

**FALL 2008 RAPTOR MIGRATION STUDIES AT
COMMISSARY RIDGE IN SOUTHWESTERN WYOMING**



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



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INTRODUCTION

The Commissary Ridge Raptor Migration Project in southwest Wyoming is an ongoing effort to monitor long-term trends in populations of raptors using the central Rocky Mountain migratory flyway. The Commissary Ridge 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 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 et al. 2002, Hoffman and Smith 2003, Smith et al. 2008a, 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, Bildstein et al. 2008).

To be effective for regional monitoring of broadly distributed species, migration monitoring must involve a network of well-distributed, standardized counts that effectively sample all major flyways and known subpopulations (Smith and Hoffman 2000). Before 2002, no long-term raptor migration surveys were being conducted in the state of Wyoming, and coverage of the central Rocky Mountains between Montana and New Mexico was generally sparse. Following two years of exploratory surveys throughout Wyoming, in 2002 HWI initiated the first full-season, fall-migration count at Commissary Ridge in southwestern Wyoming, with annual counts continuing each year since. During fall 2004, HWI also initiated for the first time at the site an exploratory trapping and banding program, which also has continued each year since. This report summarizes the results of the fall 2008 count and banding efforts.

STUDY SITE

The study site is located atop the southern end of Commissary Ridge on the southwestern tip of South Fork Mountain, about 37 km north of Kemmerer, Wyoming, on land managed by the Bureau of Land Management, Kemmerer Field Office (Figures 1 and 2). The site is accessed from Hwy 233 just northeast of Lake Viva Naughton, and is located on the western edge of a broad ridge top overlooking the Ham's Fork River Valley and Lake Viva Naughton to the west (42°01'29"N 110°35'22"W; T24 R116 S28 SESW; elevation ~2,700 m). The location provides an unobstructed 360° view of the surrounding landscape. The ridge top features primarily rocky substrates and low growing, desert shrubs and grasses, with scattered stands of mixed-conifer and aspen in sheltered pockets and ravines.

In 2008, we continued the use of two trapping sites (Figure 2). **Ganth's Tooth** station was located ~3.7 km north of the count site at ~2,745 m elevation on a sheltered knoll along the western margin of the ridge top. **South Bowl** station was located ~2.4 km south of the observation point at ~2,600 m elevation within a sheltered "bowl" along the western margin of the ridge top. Both of these trapping stations were first used in 2006, but this was the first season that a full-scale blind and trap array were deployed at the South Bowl station. The two trapping arenas generally were used alternately throughout the season, except when the presence of HWI science staff enabled simultaneous operation of both blinds.

METHODS

STANDARDIZED COUNT

Weather permitting, trained observers conducted daily counts from a single, traditional observation post from 27 August through 5 November. This was the fourth season of migration counting experience for official Lead Observer Sue Bruner, who also attended pre-season review training in Salt Lake City. Sedona Maniak was a late hire with no previous migration counting experience, but she received extensive on-site field and protocol training from Site Coordinator, William Blake, Sue Bruner, and HWI Conservation Science Director, Jeff Smith (see Appendix A for a complete history of observer participation). Other crewmembers, especially Chase Cammarota, also regularly assisted with the counts, especially during the peak of migration activity. Count efforts did not occur when heavy fog or other

severe weather precluded effective counting or safety issues precluded access to the site. Otherwise, counts occurred daily and usually from 0900–1700 H Mountain Standard Time (MST). 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 MST.
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 (high, moderate, low, none) for each hour, recorded on the hour.
7. Daily start and end times for each official observer.

The seasonal and daily duration of observation effort can greatly affect count statistics (Hussell 1985, Bednarz and Kerlinger 1989, Bednarz et al. 1990). To generally adjust for variation in sampling effort due to inclement weather and other unforeseeable events, and therefore render data from different years and sites comparable, common practice calls for converting counts to annual passage rates: total number of migrants counted / total hours of observation * 100 = birds / 100 hrs (also see Hoffman and Smith 2003). In comparing 2008 annual statistics against means and 95% confidence intervals for previous seasons, we equate significance with a 2008 value falling outside the bounds of the confidence interval for the associated mean.

TRAPPING AND BANDING

Weather permitting, 2–4 trappers, periodically assisted by HWI staff and other crewmembers, typically operated a single trapping station each day between 0900 and 1700 H MST. Capture devices included mist nets, dho-gaza nets, and remotely triggered bow nets. Trappers lured migrating raptors into the capture stations from a camouflaged blind using live, non-native avian lures attached to lines manipulated from the blind. 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 of capture, usually much quicker, unless outfitted with a satellite transmitter, which takes longer.

RESULTS AND DISCUSSION

WEATHER

Inclement weather fully precluded five days of potential observations in 2008 and reduced observation time to ≤ 4 hours on six other days (see Appendix D for daily weather records). The number of fully precluded days closely matched the 2002–2007 average of 5.3 days, whereas the number of partially precluded days was moderately above the average of 4.7 days. Unlike last year, late-season snow and fog

made camp break-down and conducting the count through 5 November more of a challenge in 2008. Forty-five percent of the active observation days featured predominantly fair skies, 30% transitional skies (i.e., shifted from fair skies to mostly cloudy or overcast skies during the day, or vice versa), and 26% mostly cloudy to overcast/stormy skies. The 2002–2007 averages for the site are 49% fair, 30% transitional, and 24% mostly cloudy to overcast skies, indicating that the 2008 season featured average sky conditions. Seventeen percent of the active observation days included some rain or snow showers, matching the 2002–2007 average of 17%. In contrast, a substantial 52% of the active days included appreciable, visibility reducing fog and especially haze, which is three times the average for the previous six seasons (17%). That said, even a high prevalence of foggy conditions combined with an average proportion of hazy days did not substantially reduce estimates of overall visibility: 78 km to the east and a record-high 87 km to the west in 2008, compared to averages of 70 and 74 km, respectively. This may speak more to the subjective nature of these ratings, than actual conditions on the ground.

In 2008, temperatures during active observation periods averaged 13.8°C (average of daily values, which were in turn averages of hourly readings), ranging from -5.3–27.2°C. The average was only slightly higher than the previous six-year mean of 13.1°C; however, the range of values was the widest yet recorded, with the low reading a record low and the high reading a record high. Barometric pressure readings during active observation periods averaged 30.22 in Hg (average of daily values, which were in turn averages of hourly readings), ranging from 29.66–30.55 in Hg, with all values falling within previous ranges.

In 2008, light winds (<12 kph) predominated on 11% of the active observation days, moderate winds (12–28 kph) on 55%, and strong winds (>28 kph) on 35%. These values all closely matched the relevant averages for the previous six seasons (11% light, 54% moderate, and 35% strong). As usual, W–NW winds were the most common pattern, prevailing on 64% of the active days and matching the average for the site. Similarly, the third most common pattern, NE–SE winds, prevailed on a near-average 6% of the active days (average 5%). In contrast, SW–W winds prevailed on an above-average 20% of the active days (average 13%), whereas days featuring a mix of SW–NW and NE–SE winds—on average the third most common pattern—were less common than usual (3% vs. average of 7%).

Good to excellent thermal-lift conditions, as assessed by the observers, predominated on an above-average 38% of the active days (average 30%).

In summary, inclement weather took a near average toll on the observation effort in 2008, with sky conditions and precipitation during active observation periods nearly matching averages. Hazy and especially foggy conditions were much more common than usual, however, but did not contribute to any noticeable reductions in average visibility. The temperature regime averaged slightly warmer but overall more variable than usual. The wind speeds and directions were near average except that relatively steady SW–W winds were slightly more common than usual while days of mixed SW–NW and NE–SE winds were less common than usual.

OBSERVATION EFFORT

Counts occurred on 66 of 71 possible days between 27 August and 5 November 2008, averaging 7.5 hours per active day and encompassing 493.33 total hours of observation (see Appendix D for annual data). The numbers of observation days and hours were both the second highest recorded to date (10–11% above average), with 2008 the third season that the count has continued through the first few days of November. The number of observers averaged 2.0 per hour in 2008, which matches the 2002–2007 average for the site of $2.0 \pm 95\%$ CI of 0.10 observers per hour.

FLIGHT SUMMARY

Flight Volume and Composition

The observers tallied 4,492 migrants of 17 species during the 2008 season, which is a non significant 11% higher than the 2002–2007 average (Table 1) but the second highest total recorded to date (see Appendix D for 2008 daily count records and Appendix E for annual count summaries). The flight was composed of 38% buteos, 36% accipiters, 12% eagles, 10% falcons, 3% vultures, and <1% each of Ospreys, harriers, and unidentified raptors (Figure 3). The proportion of buteos was significantly above average, primarily due to a record-high count of Swainson’s Hawks, and the proportions of falcons and unidentified raptors were significantly below average compared to the previous six seasons. The most abundant species were the Red-tailed Hawk (26% of the total count), Sharp-shinned Hawk (25%), Cooper’s Hawk (9%), Swainson’s Hawk (8%), Golden Eagle (8%), Bald Eagle (6%), American Kestrel (5%), Turkey Vulture (3%), and Northern Goshawk (1%). All other species each comprised $\leq 1\%$ of the total.

The 2008 counts and passage rates both were significantly above average for Swainson’s Hawks, Rough-legged Hawks, Merlins, and Peregrine Falcons (Table 1). The counts of Golden and Bald Eagles also were significantly above average, but passage rates of these species were only non-significantly above average. The counts were not significantly below average for any species; however, the passage rates of American Kestrels and Prairie Falcons were significantly below average. The counts of Swainson’s Hawks and Rough-legged Hawks rose to new record highs, but no record low counts occurred in 2008 (Appendix E). Curiously, Swainson’s Hawk counts were significantly above average at all of HWI’s Rocky Mountain migration count sites in 2008, especially in New Mexico where the count reached into the thousands for only the third time in 25 years (Smith and Neal 2009a, b, c).

Seven years is too short a period to support robust analyses of population trends (e.g., see Smith et al. 2008a), with 10–15 years typically considered the minimum time frame for conducting analyses of trends in raptor migration counts (e.g., see Farmer and Hussell 2008). Therefore, we do yet present herein such analyses. Moreover, casual examination of variation in the annual species-specific counts (Appendix E) and associated passage rates recorded to date reveals few definitive patterns; however, three exceptions warrant mention here: 1) an increasing trend for Northern Goshawks; 2) a declining trend for American Kestrels; and 3) a strong increasing trend for Peregrine Falcons. The counts of Northern Goshawks at this site are among the highest across HWI’s monitoring network, and most of our other sites currently are showing stable to declining long-term trends for this species. That said, some other sites have shown recent rebounds in the past five years, likely related to the lessening influence of widespread drought in many areas of the interior West. The apparent decline in kestrel numbers is particularly noteworthy, because this species currently is showing declines across the continent (Farmer et al. 2008, Farmer and Smith in review). Conversely, the increasing trend for Peregrine Falcons matches similar trends across the continent (Farmer et al. 2008).

Age Ratios

Among 10 species for which suitable age-specific data were collected, two species showed immature : adult count ratios that were significantly above average in 2008 and seven species showed significantly below average age ratios (Table 2). Among the three species with above-average age ratios, the overall counts of aged Broad-winged and Ferruginous Hawks were too small to warrant much attention. For Bald Eagles, the counts of identified adults and non-adults both were well above average, but the count of non-adults was proportionately higher (Table 2), suggesting that both productivity and adult survivorship may have been high for this species in the northern Rocky Mountains in 2008. Among the seven species with significantly low age ratios in 2008 (Northern Harrier, Sharp-shinned Hawk, Cooper’s Hawk, Northern Goshawk, Red-tailed Hawk, Golden Eagle, and Peregrine Falcon), all except the Golden Eagle showed reduced counts of immature birds, suggesting that low productivity in 2008 may have been a factor for these species. It is important to note, however, that atypically high proportions of unaged birds

may confound the comparisons for Northern Harriers, Northern Goshawks, and Peregrine Falcons. Moreover, at least for the latter two species, high overall counts (Table 1) appear to argue against low productivity being a problem. For Sharp-shinned Hawks, one of the species for which the proportion of unaged birds was not significantly different from average, the count of identified immatures was only moderately below average, but the count of adults was way above average (hence the low age ratio). This suggests that overwinter survival of the previous year's fledglings and/or general adult survival were strong for this species in 2008.

Daily and Seasonal Migration Patterns

The diel rhythm of migration at Commissary Ridge in 2008 followed a slightly bi-modal distribution, with a steep rise in activity between 0900 and 1200 H, followed by a slight "noon lull," then a modest secondary peak during the 1400 H, and finally a gradual tapering off of activity through the 1700 H (Figure 4). This pattern is similar to the average pattern for the site.

The overall, combined-species seasonal activity pattern for 2008 differed from the average pattern in showing unusually low activity during the first month of the season, but then atypically high activity spikes in late-September, mid-October, and late October (Figure 5). The slow start corresponded to unusually mild early-season weather, especially atypically light and variable winds. The high late-September spike did not appear linked with any regional or northerly weather patterns, but may be attributed to a "catching up" effect given the lag in activity prior to this period. The above-average activity level during mid-October occurred between three snow events, which collectively resulted in two missed days and two other days of substantially reduced observation time (Appendix C). The final activity spike involved several species, most notably unusually high late-season activity for Northern Harriers and strong showings for Northern Goshawks, Rough-legged Hawks, and Golden and Bald Eagles.

The overall combined-species median passage date of 29 September was a non-significant 2 days later than average (Table 3). At the species level, only the Ferruginous Hawk showed an earlier than average median passage; however, only seven species (Osprey, Red-tailed Hawk, and all four falcon species) showed significantly late overall timing (Table 3). Age and sex-specific data also revealed primarily late timing, except that while immature Northern Goshawks were significantly late, adults were non-significantly early (Table 4).

TRAPPING AND BANDING SUMMARY

Trapping occurred on 55 of 64 possible days between 28 August and 30 October 2008, with effort totaling a record high 436.41 station hours (see Appendix F for daily trapping records and Appendix G for annual trapping summaries). The number of trapping days matched the previous high, whereas the number of station hours was 20% above average. Trapping occurred at the Ganth's Tooth (GT) station on 46 days (327.66 hrs) and at the South Bowl (SB) station on 16 days (108.75 hrs).

The crew captured and banded 187 raptors of 10 species in 2008 (Table 5). The most commonly captured species were the Sharp-shinned Hawk (50% of all captures), Cooper's Hawk (24%), Red-tailed Hawk (10%), Northern Goshawk (8%), Merlin (3%), American Kestrel (2%), and Peregrine Falcon (2%). All other species each comprised $\leq 1\%$ of the total. The capture of 5 Merlins and 3 Peregrine Falcons both comprised new record highs for the site (Appendix G) and it was particularly auspicious that the first capture of the season was a healthy immature female peregrine! In addition, the non-targeted capture of a juvenile Bald Eagle represented only the fourth such capture in HWI's 29 year history of migration trapping, and the crew experienced several other near misses with young Bald Eagles through the remainder of the season!

Both trapping stations continued to serve well this season and resulted in solid trapping efficiency, despite the continual problem of high winds, with each offering unique characteristics, but similar successes.

Both blinds produced identical overall capture rates of 4.3 captures per 10 station hours; however, this is not entirely a fair comparison because the capture rate estimate for the SB station is somewhat inflated due to lower overall effort (i.e., the more hours put in at station, the lower the capture rate due to greater inclusion of more low productivity hours). One particularly noticeable difference between the two stations is that eagle captures generally occur only at the GT station.

Compared to the counts, banding data yield unique and useful sex-age specific data only for the three accipiters and American Kestrels (Table 6). The 2008 count- and capture-based age ratios for Sharp-shinned Hawks were 52% and 39% below average, respectively. The two 2008 ratios differed markedly in terms of magnitude (0.5 and 1.7, respectively), but this is typical at this site as well as most other HWI banding sites where immature birds tend to be more susceptible to capture than adults. In combination, these data suggest that immature Sharp-shinned Hawks were proportionately less abundant and slightly more susceptible to capture (hungrier) than usual compared to adults of the same species. For Cooper's Hawks, the count and capture age ratios were similarly below average (58% and 59%, respectively) and of the same magnitude (0.5). At this site, the count age ratio for Cooper's Hawks (1.1) averages slightly lower than the capture age ratio (1.3), again suggesting that immature birds generally are at least slightly more susceptible to capture than adults. Thus, in combination the 2008 statistics again suggest that immature Cooper's Hawks were less abundant than usual, but in this case were, if anything, a little less susceptible to capture compared to adults of the same species. For Northern Goshawks, the 2008 count and capture age ratios again were both substantially below average (82% and 61%, respectively), but similar to the case for Sharp-shinned Hawks, the difference in the magnitudes of the changes suggested that immature goshawks were both less abundant and more susceptible to capture than usual in 2008 compared to adults of the same species. However, here we must again caution that a much higher than average proportion of unaged goshawks recorded by the counters (Table 2; likely biased in favor of aging the much more distinct adults) may substantially confound the comparisons for this species

Unlike the counts, banding also yields useful data on accipiter sex ratios, or at least sex-related susceptibility to capture. In 2008, female Sharp-shinned Hawks were captured 1.5 times more often than males the same species, but this sex ratio was 16% below average (Table 6). Similarly, female Cooper's Hawks were captured 2.7 times more often than males of the species, but this sex ratio was 45% below average (Table 6). These statistics suggest that, as usual, females of both species were caught much more often than males of the same species, but to a lesser degree than usual. Unlike for the two smaller accipiters, at this site female Northern Goshawks generally are captured less often than males (average sex ratio of 0.62); however, this was not true in 2008 when the capture sex ratio was 3.7 or 489% above average! Whether this is an indication that females were particularly abundant or just very hungry is unknown.

Immature and adult American Kestrels were caught equally often in 2008 (two of each), which is atypical in that the average immature : adult capture ratio for the site is 3.6. In comparison to past seasons, immature males were particularly scarce in 2008 (Table 6); however, it is likely that preferential use of European Starlings as lures instead of House Sparrows contributed to this difference. The count-based female : male ratio for American Kestrels, which averages 1.0, was 46% below average in 2008 (Table 6), suggesting that females, not males, were substantially under-represented in this season's flight.

ENCOUNTERS WITH PREVIOUSLY BANDED BIRDS

In 2008, we received the first report from the National Bird Banding Lab of an encounter with one of the raptors we banded at Commissary Ridge. This female Cooper's Hawk was banded as a hatch-year bird on 12 September 2007 and found dead of unknown causes on 11 December 2008 in the Oro Valley of Arizona ~873 km southwest of the project site.

SATELLITE TRACKING

We outfitted one new immature male Golden Eagle with a satellite transmitter at the site in 2008. After capture on 24 October, this bird initially moved north about 100 km up along the Salt River Range in western Wyoming, but then returned to near the project area after about five weeks and remained just east of the site for the next three weeks. Then in early January he began moving slowly northwest and by mid-February had traveled up into southeastern Idaho to an area east of Pocatello, where he has remained since then. We await further data to determine whether he continues north or remains a wandering regional resident.

After having traveled across the Great Basin to her winter range in southern Baja California, the adult, female Red-tailed Hawk that we outfitted at the site during fall 2007 began her return spring migration around 24 March 2008 and retraced her previous fall route back to southwestern Wyoming. Along the way she stopped and spent two months from mid-April to mid-June in northern Baja California near an area where she stopped for a few days on the way south the previous fall (possible breeding attempt??). As a result, she did not return to Wyoming until late June/early July and then by late August, unfortunately sensor data indicated that she had died or was killed. We found her scattered remains in a forested area about 50 km east of the project site very near to what easily could have been a Red-tailed Hawk nest. The nest appeared in good shape but likely had not been used in 2008, and whether this might have been her former breeding area or just a coincidence of location is unknown.

Tracking summaries and maps for all of HWI's satellite-tracked raptors can be found at <http://www.hawkwatch.org>.

RESIDENT RAPTORS

Though not the focus of this study, carefully tracking the occurrence and movements of resident raptors around the site during the migration count both assists the counters in distinguishing resident from migrating birds and provides useful information over time concerning the status and productivity of the local raptor community.

Turkey Vulture activity was common through early September. Up to 6 vultures often were seen together, kettling on thermals near the quills (northeast of the count site) and around the observation point, or flying down to Viva Naughton Reservoir.

The crew observed only one sighting of a probable resident Osprey in the Ham's Fork Valley during migration observations. The closest known Osprey nest is ~13 km (8 mi) south of the count site along the Ham's Fork River, and another active nest site is located on the north side of Kemmerer ~35 km south of the count site.

At least one immature Northern Harrier was present on the ridge in 2008. In September, a local pair of adult harriers often was seen hunting on both sides of the ridge, most often between the western ridgeline and main road just north of the observation post. They were seen a few times a day at the beginning of the season, but less frequently as the season progressed. Their territory was thought to be located near the wetland complexes directly east or west of Commissary Ridge. An immature bird was last seen in mid-October.

One immature Sharp-shinned Hawk and one unknown-age Cooper's Hawk were recorded as resident birds during the season. Unlike in previous years, the presence of truly local goshawks (i.e., a local family) was not obvious in 2008, suggesting that they did not breed successfully in the immediate vicinity of the project area.

Red-tailed Hawks are the most abundant residents at Commissary Ridge. At least four adults and two juveniles frequented the project area in 2008. These included one dark-morph adult, which may have been a resident breeder since at least 2000. Three light-morph adults and two immatures (one light and one dark-morph) typically were seen along the north ridge where they often intercepted and escorted

migrants. Resident red-tails were active along the ridge until early October, but the adults from the north ridge were still present at season's end. Two Red-tailed Hawk nests are known in the area, one to the south of the observation post and one down in the valley to the west of the lookout, but there may well be others farther north. Commissary Ridge also appears to provide critical stopover habitat for red-tails, as birds often emerged from the surrounding forest to migrate in the morning. No resident Swainson's Hawk activity was observed in 2008, even though one known Swainson's Hawk nest is located near a rural RV park in the valley to the southwest of the ridge. Beginning in mid-to-late October, several Rough-legged Hawks (2 light-morph adult females, 2 light adult males, 1 light immature, and 1-2 light unknowns) routinely were seen hunting along the ridge and apparently commuting up from the Ham's Fork Valley to roost in the forested areas of the north ridge. This same behavior was noted in 2007.

At least one family group of Golden Eagles, including two adults and two immature birds, frequented the north ridge in 2008. These birds regularly were seen coursing low west of the ridge and atop the ridge a few kilometers north of the project area, as well as commuting to and from the Ham's Fork Valley to the west and often escorting migrants through the area. Apparently resident Golden Eagles also were often observed coursing along the east slope of South Fork Mountain, but whether these birds comprised members of another family is unknown. Suitable nesting areas are found on both sides of the ridge.

Beginning in early October, at least 2–3 adult, 1–2 juvenile, and 1–2 subadult Bald Eagles frequented the north ridge area, likely foraging in the Ham's Fork Valley to the west and roosting in forested areas on the ridgetop. According to the BLM, there is one known Bald Eagle nest on Lake Viva Naughton west of the project site.

At least one pair of American Kestrels resided on the ridge this season. They were seen only early in the season hunting the center ridge and western ridgelines or buzzing our decoy owl.

This is a fairly typical assemblage of resident species for the project area; however, the numbers of juvenile birds seemed relatively scarce overall. Moreover, a complete lack of sightings of resident Prairie and Peregrine Falcons is conspicuous.

SITE VISITATION AND PUBLIC OUTREACH

Public awareness of HWI's newest migration-monitoring project is still developing. Public visitation was similar to last year, with eight visitors recorded on our visitor log. These folks originated in Utah, Wyoming, and California, and all came specifically to visit the project.

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LITERATURE CITED

- Bednarz, J. C., D. Klem, Jr., L. J. Goodrich, and S. E. Senner. 1990. Migration counts of raptors at Hawk Mountain, Pennsylvania, as indicators of population trends, 1934–1986. *Auk* 107:96–109.
- Bednarz, J. C., and P. Kerlinger. 1989. Monitoring hawk populations by counting migrants. Pages 328–342 *in* B. Pendleton (Editor), *Proceedings of the Northeast Raptor Management Symposium and Workshop*. National Wildlife Federation, Washington, D.C., U.S.A.

- Bildstein, K. L. 2001. Why migratory birds of prey make great biological indicators. Pages 169–179 in K. L. Bildstein and D. Klem, Jr. (Editors), *Hawkwatching in the Americas*. Hawk Migration Association of North America, North Wales, Pennsylvania, U.S.A.
- Bildstein, K. L., J. P. Smith, E. Ruelas Inzunza, and R. R. Veit (Editors). 2008. *State of North America's birds of prey*. Series in Ornithology No. 3. Nuttall Ornithological Club, Cambridge, Massachusetts, and American Ornithologists' Union, Washington, DC U.S.A.
- Farmer, C. J., and D. J. T. Hussell. 2008. The raptor population index in practice. Pages 165–178 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 U.S.A.
- Farmer, C. J., L. J. Goodrich, E. Ruelas Inzunza, and J. P. Smith. 2008. Conservation status of North America's birds of prey. Pages 303–420 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 U.S.A.
- 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.
- 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.
- Hussell, D. J. T. 1985. Analysis of hawk migration counts for monitoring population levels. Pages 243–254 in M. Harwood (Editor), *Proceedings of Hawk Migration Conference IV*. Hawk Migration Association of North America.
- 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 U.S.A.
- 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 U.S.A.
- Smith, J. P., and S. W. Hoffman. 2000. The value of extensive raptor migration monitoring in western North America. Pages 597–615 in R. D. Chancellor and B.-U. Meyburg (Editors), *Raptors at risk*. World Working Group on Birds of Prey and Owls, Berlin, Germany, and Hancock House Publishers, British Columbia, Canada and Washington, U.S.A.
- Smith, J. P., and M. C. Neal. 2009a. Fall 2008 raptor migration study in the Wellsville Mountains of northern Utah. HawkWatch International, Inc., Salt Lake City, Utah, U.S.A. 28pp.
- Smith, J. P., and M. C. Neal. 2000b. Fall 2008 raptor migration studies in the Manzano Mountains, New Mexico. HawkWatch International, Inc., Salt Lake City, Utah, U.S.A. 37 pp.
- Smith, J. P., and M. C. Neal. 2009c. Fall 2008 raptor migration study in the Bridger Mountains, Montana. HawkWatch International, Inc., Salt Lake City, Utah, U.S.A. 26 pp.
- 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, U.K., and Hawk Mountain Sanctuary Association, Kempton, Pennsylvania, U.S.A.

Table 1. Annual raptor migration counts and passage rates by species at Commissary Ridge, Wyoming: 2002–2007 versus 2008.

SPECIES	COUNTS			RAPTORS/100 HOURS		
	2002–2007 ¹	2008	% CHANGE	2002–2007 ¹	2008	% CHANGE
Turkey Vulture	110.8 ± 44.8	150	+35	25.0 ± 9.4	30.4	+21
Osprey	31.5 ± 14.8	27	-14	6.9 ± 3.0	5.5	-20
Northern Harrier	31.2 ± 4.2	32	+3	7.2 ± 1.4	6.5	-10
Sharp-shinned Hawk	904.5 ± 427.9	1,109	+23	201.9 ± 86.7	224.8	+11
Cooper's Hawk	439.7 ± 98.6	382	-13	100.2 ± 23.3	77.4	-23
Northern Goshawk	37.8 ± 23.0	52	+37	8.3 ± 4.5	10.5	+27
Unknown small accipiter	63.8 ± 12.2	25	-61	14.9 ± 4.3	5.1	-66
Unknown large accipiter	15.2 ± 8.6	8	-47	3.3 ± 1.8	1.6	-51
Unknown accipiter	41.5 ± 31.4	49	+18	9.0 ± 6.3	9.9	+10
TOTAL ACCIPITERS	1,502.5 ± 533.7	1,625	+8	337.7 ± 108.3	329.4	-2
Broad-winged Hawk	9.0 ± 5.4	13	+44	2.1 ± 1.2	2.6	+28
Swainson's Hawk	51.2 ± 15.4	352	+588	12.3 ± 5.6	71.4	+481
Red-tailed Hawk	1,027.8 ± 261.3	1,148	+12	230.7 ± 48.0	232.7	+1
Ferruginous Hawk	7.0 ± 3.5	7	0	1.6 ± 0.8	1.4	-12
Rough-legged Hawk	8.2 ± 3.1	34	+316	1.8 ± 0.6	6.9	+281
Unidentified buteo	51.2 ± 19.8	144	+181	11.2 ± 3.8	29.2	+162
TOTAL BUTEOS	1,154.3 ± 266.8	1,698	+47	259.6 ± 49.2	344.2	+33
Golden Eagle	264.7 ± 62.4	345	+30	61.8 ± 21.0	69.9	+13
Bald Eagle	152.8 ± 74.1	262	+71	35.9 ± 19.4	53.1	+48
Unidentified eagle	10.0 ± 6.3	34	+240	2.3 ± 1.3	6.9	+204
TOTAL EAGLES	427.5 ± 133.6	641	+50	100.0 ± 39.8	129.9	+30
American Kestrel	286.3 ± 71.9	219	-24	65.2 ± 16.5	44.4	-32
Merlin	14.3 ± 6.8	25	+74	3.2 ± 1.4	5.1	+58
Prairie Falcon	11.5 ± 5.5	6	-48	2.5 ± 1.1	1.2	-52
Peregrine Falcon	9.5 ± 4.7	15	+58	2.1 ± 0.9	3.0	+47
Unknown small falcon	3.2 ± 1.7	9	+184	0.7 ± 0.4	1.8	+166
Unknown large falcon	2.8 ± 2.1	5	+76	0.6 ± 0.4	1.0	+67
Unknown falcon	2.8 ± 2.6	1	-65	0.6 ± 0.6	0.2	-68
TOTAL FALCONS	330.5 ± 70.0	280	-15	75.0 ± 15.3	56.8	-24
Unidentified raptor	54.8 ± 27.8	39	-29	12.3 ± 5.8	7.9	-36
GRAND TOTAL	3,643.2 ± 930.6	4,492	+23	823.6 ± 192.5	910.5	+11

¹ Mean ± 95% confidence interval.

Table 2. Annual raptor migration counts by age classes and immature : adult ratios for selected species at Commissary Ridge, Wyoming: 2002–2007 versus 2008.

SPECIES	TOTAL AND AGE-CLASSIFIED COUNTS						IMMATURE : ADULT			
	2002–2007 AVERAGE			2008			% UNKNOWN AGE		RATIO	
	TOTAL	IMM.	ADULT	TOTAL	IMM.	ADULT	2002–2007 ¹	2008	2002–2007 ¹	2008
Northern Harrier	31	9	11	32	3	12	37 ± 7.0	53	0.9 ± 0.2	0.3
Sharp-shinned Hawk	905	254	268	1109	208	406	43 ± 3.2	45	1.1 ± 0.2	0.5
Cooper's Hawk	440	128	125	382	62	132	43 ± 6.1	49	1.1 ± 0.3	0.5
Northern Goshawk	38	13	8	52	5	14	28 ± 15.5	63	2.0 ± 1.0	0.4
Broad-winged Hawk	9	2	3	13	1	2	49 ± 14.9	77	0.5 ± 0.3	0.5
Red-tailed Hawk	1028	254	507	1148	151	681	25 ± 2.8	28	0.5 ± 0.1	0.2
Ferruginous Hawk	7	2	2	7	2	1	59 ± 16.4	57	1.1 ± 0.6	2.0
Golden Eagle	265	138	90	345	174	127	14 ± 3.6	13	1.6 ± 0.1	1.4
Bald Eagle	153	51	100	262	100	161	1 ± 0.5	0	0.5 ± 0.0	0.6
Peregrine Falcon	10	1	3	15	0	3	48 ± 14.9	80	0.6 ± 0.4	0.0

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 Commissary Ridge, Wyoming in 2008, with comparisons of 2008 and 2002–2007 average median passage dates.

SPECIES	2008				2002–2007
	FIRST OBSERVED	LAST OBSERVED	BULK PASSAGE DATES ¹	MEDIAN PASSAGE DATE ²	MEDIAN PASSAGE DATE ^{2,3}
Turkey Vulture	27-Aug	8-Oct	15-Sep – 30-Sep	23-Sep	22-Sep ± 2.0
Osprey	27-Aug	9-Oct	27-Aug – 6-Oct	23-Sep	16-Sep ± 2.3
Northern Harrier	13-Sep	31-Oct	19-Sep – 30-Oct	1-Oct	27-Sep ± 7.5
Sharp-shinned Hawk	28-Aug	1-Nov	21-Sep – 18-Oct	27-Sep	26-Sep ± 2.7
Cooper's Hawk	27-Aug	19-Oct	13-Sep – 1-Oct	25-Sep	22-Sep ± 2.9
Northern Goshawk	5-Sep	31-Oct	19-Sep – 28-Oct	7-Oct	07-Oct ± 6.0
Broad-winged Hawk	7-Sep	16-Oct	13-Sep – 9-Oct	24-Sep	24-Sep ± 3.4
Swainson's Hawk	27-Aug	16-Oct	22-Sep – 2-Oct	27-Sep	19-Sep ± 5.1
Red-tailed Hawk	27-Aug	5-Nov	13-Sep – 19-Oct	13-Oct	03-Oct ± 5.8
Ferruginous Hawk	8-Sep	28-Oct	8-Sep – 28-Oct	23-Sep	27-Sep ± 8.6
Rough-legged Hawk	7-Oct	5-Nov	14-Oct – 1-Nov	24-Oct	21-Oct ± 3.3
Golden Eagle	27-Aug	2-Nov	17-Sep – 31-Oct	17-Oct	12-Oct ± 5.1
Bald Eagle	6-Sep	5-Nov	14-Oct – 1-Nov	24-Oct	21-Oct ± 5.2
American Kestrel	28-Aug	25-Oct	14-Sep – 7-Oct	25-Sep	21-Sep ± 2.9
Merlin	5-Sep	5-Nov	10-Sep – 27-Oct	15-Oct	02-Oct ± 6.7
Prairie Falcon	13-Sep	21-Oct	13-Sep – 21-Oct	28-Sep	24-Sep ± 2.9
Peregrine Falcon	10-Sep	5-Nov	10-Sep – 20-Oct	27-Sep	25-Sep ± 1.0
Total	27-Aug	5-Nov	17-Sep – 23-Oct	29-Sep	27-Sep ± 2.1

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 ± 95% confidence interval in days; calculated using only data for years with counts ≥5 birds.

Table 4. Median passage dates by age classes for selected species of migrating raptors at Commissary Ridge, Wyoming: 2002–2007 versus 2008.

SPECIES	ADULT		IMMATURE / SUBADULT	
	2002–2007 ¹	2008	2002–2007 ¹	2008
Northern Harrier	02-Oct ± 11.8	29-Oct	30-Sep ± 2.7	0-Jan
Sharp-shinned Hawk	03-Oct ± 3.7	7-Oct	22-Sep ± 5.2	25-Sep
Cooper's Hawk	23-Sep ± 2.3	25-Sep	18-Sep ± 3.0	25-Sep
Northern Goshawk ²	23-Oct ± 8.7	22-Oct	23-Sep ± 6.7	15-Oct
Red-tailed Hawk	07-Oct ± 6.0	13-Oct	28-Sep ± 5.5	8-Oct
Golden Eagle	18-Oct ± 6.0	21-Oct	08-Oct ± 3.5	15-Oct
Bald Eagle	20-Oct ± 4.9	24-Oct	21-Oct ± 5.1	26-Oct

Note: Median passage dates are dates by which 50% of the flight had passed the lookout; values were calculated based only on counts of ≥5 birds per year.

¹ Mean ± 95% confidence interval in days; unless otherwise indicated, values were calculated only for species with ≥3 years of counts ≥5 birds per year.

Table 5. Capture totals, rates, and successes for migrating raptors at Commissary Ridge, Wyoming: 2004–2007 versus 2008.

SPECIES	CAPTURE TOTAL		CAPTURE RATE ¹		CAPTURE SUCCESS (%) ²	
	2004–2007 ³	2008	2004–2007 ³	2008	2004–2007 ³	2008
Sharp-shinned Hawk	67.8 ± 29.7	94	19.4 ± 6.63	21.5	7.2 ± 3.1	8.1
Cooper's Hawk	46.3 ± 23.6	44	13.4 ± 5.78	10.1	8.5 ± 4.1	10.8
Northern Goshawk	15.5 ± 11.0	14	4.4 ± 2.59	3.2	28.0 ± 14.8	25.5
Red-tailed Hawk	9.5 ± 6.3	18	2.7 ± 1.56	4.1	0.8 ± 0.3	1.4
Golden Eagle	0.8 ± 0.9	2	0.2 ± 0.25	0.5	0.3 ± 0.3	0.5
Bald Eagle	0.0 ± 0.0	1	0.0 ± 0.10	0.2	0.0 ± 0.0	0.4
American Kestrel	5.5 ± 5.2	5	1.5 ± 1.14	1.1	1.9 ± 1.6	2.2
Merlin	2.3 ± 1.7	5	0.7 ± 0.47	1.1	14.0 ± 15.4	19.2
Prairie Falcon	1.3 ± 0.9	1	0.4 ± 0.26	0.2	9.9 ± 10.8	14.3
Peregrine Falcon	0.5 ± 0.6	3	0.1 ± 0.28	0.7	3.5 ± 4.3	15.8
All Species	150.0 ± 72.4	187	43.1 ± 16.39	42.8	3.9 ± 0.8	4.4

¹ Captures / 100 station hours.

² Number of birds captured / number of birds observed * 100, with birds identified only to the generic group level (i.e., unknown accipiter, buteo, falcon, or eagle) allocated to relevant species in proportion to their occurrence. For calculating the “all species” values, non-trappable species and distant birds not identified at least to the generic group level were excluded.

³ Mean ± 95% confidence interval in days; unless otherwise indicated, values were calculated only for species with ≥3 years of counts ≥5 birds per year.

Table 6. 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 Commissary Ridge, Wyoming: 2004–2007 versus 2008.

SPECIES	YEARS	FEMALE		MALE		FEMALE : MALE RATIO	IMM. : ADULT RATIO
		HY	AHY	HY	AHY		
Sharp-shinned Hawk	Avg. 2004–2007 ¹	28	15	19	6	1.84 ± 0.65	2.8 ± 1.26
	2008	31	26	24	13	1.54	1.7
Cooper's Hawk	Avg. 2004–2007 ¹	18	19	6	3	4.81 ± 1.72	1.3 ± 0.52
	2008	7	25	8	4	2.67	0.5
Northern Goshawk	Avg. 2004–2007 ¹	4	2	6	3	0.62 ± 0.38	2.6 ± 1.61
	2008	4	7	3	0	3.67	1.0
American Kestrel	Avg. 2004–2007 ¹	1	0	4	1	0.26 ± 0.20	3.6 ± 2.04
	2008	2	1	0	1	0.89	5.0

¹ For ratios: mean ± 95% CI.

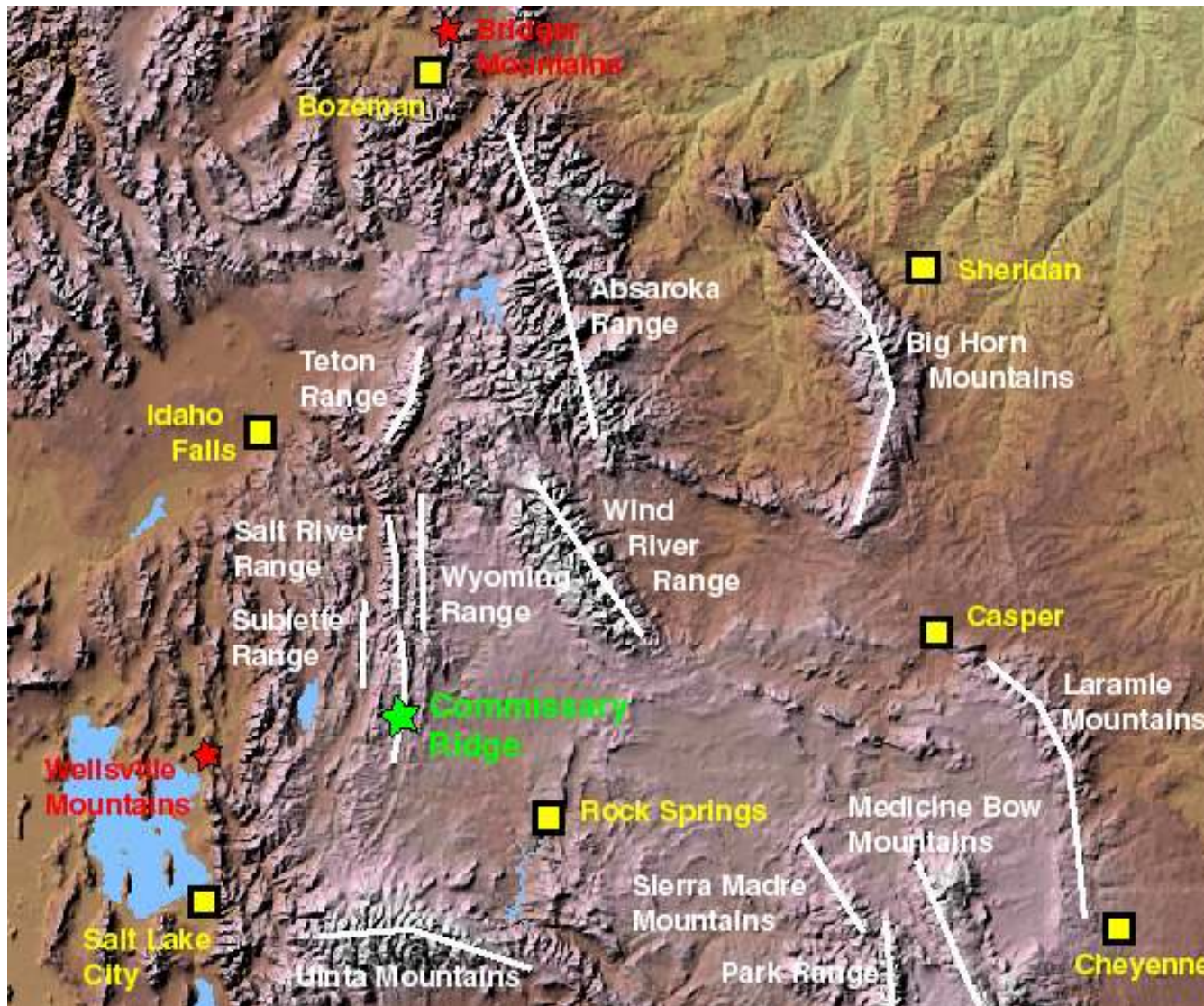


Figure 1. Location of Commissary Ridge Raptor Migration Project site in southwestern Wyoming. Red stars indicate other nearby HWI fall migration monitoring sites in Utah and Montana.

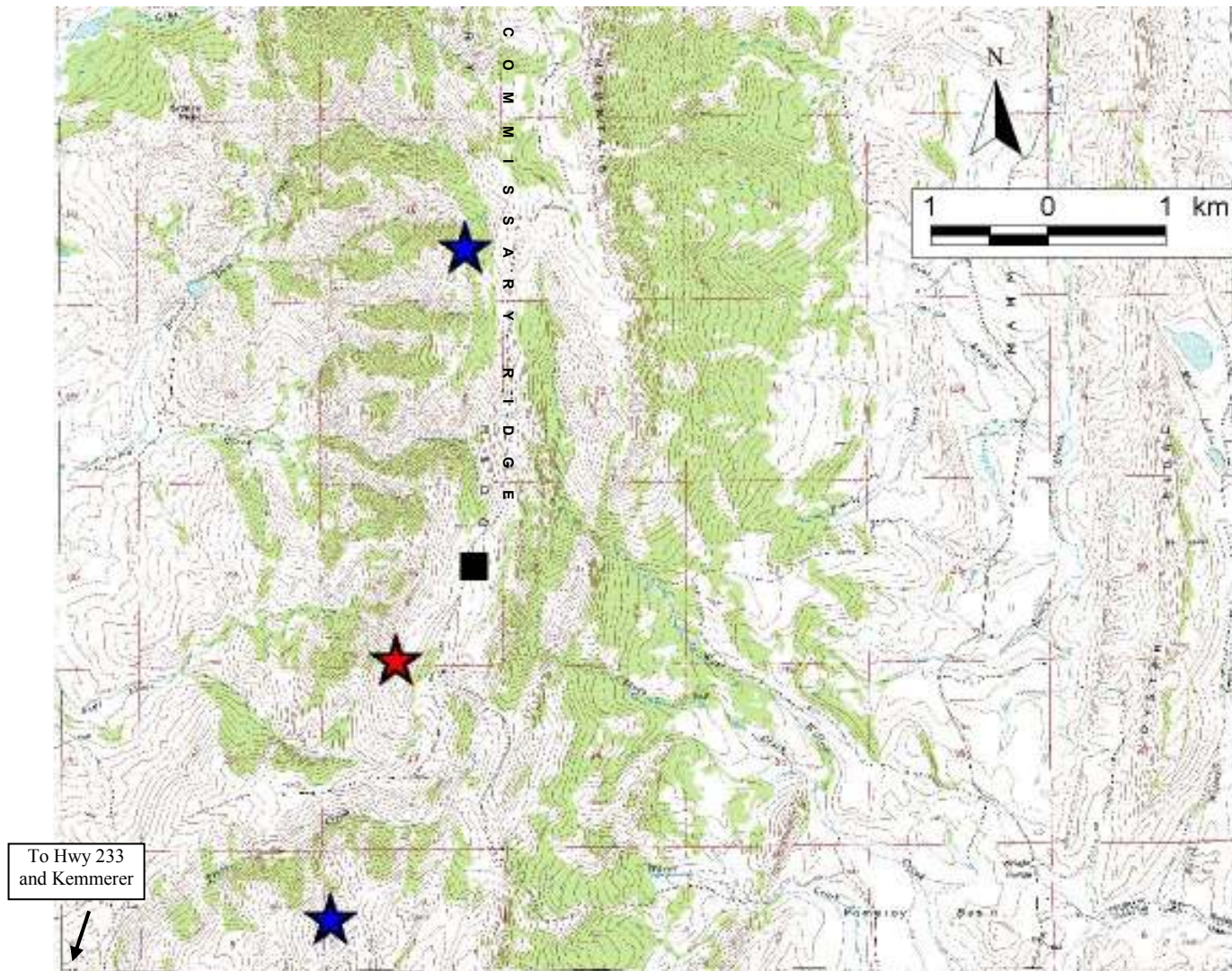


Figure 2. Close-up of Commissary Ridge Raptor Migration Project study site in southwestern Wyoming showing locations of the observation post (red star), the 2008 trapping locations (blue stars), and base camp (black square).

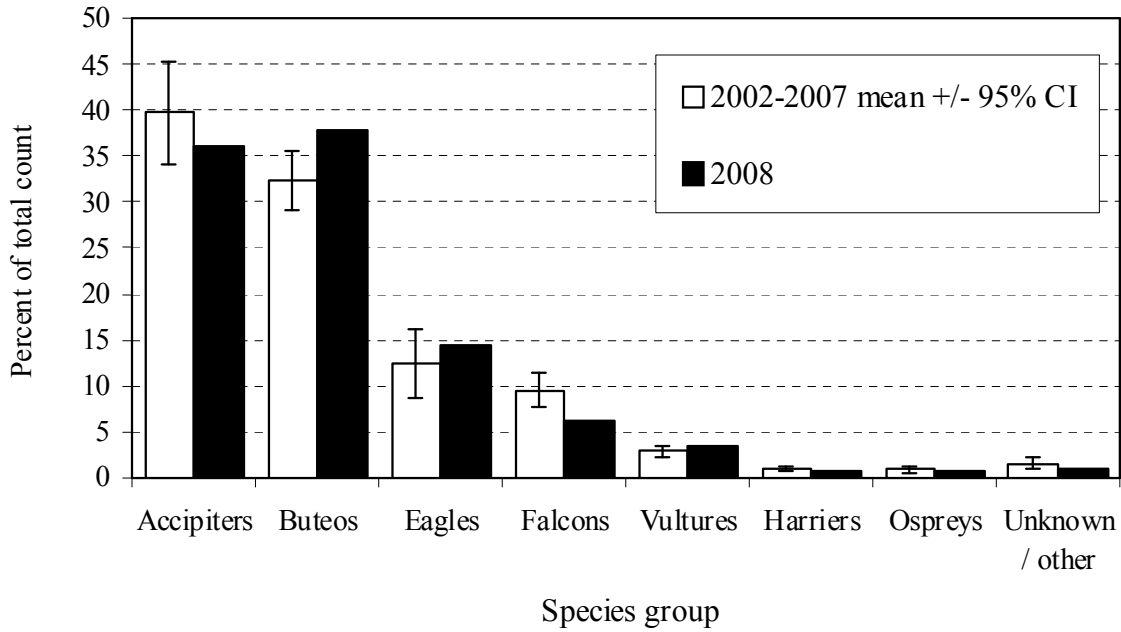


Figure 3. Composition by major species groups of the fall raptor migration at Commissary Ridge, Wyoming: 2002–2007 versus 2008.

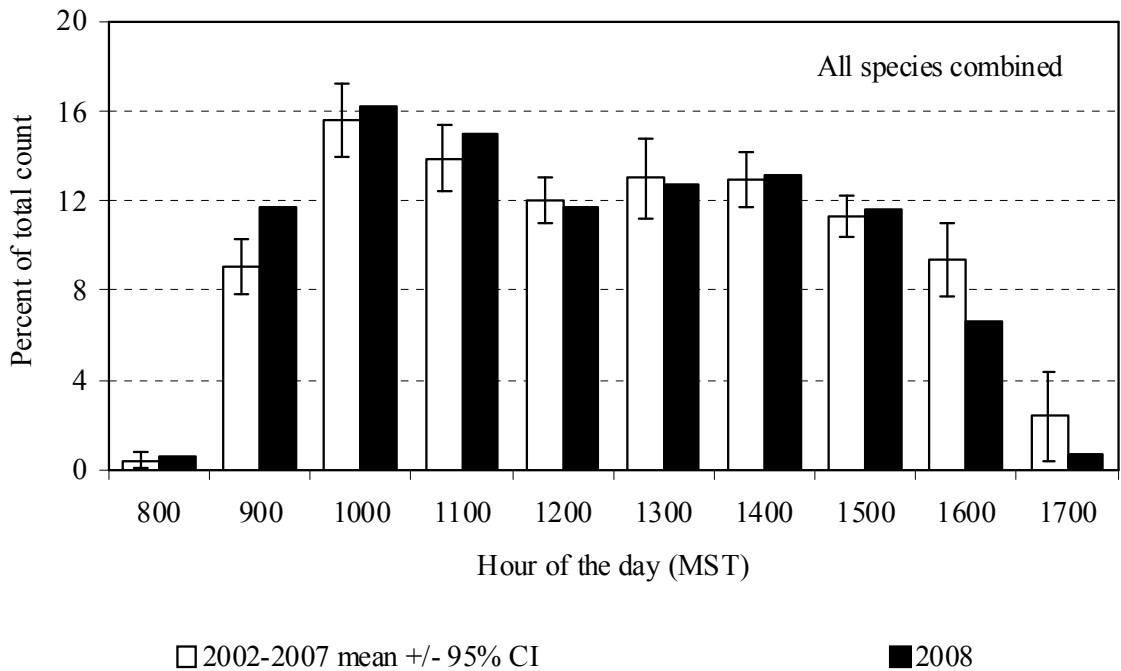


Figure 4. Daily rhythm of the fall raptor migration at Commissary Ridge, Wyoming: 2002–2007 versus 2008.

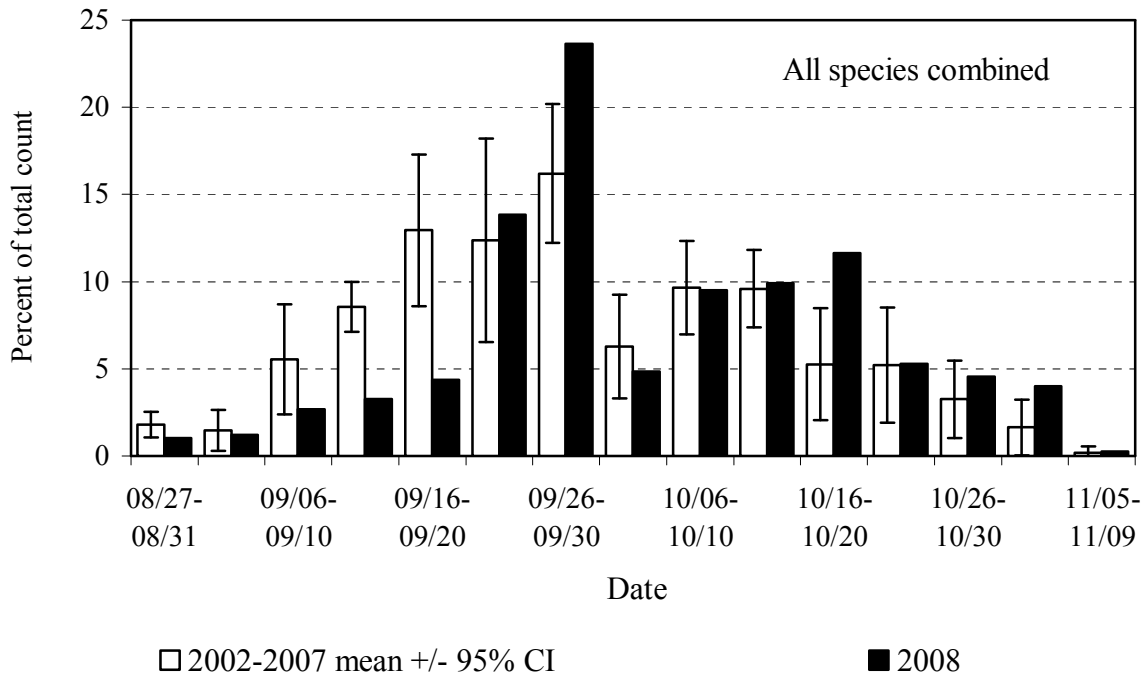


Figure 5. Combined-species seasonal distribution of activity by five-day periods for raptors during fall migration at Commissary Ridge, Wyoming: 2002–2007 versus 2008.

Appendix A. History of official observer participation at the Commissary Ridge Raptor Migration Project.

2000: Exploratory count, single observer throughout, rotating observers: Mike Neal (3)¹ and Margarite Lomow (0).

2001: Exploratory count, single observer throughout: Mike Neal (4)

2002: Single observer throughout, two observers for peak: Mike Neal (5), Nick Meyer (1), assisted by other trained crewmembers and staff.

2003: Two observers throughout: Chadette Pfaff (+), Don Higgins (0), Jason Farrell (0), assisted by Mike Neal (6).

2004: Two observers throughout: Mark Vukovich (1), Jennifer Nagy (0), assisted by other trained crewmembers and staff.

2005: Two observers throughout: Rob Spaul (1), Mary Ann Donovan (0), assisted by other trained crewmembers and staff.

2006: Two observers throughout: David Jansen (0), Tiara Westcott (0), assisted by other trained crewmembers and staff.

2007: Two observers throughout: Tiffany Russell (0), Patty Brundage (0), assisted by other trained crewmembers and staff.

2008: Two observers throughout: Sue Bruner (4), Sedona Maniak (0), Chase Cammarota (0); assisted by other trained crewmembers and staff.

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 raptors observed on migration at Commissary Ridge, Wyoming.

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	A I Br U	M F 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	AM 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 fall raptor migration at Commissary Ridge, Wyoming: 2008.

DATE	OBS. HOURS	MEDIAN		PREDOMINANT WEATHER ³	WIND		TEMP (°C) ¹	BAROM. PRESS. (IN HG) ¹	MEDIAN THERMAL LIFT ⁴	VISIB. EAST (KM) ¹	VISIB. WEST (KM) ¹	MEDIAN FLIGHT DISTANCE ⁵ / HOUR	BIRDS / HOUR
		OBSRVR / HOUR ¹	VISITOR DISTURB ²		SPEED (KPH) ¹	WIND DIRECTION							
27-Aug	8.92	2.3	0	pc-mc, blowing dust	51.1	ws	18.7	30.06	4	71	80	0	2.1
28-Aug	9.00	2.0	0	clr, haze	28.4	w	22.0	30.24	3	64	58	0	1.0
29-Aug	9.00	2.0	0	clr, AM haze	16.5	w	25.4	30.26	1	83	94	0	1.1
30-Aug	9.00	1.8	0	pc-mc, PM blowing dust	26.4	ws	27.2	30.11	2	93	97	0	0.9
31-Aug	8.50	2.0	0	ovc, PM scat rain	16.9	sw, w	22.0	29.83	3	89	96	0	1.1
01-Sep	3.75	1.8	0	ovc, AM fog/snow	29.7	w	5.5	29.99	4	58	50	0	0.8
02-Sep	8.25	1.7	0	clr	7.7	w	15.3	30.30	1	80	100	0	1.0
03-Sep	8.00	2.8	0	clr-pc	40.0	w	14.9	30.13	4	85	85	0	3.0
04-Sep	8.00	2.0	0	clr-mc, blowing dust	40.6	w	14.9	30.05	4	87	98	0	1.3
05-Sep	8.25	2.0	0	clr-pc, PM blowing dust	30.4	w	15.8	30.31	3	78	88	0	4.0
06-Sep	8.00	2.0	0	pc, PM blowing dust	29.9	w	17.4	30.16	3	88	98	0	1.9
07-Sep	8.25	1.0	0	clr, blowing dust	47.1	w	18.0	30.10	4	91	99	0	3.0
08-Sep	6.50	2.0	0	clr-ovc	15.1	e, w	17.0	30.18	2	84	86	0	3.7
09-Sep	5.83	2.0	0	ovc, blowing dust, scats/rain	28.0	w	18.3	30.04	4	78	90	0	3.9
10-Sep	8.00	2.0	0	ovc, rain	32.8	w	13.5	29.96	4	63	70	0	4.8
11-Sep	6.25	1.8	0	ovc, AM fog, PM ts/rain/snow	19.0	ne-e	8.6	30.11	4	65	52	0	1.0
12-Sep	8.00	1.5	0	clr, PM blowing dust/snow	34.4	w	15.2	30.03	3	87	97	0	5.5
13-Sep	8.00	2.0	0	clr, haze, PM blowing dust/snow	26.5	w	19.8	30.15	2	64	91	0	4.6
14-Sep	8.00	1.0	0	clr, PM blowing dust/snow	21.5	sw-w	20.8	30.34	2	62	92	0	2.8
15-Sep	8.25	2.0	0	clr, haze	13.2	se, sw-w	20.7	30.45	2	69	76	0	4.0
16-Sep	8.00	2.3	0	clr, haze, PM blowing dust/snow	16.8	sw-w	24.4	30.39	1	70	95	0	4.9
17-Sep	8.00	2.1	0	clr, haze	15.9	s-sw	24.6	30.31	1	73	92	0	7.8
18-Sep	8.00	2.0	0	pc-mc, PM haze/ts	23.7	e, w, nw	21.6	30.25	3	53	53	0	2.3
19-Sep	8.00	2.0	0	clr-pc, haze	21.1	e-se	18.9	30.28	3	59	71	0	5.6
20-Sep	2.50	2.0	0	mc-ovc, haze, scat ts	11.8	e-se	13.8	30.15	4	69	94	0	0.8
21-Sep	8.25	2.0	0	clr-mc, haze	28.1	w	15.5	30.03	3	70	88	0	25.5
22-Sep	2.33	2.5	0	mc-ovc, fog/haze	37.0	w	6.0	30.12	4	87	95	0	16.7
23-Sep	8.25	1.9	0	clr-ovc, AM haze	33.1	w	11.6	30.30	3	78	97	0	26.3
24-Sep	8.25	1.7	0	clr	19.0	sw-w	18.3	30.34	2	75	100	0	18.7
25-Sep	8.00	1.9	0	clr-pc, haze	35.0	sw-w	20.4	30.26	3	96	97	0	52.3
26-Sep	8.25	2.0	0	clr-mc, haze	20.3	w	18.8	30.34	1	81	97	0	16.1
27-Sep	8.75	2.0	0	clr-pc, AM haze, PM blowing dust	22.5	sw-w	22.3	30.32	2	72	98	0	42.9
28-Sep	8.25	2.0	0	clr, haze, PM blowing dust	19.7	sw-w	20.5	30.41	2	77	94	0	11.0
29-Sep	8.25	2.0	0	clr, haze	13.3	sw-w	21.7	30.44	2	80	98	0	5.5
30-Sep	8.50	2.0	0	clr-mc, haze	15.9	sw-w	21.4	30.48	1	88	94	0	8.2
01-Oct	8.25	1.7	0	clr-ovc, AM haze, PM ts	11.6	calm/var	21.2	30.39	2	78	93	0	4.2
02-Oct	8.50	1.7	0	clr-ovc, haze	17.1	w	21.1	30.15	2	90	94	0	8.1
03-Oct	8.25	1.9	0	mc-ovc, haze, PM scat rain	11.8	w	16.5	29.99	3	98	97	0	5.2
04-Oct	0.00			Weather Day: fog/rain									
05-Oct	5.75	1.9	0	pc-ovc	42.4	w	6.3	29.86	4	94	96	0	7.8
06-Oct	6.50	2.0	0	mc-ovc, haze	31.1	w	7.7	30.18	4	98	93	0	6.9
07-Oct	8.25	1.8	0	clr-pc, PM blowing dust	33.4	w	11.9	30.28	2	87	95	0	24.4
08-Oct	8.25	1.7	0	clr, blowing dust	37.4	w	10.8	30.12	3	76	97	0	6.3

Appendix C. continued

DATE	OBS. HOURS	MEDIAN		PREDOMINANT WEATHER ³	WIND		TEMP (°C) ¹	BAROM.	MEDIAN THERMAL	VISIB. EAST	VISIB. WEST	MEDIAN FLIGHT	BIRDS / HOUR
		OBSRVR / HOUR ¹	VISITOR DISTURB ²		SPEED (KPH) ¹	WIND DIRECTION		PRESS. (IN HG) ¹	LIFT ⁴	(KM) ¹	(KM) ¹	DISTANCE ⁵	
09-Oct	8.25	1.7	0	clr, blowing dust	37.4	w	10.8	30.12	3	76	97	0	6.3
10-Oct	8.25	1.9	0	ovc, haze, PM blowing dust	30.4	w	10.7	29.72	2	96	91	0	10.2
11-Oct	2.00	2.0	0	mc-ovc	16.0	e	3.3	29.66	3	70	81	0	0.5
12-Oct	0.00			Weather Day: fog/snow									
13-Oct	0.00			Weather Day: fog/snow									
14-Oct	5.00	2.0	0	pc	26.9	w	-0.4	30.30	3	86	86	0	72.8
15-Oct	8.25	2.0	0	clr-pc	28.1	w	3.6	30.22	3	100	99	0	9.7
16-Oct	7.75	1.9	0	clr-mc	28.9	w	5.9	30.20	3	88	94	0	6.6
17-Oct	8.00	2.0	0	pc-ovc, AM fog/snow	35.7	sw-nw	4.4	30.26	4	93	89	0	7.6
18-Oct	8.25	2.3	0	clr	23.9	w	8.9	30.43	3	95	97	0	13.1
19-Oct	8.25	2.2	0	pc-mc, AM haze	29.7	w	8.2	30.22	3	87	95	0	27.0
20-Oct	8.25	2.0	0	clr-ovc	11.9	w	11.5	30.25	3	90	99	0	9.6
21-Oct	7.25	2.1	0	ovc, rain/snow	8.0	var	10.7	30.20	4	49	68	0	7.9
22-Oct	6.50	1.9	0	pc-ovc, PM snow	44.0	w-nw	6.9	30.04	4	61	62	0	8.3
23-Oct	8.25	1.7	0	clr-pc	20.5	w	2.5	30.40	3	88	98	0	3.5
24-Oct	8.25	1.9	0	clr, AM haze	33.0	w	7.7	30.19	2	94	100	0	5.8
25-Oct	8.25	2.3	0	clr-ovc, AM haze	31.0	w	7.4	30.19	4	74	88	0	5.9
26-Oct	8.25	2.0	0	pc-mc, blowing snow	55.5	w	7.0	30.14	4	94	96	0	3.9
27-Oct	8.00	1.9	0	mc-ovc, AM haze	20.1	w	8.6	30.54	3	84	97	0	3.6
28-Oct	8.25	2.1	0	clr, AM haze	17.0	wsw-w	14.0	30.54	2	79	91	0	7.8
29-Oct	8.00	3.0	0	clr	15.8	w	14.3	30.51	2	98	99	0	4.0
30-Oct	8.00	2.9	0	clr-mc, AM scat snow, PM blowing snow	27.3	w	12.9	30.25	4	79	90	0	6.0
31-Oct	7.75	2.0	0	pc	20.1	w	13.6	30.33	3	86	95	0	8.0
01-Nov	7.75	2.0	0	ovc, haze	14.1	wsw	12.4	30.45	4	94	96	0	6.1
02-Nov	7.75	2.0	0	ovc	15.7	w	12.9	30.33	4	88	94	0	8.9
03-Nov	0.00			Weather Day: snow									
04-Nov	3.00	2.0	0	ovc, fog	3.8	w	4.8	30.55	4	5	5	0	0.0
05-Nov	0.00			Weather Day: fog/snow									

¹ Average of hourly records.

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

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

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. Raptor counts by day and species during fall migration at Commissary Ridge, Wyoming: 2008.

DATE	HOURS	SPECIES ¹																							BIRDS				
		TV	OS	NH	SS	CH	NG	SA	LA	UA	BW	SW	RT	FH	RL	UB	GE	BE	UE	AK	ML	PR	PG	SF	LF	UF	UU	TOTAL	/HOUR
27-Aug	8.92	1	3	0	0	2	0	0	0	0	0	1	10	0	0	0	2	0	0	0	0	0	0	0	0	0	0	19	2.1
28-Aug	9.00	0	0	0	1	1	0	0	0	0	0	0	3	0	0	0	1	0	0	3	0	0	0	0	0	0	9	1.0	
29-Aug	9.00	2	0	0	0	1	0	0	0	0	0	1	2	0	0	0	3	0	0	1	0	0	0	0	0	0	10	1.1	
30-Aug	9.00	1	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	8	0.9	
31-Aug	8.50	2	1	0	0	0	0	0	0	0	0	0	1	0	0	0	5	0	0	0	0	0	0	0	0	0	9	1.1	
01-Sep	3.75	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0	3	0.8	
02-Sep	8.25	1	0	0	2	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	1	0	8	1.0	
03-Sep	8.00	1	0	0	1	0	0	1	0	0	0	1	16	0	0	2	1	0	0	0	0	0	1	0	0	0	24	3.0	
04-Sep	8.00	0	0	0	0	1	0	0	0	0	0	0	8	0	0	0	0	0	0	1	0	0	0	0	0	0	10	1.3	
05-Sep	8.25	1	0	0	2	3	2	0	1	0	0	7	12	0	0	1	1	0	1	1	1	0	0	0	0	0	33	4.0	
06-Sep	8.00	0	0	0	3	3	0	0	0	0	0	0	5	0	0	0	3	1	0	0	0	0	0	0	0	0	15	1.9	
07-Sep	8.25	0	1	0	3	2	0	0	0	1	1	3	8	0	0	2	1	0	0	2	0	0	0	0	0	1	0	25	3.0
08-Sep	6.50	2	0	0	5	5	0	0	1	1	0	0	3	1	0	1	2	0	0	1	1	0	0	0	0	1	24	3.7	
09-Sep	5.83	1	0	0	6	6	0	0	0	0	0	0	8	0	0	1	1	0	0	0	0	0	0	0	0	0	23	3.9	
10-Sep	8.00	0	4	0	8	6	1	0	0	0	0	5	7	0	0	2	0	1	0	0	2	0	2	0	0	0	38	4.8	
11-Sep	6.25	0	0	0	0	0	0	0	0	1	0	1	1	0	0	2	0	0	0	1	0	0	0	0	0	0	6	1.0	
12-Sep	8.00	0	1	0	12	5	0	0	1	0	0	1	17	0	0	1	0	0	0	5	0	0	0	0	0	1	44	5.5	
13-Sep	8.00	0	0	1	7	6	0	1	2	0	1	0	11	0	0	0	0	0	6	0	1	0	0	0	1	37	4.6		
14-Sep	8.00	1	0	0	3	2	0	0	0	2	0	0	4	0	0	5	0	1	0	3	0	0	0	1	0	0	22	2.8	
15-Sep	8.25	2	0	0	4	1	0	6	0	0	0	0	8	0	0	2	2	0	1	6	0	0	0	0	0	1	33	4.0	
16-Sep	8.00	1	0	0	16	7	1	0	0	1	0	0	4	0	0	1	2	0	0	5	0	0	0	1	0	0	39	4.9	
17-Sep	8.00	10	2	2	19	13	0	0	1	1	1	0	3	0	0	2	7	0	0	1	0	0	0	0	0	0	62	7.8	
18-Sep	8.00	4	0	0	6	0	1	0	0	2	0	0	2	1	0	0	2	0	0	0	0	0	0	0	0	0	18	2.3	
19-Sep	8.00	8	0	1	2	1	1	0	0	2	0	2	11	0	0	6	6	1	0	2	0	0	0	0	0	2	45	5.6	
20-Sep	2.50	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0.8	
21-Sep	8.25	13	1	1	74	50	3	1	1	4	1	9	28	0	0	0	3	0	0	15	1	0	2	1	0	2	210	25.5	
22-Sep	2.33	0	0	1	10	0	0	0	0	0	0	18	5	1	0	1	3	0	0	0	0	0	0	0	0	0	39	16.7	
23-Sep	8.25	30	4	0	47	23	6	0	1	1	1	20	50	1	0	9	2	1	1	15	0	0	2	0	2	1	217	26.3	
24-Sep	8.25	9	0	1	79	17	1	1	0	2	3	3	17	0	0	2	4	0	0	11	1	1	0	0	0	2	154	18.7	
25-Sep	8.00	20	4	0	167	100	0	1	0	13	1	1	34	0	0	16	7	5	0	39	0	0	1	0	1	0	418	52.3	
26-Sep	8.25	2	0	0	34	23	0	0	0	0	0	40	21	0	0	2	6	0	0	5	0	0	0	0	0	0	133	16.1	
27-Sep	8.75	7	1	4	64	33	1	1	0	6	1	172	23	1	0	13	13	0	0	32	0	0	1	1	0	1	375	42.9	
28-Sep	8.25	3	0	1	17	14	2	0	0	0	0	22	11	0	0	7	3	0	0	8	1	1	0	0	0	1	91	11.0	
29-Sep	8.25	11	0	0	4	4	1	1	0	1	0	0	6	0	0	10	0	2	0	5	0	0	0	0	0	0	45	5.5	
30-Sep	8.50	6	0	3	16	14	0	0	0	3	0	8	8	0	0	1	2	0	0	7	1	1	0	0	0	0	70	8.2	

Appendix D. continued

DATE	HOURS	SPECIES ¹																								BIRDS			
		TV	OS	NH	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
01-Oct	8.25	0	0	1	11	4	2	0	0	1	0	1	8	0	0	2	2	0	0	2	0	0	0	0	0	0	1	35	4.2
02-Oct	8.50	4	1	0	15	7	1	2	0	3	0	18	4	0	0	8	3	1	0	1	0	1	0	0	0	0	0	69	8.1
03-Oct	8.25	2	0	0	15	4	1	0	0	0	1	8	3	0	0	3	3	1	0	1	0	0	1	0	0	0	0	43	5.2
04-Oct	0.00																												
05-Oct	5.75	0	1	0	18	6	0	0	0	0	0	1	10	0	0	1	0	1	1	3	0	0	1	0	0	0	2	45	7.8
06-Oct	6.50	1	1	0	11	2	0	0	0	3	0	2	15	0	0	1	2	1	1	3	2	0	0	0	0	0	0	45	6.9
07-Oct	8.25	2	1	0	88	9	3	0	0	0	0	2	64	0	1	7	5	0	0	17	0	0	1	0	0	0	1	201	24.4
08-Oct	8.25	1	0	0	23	2	0	0	0	0	0	1	23	0	0	0	1	0	0	1	0	0	0	0	0	0	0	52	6.3
09-Oct	8.25	0	1	0	19	0	0	1	0	0	1	3	49	1	0	0	3	2	0	4	0	0	0	0	0	0	0	84	10.2
10-Oct	2.00	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.5
11-Oct	0.00																												
12-Oct	0.00																												
13-Oct	5.00	0	0	1	30	0	2	2	0	0	0	0	300	0	0	7	17	4	0	0	1	0	0	0	0	0	0	364	72.8
14-Oct	8.25	0	0	0	2	0	1	1	0	0	0	0	42	0	3	6	19	5	1	0	0	0	0	0	0	0	0	80	9.7
15-Oct	7.75	0	0	0	18	0	1	0	0	0	0	0	17	0	0	0	9	4	0	0	2	0	0	0	0	0	0	51	6.6
16-Oct	8.00	0	0	0	6	1	0	0	0	0	1	1	33	0	1	1	10	2	0	2	0	0	0	1	0	0	2	61	7.6
17-Oct	8.25	0	0	0	16	2	2	1	0	0	0	0	44	0	0	0	21	13	6	0	2	0	1	0	0	0	0	108	13.1
18-Oct	8.25	0	0	0	115	0	0	2	0	0	0	0	61	0	1	1	15	14	4	6	2	0	1	0	0	0	1	223	27.0
19-Oct	8.25	0	0	1	24	1	1	2	0	0	0	0	9	0	2	8	4	21	2	1	2	0	0	0	0	0	1	79	9.6
20-Oct	7.25	0	0	1	19	0	1	0	0	0	0	0	4	0	3	2	3	14	6	1	0	0	1	0	0	0	2	57	7.9
21-Oct	6.50	0	0	0	8	0	0	1	0	0	0	0	10	0	0	2	13	9	3	1	0	1	0	1	0	0	5	54	8.3
22-Oct	8.25	0	0	1	8	0	2	0	0	1	0	0	8	0	0	3	4	1	0	0	0	0	1	0	0	0	0	29	3.5
23-Oct	8.25	0	0	0	3	0	0	0	0	0	0	0	10	0	0	0	18	17	0	0	0	0	0	0	0	0	0	48	5.8
24-Oct	8.25	0	0	0	3	0	2	0	0	0	0	0	13	0	6	0	13	12	0	0	0	0	0	0	0	0	0	49	5.9
25-Oct	8.25	0	0	0	5	0	1	0	0	0	0	0	2	0	0	2	12	8	1	1	0	0	0	0	0	0	0	32	3.9
26-Oct	8.00	0	0	1	2	0	1	0	0	0	0	0	10	0	2	0	6	6	0	0	1	0	0	0	0	0	0	29	3.6
27-Oct	8.25	0	0	4	7	0	3	0	0	0	0	0	22	0	0	1	12	10	0	0	3	0	0	0	0	0	2	64	7.8
28-Oct	8.00	0	0	0	4	0	3	0	0	0	0	0	9	1	1	0	5	7	1	0	0	0	0	0	0	0	1	32	4.0
29-Oct	8.00	0	0	3	14	0	2	0	0	0	0	0	11	0	0	0	4	13	0	0	1	0	0	0	0	0	0	48	6.0
30-Oct	7.75	0	0	1	9	0	2	0	0	0	0	0	7	0	1	0	15	26	0	0	0	0	0	1	0	0	0	62	8.0
31-Oct	7.75	0	0	3	1	0	1	0	0	0	0	0	3	0	2	0	16	18	3	0	0	0	0	0	0	0	0	47	6.1
01-Nov	7.75	0	0	0	3	0	0	0	0	0	0	0	2	0	8	0	19	35	2	0	0	0	0	0	0	0	0	69	8.9
02-Nov	0.00																												
03-Nov	3.00	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
04-Nov	0.00																												
05-Nov	3.00	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	0	5	0	0	1	0	1	0	0	0	0	11	3.7
Total	493.33	150	27	32	1109	382	52	25	8	49	13	352	1148	7	33	144	344	262	34	219	25	6	15	9	5	1	39	4490	599.2

¹ See Appendix B for explanation of species codes.

Appendix E. Annual observation effort and raptor counts by species during fall migration at Commissary Ridge, Wyoming: 2001–2008.

	2001	2002	2003	2004	2005	2006	2007	2008	Mean
Start date	3-Sep	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug	26-Aug
End date	23-Oct	29-Oct	29-Oct	3-Nov	31-Oct	31-Oct	5-Nov	5-Nov	31-Oct
Observation days	22	45	63	65	64	56	66	66	61
Observation hours	145.88	322.67	474.85	452.67	478.83	443.58	494.56	493.33	451.50
Raptors/100 hrs	1155.7	990.8	644.4	916.6	985.3	415.0	990	911	836
SPECIES	RAPTOR COUNTS								
Turkey Vulture	67	97	66	164	114	39	185	150	116
Osprey	16	11	31	59	36	11	41	27	31
Northern Harrier	40	32	25	38	36	26	30	32	31
Sharp-shinned Hawk	303	675	516	1,118	1,687	217	1,214	1,109	934
Cooper's Hawk	256	409	329	614	462	289	535	382	431
Northern Goshawk	11	21	7	49	35	26	89	52	40
Unknown small accipiter	11	78	75	75	55	39	61	25	58
Unknown large accipiter	4	6	13	34	11	6	21	8	14
Unknown accipiter	29	16	58	69	2	6	98	49	43
TOTAL ACCIPITERS	614	1,205	998	1,959	2,252	583	2,018	1,625	1,520
Broad-winged Hawk	1	8	5	22	9	3	7	13	10
Swainson's Hawk	18	82	28	62	52	47	36	352	94
Red-tailed Hawk	323	823	1,042	961	1,319	563	1,459	1,148	1,045
Ferruginous Hawk	7	6	3	15	8	7	3	7	7
Rough-legged Hawk	20	5	5	8	13	5	13	34	12
Unidentified buteo	19	17	87	63	42	35	63	144	64
TOTAL BUTEOS	388	941	1,170	1,131	1,443	660	1,581	1,698	1,232
Golden Eagle	279	352	233	152	316	211	324	345	276
Bald Eagle	72	233	90	76	137	82	299	262	168
Unidentified eagle	5	10	7	10	2	6	25	34	13
TOTAL EAGLES	356	595	330	238	455	299	648	641	458
American Kestrel	166	258	355	403	317	156	229	219	277
Merlin	7	9	6	26	11	10	24	25	16
Prairie Falcon	1	6	5	6	18	13	21	6	11
Peregrine Falcon	5	3	3	11	13	9	18	15	10
Unknown small falcon	2	0	3	6	2	5	3	9	4
Unknown large falcon	5	0	0	5	2	4	6	5	3
Unknown falcon	0	2	0	1	0	7	7	1	3
TOTAL FALCONS	186	278	372	458	363	204	308	280	323
Unidentified raptor	19	38	68	102	19	19	83	39	53
ALL SPECIES	1,686	3,197	3,060	4,149	4,718	1,841	4,894	4,492	3,764

Appendix F. Raptor capture totals by day and species during fall migration at Commissary Ridge, Wyoming: 2008.

DATE	STN.		SPECIES ¹										CAPTURES /		
	HOURS		NH	SS	CH	NG	RT	GE	BE	AK	ML	PR	PG	TOTAL	HR
28-Aug	4.50		0	1	0	0	1	0	0	0	0	0	1	3	0.7
29-Aug	6.25		0	1	1	1	1	0	0	1	0	0	0	5	0.8
30-Aug	4.25		0	0	0	0	0	0	0	0	0	0	0	0	0.0
31-Aug	4.92		0	1	0	0	0	0	0	0	0	0	1	2	0.4
01-Sep	0.00														
02-Sep	7.33		0	0	1	0	0	0	0	0	0	0	0	1	0.1
03-Sep	4.83		0	0	0	0	0	0	0	0	0	0	0	0	0.0
04-Sep	7.50		0	0	0	0	1	0	0	0	0	0	0	1	0.1
05-Sep	8.00		0	2	0	0	0	0	0	0	0	0	0	2	0.3
06-Sep	7.75		0	0	1	0	0	0	0	1	0	0	0	2	0.3
07-Sep	8.00		0	3	0	0	0	0	0	0	0	0	0	3	0.4
08-Sep	7.00		0	5	3	0	0	0	0	1	0	0	0	9	1.3
09-Sep	7.83		0	0	1	1	0	0	0	0	0	0	0	2	0.3
10-Sep	7.00		0	1	1	0	0	0	0	0	0	0	0	2	0.3
11-Sep	4.50		0	1	0	0	0	0	0	0	0	0	0	1	0.2
12-Sep	5.00		0	0	0	0	0	0	0	0	0	0	0	0	0.0
13-Sep	7.75		0	1	0	0	1	0	0	0	0	0	0	2	0.3
14-Sep	6.00		0	4	0	0	2	0	0	0	0	0	0	6	1.0
15-Sep	8.08		0	6	2	0	0	0	0	0	0	0	0	8	1.0
16-Sep	7.75		0	1	2	0	0	0	0	0	0	1	0	4	0.5
17-Sep	7.75		0	3	2	0	1	0	0	1	0	0	0	7	0.9
18-Sep	7.50		0	1	2	0	0	0	0	0	0	0	0	3	0.4
19-Sep	7.58		0	4	0	0	0	0	0	0	0	0	0	4	0.5
20-Sep	13.08		0	1	1	0	0	0	0	0	0	0	0	2	0.2
21-Sep	15.33		0	6	5	0	1	0	0	0	0	0	0	12	0.8
22-Sep	0.00														
23-Sep	7.67		0	3	0	0	0	0	0	0	0	0	0	3	0.4
24-Sep	7.50		0	6	8	0	1	0	0	0	0	0	0	15	2.0
25-Sep	8.00		0	5	4	0	0	0	0	0	0	0	0	9	1.1
26-Sep	7.50		0	3	4	0	0	0	0	0	0	0	0	7	0.9
27-Sep	7.25		0	3	5	0	0	1	0	0	0	0	0	9	1.2
28-Sep	7.67		0	1	0	0	0	0	0	0	0	0	0	1	0.1
29-Sep	16.00		0	3	0	1	1	0	0	0	0	0	1	6	0.4
30-Sep	7.17		0	5	0	0	0	0	0	0	0	0	0	5	0.7
01-Oct	7.25		0	3	1	1	0	0	0	0	0	0	0	5	0.7
02-Oct	0.00														
03-Oct	7.75		0	2	0	0	1	0	0	0	0	0	0	3	0.4
04-Oct	0.00														
05-Oct	0.00														

Appendix F. continued

STN.		SPECIES ¹											CAPTURES /	
DATE	HOURS	NH	SS	CH	NG	RT	GE	BE	AK	ML	PR	PG	TOTAL	HOURL
06-Oct	6.50	0	1	0	0	0	0	0	0	0	0	0	1	0.2
07-Oct	7.25	0	1	0	1	1	0	0	0	0	0	0	3	0.4
08-Oct	7.67	0	1	0	1	1	0	0	0	0	0	0	3	0.4
09-Oct	6.75	0	2	0	0	1	0	0	0	1	0	0	4	0.6
10-Oct	4.33	0	0	0	0	0	0	0	0	0	0	0	0	0.0
11-Oct	0.00													
12-Oct	0.00													
13-Oct	0.00													
14-Oct	0.00													
15-Oct	7.75	0	0	0	0	0	0	0	0	0	0	0	0	0.0
16-Oct	4.50	0	0	0	0	1	0	0	0	0	0	0	1	0.2
17-Oct	7.75	0	0	0	1	0	0	0	0	0	0	0	1	0.1
18-Oct	7.67	0	7	0	0	0	0	1	1	1	0	0	10	1.3
19-Oct	7.67	0	3	0	2	1	0	0	0	0	0	0	6	0.8
20-Oct	8.00	0	0	0	1	0	0	0	0	1	0	0	2	0.3
21-Oct	7.83	0	0	0	0	1	0	0	0	0	0	0	1	0.1
22-Oct	7.92	0	0	0	0	0	0	0	0	0	0	0	0	0.0
23-Oct	7.33	0	0	0	0	0	0	0	0	0	0	0	0	0.0
24-Oct	12.75	0	0	0	0	0	1	0	0	0	0	0	1	0.1
25-Oct	6.25	0	0	0	0	0	0	0	0	0	0	0	0	0.0
26-Oct	7.33	0	1	0	0	0	0	0	0	0	0	0	1	0.1
27-Oct	15.17	0	0	0	0	0	0	0	0	1	0	0	1	0.1
28-Oct	15.33	0	1	0	2	1	0	0	0	1	0	0	5	0.3
29-Oct	14.75	0	1	0	1	0	0	0	0	0	0	0	2	0.1
30-Oct	6.67	0	0	0	1	0	0	0	0	0	0	0	1	0.1
Total	436.41	0	94	44	14	18	2	1	5	5	1	3	187	0.4

¹ See Appendix B for explanation of species codes.

Appendix G. Annual trapping effort and capture totals by species for migrating raptors at Commissary Ridge, Wyoming: 2004–2008.

	2004	2005	2006	2007	2008	MEAN	TOTAL
First trapping day	2-Sep	29-Aug	28-Aug	29-Aug	28-Aug		
Last trapping day	17-Oct	27-Oct	30-Oct	30-Oct	30-Oct		
Number of stations	1	1	2	2	2	1.8	
Trapping days	46	55	43	48	55	49.4	
Station hours	287.43	383.50	346.12	366.43	436.41	364.1	
Captures / stn. hour	4.7	5.3	1.5	5.7	4.3	4.3	
SPECIES	RAPTOR CAPTURES						
Northern Harrier	0	0	1	2	0	0.6	3
Sharp-shinned Hawk	61	96	28	86	94	73.0	365
Cooper's Hawk	47	65	12	61	44	45.8	229
Northern Goshawk	12	17	3	30	14	15.2	76
Red-tailed Hawk	7	7	5	19	18	11.2	56
Golden Eagle	1	0	0	2	2	1.0	5
Bald Eagle	0	0	0	0	1	0.2	1
American Kestrel	3	13	1	5	5	5.4	27
Merlin	3	4	0	2	5	2.8	14
Prairie Falcon	2	2	0	1	1	1.2	6
Peregrine Falcon	0	0	1	1	3	1.0	5
All species	136	204	51	209	187	157.4	787
Recaptures ¹	0	0	0	0	0	0.0	0
Foreign Recaptures ²	0	0	0	0	0	0.0	0
Foreign Encounters ³	0	0	0	0	1	0.2	1

¹ Recaptures at Commissary Ridge of birds originally banded at Commissary Ridge.

² Recaptures at Commissary Ridge of birds originally banded elsewhere.

³ Birds originally banded at Commissary Ridge and subsequently encountered elsewhere.