averaged 11.7°C (the average of daily values, which in turn were averages of hourly readings), ranging from -0.9 – 26.3°C . The overall average was slightly below the long-term average of 12.8°C and the minimum was the second lowest recorded to date;

however, the maximum was the third highest yet recorded. The barometric pressure during active observation periods averaged 29.98 in Hg, ranging from 28.62 to 30.52 in Hg. The average was similar to the 2001–2006 average of 29.99 in Hg; however, as with the temperatures, the range of values was among the widest yet recorded. In 2007, 51% of the active days were classified as featuring predominantly good-to-excellent thermal-lift ratings, which is substantially higher than the long-term average of 40%.

In summary, inclement weather kept our 2007 observers away from the site at an above-average level, cloudier skies as well as fog/haze also were more prevalent than usual during active observation periods, and the range of temperature and barometric pressure readings were broader than usual; however, rain and snow events were less prevalent than usual during active observation periods, wind conditions were fairly typical for the site, and both estimated visibility and thermal-lift conditions averaged better than usual.

OBSERVATION EFFORT

Observations occurred on 62 of 66 possible days between the scheduled observation period of 24 August through 27 October. The number of observation days and hours (520.00) were 3% and 7% above the 1998–2006 averages of $60 \pm 95\%$ CI of 2.7 days and 483.84 ± 28.76 hours, with the difference in hours significant and the 2007 value comprising a new record high (Appendix E). The 2007 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 15% higher than the 1998–2006 average of 1.9 ± 0.07 observers/hour.

FLIGHT SUMMARY AND TRENDS

The observers counted 2,149 migrating raptors of 16 species during the 2007 season (Table 1; see Appendix D for daily count records), which is a non-significant 1% lower than the 1998–2006 average (see Appendix E for annual count summaries). The flight consisted of 63% accipiters, 20% buteos, 4% eagles, 3% harriers, 5% falcons, 2% vultures, 1% Ospreys, and 1% unknown raptors (Figure 2). The proportion of accipiters was significantly above average, whereas the proportions of eagles, harriers, Ospreys, and unknown raptors were all significantly below average. The most common species seen in 2007 were the Sharp-shinned Hawk (38% of the total count), Red-tailed Hawk (15%), Cooper's Hawk (11%), Golden Eagle (6%), and Northern Harrier (5%). All other species each comprised less than 3% of the total count.

The count of Cooper's Hawks rose to a new record high of 363 birds (Appendix E). Adjusted passage rates were significantly above average for Cooper's Hawks, Northern Goshawks, and Peregrine Falcons in 2007, whereas passage rates were significantly below average for Ospreys, Northern Harriers, Broad-winged, Swainson's and Rough-legged Hawks, Golden Eagles, and Prairie Falcons (Table 1).

Population Trends.—Regression analyses of trends in adjusted passage rates between 1998 and 2007 (after Hoffman and Smith 2003) indicated marginally significant ($P \leq 0.10$) linear declining trends for Northern Harriers (Figure 3) and Sharp-shinned Hawks (Figure 4), a marginally significant linear increasing trend for Turkey Vultures (Figure 3), and a significant ($P \leq 0.05$) linear increasing trend for Peregrine Falcons (Figure 7). In addition, significant second-order or quadratic trends were indicated for Cooper's Hawks, Broad-winged Hawks, American Kestrels, and adult Golden Eagles. The Cooper's Hawk regression tracked a declining pattern through 2003 but a strong increasing pattern since then that rose to a new record high in 2007 (Figure 4). The Broad-winged Hawk and American Kestrel regressions also tracked declining patterns through 2003, but then relatively stable patterns thereafter (Figures 5 and 7). Lastly, although no species-level trend is currently evident for Golden Eagles, a significant quadratic regression tracked 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 2005 (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 sophisticated analytical approach (also see Farmer et al. 2007) than that represented in Hoffman and Smith (2003) and used herein to present analyses updated through 2007. 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 2007.

Differences between the RPI results and those presented herein that clearly relate to addition of two more years of data include: a) replacement of a marginally significant decline among Cooper’s Hawks as indicated in the RPI results with a significant trough-shaped quadratic trend tracking a sustained recovery since 2003; b) replacement of a marginally significant decline among Northern Goshawks as indicated in the RPI results with no significant overall trend, reflecting two years of increasing counts in 2006 and especially 2007; and c) replacement of a highly significant linear declining trend for American Kestrels as indicated in the RPI results with a significant quadratic trend tracking 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 is 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 below average in 2007 among all nine species for which such comparisons were possible, with the differences significant for Northern Harriers, Broad-winged Hawks, and Golden Eagles (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 and Golden Eagles, the 2007 counts of identified immature/subadult birds were well below average, while the counts of adult birds were much closer to average, suggesting that low productivity may have contributed to the low age ratios for these species. For several other species (all three accipiters and Peregrine Falcons), however, although the 2007 age ratios remained at least slightly below average due to proportionately greater increases in counts of adults, counts of immature birds were substantially higher than average, suggesting that reduced productivity did not contribute to the low age ratios.

Seasonal Timing.—The combined-species median passage date of 21 September was a non-significant 1 day earlier than the 1998–2006 average (Table 3); however, the overall seasonal distribution differed from the average pattern in showing several five-day periods with significantly above or below average proportional activity levels (Figure 8). The first significantly below-average activity period from 16–20 September did not correspond to any particular weather event; however, the second, more extended

period of low activity between 26 September and 5 October did correspond to the first significant snow event of the season, which began on 28 September (Appendix C). A particularly noticeable late spike in activity during the 11–15 October period reflected unusually high, late activity for several species, most notably the accipiters and Red-tailed Hawks.

At the species level, only Northern Goshawks and Red-tailed Hawks showed significantly late median passage dates, whereas six species (Turkey Vulture, Osprey, Northern Harrier, Golden and Bald Eagles, and American Kestrels) showed significantly early timing in 2007 (Table 3). Most other species showed median passage dates that were within two days of average. Age- and sex-specific data revealed three noteworthy clarifications: 1) adult females and unidentified brown birds were responsible for the indication of significantly early passage among harriers, with adult males significantly late and confirmed immature birds showing average timing; 2) among Sharp-shinned and Cooper's Hawks, adults were late but immatures early, whereas the opposite was true for goshawks; and 3) the indicator of early species-level passage for Golden Eagles reflected the pattern for adults, while immatures/subadults showed significantly late timing (Table 4).

RESIDENT RAPTORS

The most commonly observed resident birds in 2007 included a group of Red-tailed Hawks. One distinctive, light-morph adult was seen almost every day hunting over the Mitchell Creek drainage and along nearby ridges. Another light-morph adult and a light-morph juvenile, presumably the three birds comprising a family group, also were seen regularly hunting the ridgelines near the observation site and often escorting migrants through the area.

Two resident American Kestrels were observed early in the season until 8 September, mostly hunting around the observation point and along the nearby ridge.

An adult Bald Eagle was seen a few times in late September and early October coming up from Lake Chelan, usually heading north to northeast towards the Methow River Valley.

A few Golden Eagles were observed in non-migratory behavior, but the observers believed they were not resident on Chelan Ridge itself.

Three Turkey Vultures were seen regularly in the eastern gap on the backside of Cooper Mountain from early September until the real first cold days of the season hit in late September.

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

TRAPPING EFFORT

Trapping occurred on 51 of 53 days between 25 August and 16 October, shut down several days earlier than hoped for by significant snowfall, with effort totaling 716.12 station hours (see Appendix F for daily trapping records). The number of trapping days and station hours were both non-significantly below their respective 2001–2006 averages of $53 \pm 95\%$ CI of 2.7 days and 763.1 ± 70.8 station hours (see Appendix G for annual trapping summaries).

TRAPPING AND BANDING RESULTS

The 2007 capture total of 672 newly banded birds and 3 recaptures of previously banded birds, involving 11 typical species, was the third highest total since HWI took over the banding program in 2001 and 13% higher than the 2001–2006 average (Table 5, Appendix G). One additional capture of a Northern Hawk-Owl was unprecedented and added some significant excitement to the mix. Based on 2001–2006 averages, the overall combined-species 2007 capture total was non-significantly above average, and at

the species level only the totals for Cooper's Hawks and Prairie Falcons were significantly above average, and only the total for American Kestrels was significantly below average (Table 5). The capture total for Cooper's Hawks (138) rose to a new record high, and the capture of 4 Prairie Falcons matched the previous high (Appendix G). The species captured most frequently in 2007 were the Sharp-shinned Hawk (67% of captures), Cooper's Hawk (20%), Red-tailed Hawk (5%), Northern Goshawk (2%), and Merlin (2%); all other species each comprised <2% of the total.

Similar patterns applied to estimates of capture totals and rates (birds captured per 100 station hours), except that the overall capture rate of 94 birds per 100 station hours and the capture rates for two additional species, Sharp-shinned and Red-tailed Hawks, were significantly above average (Table 5). In contrast, a markedly different pattern arose with regard to capture success (i.e., capture proportions of observed, trappable species). The only significant variations in estimates of capture success included high capture success for Northern Harriers and low capture success for Cooper's Hawks and Northern Goshawks. In other words, despite substantial increases in the total number caught and the capture rate, captures of Cooper's Hawks simply could not keep pace with the 66% higher-than-average flight volume.

Compared to the counts, banding at this site yields unique and substantial sex-age specific data only for the three accipiters and American Kestrels, although too few kestrels were captured in 2007 to render useful comparisons (Table 6). For Sharp-shinned Hawks, both the count and banding data indicated similarly reduced immature : adult ratios (33–36% below average), with both sets of estimates of similar magnitude. For Northern Goshawks, both datasets indicated below average age ratios in 2007, but with the count estimate a non-significant 33% below average and the capture estimate a significant 59% below average. This discrepancy suggests that either immature birds were less susceptible to capture than usual in 2007 (i.e., better fitness than usual), or adults were easier to catch. For Cooper's Hawks, the count and capture statistics showed opposite trends, with the count-based age ratio 10% below average and the capture-based ratio 95% above average. For this species, the count-based ratio averages about twice as high as the capture-based ratio. This is unusual because it suggests that immature birds typically are much less susceptible to capture than adults at this site, which is the opposite of the pattern shown at most other western sites. In 2007, however, a near doubling of the capture age ratio compared to the long-term average—despite a typical count ratio—rendered the count and capture ratios of similar magnitude and suggested that immature birds were much more susceptible than usual to capture in 2007. The capture data also uniquely indicated slightly above-average proportions of female Sharp-shinned and Cooper's Hawks, but significantly below average representation of female goshawks (Table 6).

ENCOUNTERS WITH PREVIOUSLY BANDED BIRDS

Since banding began at Chelan Ridge in 1999, 34 foreign encounters with Chelan-banded birds have been recorded. Nine new encounters occurred in 2007, involving 2 Red-tailed Hawks, 5 Sharp-shinned Hawks, and 2 Cooper's Hawks (Table 7). All were banded as hatch-year (HY) birds during the past three seasons and were found dead of unknown causes between 1.5 and 19 months later. Both Red-tailed Hawks were banded during September 2006 and found dead the following January, but one was 956 km south in central California and the other was 313 km north in British Columbia! One male Cooper's Hawk was banded during fall 2005 and recovered 19 months later in April only 19 km away from the project site. The other Cooper's Hawk, a female, was banded during fall 2006 and recovered two months later 640 km south in northern California. Three Sharp-shinned Hawks, two males and one female, were banded during fall 2006 and recovered the following year in March in southern California (1,465 km) and northern Oregon (265), and in July in British Columbia (305 km). The other two Sharp-shinned Hawks were banded during fall 2007 and recovered 41 days and 893 km later in southern California (a male) and 47 days and 1,606 km later near Phoenix, Arizona (a female). The latter bird is the fourth Sharp-shinned Hawk banded at Chelan Ridge that has been recovered east of the Sierra–Cascade range, with three previous individuals ending up in Idaho and Nevada. This suggests that although the majority

of Chelan Ridge migrants follow the Pacific Coast Flyway into western Oregon and California for the winter, roughly 15% (4 of 27) divert east and southeast from Chelan Ridge and instead travel through the Intermountain corridor into Idaho, Nevada, and Arizona. Other birds that have traveled east of the Sierra-Cascades after banding at Chelan Ridge include 2 Cooper's Hawks encountered in central Arizona and northeastern Nevada, 2 Merlins encountered in west-central Oregon and southeastern Washington, and 1 Golden Eagle tracked by satellite to a winter range in southern New Mexico. All other Chelan Ridge migrants tracked via band returns or satellite tracking have shown affinity to the Pacific Coast Flyway (*sensu* Hoffman et al. 2002), with winter ranges extending from western Washington to southern California.

VISITOR PARTICIPATION AND PUBLIC OUTREACH

The 2007 visitor logs recorded 170 individuals (with many returning visitors), mostly from surrounding Washington communities. Two other states (Pennsylvania and Wisconsin) also were represented. Organized groups included Seattle Mountaineer Birding Group, Wenatchee Valley Academy, Twisp Community School, and Twisp and Mazama home-school groups. In addition to on-site education programs and outreach, our education team also conducted 16 off-site programs in high schools in Winthrop, Omak, Brewster, and Okanogan, Washington.

In 2007, 514 hourly assessments by the observers of visitor disturbance resulted in the following ratings: 95% none, 5% low, and 0% moderate or high. This 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.

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commented that they liked seeing what was going on—even if they couldn't make it up to our project site.

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.
- 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*, 2008 Special Issue on American Kestrels.
- Goodrich, L. J., and J. P. Smith. 2008. Raptor migration in North America. In K. L. Bildstein, J. P. Smith, and E. Ruelas-Inzunza (Editors), *The state of North America's birds of prey*. Series in Ornithology No. 3. American Ornithologists' Union, Washington, DC, and Nuttall Ornithological Club, Cambridge, Massachusetts, USA.
- 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.
- Smith, J. P., C. J. Farmer, S. W. Hoffman, G. S. Kaltenecker, K. Z. Woodruff, and P. Sherrington. 2008 a. Trends in autumn counts of migratory raptors in western North America, 1983–2005. In K. L. Bildstein, J. P. Smith, and E. Ruelas-Inzunza (Editors), *The state of North America's birds of prey*. Series in Ornithology No. 3. American Ornithologists' Union, Washington, DC, and Nuttall Ornithological Club, Cambridge, Massachusetts, USA.
- Smith, J. P., C. J. Farmer, S. W. Hoffman, C. A. Lott, L. J. Goodrich, J. Simon, C. Riley, and E. Ruelas Inzunza. 2008 b. Trends in autumn counts of migratory raptors around the Gulf of Mexico, 1995–2005. In K. L. Bildstein, J. P. Smith, and E. Ruelas-Inzunza (Editors), *The state of North America's birds of prey*. Series in Ornithology No. 3. American Ornithologists' Union, Washington, DC, and Nuttall Ornithological Club, Cambridge, Massachusetts, 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: 1998–2006 versus 2007.

SPECIES	COUNTS			RAPTORS/100 HOURS		
	1998–2006 ¹	2007	% Change	1998–2006 ¹	2007	% Change
Turkey Vulture	33 ± 9.6	42	+26	7.9 ± 2.23	8.4	+7
Osprey	43 ± 10.3	31	-28	15.5 ± 4.34	8.9	-42
Northern Harrier	114 ± 24.8	60	-47	34.1 ± 8.59	16.9	-50
White-tailed Kite	0 ± 0.2	0	-100	–	–	
Sharp-shinned Hawk	802 ± 144.0	880	+10	256.5 ± 55.34	219.8	-14
Cooper's Hawk	218 ± 24.9	363	+66	75.5 ± 10.76	113.3	+50
Northern Goshawk	29 ± 8.2	49	+72	7.3 ± 2.20	13.4	+84
Unknown small accipiter ²	45 ± 32.6	45	0	–	–	
Unknown large accipiter ²	8 ± 4.6	3	-64	–	–	
Unknown accipiter	87 ± 59.3	8	-91	–	–	
TOTAL ACCIPITERS	1,171 ± 193.0	1,348	+15	–	–	
Broad-winged Hawk	5 ± 1.4	2	-62	4.5 ± 1.71	1.8	-60
Swainson's Hawk	6 ± 3.9	4	-38	4.2 ± 2.78	1.3	-69
Red-tailed Hawk	318 ± 62.3	378	+19	93.6 ± 19.71	93.3	0
Ferruginous Hawk	0 ± 0.2	0	-100	0.2 ± 0.25	0.0	-100
Rough-legged Hawk	28 ± 10.1	22	-21	19.5 ± 5.90	12.5	-36
Unidentified buteo	68 ± 26.4	29	-57	–	–	
TOTAL BUTEOS	425 ± 90.7	435	+2	–	–	
Golden Eagle	130 ± 22.2	82	-37	36.4 ± 6.31	18.3	-50
Bald Eagle	5 ± 3.0	10	+84	1.5 ± 0.78	1.7	+10
Unidentified eagle	3 ± 2.8	0	-100	–	–	
TOTAL EAGLES	138 ± 25.3	92	-33	–	–	
American Kestrel	61 ± 17.8	47	-24	19.3 ± 6.21	14.7	-24
Merlin	38 ± 7.2	40	+7	11.2 ± 2.67	8.6	-24
Prairie Falcon	8 ± 3.0	6	-23	2.2 ± 0.68	1.2	-44
Peregrine Falcon	8 ± 4.1	16	+109	2.1 ± 0.96	4.0	+88
Unknown small falcon ²	4 ± 1.4	0	-100	–	–	
Unknown large falcon ²	2 ± 0.6	1	-54	–	–	
Unknown falcon	2 ± 1.7	1	-57	–	–	
TOTAL FALCONS	121 ± 20.6	111	-8	–	–	
Unidentified raptor	116 ± 48.5	30	-74	–	–	
GRAND TOTAL	2,162 ± 316.8	2,149	-1	–	–	

¹ Mean ± 95% confidence interval.

² Designations used for the first time in 2001.

Table 2. Fall counts by age class and immature : adult ratios for selected species of migrating raptors at Chelan Ridge, WA: 1998–2006 versus 2007.

	TOTAL AND AGE-CLASSIFIED COUNTS						IMMATURE : ADULT			
	1998–2006 AVERAGE			2007			% UNKNOWN AGE		RATIO	
	TOTAL	IMM.	ADULT	TOTAL	IMM.	ADULT	1998–2006 ¹	2007	1998–2006 ¹	2007
Northern Harrier	114	38	27	60	14	22	44 ± 7.8	40	1.5 ± 0.33	0.6
Sharp-shinned Hawk	802	407	120	880	502	180	34 ± 7.2	23	4.0 ± 1.61	2.8
Cooper's Hawk	218	103	26	363	194	46	42 ± 7.9	34	4.6 ± 1.83	4.2
Northern Goshawk	29	14	4	49	23	5	37 ± 8.8	43	6.6 ± 4.49	4.6
Broad-winged Hawk	5	2	1	2	0	1	41 ± 16.9	50	1.3 ± 0.77	0.0
Red-tailed Hawk	318	71	139	378	71	139	33 ± 5.6	44	0.5 ± 0.14	0.5
Golden Eagle	130	63	28	82	36	22	30 ± 5.4	29	2.3 ± 0.43	1.6
Bald Eagle	5	1	4	10	1	9	8 ± 10.8	0	0.3 ± 0.22	0.1
Peregrine Falcon	8	2	2	16	5	5	45 ± 20.8	38	1.7 ± 1.06	1.0

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

Table 3. First and last observed, bulk-passage, and median-passage dates by species for migrating raptors at Chelan Ridge, WA in 2006, with a comparison of 2007 and 1998–2006 average median passage dates.

SPECIES	2007				1998–2006
	FIRST OBSERVED	LAST OBSERVED	BULK PASSAGE DATES ¹	MEDIAN PASSAGE DATE ²	MEDIAN PASSAGE DATE ^{2,3}
Turkey Vulture	25-Aug	26-Sep	29-Aug – 21-Sep	9-Sep	16-Sep □ 4.0
Osprey	28-Aug	14-Oct	3-Sep – 4-Oct	14-Sep	18-Sep □ 3.3
Northern Harrier	26-Aug	23-Oct	5-Sep – 10-Oct	14-Sep	22-Sep □ 2.0
Sharp-shinned Hawk	24-Aug	27-Oct	3-Sep – 14-Oct	22-Sep	21-Sep □ 2.1
Cooper's Hawk	25-Aug	24-Oct	3-Sep – 9-Oct	16-Sep	18-Sep □ 2.1
Northern Goshawk	31-Aug	26-Oct	9-Sep – 17-Oct	11-Oct	26-Sep □ 5.2
Broad-winged Hawk	11-Sep	14-Sep	–	–	12-Sep □ 2.7
Swainson's Hawk	2-Sep	12-Sep	–	–	14-Sep □ 6.5
Red-tailed Hawk	24-Aug	27-Oct	4-Sep – 17-Oct	28-Sep	25-Sep □ 2.0
Rough-legged Hawk	27-Aug	26-Oct	5-Oct – 25-Oct	15-Oct	14-Oct □ 3.4
Golden Eagle	24-Aug	27-Oct	7-Sep – 24-Oct	1-Oct	04-Oct □ 2.0
Bald Eagle	4-Sep	26-Oct	4-Sep – 25-Oct	20-Sep	16-Oct □ 5.9
American Kestrel	25-Aug	14-Oct	27-Aug – 16-Sep	4-Sep	12-Sep □ 4.9
Merlin	25-Aug	24-Oct	30-Aug – 20-Oct	21-Sep	22-Sep □ 3.1
Prairie Falcon	6-Sep	16-Oct	6-Sep – 16-Oct	21-Sep	17-Sep □ 8.1
Peregrine Falcon	28-Aug	17-Oct	28-Aug – 11-Oct	12-Sep	18-Sep □ 8.6
Total	27-Aug	27-Oct	2-Sep – 14-Oct	21-Sep	22-Sep □ 1.6

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

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

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

Table 4. Median passage dates by age for selected species of migrating raptors at Chelan Ridge, WA: 1998–2006 versus 2007.

SPECIES	ADULT		IMMATURE	
	1998–2006 ¹	2007	1998–2006 ¹	2007
Northern Harrier	22-Sep ± 2.9	18-Sep	23-Sep ± 2.5	25-Sep
Sharp-shinned Hawk	02-Oct ± 1.7	8-Oct	14-Sep ± 2.0	9-Sep
Cooper’s Hawk	26-Sep ± 2.7	29-Sep	12-Sep ± 1.9	7-Sep
Northern Goshawk	08-Oct ± 6.6	24-Sep	24-Sep ± 5.3	7-Oct
Red-tailed Hawk	28-Sep ± 2.1	5-Oct	17-Sep ± 4.1	25-Sep
Golden Eagle	06-Oct ± 2.6	1-Oct	03-Oct ± 2.3	6-Oct
Bald Eagle	15-Oct ± 7.6	15-Oct	22-Oct ²	–
Peregrine Falcon	–	11-Oct	07-Sep ³	7-Sep

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.

² Data for 2000 only.

³ Data for 2006 only.

Table 5. Fall capture totals, rates, and successes by species for migrating raptors at Chelan Ridge, WA: 2001–2006 versus 2007.

	CAPTURE TOTALS		CAPTURE RATE ¹		CAPTURE SUCCESS ²	
	2001–2006 ³	2007	2001–2006 ³	2007	2001–2006 ³	2007
Northern Harrier	13 ± 6.1	12	1.7 ± 0.73	1.7	13.5 ± 5.0	18.3
Sharp-shinned Hawk	397 ± 86.1	450	51.8 ± 9.41	62.8	55.3 ± 14.4	37.5
Cooper's Hawk	105 ± 22.0	138	13.7 ± 2.69	19.3	44.4 ± 8.9	24.9
Northern Goshawk	14 ± 4.3	16	1.9 ± 0.56	2.2	74.3 ± 44.4	28.3
Red-tailed Hawk	25 ± 11.0	33	3.2 ± 1.36	4.6	8.5 ± 4.2	5.5
Rough-legged Hawk	2.5 ± 1.94	1	0.3 ± 0.24	0.1	7.4 ± 7.1	7.9
Golden Eagle	3 ± 1.7	2	0.4 ± 0.20	0.3	2.0 ± 1.2	2.6
American Kestrel	9.0 ± 3.43	3	1.2 ± 0.42	0.4	17.1 ± 11.5	14.2
Merlin	26 ± 10.8	15	3.3 ± 1.22	2.1	54.9 ± 23.2	49.4
Prairie Falcon	3 ± 1.3	4	0.3 ± 0.17	0.6	39.0 ± 13.5	38.9
Peregrine Falcon	1.7 ± 1.1	1	0.2 ± 0.14	0.1	24.0 ± 19.6	7.2
All species	598 ± 123.9	675	78.1 ± 13.58	94.3	34.4 ± 7.6	25.4

¹ Captures / 100 station hours.

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

³ Mean of annual values ± 95% confidence interval.

Table 6. Fall capture totals by sex and age (HY = hatching year; AHY = after hatching year), female : male capture ratios, and immature : adult capture ratios for selected species of migrating raptors at Chelan Ridge, WA: 2001–2006 versus 2007.

SPECIES	YEARS	FEMALE		MALE		FEMALE : MALE RATIO	IMM. : ADULT RATIO
		HY	AHY	HY	AHY		
Sharp-shinned Hawk	Avg. 2001–2006	164	52	149	32	1.2 ± 0.07	3.7 ± 0.47
	2007	166	92	151	41	1.3	2.4
Cooper's Hawk	Avg. 2001–2006	40	23	34	9	1.6 ± 0.19	2.3 ± 0.28
	2007	66	19	47	6	1.6	4.5
Northern Goshawk	Avg. 2001–2006	4	1	9	1	0.5 ± 0.11	10.5 ± 3.49
	2007	1	1	12	2	0.1	4.3
American Kestrel	Avg. 2001–2006	1	1	5	1	0.3 ± 0.04	4.2 ± 1.58
	2007	2	0	0	1	2.0	2.0

¹ Mean ± 95% CI.

Table 7. Foreign encounters in 2007 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
1807 – 93933	RT	U	10-Sep-06	HY	Kentfield, CA	2-Jan-07	SY	956	found dead
1177 – 06572	RT	U	16-Sep-06	HY	Clearwater, BC	11-Jan-07	SY	313	found dead
1232 – 35106	SS	M	02-Sep-06	HY	Boulevard, CA	6-Mar-07	SY	1,465	found dead
1623 – 21025	SS	F	7-Sep-06	HY	Hood River, OR	17-Mar-07	SY	265	found dead
0804 – 30820	CH	M	04-Sep-05	HY	Manson, WA	1-Apr-07	TY	19	found dead
1232 – 35215	SS	M	28-Sep-06	HY	Bridge Lake, BC	3-Jul-07	SY	305	found dead
1043 – 55017	SS	M	27-Sep-07	HY	Pope Valley, CA	9-Nov-07	HY	893	found dead
1593 – 61272	SS	F	12-Sep-07	HY	Phoenix, AZ	9-Nov-07	HY	1,606	found dead
1005 – 21573	CH	F	22-Sep-06	HY	Lake Almanor, CA	21-Nov-07	SY	640	found dead

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.

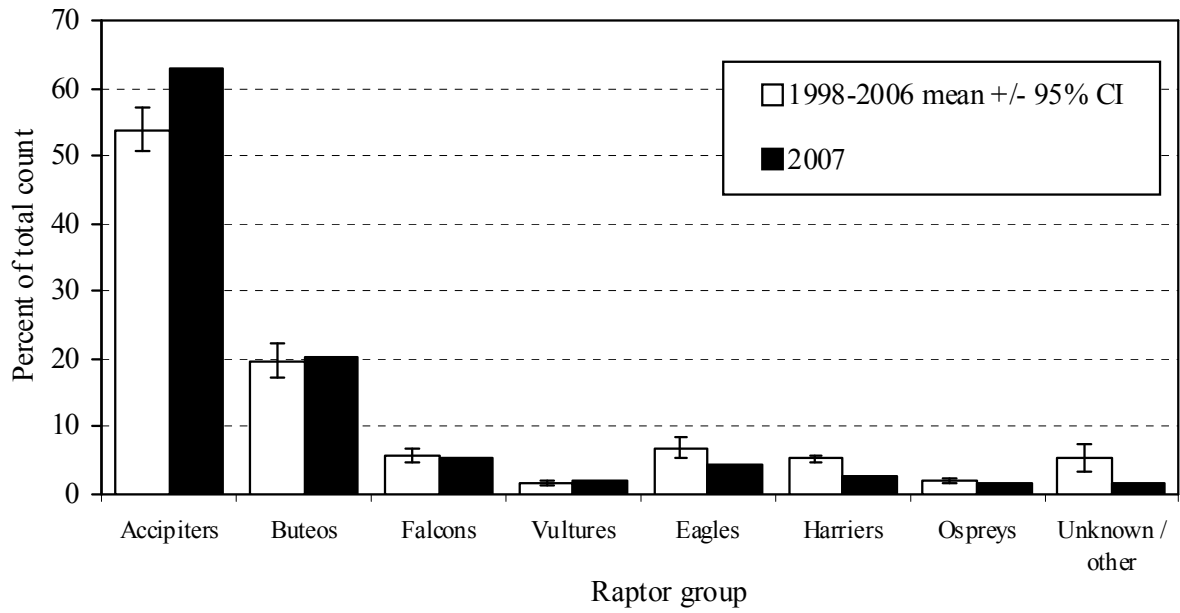


Figure 2. Fall raptor migration flight composition by major species groups at Chelan Ridge, WA: 1998–2006 versus 2007.

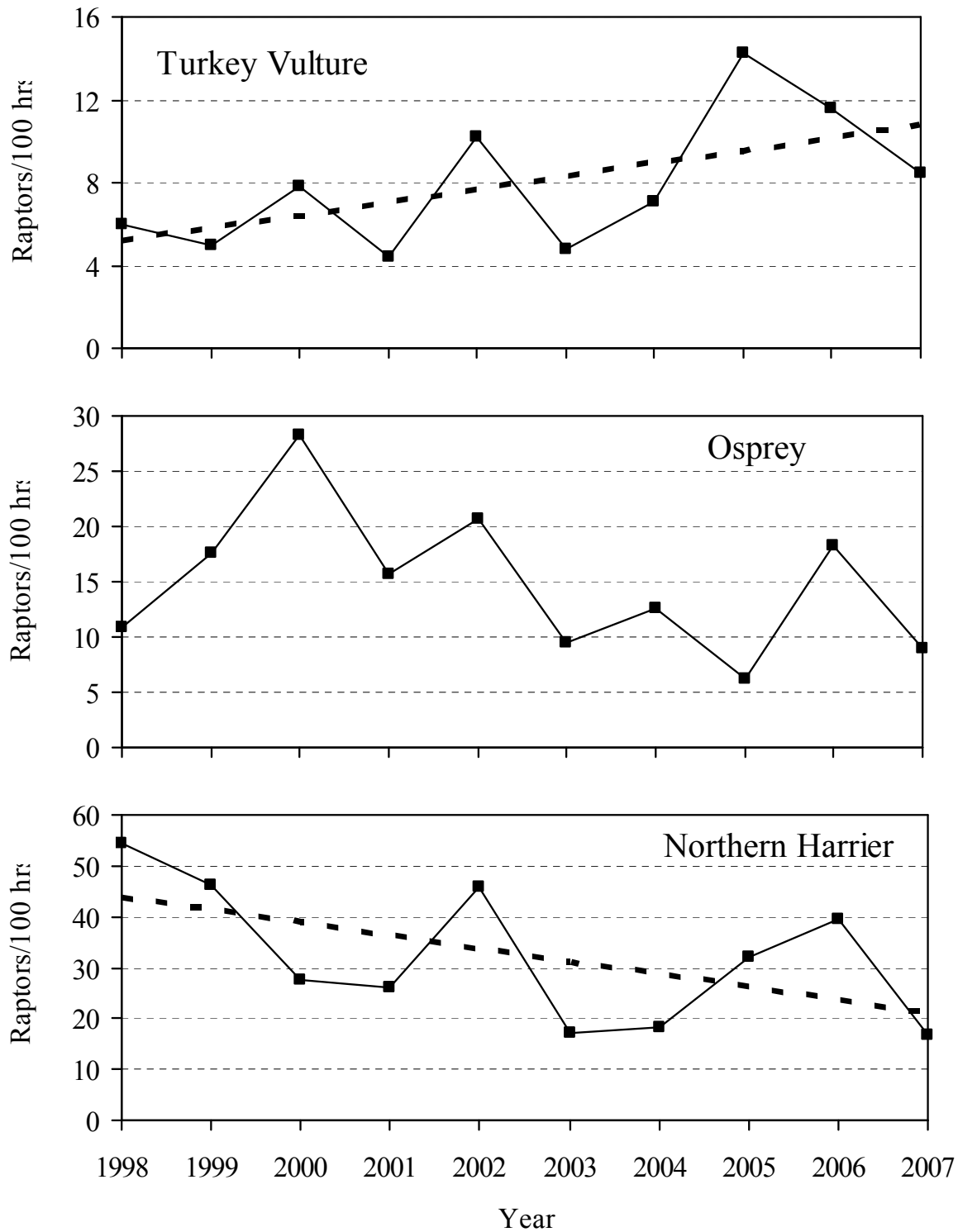


Figure 3. Adjusted fall-migration passage rates at Chelan Ridge, WA for Turkey Vultures, Ospreys, and Northern Harriers: 1998–2007. Dashed lines indicate significant linear or quadratic regressions.

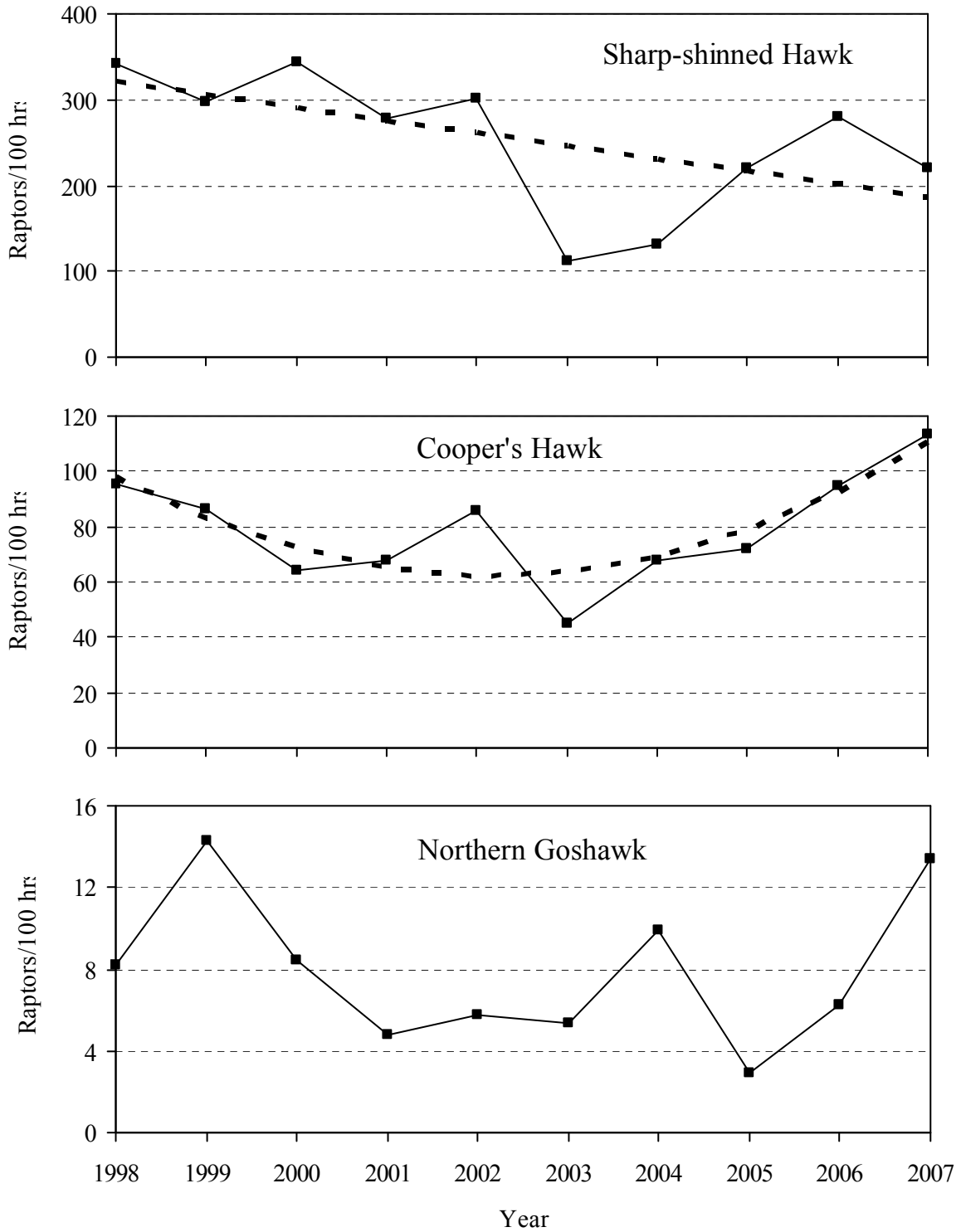


Figure 4. Adjusted fall-migration passage rates at Chelan Ridge, WA for Sharp-shinned Hawks, Cooper's Hawks, and Northern Goshawks: 1998–2007. Dashed lines indicate significant linear or quadratic regressions.

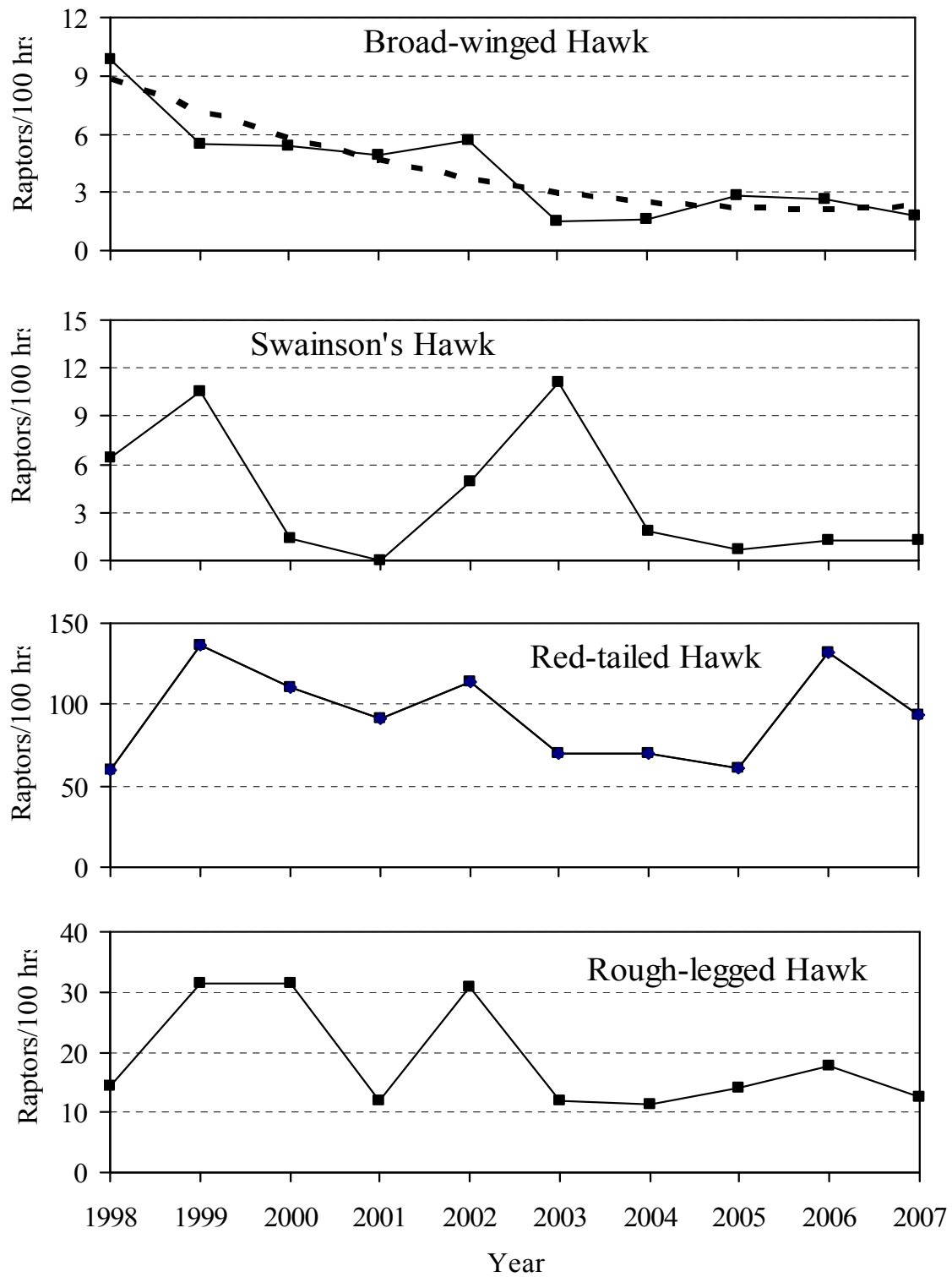


Figure 5. Adjusted fall-migration passage rates at Chelan Ridge, WA for Broad-winged, Swainson's, Red-tailed, and Rough-legged Hawks: 1998–2007. Dashed lines indicate significant linear or quadratic regressions.

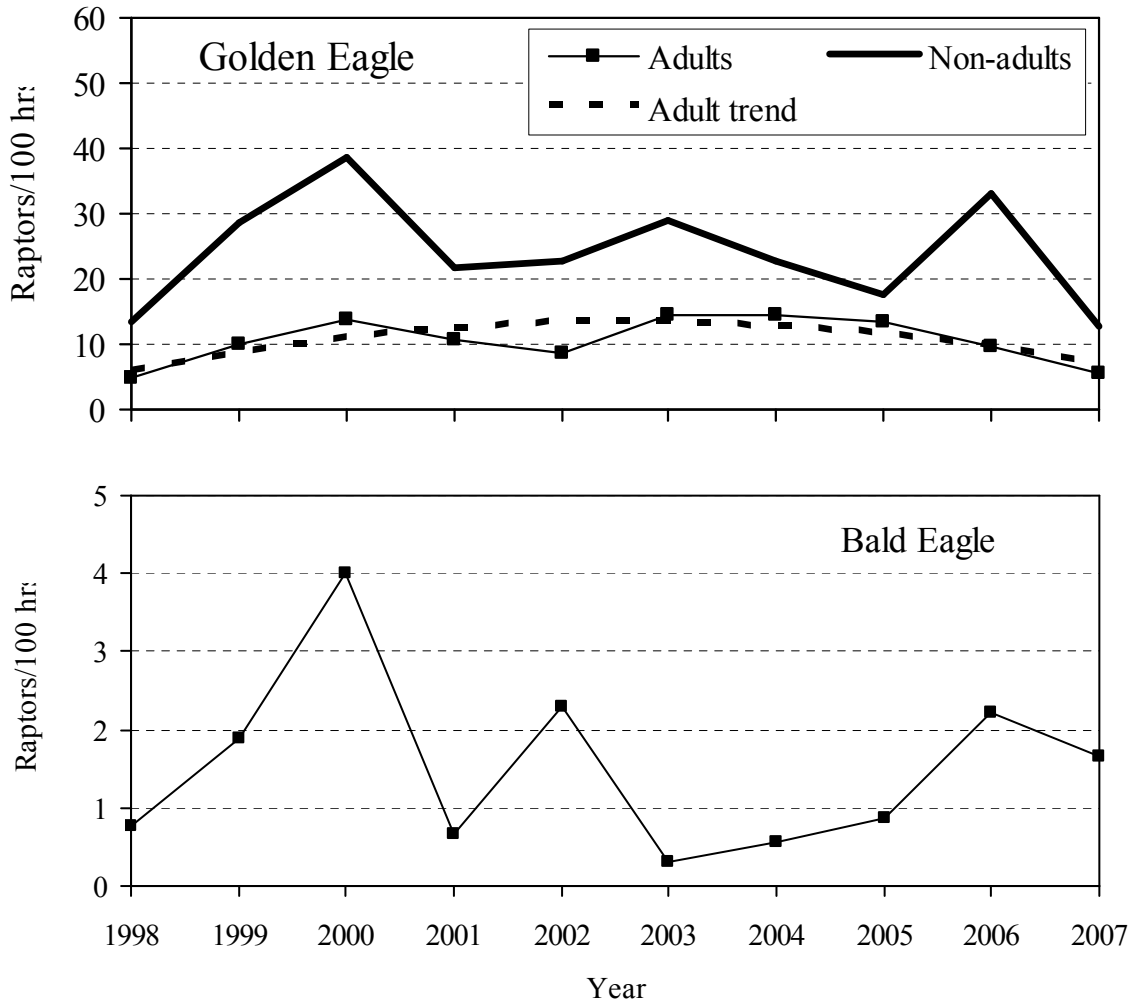


Figure 6. Adjusted fall-migration passage rates at Chelan Ridge, WA for Golden and Bald Eagles: 1998–2007. Dashed lines indicate significant linear or quadratic regressions.

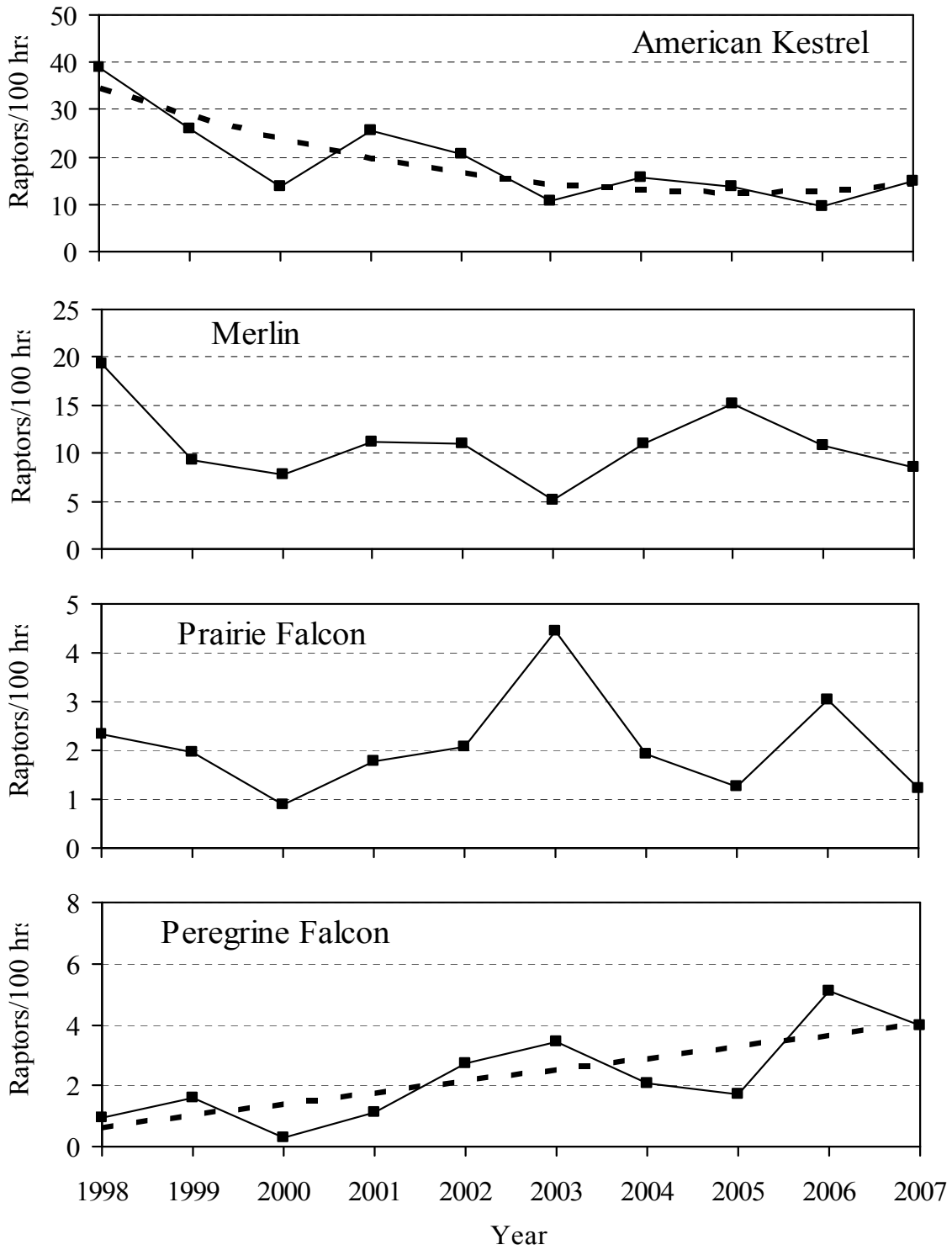


Figure 7. Adjusted fall-migration passage rates at Chelan Ridge, WA for American Kestrels, Merlins, Prairie Falcons, and Peregrine Falcons: 1998–2006. Dashed lines indicate significant linear or quadratic regressions.

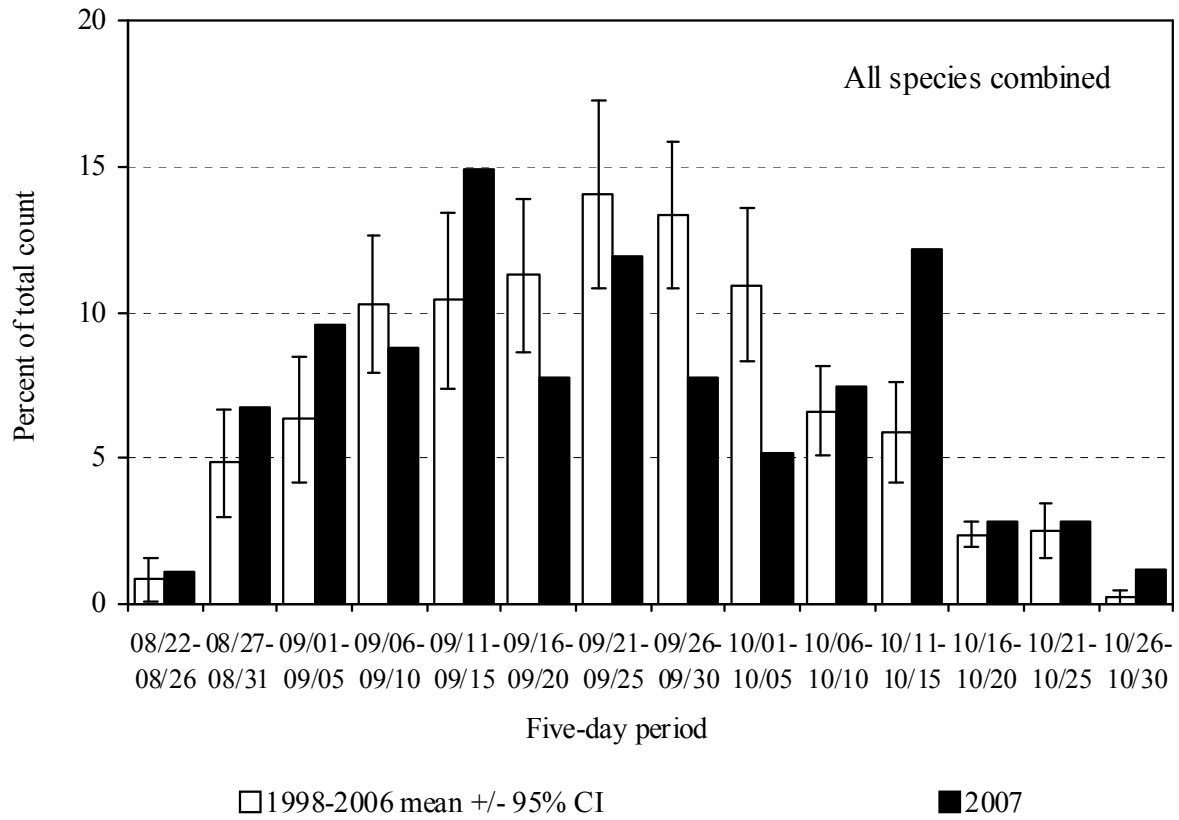


Figure 8. Combined-species passage volume by five-day periods for migrating raptors at Chelan Ridge, WA: 1998–2006 versus 2007.

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 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), with assistance from Rob Spaul (2+), Ben Vang-Johnson (1+), and Richard Hendrick (4+).

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: 2007.

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	3.00	1.9	0	pc, AM haze	16.7	ssw	26.3	28.68	3	100	77	2	1.3
25-Aug	9.00	2.9	0	pc, PM haze	15.6	ssw-sw	19.3	28.62	3	89	74	3	1.4
26-Aug	9.00	2.6	0	pc-mc	11.5	sw	15.8	28.65	2	91	73	3	0.7
27-Aug	9.00	2.0	0	clr-mc, haze	5.0	nne, w	15.5	28.80	2	100	71	3	1.9
28-Aug	9.25	2.0	0	clr, haze	13.5	ssw	17.5	28.89	2	68	42	2	2.9
29-Aug	9.00	2.0	0	clr-pc	8.4	sse, calm	21.4	28.89	1	75	70	2	5.0
30-Aug	9.00	8.0	0	clr-pc	8.0	sse, calm	22.9	28.80	2	71	80	2	4.0
31-Aug	9.00	2.0	0	mc-ovc, haze	23.9	ssw-sw	19.2	30.18	3	77	68	1	2.2
1-Sep	9.00	2.0	0	pc-mc	6.4	nne, calm	17.4	30.24	1	100	100	2	3.1
2-Sep	9.00	2.0	0	pc-mc, haze	10.7	sw	19.6	30.25	2	100	82	2	5.2
3-Sep	9.00	2.0	0	pc-mc	7.3	sse, ssw	18.8	30.16	2	93	85	1	3.9
4-Sep	9.25	2.3	0	clr-pc, haze	7.5	ne, w	21.1	30.16	2	100	68	3	6.6
5-Sep	8.75	2.5	0	clr-pc	8.6	ne, ssw	18.8	30.21	2	100	89	2	3.9
6-Sep	9.00	2.0	0	clr-pc	5.3	calm-var	16.7	30.27	1	100	86	1	3.4
7-Sep	9.00	2.0	0	clr-mc, haze	16.2	n, nw	12.4	30.31	3	100	84	3	1.7
8-Sep	9.00	2.0	0	clr-pc	6.8	ne, wsw	15.8	30.47	1	100	100	2	3.2
9-Sep	9.00	1.9	0	clr-pc	8.9	calm-var	15.0	30.51	1	100	94	2	5.6
10-Sep	9.00	2.0	0	clr, haze	7.6	calm, wsw	20.3	30.52	2	100	85	2	7.0
11-Sep	9.00	2.0	0	clr, haze	16.0	sw	20.5	30.30	2	78	80	2	11.2
12-Sep	9.00	1.7	0	clr	9.6	n, ne	18.3	30.21	2	100	100	2	7.3
13-Sep	9.00	2.0	0	clr	7.0	calm, nne, nnw	17.6	30.28	1	100	90	1	4.9
14-Sep	9.00	2.0	0	clr, haze	4.9	ne, sw	20.0	30.24	2	81	71	2	4.6
15-Sep	9.00	2.0	1	clr, haze	8.4	sse, ssw	19.5	30.22	2	100	100	1	7.6
16-Sep	9.00	2.0	0	clr-ovc, haze	6.4	sw	14.4	30.04	4	68	53	2	4.3
17-Sep	9.00	2.0	0	pc	7.6	calm-var	12.1	30.14	1	100	100	1	3.3
18-Sep	9.00	2.5	0	ovc	7.5	nne, sw	9.6	30.09	4	70	60	2	3.3
19-Sep	9.00	3.0	0	pc-mc	11.5	calm, nne	7.5	30.21	1	100	97	2	3.6
20-Sep	9.00	2.0	0	ovc, PM haze	8.8	sw	10.1	30.02	3	66	60	3	4.0
21-Sep	8.50	2.2	0	pc	12.1	ssw	11.6	30.10	2	100	94	1	4.0
22-Sep	9.00	2.0	0	pc-mc	8.8	calm, sw	9.4	29.90	1	100	100	2	7.4
23-Sep	9.00	2.0	1	clr	11.5	nne, nw	8.6	30.12	3	100	95	3	3.9
24-Sep	9.00	2.2	0	clr-pc	10.4	calm	9.4	30.32	2	100	85	2	7.1
25-Sep	8.50	2.0	0	pc-mc	10.4	ssw	13.6	30.29	3	100	80	2	6.6
26-Sep	9.00	2.2	0	pc-mc	6.0	calm, s, sw	16.3	30.33	1	100	100	2	7.7
27-Sep	9.00	2.0	0	mc-ovc	11.4	calm, s, sw	13.8	30.00	3	100	97	1	2.0
28-Sep	9.00	1.9	0	ovc, scat snow/rain	7.6	sw	7.6	29.59	4	48	46	3	5.0
29-Sep	9.00	2.5	0	mc-ovc	11.7	calm, s, sw	6.3	30.04	3	100	91	1	3.9
30-Sep	0.00			ovc, snow, fog									
1-Oct	9.00	2.4	0	pc-mc	13.6	calm, sw	5.8	30.10	2	100	64	2	3.1
2-Oct	1.50	2.0	0	ovc, snow, fog	44.3	sw	3.0	29.89	4	35	28	-	0.0
3-Oct	9.00	2.0	0	pc-ovc	14.4	calm, sw	4.2	29.86	3	88	58	1	2.0
4-Oct	7.00	2.4	0	ovc, haze	2.7	calm, sw	3.0	29.88	4	52	32	2	1.6
5-Oct	9.00	2.4	0	clr-pc	11.2	nne, w	4.7	30.05	2	100	100	2	6.0
6-Oct	9.00	2.0	0	clr-ovc, haze	12.1	ssw-sw	5.9	30.18	3	77	35	2	1.9
7-Oct	9.00	2.8	0	mc, AM fog	25.8	calm, sw	6.4	30.11	4	82	26	2	3.1
8-Oct	9.00	2.0	0	pc-ovc, haze	9.5	ne	5.1	30.10	4	77	73	3	4.1
9-Oct	9.00	1.8	0	mc-ovc, haze	17.5	se, ssw	10.7	29.99	4	88	64	3	6.0
10-Oct	8.00	2.1	0	pc-ovc	11.0	sw	8.6	29.94	4	53	65	2	3.0

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	ovc, haze	4.1	calm, ne, s	7.1	30.15	4	51	61	3	7.8
12-Oct	0.00			ovc, fog, snow									
13-Oct	9.00	2.0	0	clr, haze	7.5	ssw	8.5	30.19	2	100	100	2	7.9
14-Oct	9.00	2.0	0	clr-mc, haze	11.1	ssw	8.5	30.14	2	64	90	3	10.4
15-Oct	8.75	2.0	0	mc-ovc, haze, PM ts	5.0	calm-var	9.2	29.88	3	48	65	2	3.0
16-Oct	7.50	2.0	0	pc-ovc, haze	16.7	sw	5.0	29.64	3	46	56	3	3.2
17-Oct	9.00	1.4	0	mc-ovc	9.0	sw	3.4	29.80	3	91	58	2	2.8
18-Oct	0.00			snow									
19-Oct	0.00			snow									
20-Oct	3.50	2.0	0	mc	9.6	sw	3.6	29.91	3	100	40	2	3.1
21-Oct	5.00	1.7	0	mc-ovc, haze	22.7	sw	-0.8	30.32	4	46	38	-	0.0
22-Oct	5.50	1.8	0	mc, haze	34.3	sw	6.6	30.38	3	77	39	2	1.8
23-Oct	6.00	3.7	0	clr, fog/haze	17.1	ssw	11.6	30.38	2	100	100	1	2.5
24-Oct	7.25	2.7	0	pc-ovc	32.0	sw	7.4	30.08	4	64	42	2	2.1
25-Oct	7.50	2.0	0	clr-pc	5.2	nne, nnw	-0.9	30.31	2	100	98	3	2.8
26-Oct	8.00	1.7	0	clr, PM haze	8.7	calm, ne	1.8	30.42	3	88	96	3	2.1
27-Oct	6.92	3.0	0	pc-mc	14.7	ssw	2.3	30.27	3	88	74	1	1.2

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: 2007.

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	3.00	0	0	0	0	2	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	4	1.3
25-Aug	9.00	1	0	0	0	2	2	0	2	0	0	0	0	1	0	0	1	0	0	0	2	1	0	0	0	0	0	1	13	1.4
26-Aug	9.00	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	1	0	0	0	0	0	0	6	0.7
27-Aug	9.00	0	0	0	0	4	1	0	2	0	0	0	0	4	0	1	1	1	0	0	2	0	0	0	0	0	0	1	17	1.9
28-Aug	9.25	2	2	0	0	7	2	0	0	0	0	0	0	5	0	0	0	1	0	0	5	1	0	2	0	0	0	0	27	2.9
29-Aug	9.00	3	0	0	0	17	5	0	2	0	1	0	0	7	0	0	4	1	0	0	2	0	0	0	0	1	0	2	45	5.0
30-Aug	9.00	4	0	0	0	13	5	0	3	1	1	0	0	5	0	0	0	0	0	0	3	1	0	0	0	0	0	0	36	4.0
31-Aug	9.00	0	0	0	0	12	2	2	2	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	20	2.2
1-Sep	9.00	2	0	0	0	15	3	0	4	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0	0	0	1	28	3.1
2-Sep	9.00	2	1	3	0	13	15	0	2	0	0	0	2	6	0	0	0	1	0	0	2	0	0	0	0	0	0	0	47	5.2
3-Sep	9.00	0	3	0	0	17	6	0	1	0	0	0	0	2	0	0	0	0	0	0	2	1	0	2	0	0	0	1	35	3.9
4-Sep	9.25	0	1	1	0	27	11	0	1	0	0	0	0	8	0	0	0	3	1	0	8	0	0	0	0	0	0	0	61	6.6
5-Sep	8.75	2	1	2	0	11	6	0	2	0	0	0	0	7	0	0	1	0	0	0	0	0	0	0	0	0	1	1	34	3.9
6-Sep	9.00	1	0	0	0	16	9	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	1	0	0	0	1	31	3.4
7-Sep	9.00	0	0	1	0	7	1	1	0	0	0	0	0	3	0	0	0	1	1	0	0	0	0	0	0	0	0	0	15	1.7
8-Sep	9.00	2	1	1	0	8	8	0	1	0	0	0	0	3	0	0	1	2	0	0	1	0	0	0	0	0	0	1	29	3.2
9-Sep	9.00	1	0	1	0	24	12	2	3	0	1	0	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	1	50	5.6
10-Sep	9.00	1	1	4	0	21	20	1	1	0	0	0	0	9	0	0	0	0	1	0	4	0	0	0	0	0	0	0	63	7.0
11-Sep	9.00	2	4	4	0	47	17	0	1	0	0	1	0	18	0	0	0	2	1	0	3	0	0	0	0	0	0	1	101	11.2
12-Sep	9.00	3	0	6	0	21	13	1	3	0	0	0	1	10	0	0	3	1	0	0	1	2	0	1	0	0	0	0	66	7.3
13-Sep	9.00	1	0	4	0	16	10	1	3	0	0	0	0	5	0	0	0	2	0	0	0	1	0	0	0	0	0	1	44	4.9
14-Sep	9.00	1	2	5	0	13	11	2	0	0	0	1	0	4	0	0	0	0	0	0	2	0	0	0	0	0	0	0	41	4.6
15-Sep	9.00	0	2	0	0	36	13	0	1	0	1	0	0	8	0	0	0	1	0	0	3	2	0	1	0	0	0	0	68	7.6
16-Sep	9.00	0	1	0	0	21	12	0	0	0	0	0	0	2	0	0	0	0	0	0	2	1	0	0	0	0	0	0	39	4.3
17-Sep	9.00	0	0	0	0	15	9	1	1	0	0	0	0	3	0	0	0	0	0	0	0	1	0	0	0	0	0	0	30	3.3
18-Sep	9.00	1	1	1	0	12	5	0	0	0	0	0	0	5	0	0	0	2	0	0	0	2	1	0	0	0	0	0	30	3.3
19-Sep	9.00	0	0	0	0	4	9	0	0	0	1	0	0	9	0	0	2	2	0	0	0	2	0	0	0	0	0	3	32	3.6
20-Sep	9.00	1	1	1	0	15	10	1	0	0	0	0	0	6	0	0	0	0	1	0	0	0	0	0	0	0	0	0	36	4.0
21-Sep	8.50	8	2	2	0	8	5	1	0	0	0	0	0	6	0	0	0	0	0	0	0	1	1	0	0	0	0	0	34	4.0
22-Sep	9.00	0	0	2	0	30	12	1	4	0	0	0	0	11	0	0	0	2	0	0	0	0	0	1	0	0	0	4	67	7.4
23-Sep	9.00	0	0	0	0	18	5	1	0	0	0	0	0	6	0	0	0	2	0	0	0	3	0	0	0	0	0	0	35	3.9
24-Sep	9.00	0	1	1	0	31	16	2	0	0	0	0	0	9	0	0	1	2	0	0	0	1	0	0	0	0	0	0	64	7.1
25-Sep	8.50	0	0	2	0	35	9	0	0	0	0	0	0	7	0	0	0	1	0	0	1	1	0	0	0	0	0	0	56	6.6
26-Sep	9.00	3	3	3	0	31	13	0	2	0	0	0	0	8	0	0	1	2	0	0	0	0	0	1	0	0	0	2	69	7.7
27-Sep	9.00	0	0	0	0	11	3	0	0	0	0	0	0	1	0	0	0	2	0	0	0	1	0	0	0	0	0	0	18	2.0

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	9.00	0	0	1	0	25	11	0	0	0	0	0	0	5	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	45	5.0
29-Sep	9.00	0	0	1	0	22	6	0	0	0	0	0	0	3	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	35	3.9
30-Sep	0.00																														
1-Oct	9.00	0	0	0	0	12	6	0	1	1	0	0	0	2	0	0	0	5	0	0	0	0	0	0	0	0	0	0	1	28	3.1
2-Oct	1.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
3-Oct	9.00	0	0	0	0	10	4	0	0	0	0	0	0	1	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	18	2.0
4-Oct	7.00	0	1	0	0	6	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	11	1.6
5-Oct	9.00	0	0	1	0	18	2	0	0	1	1	0	0	22	0	2	2	1	0	0	0	0	0	1	0	0	0	3	54	6.0	
6-Oct	9.00	0	1	0	0	9	4	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	1.9
7-Oct	9.00	0	0	2	0	16	1	1	0	0	0	0	0	6	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	28	3.1
8-Oct	9.00	0	1	0	0	10	6	0	0	0	0	0	0	19	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	37	4.1
9-Oct	9.00	0	0	3	0	20	7	3	0	0	0	0	0	12	0	1	0	6	0	0	0	1	1	0	0	0	0	0	54	6.0	
10-Oct	8.00	0	0	1	0	14	3	0	1	0	0	0	0	1	0	0	1	2	0	0	0	0	0	0	0	0	0	0	1	24	3.0
11-Oct	9.00	0	0	1	0	29	12	4	0	0	0	0	0	15	0	1	0	4	0	0	0	1	0	3	0	0	0	0	70	7.8	
12-Oct	0.00																														
13-Oct	9.00	0	0	1	0	18	2	4	1	0	1	0	0	25	0	4	4	8	0	0	0	0	0	0	0	0	0	0	3	71	7.9
14-Oct	9.00	0	1	3	0	41	14	7	0	0	0	0	0	20	0	1	0	3	0	0	1	2	1	0	0	0	0	0	94	10.4	
15-Oct	8.75	0	0	0	0	8	1	4	0	0	0	0	0	9	0	2	0	0	1	0	0	1	0	0	0	0	0	0	26	3.0	
16-Oct	7.50	0	0	0	0	9	0	3	0	0	0	0	0	9	0	1	0	1	0	0	0	0	1	0	0	0	0	0	24	3.2	
17-Oct	9.00	0	0	0	0	11	2	3	0	0	0	0	0	3	0	1	0	2	1	0	0	1	0	1	0	0	0	0	25	2.8	
18-Oct	0.00																														
19-Oct	0.00																														
20-Oct	3.50	0	0	0	0	2	0	0	0	0	0	0	0	7	0	0	1	0	0	0	0	1	0	0	0	0	0	0	11	3.1	
21-Oct	5.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
22-Oct	5.50	0	0	0	0	2	0	2	0	0	0	0	0	5	0	1	0	0	0	0	0	0	0	0	0	0	0	0	10	1.8	
23-Oct	6.00	0	0	1	0	8	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	3	0	0	0	0	0	0	15	2.5	
24-Oct	7.25	0	0	0	0	5	1	0	0	0	0	0	0	5	0	0	0	2	1	0	0	1	0	0	0	0	0	0	15	2.1	
25-Oct	7.50	0	0	0	0	2	0	0	1	0	1	0	0	7	0	6	3	0	1	0	0	0	0	0	0	0	0	0	21	2.8	
26-Oct	8.00	0	0	0	0	1	0	1	0	0	0	0	0	8	0	1	1	4	1	0	0	0	0	0	0	0	0	0	17	2.1	
27-Oct	6.92	0	0	0	0	2	0	0	0	0	0	0	0	2	0	0	0	4	0	0	0	0	0	0	0	0	0	0	8	1.2	
Total	507.67	42	31	60	0	880	363	49	45	3	8	2	4	378	0	22	29	82	10	0	47	40	6	16	0	1	1	30	2,149	4.2	

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: 1997–2007.

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	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
End Date	11-Oct	21-Oct	27-Oct	5-Nov	22-Oct	25-Oct	26-Oct	23-Oct	25-Oct	26-Oct	27-Oct	25-Oct
Observation days	29	53	61	67	55	62	59	59	62	64	62	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	487.45
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	448.4
SPECIES	RAPTOR COUNTS											
Turkey Vulture	4	29	21	26	14	46	30	25	58	50	42	34
Osprey	41	24	47	71	48	57	31	34	25	50	31	42
Northern Harrier	115	152	167	104	91	148	66	59	113	127	60	109
White-tailed Kite	0	0	0	0	0	0	1	0	0	0	0	0
Sharp-shinned Hawk	311	949	932	1,050	878	937	421	468	730	854	880	810
Cooper's Hawk	150	247	232	198	198	234	136	220	228	270	363	233
Northern Goshawk	38	32	50	35	16	22	17	41	13	31	49	31
Unknown small accipiter ¹	–	–	–	–	98	85	40	1	48	97	45	45
Unknown large accipiter ¹	–	–	–	–	0	10	17	6	6	11	3	8
Unknown accipiter	182	221	248	98	0	49	36	10	9	12	8	79
TOTAL ACCIPITERS	681	1,449	1,462	1,381	1,190	1,337	667	746	1,034	1,275	1,348	1,189
Broad-winged Hawk	2	7	5	5	6	9	3	2	6	4	2	5
Swainson's Hawk	0	8	17	2	0	7	15	5	2	2	4	6
Red-tailed Hawk	145	182	450	364	263	386	263	277	233	441	378	324
Ferruginous Hawk	0	0	0	1	0	0	0	0	0	0	0	0
Rough-legged Hawk	1	13	44	53	13	45	14	20	22	28	22	27
Unidentified buteo	75	58	148	97	83	82	39	15	29	57	29	64
TOTAL BUTEOS	223	268	664	522	365	529	334	319	292	532	435	426
Golden Eagle	105	55	141	174	105	135	142	130	130	157	82	125
Bald Eagle	2	2	7	15	2	8	1	2	4	8	10	6
Unidentified eagle	7	0	7	5	1	0	12	0	2	0	0	3
TOTAL EAGLES	114	57	155	194	108	143	155	132	136	165	92	134
American Kestrel	24	107	89	40	84	68	33	48	55	29	47	60
Merlin	17	55	36	26	36	38	21	39	53	34	40	38
Prairie Falcon	2	10	7	5	5	6	19	5	4	9	6	8
Peregrine Falcon	5	2	9	1	3	9	14	7	4	20	16	9
Unknown small falcon ¹	–	–	–	–	6	4	6	5	1	3	0	3
Unknown large falcon ¹	–	–	–	–	1	2	2	2	3	3	1	2
Unknown falcon	10	6	6	2	2	0	0	4	0	0	1	2
TOTAL FALCONS	58	180	147	74	137	127	95	110	120	98	111	120
Unidentified Raptor	178	216	218	62	112	178	134	27	48	52	30	108
GRAND TOTAL	1,414	2,375	2,881	2,434	2,065	2,565	1,513	1,452	1,826	2,349	2,149	2,161

¹ Designations used for the first time in 2001.

Appendix F. Daily capture totals of migrating raptors at Chelan Ridge, WA: 2007.

DATE	STN.	SPECIES ¹											CAPTURES	
	HOURS	NH	SS	CH	NG	RT	RL	GE	AK	ML	PR	PG	TOTAL	/ STN HR
25-Aug	8.50	0	0	0	0	0	0	0	0	0	0	0	0	0.0
26-Aug	0.00													
27-Aug	7.25	0	2	1	0	0	0	0	1	1	0	0	5	0.7
28-Aug	8.25	0	0	3	0	1	0	0	0	0	0	0	4	0.5
29-Aug	8.50	0	6	2	0	1	0	0	0	0	0	0	9	1.1
30-Aug	8.83	0	6	3	0	2	0	0	0	0	0	0	11	1.2
31-Aug	13.58	0	7	0	0	0	0	0	0	0	0	0	7	0.5
1-Sep	17.16	0	12	6	1	0	0	0	1	0	0	0	20	1.2
2-Sep	17.50	1	9	10	0	2	0	0	0	0	0	0	22	1.3
3-Sep	17.25	0	10	2	0	2	0	0	0	0	0	0	14	0.8
4-Sep	8.50	0	9	9	0	0	0	0	0	0	0	0	18	2.1
5-Sep	16.50	0	2	5	0	1	0	0	0	0	0	1	9	0.5
6-Sep	9.00	0	5	3	0	0	0	0	0	0	0	0	8	0.9
7-Sep	17.50	0	4	6	1	1	0	0	0	0	0	0	12	0.7
8-Sep	17.50	0	9	6	0	0	0	0	0	0	0	0	15	0.9
9-Sep	17.50	0	9	6	0	0	0	0	0	1	0	0	16	0.9
10-Sep	9.25	1	13	7	0	0	0	0	0	0	0	0	21	2.3
11-Sep	17.25	0	21	11	0	2	0	0	0	0	0	0	34	2.0
12-Sep	17.33	0	10	9	0	1	0	0	0	1	0	0	21	1.2
13-Sep	8.58	2	13	3	0	2	0	0	0	0	1	0	21	2.4
14-Sep	17.25	0	12	0	0	1	0	0	0	1	0	0	14	0.8
15-Sep	18.00	0	29	10	0	0	0	0	0	0	0	0	39	2.2
16-Sep	17.75	1	12	5	1	0	0	0	0	0	0	0	19	1.1
17-Sep	8.83	0	11	2	0	2	0	0	0	1	0	0	16	1.8
18-Sep	17.41	1	7	7	0	1	0	0	0	0	0	0	16	0.9
19-Sep	17.50	0	13	0	0	0	0	0	0	0	0	0	13	0.7
20-Sep	8.41	0	8	0	0	0	0	0	0	0	0	0	8	1.0
21-Sep	15.08	0	8	1	1	1	0	0	0	1	1	0	13	0.9
22-Sep	14.58	0	10	4	0	0	0	0	0	1	0	0	15	1.0
23-Sep	17.70	0	11	1	0	0	0	0	0	0	0	0	12	0.7
24-Sep	13.00	0	16	1	0	1	0	1	1	0	0	0	20	1.5
25-Sep	8.50	0	18	2	1	1	0	0	0	1	0	0	23	2.7
26-Sep	17.67	0	16	2	0	0	0	0	0	0	0	0	18	1.0
27-Sep	17.50	0	15	1	0	1	0	0	0	2	0	0	19	1.1

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	15.83	2	15	1	0	0	0	0	0	1	0	0	19	1.2
29-Sep	17.30	0	15	1	0	0	0	0	0	0	0	0	16	0.9
30-Sep	0.00													
1-Oct	8.65	0	2	1	0	0	0	0	0	1	0	0	4	0.5
2-Oct	4.21	0	2	1	0	1	0	0	0	0	0	0	4	1.0
3-Oct	15.50	0	3	0	0	2	0	0	0	0	0	0	5	0.3
4-Oct	14.59	0	6	0	0	0	0	0	0	1	0	0	7	0.5
5-Oct	16.91	2	3	0	0	0	0	0	0	0	0	0	5	0.3
6-Oct	16.50	0	4	0	0	0	0	0	0	0	0	0	4	0.2
7-Oct	16.50	0	2	1	0	3	0	0	0	0	0	0	6	0.4
8-Oct	16.58	0	6	0	1	0	0	0	0	0	0	0	7	0.4
9-Oct	16.75	0	5	1	0	1	0	0	0	1	1	0	9	0.5
10-Oct	14.62	0	10	0	0	0	0	0	0	0	0	0	10	0.7
11-Oct	16.50	0	8	2	0	1	1	0	0	1	0	0	13	0.8
12-Oct	9.17	0	5	0	0	0	0	0	0	0	0	0	5	0.5
13-Oct	16.55	0	6	2	2	1	0	1	0	0	0	0	12	0.7
14-Oct	16.80	2	16	0	6	0	0	0	0	0	0	0	24	1.4
15-Oct	16.42	0	4	0	0	1	0	0	0	0	0	0	5	0.3
16-Oct	11.83	0	5	0	2	0	0	0	0	0	1	0	8	0.7
Total	716.12	12	450	138	16	33	1	2	3	15	4	1	675	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: 1999–2007.

	1999 ¹	2000 ¹	2001	2002	2003	2004	2005	2006	2007	MEAN	TOTAL
First trapping day	28-Aug	2-Sep	30-Aug	27-Aug	23-Aug	25-Aug	25-Aug	25-Aug	25-Aug		
Last trapping day	16-Oct	14-Oct	17-Oct	19-Oct	25-Oct	18-Oct	22-Oct	22-Oct	16-Oct		
Number of stations	2	2	2	2	2	2	2	2	2	2	
Trapping days	47	42	44	54	56	53	56	56	51	51	
Station hours	388	?	612.8	837.3	803.3	699.6	828.2	797.3	716.1	710.3	
Captures / stn. hour	5.7	?	8.6	8.1	7.3	5.0	7.5	10.2	9.4	7.7	
SPECIES	RAPTOR CAPTURES										
Northern Harrier	4	3	10	13	11	6	12	28	12	11.0	99
Sharp-shinned Hawk	139	125	341	459	394	237	389	556	450	344	3,096
Cooper's Hawk	42	46	107	127	100	58	137	100	138	95	855
Northern Goshawk	14	10	12	13	9	16	11	24	16	14	125
Red-tailed Hawk	11	8	22	29	20	16	11	50	33	22	200
Rough-legged Hawk	0	1	1	2	1	0	5	6	1	1.9	17
Golden Eagle	0	1	2	0	4	2	2	6	2	2	19
American Kestrel	3	0	8	10	17	5	6	8	3	7	60
Merlin	6	4	17	21	25	10	49	31	15	20	178
Prairie Falcon	1	1	3	4	4	1	0	3	4	2	21
Peregrine Falcon	0	0	2	0	4	1	1	2	1	1	11
All species	220	199	525	678	589	352	623	814	675	520	4,681
Recaptures ²	0	0	0	0	0	0	0	0	1	0	1
Foreign Recaptures ³	0	0	0	1	0	0	0	2	2	0.7	6
Foreign Encounters ⁴	0	1	5	2	1	1	4	11	9	3.8	34

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.