FALL 2003 RAPTOR MIGRATION STUDY AT COMMISSARY RIDGE IN SOUTHWESTERN WYOMING

HawkWatch International, Inc.
Salt Lake City, Utah

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

HawkWatch International (HWI) and its organizational precursors have been monitoring raptor migrations in North America since the late 1970s (Hoffman et al. 2002, Hoffman and Smith 2003). During 2003, HWI conducted or co-sponsored 14 long-term, annual migration counts and six migration banding studies in ten states and Veracruz, Mexico. The primary objective of these efforts is to track long-term population trends of diurnal raptors throughout primarily western North America (Hoffman and Smith 2003). Raptors feed atop food pyramids, inhabit most ecosystems, occupy large home ranges, and are sensitive to environmental contamination and other human disturbances. Therefore, they serve as important biological indicators of ecosystem health (Bildstein 2001). Moreover, due to the remoteness and widespread distribution of most raptor populations, migration counts represent a particularly cost-effective and efficient method for monitoring the regional status and trends of multiple raptor species (Bednarz and Kerlinger 1989, Dunn and Hussell 1995, Dixon et al. 1998, Zalles and Bildstein 2000, Smith and Hoffman 2000, Hoffman and Smith 2003).

Intensive counting and banding operations also provide valuable information about breeding and wintering distributions, migratory routes, migratory behavior, mortality factors and longevity, morphometric variation, molt sequences and timing, and health assessments (e.g., Hoffman et al. 2002). This information enables us to better 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 HWI's mission.

Most of HWI's migration-monitoring projects are located atop mountain ridges in the western United States. Migrating raptors concentrate along north–south aligned mountain ranges for several reasons. Many seek to save energy on their long journeys by taking advantage of wind-driven updrafts that routinely occur along such ranges. Strong updrafts frequently occur along the western flanks of north–south ranges as predominantly westerly winds are deflected upward by the montane topography. Long north–south ranges also serve as navigational aids by forming a "leading line" (*sensu* Geyr von Shweppenberg 1963:192) that raptors can follow en route to their seasonal destination. In many cases, especially in arid landscapes such as the Great Basin, montane ridges may also attract migrants because they provide the only available forested habit. For species such as the accipiter hawks, forest cover may be a necessary requirement to provide suitable stopover and foraging habitat.

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). Prior to 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, and completed the second consecutive full-season count at the site in 2003. Herein we report the results of the 2003 count.

STUDY SITE

The study site was 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 (42°01'29"N 110°35'22"W; T24 R116 S28 SESW; elevation ~2,700 m; Figure 1). The site is accessed from Hwy 233 just northeast of Lake Viva Naughton (Figure 2). The count site was located on the western edge of a broad ridgetop overlooking the Ham's Fork River Valley and Lake Viva Naughton to the west. The location provided an unobstructed 360° view of the surrounding landscape. The ridgetop featured primarily rocky substrates and low growing, desert shrubs and grasses, with scattered stands of mixed-conifer and aspen forest in sheltered pockets and ravines.

METHODS

Weather permitting, trained observers conducted daily counts from a single observation post from late August through late October 2003. Primary observer Chadette Pfaff, who worked the whole season, was new to full-season migration counting but had previously participated in HWI migration projects in New Mexico and received pre-season training in 2003. Primary observers Don Higgins, who worked the first several weeks of the season, and Jason Farrell, who worked the remainder of the season, were both new to migration counting but received preseason training. Mike Neal, who was involved in all previous exploratory work that led up to this project and served as lead observer in 2002, provided on-site training for the other observers and periodically served as a substitute observer during the 2003 season.

Counts 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 hrs 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 A 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 hrs 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).

RESULTS AND DISCUSSION

WEATHER

Inclement weather precluded three full days of potential observations in 2003, including the last two days of October, and severely hampered observations (<4 hrs observation) on two other days (see Appendix B for daily weather records). Fifty-three percent of the active observation days featured predominantly fair skies (10% including some fog or haze), 27% transitional skies (shifted from fair skies to mostly cloudy or overcast skies during the day, or vice versa; 2% including some fog/haze or rain/snow), and 21% mostly cloudy to overcast/stormy skies (13% including some fog/haze and/or rain/snow). The 2002 season featured substantially stormier weather than in 2003. In 2002, inclement weather entirely or severely precluded observations on 13 days. Only 38% of the active observation days featured

predominantly fair skies, while 31% featured mostly cloudy to overcast skies and 22% of those days included some fog/haze and/or rain/snow. Wildfires also precluded access to the site for 12 days in late August and early September in 2002.

In 2003, the temperature during active observation periods averaged 14.8°C (average of daily values, which were in turn averages of hourly readings), ranging from 5.8–22.6°C. These values are warmer than in 2002 (mean 12.5, range 0.5–21.3°C).

In 2003, light winds (<12 kph) predominated on 11% of the active observation days, moderate winds (12–28 kph) on 41%, and strong winds (>28 kph) on 48%. Moderate winds were proportionately more prevalent in 2002, predominating on 60% of the active observation days (light 4%, strong 36%). West to northwest winds have consistently been the most common wind pattern at the site, predominating on 64% of 21 exploratory count days in 2001, 78% of the active observation days in 2002, and 55% of the active days in 2003. Compared to 2002, the main difference in wind patterns in 2003 was a distinct shift in favor of southwesterly as opposed to northwesterly winds (2003: 35% of days with notable southwesterly component; only 13% in 2002). Fair to poor thermal-lift conditions predominated on 77% of the active observation days in 2003, good to excellent conditions on 23%. The comparative values for 2002 are 62% and 38%, respectively. Visibility averaged roughly 80 km to the east and west in 2003, which is 5–10 km better than in 2002.

In summary, compared to 2002, the 2003 season featured less-stormy and warmer weather; more days with predominantly light winds but substantially more days with primarily strong winds; on average poorer thermal-lift conditions, reflecting the high prevalence of strong winds; a higher prevalence of southwesterly as opposed to northwesterly winds; and visibility averaged slightly better.

OBSERVATION EFFORT

Observation effort totaled 63 days and 474.85 hours (Table 1) between 27 August and 29 October 2003 (Table 1, Appendix B). Daily coverage ranged from 1.0–9.25 hrs, averaging 7.2 hrs per day of active observation. The overall coverage figures are 40–47% higher than in 2002, reflecting the 12-day wildfire closure and increased storminess of the 2002 season.

FLIGHT VOLUME AND COMPOSITION

The observers tallied 3,060 migrants of 17 species during the 2003 season (Table 1, and see Appendix C for daily count records). The flight was composed of 33% accipiters, 38% buteos, 11% eagles, 12% falcons, 2% vultures, 1% each of Ospreys and Northern Harriers, and 2% other species and unidentified raptors (Figure 3). In comparison to 2002, these proportions represent increases in the relative abundance of buteos, falcons, and Ospreys, and decreases for other species groups. The most abundant species were the Red-tailed Hawk (34% of the total count), Sharp-shinned Hawk (17%), American Kestrel (12%), Cooper's Hawk (11%), Golden Eagle (8%), Bald Eagle (3%), and Turkey Vulture (2%). All other species each comprised ≤1% of the total.

The 12-day wildfire closure in 2002 confounds comparisons of the 2002 and 2003 counts. In terms of absolute numbers, I estimated that we probably missed 300–500 birds during the closure period, which would render the overall 2002 count closer to 3,500–3,700 birds rather than the recorded tally of 3,192 (Smith 2003). Not being able to count during the closure had the most significant impact on counts of species whose migrations routinely begin early in the season, most notably Ospreys, Northern Harriers, Sharp-shinned Hawks, Cooper's Hawks, Swainson's Hawks, and to lesser degrees Red-tailed hawks and Golden Eagles. However, among these species, the only ones to show higher overall counts in 2003 were Ospreys, Red-tailed Hawks, and American Kestrels (Table 1). In fact, these were the only species for which counts were higher in 2003 than in 2002.

Rendering the two datasets in terms of passage rates helps ameliorate the confounding influence of coverage variation; however, because the 2002 wildfire closure occurred early in the season when passage

rates were still relatively low, the 2002 annual passage rate estimates are probably somewhat inflated due to proportionately greater coverage of periods when flight volume was high. Regardless, the 2003 passage rates were more than 30% below the 2002 rates for all but three species (Table 1), which is a substantially greater reduction than can be easily explained by the 2002 inflation factor. Moreover, although again the data did not rest on an equal footing, comparisons of passage rates derived from a limited 21-day count in 2001 and from the 2002 count also revealed probable declines for most species (Smith 2003). Thus, the generally low 2003 counts appear to extend this pattern, which may be related to the effects of prolonged and widespread drought (Hoffman and Smith 2003).

Among other fall migration sites closest to Commissary Ridge, the 2003 overall combined-species count dropped 12% in the Wellsville Mountains of Utah compared to the 1977–2001 average for that site (Smith 2004a); dropped 13% in the Bridger Mountains of southwestern Montana compared to the 1991–2002 average for that site (Smith 2004b); dropped 9% in the Goshute Mountains of northeastern Nevada compared to the 1983–2002 average that site (but dropped ~40% compared to the past five years; Smith 2004c); and rose 26% in the Manzano Mountains of New Mexico compared to the 1985–2002 average for that site (Smith 2004d).

Thus, continuing declines likely related to the drought applied to several other sites in the interior West in 2003. However, two other confounding factors also may have contributed to artificially low counts at Commissary Ridge in 2003. First, despite careful screening and training, one of the observers we first assigned to work the site in 2003 simply did not work out and almost certainly resulted in lower than expected counts during the first four weeks of the season. We subsequently replaced this person with a higher caliber individual and therefore expect that counts from the later half of the season are more robust. It is also true, however, that the overall caliber of our 2003 full-time observers was less than in 2002, because the lead counter in 2002 was a multi-year veteran of raptor migration counts, whereas all the full-time counters in 2003 were relative novices. Another indication of the effects of this difference in skill level is much higher proportions of partially identified accipiters and buteos in 2003 compared to 2002 (Table 1). Second, a higher prevalence of blue-sky days and strong winds in 2003 most likely rendered the detection of migrants more difficult than in 2002, especially for the less experienced observation team.

Future multivariate statistical modeling will allow us to largely remove the effects of observer variation and account for the influence of weather in producing long-term trend indices. In the meantime, fine-scale comparisons of the 2002 and 2003 count results are probably unwise. Suffice it to say that the two counts were in the same ballpark, but indications are that overall flight volume probably decreased at least slightly between 2002 and 2003 for most species. Obvious exceptions to probable declines include Ospreys, for which the count tripled compared to 2002 and doubled compared to 2001; Red-tailed Hawks, for which the count increased 27% in 2003 compared to 2002; and American Kestrels, for which the count increased 38% in 2003 compared to 2002. Counts of Ospreys were also slightly above average in Nevada and well above average in New Mexico in 2003, but were well below average in Utah and Montana. Counts of Red-tailed Hawks were at least slightly above average in all four of these migration-project areas. Counts of kestrels were above average in Montana and New Mexico, but below average in Utah and Nevada.

DAILY AND SEASONAL MIGRATION PATTERNS

The average daily rhythm of the migration at Commissary Ridge followed a similar pattern in 2002 and 2003 (Figure 4). Flight activity typically increased rapidly to a peak during the 1000 hour, tapered off slightly during the next hour, and then remained fairly steady through the 1600 hour before rapidly tapering off to minimal activity by the end of the 1700-hour. This is a fairly typical daily rhythm for western migration sites, except that a peak during the 1000 hour is an hour or two earlier than at most other similar sites. Reasons for this earlier peak are not yet clear.

Overall, combined-species seasonal activity also followed roughly similar patterns in 2002 and 2003: a bimodal pattern with a primary activity peak in late September and secondary peak in mid-October (Figure 5). The late September activity peak corresponds primarily to peak activity periods for Turkey Vultures, immature accipiters, immature Red-tailed Hawks, and American Kestrels, whereas the mid-October activity peak corresponds primarily to peak activity for adult accipiters, adult Red-tailed Hawks, and eagles (Tables 2 and 3). Curiously, this prominent bimodal pattern is not shown as distinctly at other western sites, probably reflecting higher relative abundance of late-season Red-tailed Hawks and especially eagles.

The 12-day gap in coverage in 2002 again potentially confounds comparisons of species-specific median passage dates in 2002 and 2003, by causing the 2002 values to potentially be later than would be the case had coverage been more consistent throughout the season. This is likely to be especially true for species or age classes (namely immature birds) with primary activity periods in September (Tables 2 and 3).

AGE RATIOS

Among 10 species that show sufficient age-related plumage variation to allow for in-flight differentiation of immature and adult birds, identified adults were at least 20% more common than immatures for seven species, immature and adult Northern Harriers were equally common, and identified adults were 30–40% less common than immatures/subadults for Northern Goshawks and Golden Eagles (Table 4). Immature : adult ratios were at least slightly lower than in 2002 for six species, higher than in 2002 for three species, and did not vary appreciably for one species. Lower immature : adult ratios due to proportionately low abundance of immature birds, which was the case for all species showing reduce age ratios in 2003, may be indicative of reduced nesting success and juvenile recruitment within source populations.

RESIDENT RAPTORS

A resident immature Sharp-shinned Hawk was observed twice in early and mid-September. At least one resident immature Cooper's Hawk was seen regularly from 1 to 23 September. Several times early in the season, a maximum of three brown Northern Harriers were observed acting as locals. At least one of these birds was positively identified as an immature bird. An adult male harrier also was observed several times with an immature bird. Single harrier observations persisted until 8 October. Two pairs of adult Red-tailed Hawks (three light morphs and a dark morph) were recorded regularly as locals until 27 September. Up to three immature light-morph Red-tailed Hawks also were commonly seen in the area, with the last local immature recorded on 21 October. One resident adult, light-morph Swainson's Hawk was recorded frequently between 31 August and 15 September. At least one immature and one adult Golden Eagles were identified early in the season. Some display flight by an unknown eagle was recorded on 31 August, and one instance of two unidentified Golden Eagles flying together occurred on 13 September, but that was the limit of obvious activity indicating a resident pair. However, sightings of apparently local adults and at least on immature eagle continued throughout the season, clearly suggesting that a local family group was present in the area. At least two female and one male American Kestrels were identified as residents and were seen regularly through 4 October. One possible resident Prairie Falcon was seen on 7 September moving south to northeast through the area. Resident Turkey Vultures were observed frequently through 25 September. The highest count of a non-migratory group was five, but three vultures were seen together regularly.

This resident assemblage is similar to that recorded in 2002. Differences include the fact that local adult Sharp-shinned and Cooper’s Hawks were apparent in 2002, as well as an immature Northern Goshawk, and several resident Bald Eagles were observed foraging along the adjacent Ham’s Fork River Valley to the west late in the season in 2002.

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Table 1. Observation effort and fall-migration counts and passage rates by raptor species at Commissary Ridge, Wyoming: 2002–2003.

	2002	2003	% CHANGE	2002	2003	% CHANGE
Start date	27-Aug	27-Aug				
End date	29-Oct	29-Oct				
Observation days	45	63	+40			
Observation hours	322.67	474.85	+47			
SPECIES	RAPTOR COUNTS			RAPTORS / 100 HOURS		
Turkey Vulture	97	66	-32	30.1	13.9	-54
Osprey	11	31	+182	3.4	6.5	+92
Northern Harrier	32	25	-22	9.9	5.3	-47
Sharp-shinned Hawk	675	516	-24	209.2	108.7	-48
Cooper's Hawk	409	329	-20	126.8	69.3	-45
Northern Goshawk	21	7	-67	6.5	1.5	-77
Unknown small accipiter	78	75	-4	24.2	15.8	-35
Unknown large accipiter	6	13	+117	1.9	2.7	+47
Unknown accipiter	16	58	+263	5.0	12.2	+146
TOTAL ACCIPITERS	1205	998	-17	373.4	210.2	-44
Broad-winged Hawk	8	5	-38	2.5	1.1	-58
Swainson's Hawk	82	28	-66	25.4	5.9	-77
Red-tailed Hawk	823	1042	+27	255.1	219.4	-14
Ferruginous Hawk	6	3	-50	1.9	0.6	-66
Rough-legged Hawk	5	5	0	1.5	1.1	-32
Unidentified buteo	17	87	+412	5.3	18.3	+248
TOTAL BUTEOS	941	1170	24	291.6	246.4	-16
Golden Eagle	352	233	-34	109.1	49.1	-55
Bald Eagle	233	90	-61	72.2	19.0	-74
Unidentified eagle	10	7	-30	3.1	1.5	-52
TOTAL EAGLES	595	330	-45	184.4	69.5	-62
American Kestrel	258	355	+38	80.0	74.8	-7
Merlin	9	6	-33	2.8	1.3	-55
Prairie Falcon	6	5	-17	1.9	1.1	-43
Peregrine Falcon	3	3	0	0.9	0.6	-32
Unknown small falcon	0	3	–	0.0	0.6	–
Unknown large falcon	0	0	–	0.0	0.0	–
Unknown falcon	2	0	-100	0.6	0.0	-100
TOTAL FALCONS	278	372	+34	86.2	78.3	-9
Unidentified raptor	38	68	+79	11.8	14.3	+22
GRAND TOTAL	3197	3060	-4	990.8	644.4	-35

Table 2. First and last observed and bulk passage dates by species for the fall raptor migration at Commissary Ridge, Wyoming in 2003, with a comparison of median passage dates in 2002 and 2003.

Species	2003 First Observed	2003 Last Observed	2003 Bulk Passage Dates[1]	2003 Median Passage Date[2]	2002 Median Passage Date[2]
Turkey Vulture	28-Aug	11-Oct	11-Sep – 27-Sep	20-Sep	23-Sep
Osprey	6-Sep	12-Oct	11-Sep – 20-Sep	11-Sep	20-Sep
Northern Harrier	27-Aug	22-Oct	9-Sep – 22-Oct	28-Sep	22-Sep
Sharp-shinned Hawk	27-Aug	27-Oct	15-Sep – 19-Oct	30-Sep	25-Sep
Cooper's Hawk	27-Aug	26-Oct	14-Sep – 15-Oct	23-Sep	23-Sep
Northern Goshawk	20-Sep	21-Oct	20-Sep – 21-Oct	14-Oct	5-Oct
Broad-winged Hawk	20-Sep	23-Oct	20-Sep – 23-Oct	21-Sep	23-Sep
Swainson's Hawk	31-Aug	25-Sep	6-Sep – 21-Sep	11-Sep	27-Sep
Red-tailed Hawk	27-Aug	28-Oct	20-Sep – 23-Oct	13-Oct	6-Oct
Ferruginous Hawk	27-Aug	10-Oct	–	–	19-Sep
Rough-legged Hawk	18-Oct	24-Oct	7-Sep – 24-Oct	20-Oct	20-Oct
Golden Eagle	27-Aug	29-Oct	8-Sep – 25-Oct	8-Oct	9-Oct
Bald Eagle	1-Sep	29-Oct	4-Oct – 24-Oct	18-Oct	16-Oct
American Kestrel	31-Aug	19-Oct	20-Sep – 29-Sep	19-Sep	23-Sep
Merlin	20-Sep	14-Oct	20-Sep – 14-Oct	7-Oct	24-Sep
Prairie Falcon	7-Sep	16-Oct	7-Sep – 16-Oct	20-Sep	23-Sep
Peregrine Falcon	29-Sep	24-Oct	–	–	–
Combined	27-Aug	29-Oct	15-Sep – 22-Oct	29-Sep	26-Sep

[1] Dates between which the central 80% of the flight passed the lookout; calculated only for species with a total count ≥5 birds.

[2] Date by which 50% of the flight had passed the lookout; calculated only for species with a total count ≥5 birds.

Table 3. Fall-migration median passage dates by age classes for selected raptor species at Commissary Ridge, Wyoming: 2002–2003.

	Immature/Subadult		Adult	
Species	2002	2003	2002	2003
Northern Harrier	25-Sep	3-Oct	25-Sep	27-Sep
Sharp-shinned Hawk	20-Sep	4-Oct	8-Oct	7-Oct
Cooper's Hawk	20-Sep	21-Sep	24-Sep	21-Sep
Northern Goshawk	22-Sep	–	9-Oct	–
Red-tailed Hawk	24-Sep	11-Oct	9-Oct	14-Oct
Golden Eagle	9-Oct	7-Oct	11-Oct	11-Oct
Bald Eagle	15-Oct	20-Oct	16-Oct	18-Oct

Note: Median passage dates are dates by which 50% of the flight had passed the lookout; calculated only for species with age-specific total counts of ≥5 birds.

Table 4. Annual fall-migration counts by age classes and immature : adult ratios for selected raptor species at Commissary Ridge, Wyoming: 2002–2003.

	Total and Age-classified Counts						% Unknown Age		Imm. : Adult Ratio	
	2002			2003						
	Total	Imm.	Adult	Total	Imm.	Adult	2002	2003	2002	2003
Northern Harrier	32	5	10	25	9	9	53	28	0.5	1.0
Sharp-shinned Hawk	675	220	213	516	78	195	36	47	1.0	0.4
Cooper's Hawk	409	163	109	329	68	112	33	45	1.5	1.3
Northern Goshawk	21	8	10	7	4	3	14	0	0.8	1.3
Broad-winged Hawk	8	2	5	5	0	3	13	40	0.4	0.0
Red-tailed Hawk	823	212	411	1042	385	487	24	16	0.5	0.8
Ferruginous Hawk	6	3	2	3	0	1	17	67	1.5	0.0
Golden Eagle[1]	352	172	117	233	99	70	18	27	1.5	1.4
Bald Eagle[1]	233	75	158	90	28	62	0	0	0.5	0.5
Peregrine Falcon	3	2	0	3	0	2	33	33	2.0	0.0

[1] For Golden and Bald Eagles, counts of immature birds include all juvenile and subadult plumage classes (see Appendix A).

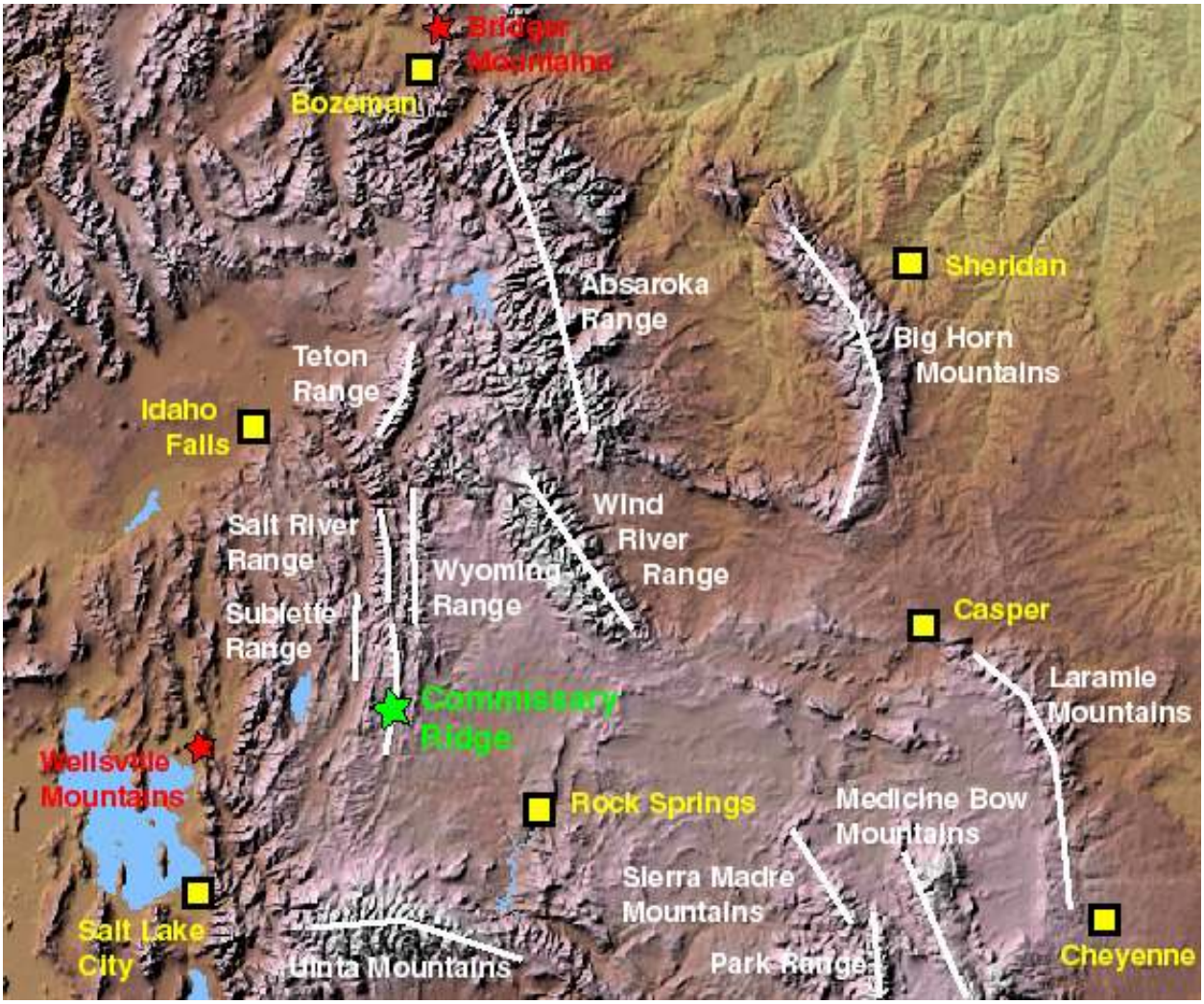
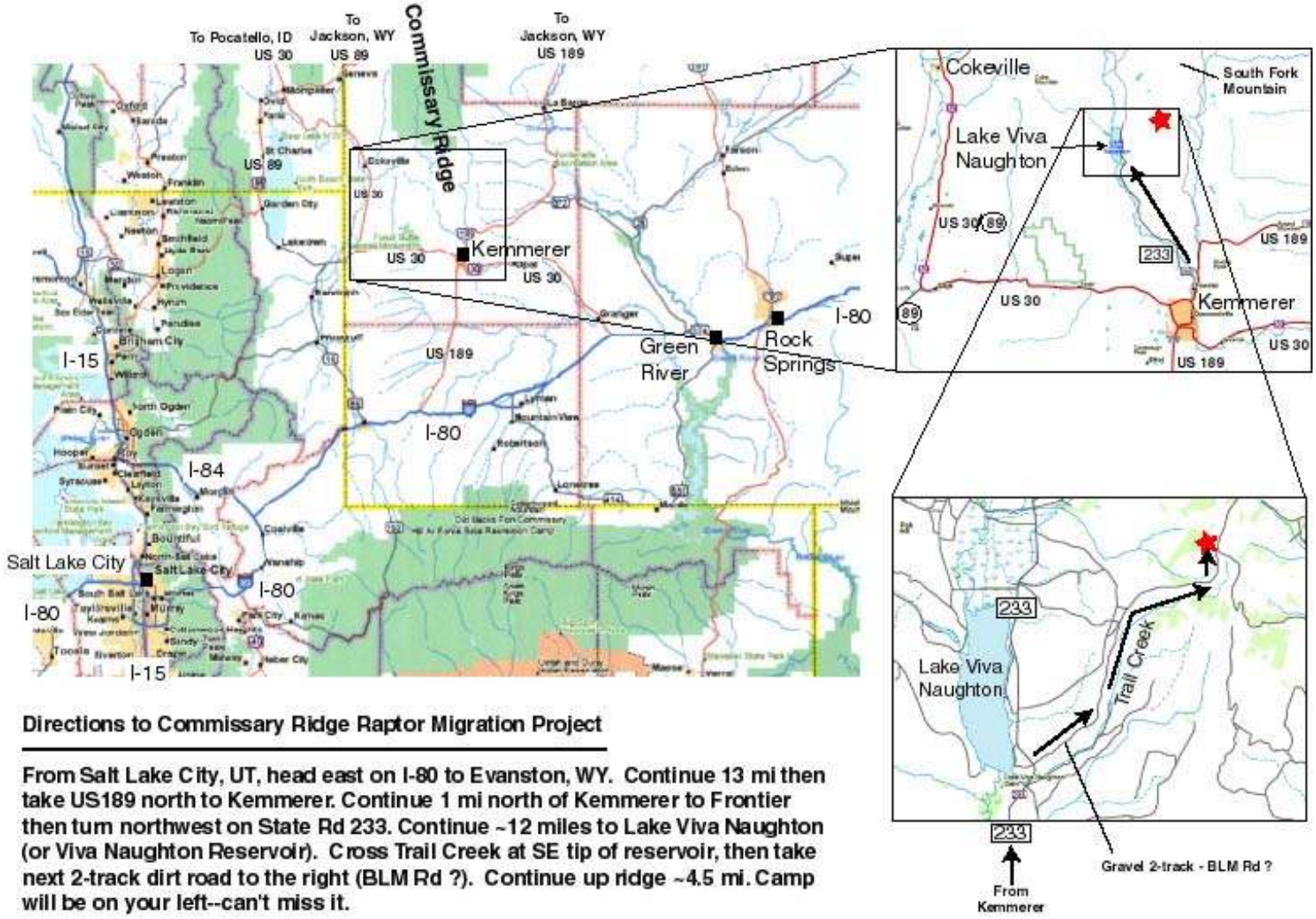


Figure 1. Location of Commissary Ridge Raptor Migration Project site in southwestern Wyoming. Red stars indicate other nearby HWI fall migration monitoring sites in Utah and Montana.



Directions to Commissary Ridge Raptor Migration Project

From Salt Lake City, UT, head east on I-80 to Evanston, WY. Continue 13 mi then take US189 north to Kemmerer. Continue 1 mi north of Kemmerer to Frontier then turn northwest on State Rd 233. Continue ~12 miles to Lake Viva Naughton (or Viva Naughton Reservoir). Cross Trail Creek at SE tip of reservoir, then take next 2-track dirt road to the right (BLM Rd ?). Continue up ridge ~4.5 mi. Camp will be on your left--can't miss it.

From Rock Springs, WY, head west on I-80 37 mi, then take US30 northwest to Kemmerer. Continue as above.
From Idaho, proceed to Pocatello then take I-15 south to US30. Proceed southeast on US 30 to Kemmerer. Continue as above.

Figure 2. Directions for accessing the Commissary Ridge Raptor Migration Project site in southwestern Wyoming.

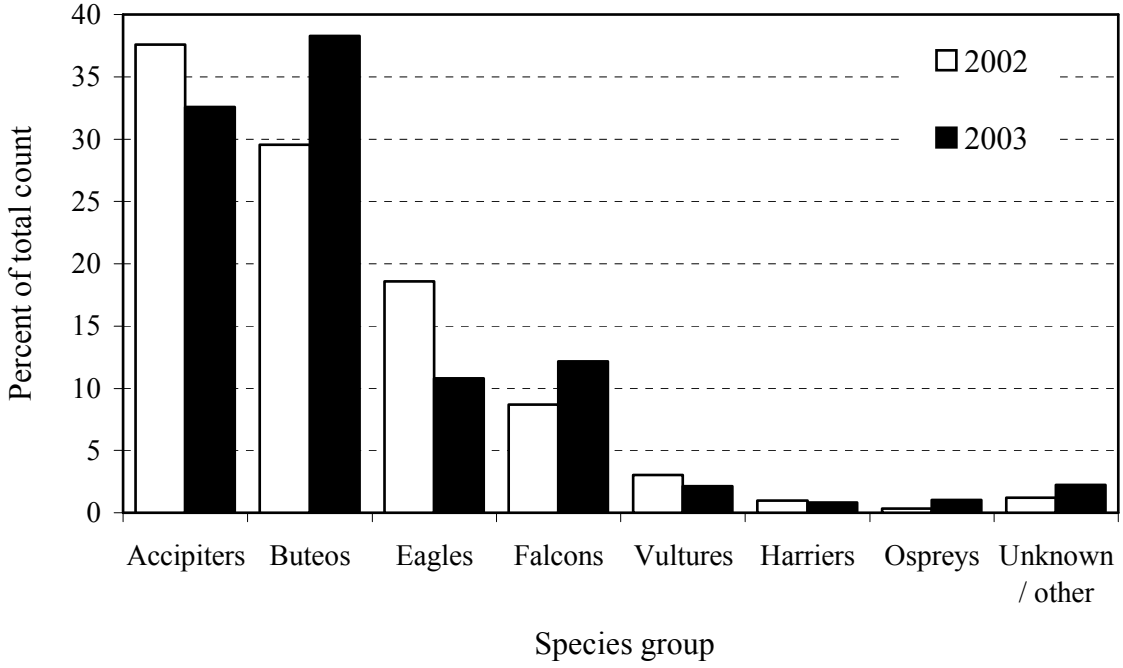


Figure 3. Composition by major species groups of the fall raptor migration at Commissary Ridge, Wyoming: 2002–2003.

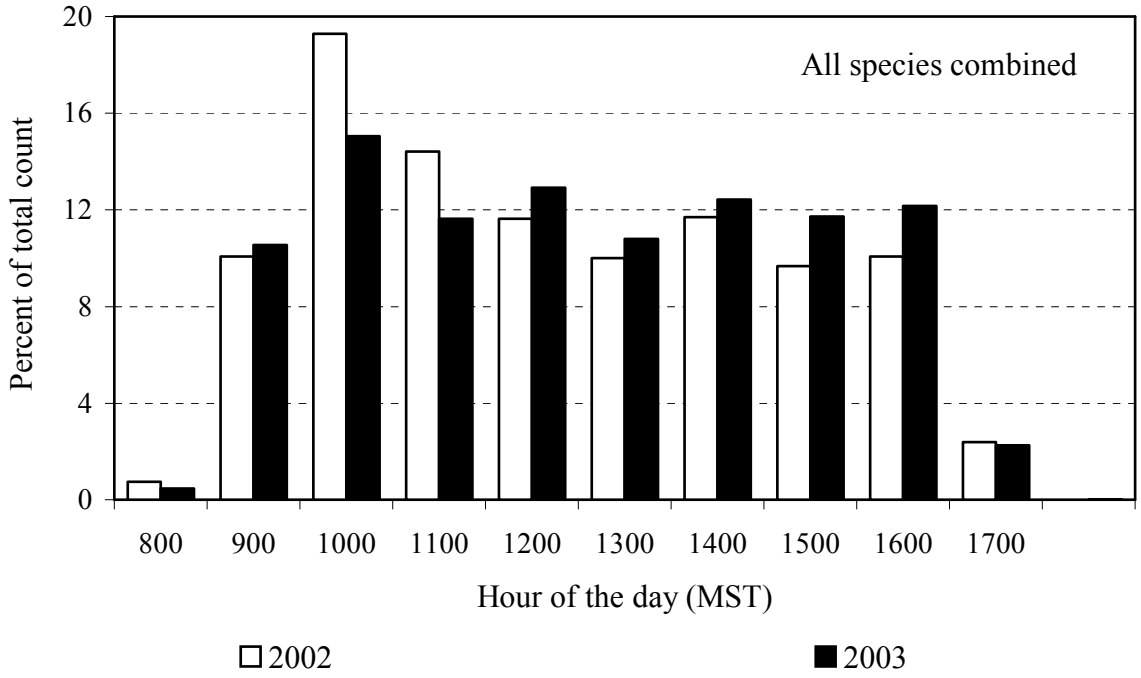


Figure 4. Daily rhythm of the fall raptor migration at Commissary Ridge, Wyoming: 2002–2003.

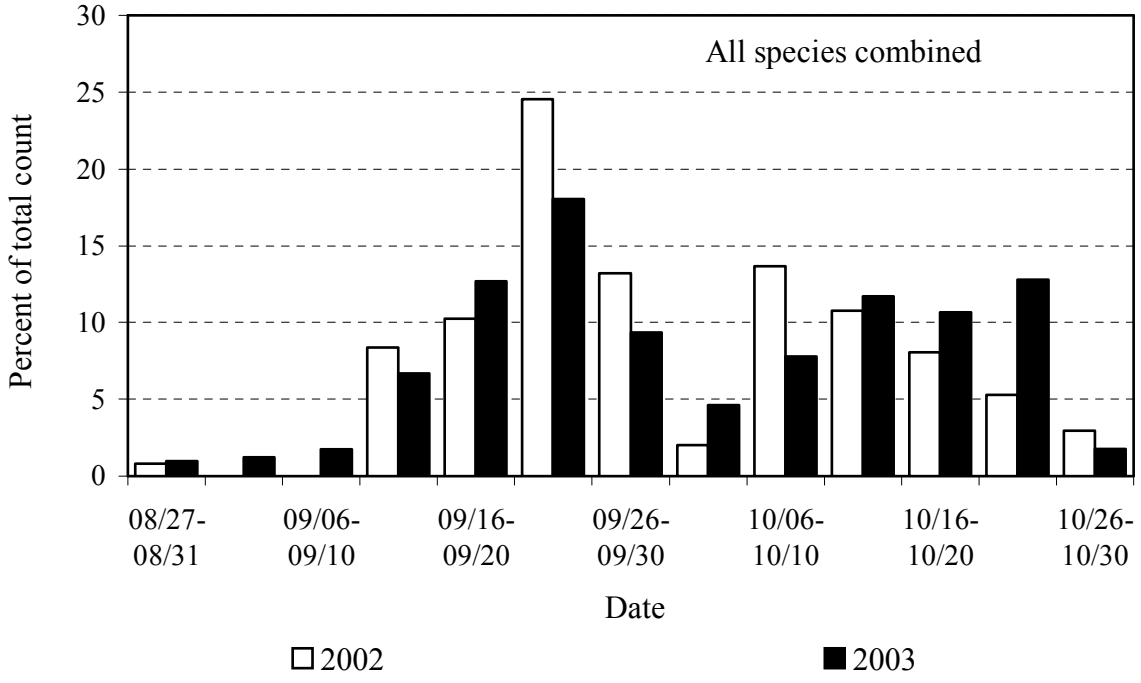


Figure 5. Combined-species seasonal pattern of the fall raptor migration at Commissary Ridge, Wyoming: 2002–2003.

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

[1] Age codes: A = adult, I = immature (HY), Br = brown (adult female or immature), U = unknown age.

[2] Sex codes: M = male, F = female, U = unknown.

[3] Color morph codes: D = dark or rufous, L = light, U – unknown, NA = not applicable.

[4] Golden Eagle age codes: I = Immature: juvenile or first-year bird, bold white wing patch visible below, bold white in tail, no molt; S = Subadult: white wing patch variable or absent, obvious white in tail and molt or tawny bar visible on upper wing; NA = Not adult: unknown age immature/subadult; A = Adult: no white in wings or tail; U = Unknown.

[5] Bald Eagle age codes: I = Immature: juvenile or first-year bird, dark breast and tawny belly; S1 = young Subadult: Basic I and II plumages, light belly, upside-down triangle on back; S2 = older Subadult: Basic III plumage, head mostly white with osprey-like dark eye line and dark band on tail; NA = Not adult: unknown age immature/subadult; A = Adult: includes near adult with dark flecks in head and dark tail tip, and adult with white head and tail; U = Unknown.

Appendix B. Daily observation effort, visitor disturbance ratings, weather records, and flight summaries for the fall raptor migration at Commissary Ridge, Wyoming: 2003.

Date	Obs. Hours	Obsrvr / Hour[1]	Median Visitor Disturb[2]	Predominant Weather[3]	Wind Speed (kph)[1]	Wind Direction	Temp (°C)[1]	Barom. Press. (in Hg)[1]	Median Thermal Lift[4]	Visib. East (km)[1]	Visib. West (km)[1]	Median Flight Distance[5]	Birds / Hour
27-Aug	8.00	2.9	0	clr-mc	42	w-wnw	19.7	29.87	4	82	88	0	0.9
28-Aug	8.00	2.1	0	clr-pc	28	wsw-wnw	22.6	29.98	1	87	89	0	0.8
29-Aug	5.50	2.0	0	mc-ovc, PM rain	6	var	18.8	30.02	4	65	57	0	0.4
30-Aug	4.50	2.0	0	ovc, AM fog, scat rain	25	w-nw	14.5	29.99	4	51	46	0	0.4
31-Aug	8.00	2.0	0	clr	10	w	18.6	30.04	1	85	88	0	1.6
1-Sep	8.00	2.0	0	clr-mc	17	sse, w-nw	21.3	30.06	2	70	92	0	2.5
2-Sep	7.00	1.6	0	mc-ovc, PM ts/rain	12	wnw-nw, calm/var	18.9	30.07	4	81	80	1	1.4
3-Sep	8.00	2.0	0	clr-pc	13	ese, ne	18.7	30.14	3	83	95	0	0.1
4-Sep	8.00	1.9	0	clr-pc	7	e-se, w-wsw	22.3	30.08	2	82	81	0	0.5
5-Sep	5.00	1.7	0	ovc, scat rain	8	se/calm, nw	18.5	30.02	4	71	76	0	0.4
6-Sep	7.75	2.0	0	pc-ovc	20	w-nw	20.2	29.95	4	44	71	0	1.7
7-Sep	8.25	2.0	0	clr	33	w-nw	18.2	29.85	3	85	86	0	2.1
8-Sep	4.20	1.8	0	ovc-clr	31	wnw-nw	13.9	29.59	4	56	66	0	1.0
9-Sep	7.00	1.8	0	ovc, PM rain	16	nw, sse-sw	13.3	29.59	4	72	71	0	2.7
10-Sep	0.00			fog									
11-Sep	8.00	2.0	0	clr-pc	43	w-nw	11.2	29.92	4	98	88	0	4.1
12-Sep	8.50	4.0	1	clr-mc	59	w-nw	12.5	29.61	4	76	80	0	8.5
13-Sep	8.00	2.0	0	clr	22	w-nw	12.8	29.96	2	97	98	0	5.0
14-Sep	8.00	1.9	0	clr	23	w-nw	14.2	29.98	2	77	98	0	2.8
15-Sep	8.00	1.5	0	clr-pc, AM haze	41	w	18.3	29.83	3	83	86	0	4.6
16-Sep	8.00	1.8	0	pc-ovc	56	sw-wnw	17.5	29.52	4	55	58	0	3.8
17-Sep	1.00	2.0	0	ovc, snow	43	w	8.3	29.42	4	28	14	0	1.0
18-Sep	8.00	2.0	0	clr-pc	15	sw-wnw	10.0	29.94	3	89	92	0	1.9
19-Sep	8.00	1.0	0	mc-clr	23	w-wnw	15.2	29.86	3	86	87	0	6.0
20-Sep	9.25	2.7	0	clr	41	w	14.2	29.84	3	85	86	0	31.8
21-Sep	8.50	3.0	0	clr	36	wnw-nw	14.8	29.88	3	91	89	0	25.1
22-Sep	8.25	1.8	0	clr	27	w-nw	17.5	29.95	3	76	97	1	8.2
23-Sep	8.25	2.0	0	clr	42	wsw-nw	18.0	29.85	3	85	89	0	14.3
24-Sep	8.50	3.0	0	clr	29	nw	18.5	29.95	3	83	94	0	8.2
25-Sep	8.00	2.5	0	clr	45	w-wnw	19.2	29.95	4	82	83	0	10.4
26-Sep	8.00	3.0	0	clr-mc	48	wnw-nw	18.9	29.92	4	81	84	0	13.1
27-Sep	8.00	2.0	0	clr	18	wsw-w	17.8	29.99	2	76	90	0	5.5
28-Sep	6.75	2.0	0	clr	18	ene-ese, w	17.6	29.98	3	87	86	0	5.9
29-Sep	8.00	2.0	0	clr, haze	21	e-se, sw-w	16.3	29.86	2	73	90	0	7.4
30-Sep	8.00	2.0	0	clr	11	e, sw-w	14.2	30.05	3	81	81	0	4.8
1-Oct	7.50	2.0	0	mc-ovc, AM haze, PM ts	13	ese, sw-wnw, s	19.1	30.03	3	70	78	0	6.7
2-Oct	3.32	2.0	0	ovc, PM ts/rain	2	calm/ne	15.2	29.83	4	74	81	0	1.5
3-Oct	8.00	1.8	0	pc	36	e-ese	12.4	29.81	3	73	89	0	0.6
4-Oct	8.00	2.0	0	clr	13	ese, sw-w	14.0	29.78	3	82	89	1	8.0
5-Oct	8.00	2.0	0	clr, haze	18	w-wnw	16.9	29.89	2	85	90	0	2.3
6-Oct	8.00	2.0	0	clr-pc	17	w-wnw	18.0	29.89	3	86	86	0	3.5
7-Oct	8.00	2.0	0	pc-ovc, AM haze	22	wsw-wnw	16.3	29.73	4	76	88	0	4.1
8-Oct	8.00	2.0	0	clr, PM haze	39	w	16.3	29.76	4	85	85	0	6.4
9-Oct	8.00	2.0	0	clr, AM haze	38	sw-w	18.3	29.67	2	85	84	0	7.8
10-Oct	7.50	2.0	0	ovc-clr	55	wsw-wnw	7.1	29.49	4	81	79	0	8.5
11-Oct	8.50	1.9	0	clr	23	sw-w	8.8	29.85	3	83	80	1	7.4
12-Oct	8.00	2.0	0	pc-mc	47	w-wnw	12.4	29.78	4	83	77	0	16.1
13-Oct	8.00	2.0	0	clr-mc	37	w	5.9	29.88	3	90	89	0	1.9
14-Oct	8.00	2.0	0	ovc-clr	35	s, w-wnw	9.6	29.69	4	82	85	0	8.9
15-Oct	7.50	2.0	0	ovc	37	wsw-w	8.4	29.72	4	83	83	0	10.7

Appendix B. continued

Date	Obs. Hours	Obsrvr / Hour[1]	Median Visitor Disturb[2]	Predominant Weather[3]	Wind Speed (kph)[1]	Wind Direction	Temp (°C)[1]	Barom. Press. (in Hg)[1]	Median Thermal Lift[4]	Visib. East (km)[1]	Visib. West (km)[1]	Median Flight Distance[5]	Birds / Hour
16-Oct	8.00	2.0	0	clr-pc	48	w	11.1	29.94	4	77	82	1	3.8
17-Oct	8.00	1.4	0	clr, AM haze	31	w-wnw	14.9	30.10	3	83	82	1	5.0
18-Oct	8.00	2.0	0	pc-ovc	15	s-wsw	17.3	30.13	2	85	83	0	5.0
19-Oct	8.00	1.6	0	mc-ovc	40	wsw-w	15.2	30.01	4	87	91	0	21.0
20-Oct	8.00	1.4	0	clr-pc	24	wsw-wnw	16.6	30.19	2	88	83	0	6.1
21-Oct	8.00	2.0	0	clr-pc	21	w-wnw	16.0	30.24	3	86	87	0	9.4
22-Oct	8.00	2.0	0	clr	21	sw-wsw	18.3	30.08	2	90	91	0	10.3
23-Oct	7.50	2.0	0	clr-ovc	42	w	14.8	29.85	4	79	78	0	16.9
24-Oct	8.00	1.4	0	clr-ovc	41	w-wnw	6.7	29.82	4	89	84	0	11.9
25-Oct	8.00	2.0	0	clr-pc	16	sw-wnw	5.8	30.07	3	85	85	0	1.5
26-Oct	8.00	1.9	0	pc-mc	26	w-nw	9.4	30.14	4	88	84	0	2.1
27-Oct	8.00	1.4	0	ovc	47	w	7.6	29.82	4	79	83	0	2.4
28-Oct	8.00	2.0	0	ovc	48	w	8.5	29.56	4	82	79	0	1.5
29-Oct	4.83	2.0	0	ovc	47	w	7.1	29.08	4	73	60	0	1.2
30-Oct	0.00			snow									
31-Oct	0.00			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 C. Fall raptor-migration counts by day and species at Commissary Ridge, Wyoming: 2003.

		Species[1]																										Birds
Date	Hours	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	8.00	0	0	1	1	1	0	0	0	0	0	0	1	2	0	0	1	0	0	0	0	0	0	0	0	0	0	7	0.9
28-Aug	8.00	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	6	0.8
29-Aug	5.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2	0.4
30-Aug	4.50	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0.4
31-Aug	8.00	0	0	1	2	1	0	0	0	0	0	1	5	0	0	1	1	0	0	1	0	0	0	0	0	0	0	13	1.6
01-Sep	8.00	1	0	0	1	1	0	1	0	0	0	1	8	0	0	2	4	1	0	0	0	0	0	0	0	0	0	20	2.5
02-Sep	7.00	1	0	0	0	0	0	0	1	0	0	0	3	0	0	0	4	1	0	0	0	0	0	0	0	0	0	10	1.4
03-Sep	8.00	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.1
04-Sep	8.00	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	4	0.5
05-Sep	5.00	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0.4
06-Sep	7.75	0	1	0	3	0	0	0	0	0	0	1	4	0	0	0	3	0	0	0	0	0	0	0	0	0	1	13	1.7
07-Sep	8.25	0	1	0	4	2	0	0	0	0	0	0	3	0	0	2	4	0	0	0	0	1	0	0	0	0	0	17	2.1
08-Sep	4.20	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	4	1.0
09-Sep	7.00	1	0	1	2	2	0	0	0	0	0	0	2	0	0	10	1	0	0	0	0	0	0	0	0	0	0	19	2.7
10-Sep	0.00	No observations – inclement weather																											
11-Sep	8.00	2	2	0	6	5	0	1	0	0	0	1	9	0	0	4	0	0	0	1	0	0	0	0	0	0	2	33	4.1
12-Sep	8.50	2	16	2	5	10	0	0	1	0	0	11	16	0	0	4	0	0	0	4	0	0	0	0	0	0	1	72	8.5
13-Sep	8.00	2	0	1	13	5	0	0	2	0	0	0	6	0	0	2	5	0	0	3	0	0	0	0	0	0	1	40	5.0
14-Sep	8.00	0	0	0	9	5	0	0	0	3	0	0	2	0	0	0	1	0	0	1	0	0	0	0	0	0	1	22	2.8
15-Sep	8.00	0	0	0	10	6	0	0	1	1	0	1	8	0	0	0	5	0	0	3	0	0	0	0	0	0	2	37	4.6
16-Sep	8.00	1	4	0	3	4	0	0	0	0	0	2	9	0	0	0	5	0	0	0	0	1	0	0	0	0	1	30	3.8
17-Sep	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1.0
18-Sep	8.00	0	0	0	7	1	0	0	0	2	0	0	3	0	0	0	1	0	0	1	0	0	0	0	0	0	0	15	1.9
19-Sep	8.00	0	2	1	14	8	0	1	1	0	0	0	8	0	0	0	5	0	0	5	0	0	0	0	0	0	3	48	6.0
20-Sep	9.25	18	1	3	11	29	1	6	0	2	1	6	29	0	0	7	9	0	0	167	1	0	0	0	0	0	3	294	31.8
21-Sep	8.50	9	0	0	59	46	0	2	3	3	1	2	33	0	0	1	5	0	0	44	1	1	0	0	0	0	3	213	25.1
22-Sep	8.25	6	0	0	8	15	0	2	2	0	1	0	18	0	0	0	4	0	0	9	0	0	0	0	0	0	3	68	8.2
23-Sep	8.25	3	0	0	25	19	0	2	1	7	0	0	21	0	0	1	4	0	0	31	0	0	0	1	0	0	3	118	14.3
24-Sep	8.50	1	0	0	12	11	0	4	0	1	0	1	22	0	0	2	2	0	0	13	0	0	0	0	0	0	1	70	8.2
25-Sep	8.00	2	0	0	12	15	1	1	0	4	0	1	25	0	0	3	6	1	0	12	0	0	0	0	0	0	0	83	10.4
26-Sep	8.00	3	0	0	14	17	0	6	0	4	0	0	36	0	0	3	5	0	0	15	0	0	0	0	0	0	2	105	13.1
27-Sep	8.00	8	0	1	5	8	0	2	0	0	0	0	12	0	0	0	4	1	0	3	0	0	0	0	0	0	0	44	5.5
28-Sep	6.75	0	0	1	7	9	0	4	0	3	0	0	6	0	0	1	6	1	0	2	0	0	0	0	0	0	0	40	5.9
29-Sep	8.00	0	0	1	15	3	0	11	0	0	0	0	5	0	0	0	4	1	0	13	0	0	1	2	0	0	3	59	7.4
30-Sep	8.00	0	0	0	3	4	0	0	0	6	0	0	13	0	0	8	2	0	1	0	0	0	0	0	0	0	1	38	4.8

Appendix C. continued

		Species[1]																										Birds
Date	Hours	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	7.50	1	0	1	15	5	0	6	0	0	0	0	10	0	0	0	5	0	0	3	0	0	0	0	0	0	4	50	6.7
02-Oct	3.32	0	0	0	2	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	5	1.5
03-Oct	8.00	0	0	0	1	1	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0.6
04-Oct	8.00	0	0	1	14	6	1	4	0	5	0	0	13	0	0	5	4	6	0	4	0	0	0	0	0	0	1	64	8.0
05-Oct	8.00	0	0	1	4	4	0	0	0	0	0	0	4	0	0	0	0	1	0	0	0	0	0	0	0	0	4	18	2.3
06-Oct	8.00	0	0	1	3	4	0	0	0	4	0	0	8	0	0	2	3	2	0	1	0	0	0	0	0	0	0	28	3.5
07-Oct	8.00	0	0	1	5	3	0	0	0	0	0	0	18	0	0	3	1	1	0	1	0	0	0	0	0	0	0	33	4.1
08-Oct	8.00	0	1	0	14	1	0	0	0	3	0	0	12	0	0	0	5	3	1	4	1	0	0	0	0	0	6	51	6.4
09-Oct	8.00	1	0	0	10	4	0	2	0	0	0	0	29	0	0	1	9	1	0	2	0	0	1	0	0	0	2	62	7.8
10-Oct	7.50	0	0	1	8	10	0	7	0	0	0	0	32	1	0	0	4	0	0	1	0	0	0	0	0	0	0	64	8.5
11-Oct	8.50	2	1	0	21	5	0	0	0	2	1	0	21	0	0	0	5	3	0	0	1	1	0	0	0	0	0	63	7.4
12-Oct	8.00	0	1	1	36	12	0	3	0	3	0	0	54	0	0	2	5	5	2	2	1	0	0	0	0	0	2	129	16.1
13-Oct	8.00	0	0	0	1	5	0	1	0	0	0	0	5	0	0	0	0	1	0	1	0	0	0	0	0	0	1	15	1.9
14-Oct	8.00	0	0	0	29	6	0	2	0	4	0	0	17	0	0	2	6	1	0	0	1	0	0	0	0	0	3	71	8.9
15-Oct	7.50	0	0	0	20	7	1	1	1	0	0	0	40	0	0	1	3	4	0	1	0	0	0	0	0	0	1	80	10.7
16-Oct	8.00	0	0	0	9	1	0	1	0	0	0	0	15	0	0	0	2	0	0	0	0	1	0	0	0	0	1	30	3.8
17-Oct	8.00	0	0	0	4	5	0	0	0	0	0	0	23	0	0	0	4	0	1	0	0	0	0	0	0	0	3	40	5.0
18-Oct	8.00	0	0	0	7	8	0	2	0	0	0	0	11	0	1	2	4	3	0	1	0	0	0	0	0	0	1	40	5.0
19-Oct	8.00	0	0	0	18	2	1	0	0	0	0	0	113	0	0	2	8	16	0	4	0	0	0	0	0	0	4	168	21.0
20-Oct	8.00	0	0	0	8	1	0	0	0	0	0	0	35	0	1	0	3	1	0	0	0	0	0	0	0	0	0	49	6.1
21-Oct	8.00	0	0	2	7	3	2	0	0	0	0	0	46	0	1	2	7	2	0	0	0	0	0	0	0	0	3	75	9.4
22-Oct	8.00	0	0	3	5	1	0	1	0	0	0	0	54	0	0	1	7	10	0	0	0	0	0	0	0	0	0	82	10.3
23-Oct	7.50	0	0	0	14	3	0	1	0	0	1	0	83	0	1	2	12	10	0	0	0	0	0	0	0	0	0	127	16.9
24-Oct	8.00	0	0	0	3	0	0	0	0	0	0	0	66	0	1	4	12	6	1	0	0	0	1	0	0	0	1	95	11.9
25-Oct	8.00	0	0	0	1	0	0	0	0	0	0	0	3	0	0	1	4	3	0	0	0	0	0	0	0	0	0	12	1.5
26-Oct	8.00	0	0	0	3	2	0	0	0	0	0	0	3	0	0	2	7	0	0	0	0	0	0	0	0	0	0	17	2.1
27-Oct	8.00	0	0	0	1	0	0	0	0	0	0	0	8	0	0	0	9	1	0	0	0	0	0	0	0	0	0	19	2.4
28-Oct	8.00	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	4	3	0	0	0	0	0	0	0	0	0	12	1.5
29-Oct	4.83	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	2	1	0	0	0	0	0	0	0	0	0	6	1.2
30-Oct	0.00	No observations – inclement weather																											
31-Oct	0.00	No observations – inclement weather																											
Total	474.85	66	31	25	516	329	7	75	13	58	5	28	1042	3	5	87	233	90	7	355	6	5	3	3	0	0	68	3060	6.4

[1] See Appendix A for explanation of species codes.