SPRING 2002 RAPTOR MIGRATION STUDY
IN WEST-CENTRAL MONTANA NEAR ROGERS PASS

HawkWatch International, Inc.
Salt Lake City, Utah

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

The Rogers Pass spring raptor migration study in west-central Montana is an ongoing effort to monitor long-term trends in populations of raptors, primarily Golden Eagles (see Appendix A for scientific names of raptor species), using this northern Rocky Mountain migratory flyway (Smith and Hoffman 2000, Hoffman et al. 2002). To date, 14 species of migratory raptors have been recorded at the site, with counts typically ranging between 1,200 and 2,200 migrants per season. The count typically includes 93–96% Golden and Bald eagles.

The Rogers Pass project was 1 of 16 migration counts (13 fall, 3 spring) conducted or co-sponsored by HWI in North America during 2002. The primary objective of these efforts is to track long-term population trends of diurnal raptors throughout primarily western North America (Smith and Hoffman 2000). 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 likely represent the most cost-effective and efficient method for monitoring the regional status and trends of multiple raptor species (Bednarz and Kerlinger 1989, Titus et al. 1989, Bildstein et al. 1995, Dunn and Hussell 1995, Dixon et al. 1998, Smith and Hoffman 2000, Zalles and Bildstein 2000). In addition to the scientific value, HWI is also dedicated to providing opportunities for the public to learn about the ecology and conservation needs of raptors through personal exposure to raptor migrations and scientific research.

The interface of the Rocky Mountains and Great Plains represents an obvious migratory corridor for raptors, especially Golden Eagles (Tilly 1983, 1988, 1989, 1991; Tilly and Tilly 2001; Sherrington 1992, 2002). Prevailing westerly winds along the Rocky Mountain foothills create reliable updrafts for migrating raptors in a nearly continuous line extending from north-central Mexico through New Mexico, Colorado, Wyoming, Montana, and western Canada. The attractiveness of this route for spring, northbound migrants (especially eagles) is enhanced by the abundance of Columbian ground squirrels (*Spermophilus columbianus*) and black-tailed prairie dogs (*Cynomys ludovicianus*) newly emerged from winter burrows, carrion from spring calving, and migrating waterfowl. All are available on the plains in close proximity to the Rocky Mountain foothills.

The objective of the Rogers Pass study is to conduct a standardized count of primarily adult Golden Eagles migrating northward during spring through a 12.8 km (8 mi) wide corridor that is visible from Cave Knoll along the eastern edge of the Rocky Mountains near Rogers Pass in west-central Montana (Figure 1). More than 95% of the migration through this region passes within an 8 km (5 mi) wide area. This 2002 effort constituted the 14th year of spring migration study and 12th season of month-long standardized counts in the Rogers Pass area. In 1987, from a point labeled "Old Lookout" on Figure 1 (8 km northeast of Rogers Pass summit along the Middle Fork of the Dearborn River on Montana Route 200), we observed a large number of Golden Eagles passing to the northwest along Montana's Front Range on 8 days during March and April (Tilly 1988). The following year we expanded coverage during March (the period of peak adult, Golden Eagle migration activity) to 16 days and recorded 10.7 eagles/hr, which suggested the need for more complete daily counts. We then conducted standardized daily counts throughout March and early April of 1990 from Old Lookout and occasionally at three sites on the plains along Route 200 (at 9.6, 21.6, and 32 km to the northeast). The 1990 study confirmed our suspicions that migratory activity was highly concentrated along the eastern foothills of the Front Range. Thus, we conducted standardized counts at Old Lookout again in late February and March 1992. Then in 1993, in accordance with landowner preference (the Front Range foothill area is mostly private land), we moved the count to Blacktail Ranch about 4 miles southeast of Old Lookout, and have used this new site each year since then. The current site is very similar to the previous site in elevation and visibility. Both sites are within 0.8 km (0.5 mi) of the pathway used by most migrants, but the current site offers better

visibility of a secondary flight path along the Continental Divide. These latter birds are not a large part of the total migration, and differences in the count results after 1992 attributable to using the new lookout are probably minimal.

In this report, we summarize observations made at the Blacktail Ranch site during spring 2002. We present and discuss data on seasonal timing, daily flight rhythms, and the species, age, sex, and color morph composition of the flight. In addition, where appropriate we compare statistics for the 2002 season with means and annual trends for previous seasons.

STUDY AREA

The eastern edge of the Rocky Mountains runs mostly northwest to southeast through Montana. Rogers Pass is located where Montana Route 200 crosses the Continental Divide, 40 miles north-northwest of Helena (Figure 1). The current primary observation post at Cave Knoll sits atop a low ridge just west of Blacktail Cave (elevation 1,470 m) along the South Fork of the Dearborn River, 7.2 km east-northeast of Rogers Pass (elevation 1,730 m) and 4.8 km upstream from the headquarters of Blacktail Ranch (47°06.00' N, 112°17.00' W; Rogers Pass Quad, T16N R5W, S31; Figure 2). The canyon bottom and ridges are heavily forested with ponderosa pine (*Pinus ponderosa*) and Douglas-fir (*Pseudotsuga menziesii*), but there are several large clearings. A 0.4-km long clearing ends at the top of the Cave Knoll ridge, 75 m above the canyon bottom, providing an excellent view in all directions. The bulk of the migration passes along the west side of Roberts Mountain (peak elevation 1,813 m), which lies 0.8 km to the east of the lookout (Figure 1). Denton Mountain drops off into the canyon 3.2 km to the south and migrants coming off that ridge pass the lookout about 1.6 km to the west, where they continue on the ridge forming Sunset Mountain. At its closest point to the Cave Knoll lookout, the steep ridge forming the Continental Divide (average elevation 2,160 m) is 5.4 km to the southwest.

During this and past seasons, we occasionally used two alternate observation sites along the South Fork. The Upper Canyon site is in the canyon bottom in a large clearing at the base of Roberts Mountain. It is 1.5 km east northeast of Cave Knoll and affords a good view of the Continental Divide to the west while birds on the main flight path along Roberts Mountain pass directly overhead. This lookout is used when extreme wind and cold make it too difficult to observe from the more exposed Cave Knoll site. The Canyon Mouth site was used when fog or low clouds obscured the upper canyon area and shifted the flight eastward toward the east side of Roberts Mountain and the Plains (Figure 2). This site is about 4 km northeast of the Cave Knoll site on a 30-m high hill overlooking the ranch house (elevation 1,342 m). This site is in open grassland with an unobstructed view out to the Plains, along the east side of Roberts Mountain, and up the canyon to the Continental Divide where observers can spot distant migrants as they cross the canyon. Both of these alternate observation sites afford a good view of migrants as they cross the canyon and it is unlikely that their use affects the accuracy of the count to any significant degree.

METHODS

We conducted standardized daily counts of migrating raptors from the traditional lookouts described above from 1–31 March 2002. We counted every day unless hampered by inclement weather, usually beginning around 0900 hrs and ending around 1700 hrs Mountain Standard Time (MST).

During official observations, we 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. Exact time of passage (MST).
3. Wind speed and direction, air temperature, percent cloud cover, predominant cloud type(s), precipitation, visibility, and an assessment of thermal lift conditions, recorded for each hour of observation on the half hour.
4. Flight direction, altitude, and lateral distance from the Cave Knoll observation site.
5. Total minutes observed and mean number of observers (official observers plus any person that actively assisted with scanning and locating raptors for more than 10 minutes in a given hour) and visitors (all other guests) present during each hour.
6. Daily start and stop times for each observer.

We used high quality, wide-angle, 10x binoculars to assist in spotting and identifying birds. Primary identification references included Clark and Wheeler (1987), Dunne et al. (1988), and Wheeler and Clark (1995). Assessments of wind speed, cloud type, cloud cover, and flight altitude followed guidelines published by the Hawk Migration Association of North America (HMANA). We classified thermal lift as poor, fair, good or excellent based on the following criteria: (1) how rapidly raptors gained altitude in areas where there was little wind-driven lift; (2) the presence of cumulus clouds, which indicate strong thermal lift; (3) the temperature at ground level; and (4) wind speed, which tends to limit thermal formation. We recorded all weather variables on-site.

We estimated lateral distances of migrants from the Cave Knoll observation site, regardless of the observation location. Knowing the exact distance from the observation site to the various ridges used by the migrants simplified distance estimation. The migration was generally low enough that we could effectively relate the position of birds to ridgelines; however, we estimate an error factor of 10% for lateral distance estimates. We recorded lateral distances as east or west with 0 for birds passing within 0.25 mi (0.4 km), 1 for 0.25–1 mi (0.4–1.6 km), 2 for 1–2 mi (1.6–3.2 km), and so on out to 4 mi (6.4 km) west and 6 mi (9.6 km) east.

Migrant raptors tend to have a direct flight pattern. Therefore, we typically classified all birds seen perching, hunting, or performing territorial displays as residents and excluded them from the count. We recorded as northbound migrants all raptors seen heading north past the lookout that did not appear to stop or change direction while in view. We assume that southbound birds were non-migratory adults searching for more productive wintering grounds in the local region (i.e., within 100 km of their usual territory).

In this report, we compare results from the 2002 season to means for previous seasons and examine trends in annual counts and passage rates. In comparing 2002 annual statistics (i.e., passage rates, passage dates, age ratios, sex ratios, and color-morph ratios) against means and 95% confidence intervals for previous seasons, we equate significance with a 2002 value falling outside the bounds of the confidence interval for the associated mean. We generally limit comparisons of long-term counts and passage rates to comparing 2002 versus means for 1993–2001 to minimize possible sampling biases associated with changes in coverage and count locations.

Accurately ageing non-adult eagles was difficult given typical observation distances during the count. Therefore, in this report we lumped all immature (first-year eagles) and subadult Golden Eagles that still showed white in the wings or tail into the "immature" category, and all those that showed no distinct white in the wings or tail in the “adult” category. Similarly, although distinguishing different age classes of young Bald Eagles is often easier because the relevant plumage differences are more distinct, for summary purposes we again lumped all non-adult birds in a single “immature” category. However,

unlike for Golden Eagles, it is important to note that the "adult" Bald Eagle category inevitably includes most "first-plumage-adult" or Basic IV birds as described by Clark (2001), birds that can be distinguished at close range but generally not during a migration count.

RESULTS AND DISCUSSION

WEATHER SUMMARY

The weather during March 2002 was generally cold with a moderate to strong SW wind (see Appendix B for daily weather summaries). This March was similar to that of 1996 and 1997 in having a high percentage of cold days (Table 1). Cold days (i.e., a high temperature of ≤6°C) numbered 16 during March 2002, not counting five days suspended due to heavy snowfall. There were 18 days with snow and one with rain, again similar to 1996 and 1997 (Table 1). There were six measurable snowfalls during the count period, 5.1 cm (2 in) on 1 March, 25.4 cm (10 in) on 5, 6, and 7 March, 5.1 cm on 16 March, 55.9 cm (22 in) on 19 and 20 March, and 2.5 cm (1 in) on 28 and 30 March. We suspended observations for five entire days and parts of five other days because of excessive snowfall and fog. During such times, the foul weather probably translated to impossible conditions for both the observers and migrating raptors; thus, we most likely missed few migrating birds during the suspended observations. High winds and excessive cold and fog also forced us to conduct counts at the two alternate sites (Upper Canyon and Canyon Mouth) much more than usual this season (15 days versus 2–7 during the past three years).

The season featured a slightly below average number of days with strong westerly winds (12). Four of these days had wind gusts of over 80 kph—the particularly violent wind usually associated with the Front Range in March. Thermal lift rated poor on 18 days, fair on 13 days, and never good or excellent. As usual, westerly winds and cool temperatures kept thermals down, and flight conditions on convectional currents along the ridges were generally good.

OBSERVATION EFFORT

This season we counted for 167.5 hours during 26 days between 1–31 March (see Appendix C for daily observation records). The number of observation days and hours were 9% and 19% lower than the 1993–2001 means, respectively, with both differences significant and related to the high prevalence of foul weather (Table 2). Observations occurred at Cave Knoll on 11 days, Upper Canyon on 7 days, and Canyon Mouth on 8 days.

MIGRATION SUMMARY

As in past seasons, the migration consisted mainly of Golden Eagles (82% of migrants recorded; see Appendix D for count summaries for each year of the project). All eagles combined (i.e., Golden, Bald, and unidentified eagles) accounted for 94% of the total count. The 2002 eagle migration featured below average activity during the first three weeks of March, followed by a pronounced peak during the last 11 days (Figure 3). Persistent cold and snow cover kept migration to a minimum until 24 March when the peak period commenced. Another snowstorm curtailed migration on 30 March. A fair flight occurred on 31 March, followed by a large two-day snowstorm on 1 and 2 April. A marked drop in eagle migration activity typically occurs during the last week of March signaling the end of the peak passage period for adult Golden Eagles. This did not occur this year. Overall, the migration was 8–10 days later than average. Flights exceeded 100 birds on only 3 days between 24–29 March (see Appendix C for daily count records). Because the migration was delayed and still going strong at the end of the observation period, it is likely that we missed some of the migrants that normally would have passed through during March (particularly adult Golden Eagles). In fact, extended-season monitoring at Mt. Lorette, Alberta confirmed that a substantial, later-than-usual wave of Golden Eagle migration occurred in early April,

with the median passage date for the species at this site 9 days later than average (P. Sherrington personal communication). The median passage date for Golden Eagles at Jordanelle Reservoir in northern Utah also was a significant 10 days later than average (Smith 2002).

Moderate to very strong March winds resulted in low flight paths along the west slope of Roberts Mountain for most migrants. Eagles passing within 1 mi (1.6 km) of Cave Knoll near the northwest base of Roberts Mountain accounted for 80% of the total eagle flight in 2002 (Figure 4). This compares to a range of 73–90% between 1993 and 2001. The main flight lines through the count area consist of the west-facing slopes of three ridge systems (Figures 1 and 2). The most important is Roberts Mountain, continuing across the canyon on Joe's Mountain. This flight line passes the Cave Knoll lookout about 1.2 km (0.75 mi) to the east. Migrant eagles recorded as 0, 1, or 2 east were using the Roberts Mountain flight line and accounted for 67% of all migrants seen this season. Second in importance is the Denton Mountain flight line, which passes the Cave Knoll lookout about 1.6 km (1 mi) to the west and continues on the north side of the canyon along Sunset Mountain. Migrants recorded as 0, 1 or 2 west were on this line and accounted for 25% of the total eagle migration. The Continental Divide ridge, which comes to within 5.4 km (3.4 mi) west of Cave Knoll, was not used very much this season and is generally not a heavily used pathway. Migrants visible along the top of this ridge are recorded as 3 or 4 west and accounted for only 4% of the migration this season. The remaining 4% of the migration passed east of Roberts Mountain, away from the three main ridgelines.

SPECIES ACCOUNTS

We counted 916 migrating **Golden Eagles** on 25 days between 2–31 March, with counts reaching 100 or more only on 24 and 26 March (Appendix C). The count and passage rate of 546.9 birds / 100 hrs were 35% and 21% below average, respectively, with both differences significant (Table 2). Golden Eagles accounted for 89% of all eagles identified to species. Based on this figure, we estimate that 21 of 24 unidentified eagles were Golden Eagles, which brings the estimated seasonal total to 937. The count included 346 adults (83% of aged birds), 70 immatures/subadults (17% of aged birds), and 500 birds of unknown age/plumage class (55% of all Golden Eagles). The percentage of adults was slightly below the range observed during previous years (88–96%, Table 3). One resident pair of Golden Eagles occupied the study area during the season, and other non-migrating immatures or adults also occasionally wandered through.

The 2002 Golden Eagle count was the lowest recorded since daily March counts began in 1990 (Appendix D). Moreover, counts and passage rates were on an increasing trajectory through 1997, but have declined steadily since then (Figure 5). Weather influences may account for the low eagle counts after 1997. Unusually cold winter weather that lasted well into March may have produced record high counts and passage rates in 1996 and 1997. Such conditions may force a larger percentage of migrants south of the count site for the winter. In addition, prolonged winter cold may limit eagle foraging on the Plains due to a lack of emergent ground squirrels and result in a more concentrated migration along the mountains. The winters after 1997 have been unusually warm in Montana and areas to the north. Therefore, it is possible that increasing numbers of Golden Eagles are remaining north of the count site for the winter. The migration in March is mainly composed of adults, which are the birds most likely to remain north for the winter. In this regard, it may be noteworthy that the count at Mt. Lorette, Alberta, was only 1% below average in 2002 and trends there have remained relatively stable since 1997 (Sherrington 2002, personal communication). Warmer winters also may be resulting in a more dispersed migration, but if this were the primary factor, one would expect the Alberta counts to be dropping as well.

A detailed analysis of winter weather data and winter eagle counts along the Rockies was not done for this report, but may be a promising area for explaining variations in Golden Eagle counts at Rogers Pass. Weather can significantly affect surveys of migrating Golden Eagles, in particular, because in many areas

this species is only partially migratory, moving variable distances according to impending winter weather and foraging conditions. Therefore, this survey is probably not reliable for documenting relatively small population changes on a short-term basis, and multivariate analyses that account for weather influences likely will be necessary to yield reliable indications of long-term populations changes.

We counted 110 migrating **Bald Eagles** on 17 days between 2–31 March, with 1-day high counts of 39 and 21 birds on 26 and 29 March (Appendix C). The count and passage rate of 65.7 birds / 100 hrs were 27% and 10% below average, respectively, but only the difference in counts was significant (Table 2). The count was the lowest since 1990 (second lowest ever; Appendix D). Bald Eagles accounted for 11% of all eagles identified to species. Based on this figure, we estimate that 3 of 24 unidentified eagles were probably Bald Eagles, which brings the estimated seasonal total to 113. The 2002 count included 96 adults (91% of aged birds), 9 immatures and subadults (9% of aged birds), and 5 birds of unknown age/plumage class (5% of all Bald Eagles; Table 3). The percentage of adults was slightly above the range seen in previous years (78–90% for 1988–2001). During the season, individual birds occasionally wandered into the count area and then returned south. A wintering concentration of Bald Eagles occurs at Hauser Lake about 32 km (20 mi) to the southeast, which could account for these observations. Currently, no distinct long-term trend is evident for this species; however, a fairly steady and continuing decline has occurred since 1993 (Figure 5).

We counted no migrating **Ospreys** or **Northern Harriers** this year. We have recorded only two migrating Ospreys at the site, both in 1996, whereas this is the first year we have not observed migrating harriers (average 3 per year previously; Appendix D). We observed one apparent resident adult male harrier on 31 March.

We counted 4 migrating **Sharp-shinned Hawks** on 3 days between 15–31 March (Appendix C). The count was a significant 55% below average and the lowest since 1990 (Table 2, Appendix D). The count included 1 adult and 3 birds of unknown age. We recorded no resident birds.

We counted 1 migrating adult **Cooper's Hawk** on 15 March, which is typically when the smaller accipiters start moving through the area. The long-term average count is 2 (Table 2, Appendix D). We recorded no resident birds.

We counted 4 migrating **Northern Goshawks** on 3 days between 26–29 March (Appendix C). The count was 40% below average, but the difference was not significant (Table 2, Appendix D). The count included 2 adults and 2 birds of unknown age. A resident pair of adult goshawks moved into count-site area on 13 March and we observed courtship flights for the first time on 15 March. A resident pair has occupied the site every year and makes accurate counting of migrants difficult.

We counted 37 migrating **Red-tailed Hawks** on 7 days between 3–31 March (Appendix C). The count and passage rate of 22.1 birds / 100 hrs were 20% and 46% above average, respectively, with the difference in passage rates highly significant (Table 2, Appendix C). Although the pattern has been unsteady, a gradual, long-term increasing pattern is evident for this species (Figure 6), which matches the pattern observed throughout the West (Hoffman and Smith in review). The count included 16 light-morph adults, 4 dark-morph adults, and 17 birds of unknown age and color morph. The timing of Red-tailed Hawk passage was generally late, except for two migrants that passed on 3 and 9 March. The rest passed from 26 to 31 March (Appendix C). As in past seasons, a local pair occupied a territory near the lookout. The first member of the local pair arrived on territory on 23 March, which is later than usual. Both were present on 27 March. As in past years, we sometimes had trouble distinguishing migrants from non-migrants.

We counted 2 migrating light-morph **Ferruginous Hawks** of unknown age on 24 and 28 March, which is slightly below the long-term average of 3 birds (Table 2, Appendix D). Both birds were heading

northwest when counted, which is the predominant flight line for most species. We recorded no resident birds.

We counted 9 migrating **Rough-legged Hawks** on 8 days between 2–31 March (Appendix C), which is 24% lower than the long-term average count (Table 2, Appendix D). The tally included 6 light morphs, 1 dark morph, and 2 birds of unknown color morph. Seven birds headed due north toward the Plains and 2 to the NW. We recorded one non-migrant individual in the count area on 21 March.

We recorded one migrating **American Kestrel** on 31 March. We have recorded kestrels at the site only twice before, in 1992 and 1993 (Appendix D). We recorded no resident birds.

We counted 2 migrating **Merlins** of the Prairie race (*F. c. richardsonii*) on 10 and 24 March, which matches the long-term average count (Appendix D). We recorded no resident birds.

We counted 2 migrating **Prairie Falcons** on 10 and 31 March, which matches the long-term average count (Appendix D). We recorded one non-migrating individual on 9 March.

In addition to the above birds, we counted 27 raptors (2.4% of the total flight) that we could not identify to species: 24 unidentified eagles, 1 unidentified buteo, 1 unidentified falcon, and 1 unidentified raptor. These values are below average for buteos and eagles and near average for falcons and unknown raptors (Table 2, Appendix D).

OBSERVER EFFECTIVENESS

Resident birds generally did not pose a problem this season. The pair of local Northern Goshawks and the pair of local Red-tailed Hawks could have caused some confusion. It is unlikely, however, that the pair of resident adult Golden Eagles and other occasional eagles that remained in the count area had any effect on count accuracy. The local birds generally flew along different pathways than the migrants, and the resident pair of eagles frequently engaged in distinctive territorial displays.

Two observers were present at the lookout 69% of the time (Appendix D). A single observer covered 8 days. From 1993–2001, the number of single-observer days ranged from 2–12. In 2002, the prevalence of westerly winds and lack of good thermal lift kept the flight generally low and concentrated, so it is unlikely that the number of single-observer days significantly diminished the probability of detecting migrants.

BEHAVIORAL NOTES ON MIGRATION OBSERVATIONS

During days of light wind and fair, but not good, thermal lift, migrating eagles tend to pass in small "flocks" as they search for areas of reasonably good lift. We saw little of such flight behavior this season as our light wind days usually featured cold conditions with little migration. Groups of 2–5 eagles were the rule, with individuals tending to remain within <1 km of each other.

Eagles generally show no hunting behavior as they pass the lookout, instead flying directly through to the northwest. At times in past seasons, however, Golden Eagles have pursued migrating geese and swans. Waterfowl pass through on a north or northeast heading perpendicular to the mountains and the path of the Rogers Pass eagle migration. We recorded no predatory behavior this year, probably because weather conditions favored a low eagle flight and the waterfowl came through at higher altitudes.

NON-RAPTOR SPECIES OBSERVED IN MIGRATION

The 2002 waterfowl migration began late with none until 13 March when 10 Canada Geese (*Branta canadensis*) passed to the north (Table 4). Thirty Snow Geese (*Chen caerulescens*) appeared on 15 March, but cold weather resulted in reverse migration on 17 and 22 March with two small flocks crossing back to the south over the mountains. Our first duck sightings of the season were of Pintails (*Anas*

acuta) and unidentified ducks heading south. We spotted 90 of these on 22 March and 980 on 23 March. The first large northward movement of waterfowl occurred on 26 March, with 1,660 Snow Geese and the first 40 Tundra Swans (*Cygnus columbianus*). Large Snow Goose flights occurred again on 30 and 31 March. As usual, the waterfowl crossed the mountains on a southwest to northeast heading, turning north after reaching the plains. At 2,773, Snow Goose numbers were about average, having ranged from 4,015 in 1993 and 1995 to 1,331 in 1996 and only 655 in 1999. The count of 172 Tundra Swans was below average, having ranged from 895 in 1993 to 110 in 1994 and 1999. Waterfowl counts can be quite variable at this site because the birds cross the mountains from the southwest in dispersed fashion at numerous locations.

We recorded the first Mountain Bluebird (*Sialia currucoides*) on 25 March, which is later than normal. Occasional American Robins (*Turdus migratorius*) occurred in the study area throughout March, but the usual influx after mid-month did not occur. We also observed no Tree Swallows (*Tachycineta bicolor*) in the area this season. Similarly, although large concentrations of Pine Siskins (*Carduelis pinus*) and Red Crossbills (*Loxia curvirostra*) have occurred in the canyon during March in past seasons, especially in 1996, we observed none this season. In contrast, Common Redpolls (*Carduelis flammea*) were present during the entire month, with flocks of up to 60 birds. Bohemian Waxwings (*Bombycilla garrulus*) also were present in about average numbers this season, with flocks of 100 and 50 noted on 26 and 27 March. The number of dead pine trees in the canyon has increased during the past three years due to disease and insects. This year we noted several Black-backed (*Picoides arcticus*) and Three-toed Woodpeckers (*Picoides tridactylus*) feeding in the dead pines.

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Table 1. Annual summaries of weather conditions during March: 1990–2002.

	1990		1992		1993		1994		1995		1996		1997		1998		1999		2000		2001		2002	
Total sample period (days)	31		31		31		31		31		31		31		31		31		31		31		31	
Clear days (≤15% PM cloud cover)	14	45%	16	52%	10	32%	14	45%	5	16%	3	10%	8	26%	9	29%	12	39%	10	32%	13	42%	6	19%
Partly cloudy days	2	6%	5	16%	5	16%	12	39%	17	55%	10	32%	16	52%	9	29%	11	35%	10	33%	6	19%	13	42%
Overcast days (≥75%)	15	48%	10	32%	16	52%	5	16%	9	29%	19	61%	7	22%	13	42%	8	26%	11	35%	12	39%	12	39%
Days with snow	9	29%	4	13%	6	19%	9	29%	9	29%	18	58%	16	52%	12	39%	11	35%	12	39%	8	26%	18	58%
Days with rain	0	0%	5	16%	3	10%	1	3%	3	10%	3	10%	2	6%	3	10%	0	0%	0	0%	1	3%	1	3%
Entire count days suspended	7	23%	2	6%	2	6%	1	3%	4	13%	7	23%	2	6%	3	10%	2	6%	2	6%	5	21%	5	21%
Partial count days suspended	3	10%	4	13%	6	19%	4	13%	3	10%	4	13%	5	16%	6	19%	0	0%	2	6%	1	3%	5	21%
Days w/ strong (>24 kph) W or SW wind	17	55%	10	32%	17	55%	16	52%	14	45%	13	54%	25	81%	17	61%	15	48%	17	55%	13	42%	12	39%
Days of light wind (<16 kph)	4	13%	15	48%	8	26%	6	19%	5	16%	5	21%	2	6%	8	29%	9	29%	2	6%	5	21%	9	29%
Days w/ strong (>16 kph) E or NE wind	4	13%	4	13%	1	3%	0	0%	4	13%	4	17%	2	6%	3	11%	0	0%	0	0%	0	0%	1	3%
Days of poor thermal lift	13	42%	8	26%	11	35%	9	29	16	52%	17	55%	7	23%	9	29%	7	23%	9	29%	7	23%	18	58%
Days of fair thermal lift	12	39%	14	45%	17	55%	14	45%	12	39%	12	39%	19	61%	17	55%	19	61%	18	58%	23	74%	13	42%
Days of good thermal lift	6	19%	8	26%	3	10%	8	26%	3	10%	2	6%	5	21%	3	10%	5	16%	4	13%	1	3%	0	0%
Days of excellent thermal lift	0	0%	1	3%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
Cold days – high temperature ≤6°C	12	39%	2	6%	6	19%	9	29%	13	42%	20	65%	19	61%	12	39%	14	45%	12	39%	13	42%	16	52%

Table 2. Annual observation effort and raptor migration counts by species: 1993–2001 versus 2002.

	1993–2001 Mean ± 95% CI		2002	% Change	1993–2001 Mean ± 95% CI	2002	% Change
Start date	1-Mar	0.3	1-Mar				
End date	31-Mar	0.3	31-Mar				
Observation days	28.6	1.09	26	-9			
Observation hours	205.67	11.727	167.5	-19			
Species	Raptor Count				Birds / 100 hrs		
Osprey	0.2	0.44	0	-100	0.1 ± 0.25	0.0	-100
Northern Harrier	3.7	1.63	0	-100	1.8 ± 0.79	0.0	-100
Sharp-shinned Hawk	9	2.6	4	-55	4.4 ± 1.56	2.4	-46
Cooper's Hawk	2.3	1.08	1	-57	1.1 ± 0.47	0.6	-47
Northern Goshawk	6.7	2.92	4	-40	3.3 ± 1.43	2.4	-27
Unidentified accipiter	1.1	0.69	0	-100	0.6 ± 0.34	0.0	-100
Total accipiters	10.1	3.56	5	-51	4.9 ± 1.70	3.0	-40
Red-tailed Hawk	31	7.2	37	20	15.2 ± 3.74	22.1	46
Ferruginous Hawk	3.1	1.20	2	-36	1.5 ± 0.58	1.2	-21
Rough-legged Hawk	12	3.6	9	-24	5.6 ± 1.60	5.4	-5
Unidentified buteo	2.6	1.76	1	-61	1.2 ± 0.88	0.6	-52
Total buteos	48.2	8.49	49	2	23.5 ± 4.24	29.3	24
Golden Eagle	1401	169.2	916	-35	688.7 ± 102.42	546.9	-21
Bald Eagle	150	17.9	110	-27	73.3 ± 9.29	65.7	-10
Unidentified eagle	38	9.5	24	-36	18.5 ± 4.85	14.3	-23
Total eagles	1588	187.1	1050	-34	780.6 ± 112.16	626.9	-20
American Kestrel	0.2	0.29	1	350	0.1 ± 0.14	0.6	459
Merlin	1.7	1.03	2	20	0.8 ± 0.47	1.2	50
Prairie Falcon	1.7	1.03	2	20	0.8 ± 0.51	1.2	44
Gyrfalcon	0.1	0.22	0	-100	0.1 ± 0.11	0.0	-100
Unidentified falcon	0.6	0.66	1	80	0.3 ± 0.33	0.6	118
Total falcons	4.2	1.90	6	42	2.1 ± 0.89	3.6	74
Unidentified raptor	2.2	1.90	3	35	1.1 ± 0.95	1.8	66
Grand Total	1666	192.4	1118	-33	818.5 ± 115.61	667.5	-18

Table 3. Age composition of eagle migration: 1990–2002

	Year	Total	Number Classified	Adult	Immature / Subadult	% Adult	% Unknown
Golden Eagle	1990	980	679	645	34	95%	31%
	1992	1,299	532	501	31	94%	59%
	1993	1,549	894	859	35	96%	42%
	1994	1,448	678	622	56	92%	53%
	1995	1,437	800	753	47	94%	44%
	1996	1,653	692	623	69	90%	58%
	1997	1,836	665	587	78	88%	64%
	1998	1,355	664	595	69	90%	51%
	1999	1,129	553	505	48	91%	51%
	2000	1,110	642	590	52	92%	42%
	2001	1,089	612	543	69	89%	44%
	2002	916	416	346	70	83%	55%
	Total	14,885	7,411	6,823	588	92%	49%
Bald Eagle	1990	90	85	65	20	77%	6%
	1992	170	148	120	28	81%	13%
	1993	202	173	147	26	85%	14%
	1994	174	159	127	32	80%	8%
	1995	153	140	122	18	87%	8%
	1996	134	127	113	14	89%	5%
	1997	162	157	132	26	81%	3%
	1998	151	146	131	15	90%	3%
	1999	115	111	94	17	85%	3%
	2000	141	136	108	28	79%	4%
	2001	118	114	87	27	76%	3%
	2002	110	105	96	9	91%	5%
	Total	1,610	1,496	1,246	251	83%	6%

Table 4. Migrating waterfowl sighted near Rogers Pass, Montana during spring 2002.

DATE	CANADA GOOSE	SNOW GOOSE	UNIDENTIFIED GOOSE	TUNDRA SWAN	UNIDENTIFIED DUCK
1 Mar	-	-	-	-	-
2 Mar	-	-	-	-	-
3 Mar	-	-	-	-	-
4 Mar	-	-	-	-	-
5 Mar	-	-	-	-	-
6 Mar	-	-	-	-	-
7 Mar	-	-	-	-	-
8 Mar	-	-	-	-	-
9 Mar	-	-	-	-	-
10 Mar	-	-	-	-	-
11 Mar	-	-	-	-	-
12 Mar	-	-	-	-	-
13 Mar	10	-	-	-	-
14 Mar	-	-	-	-	-
15 Mar	15	30	-	-	-
16 Mar	-	-	-	-	-
17 Mar	-	(12)[1]	-	-	-
18 Mar	-	-	-	-	-
19 Mar	-	-	-	-	-
20 Mar	-	-	-	-	-
21 Mar	-	-	-	-	-
22 Mar	2	(25)	29	-	-
23 Mar	214	-	-	-	(505)
24 Mar	4	-	-	-	-
25 Mar	25	-	-	-	(45)
26 Mar	120	1660	60	40	-
27 Mar	15	-	-	-	20
28 Mar	-	-	-	30	-
29 Mar	-	-	-	12	-
30 Mar	-	650	-	-	-
31 Mar	-	470	-	90	-
Total	405	2773	89	172	(530)

[1] Numbers in parentheses indicate southward, reverse migration due to inclement weather.

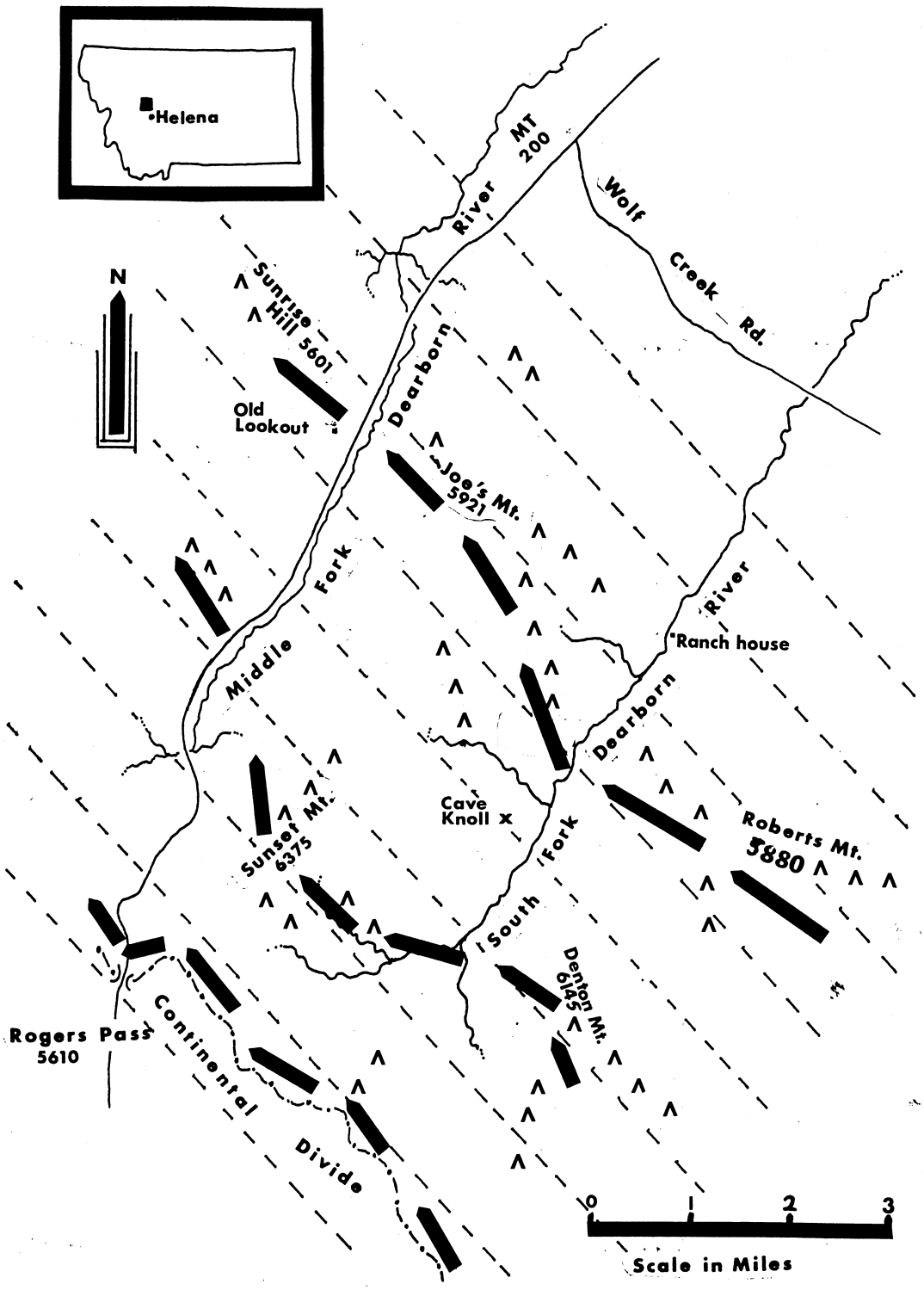

Figure 1. Map showing the east side of Rogers Pass in Montana, raptor migration observation sites, and 1-mile (1.6 km) segments used to record lateral distance from the observation sites.

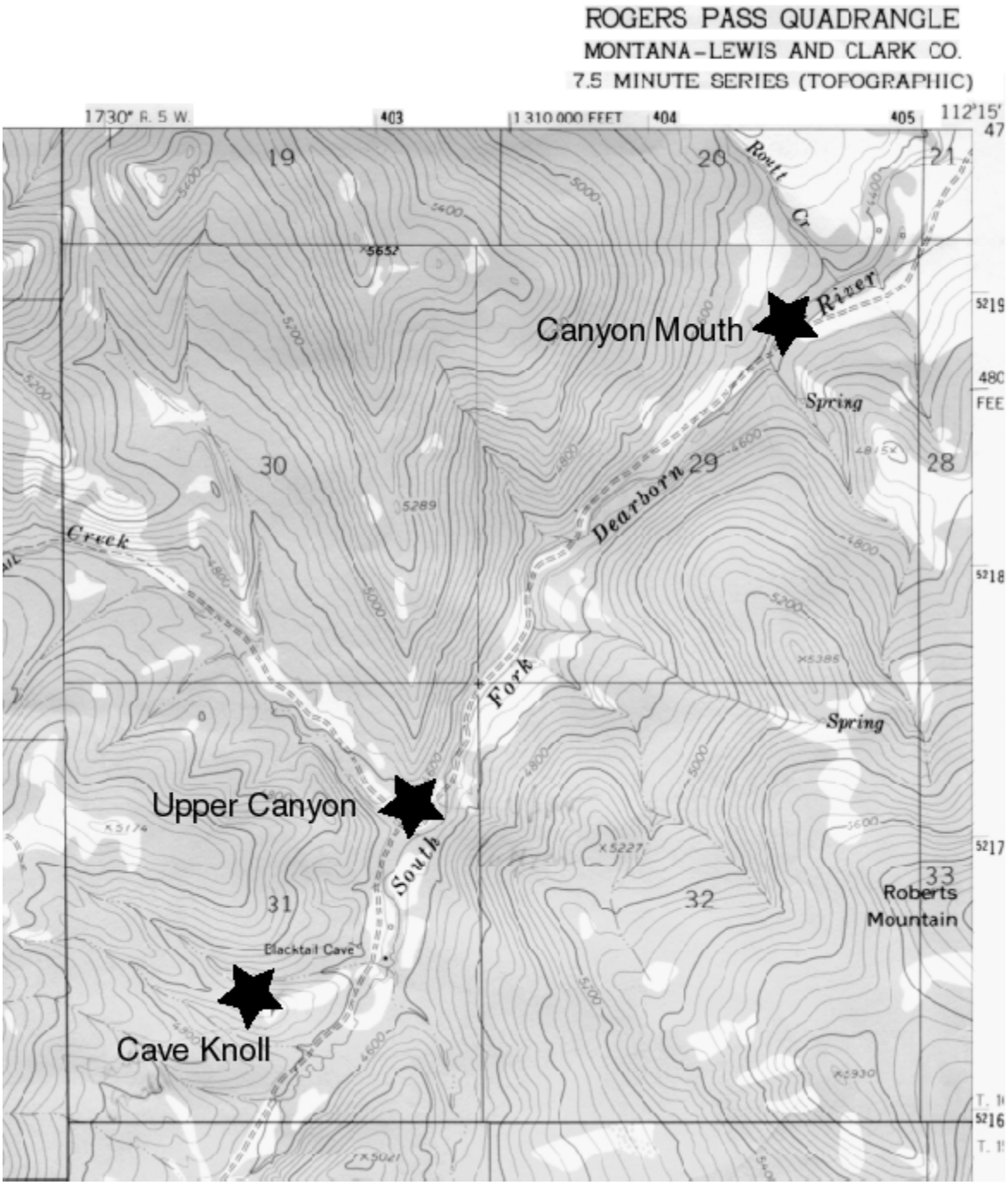

Figure 2. Topographic map showing the east side of Rogers Pass in Montana and raptor migration observation sites used during spring 2002.

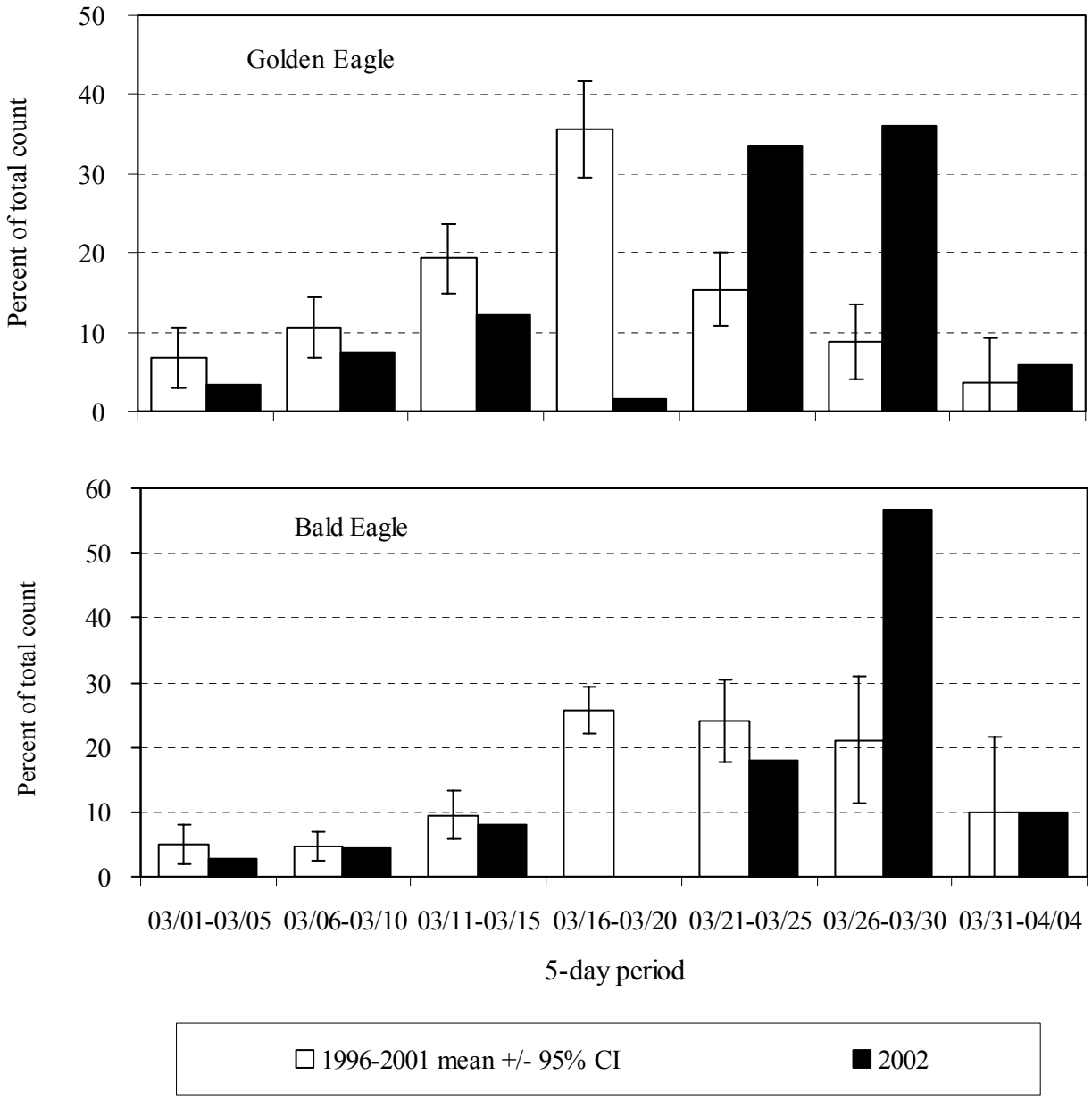

Figure 3. Seasonal migration pattern for Golden and Bald Eagles near Rogers Pass, Montana: 1996–2001 versus 2002.

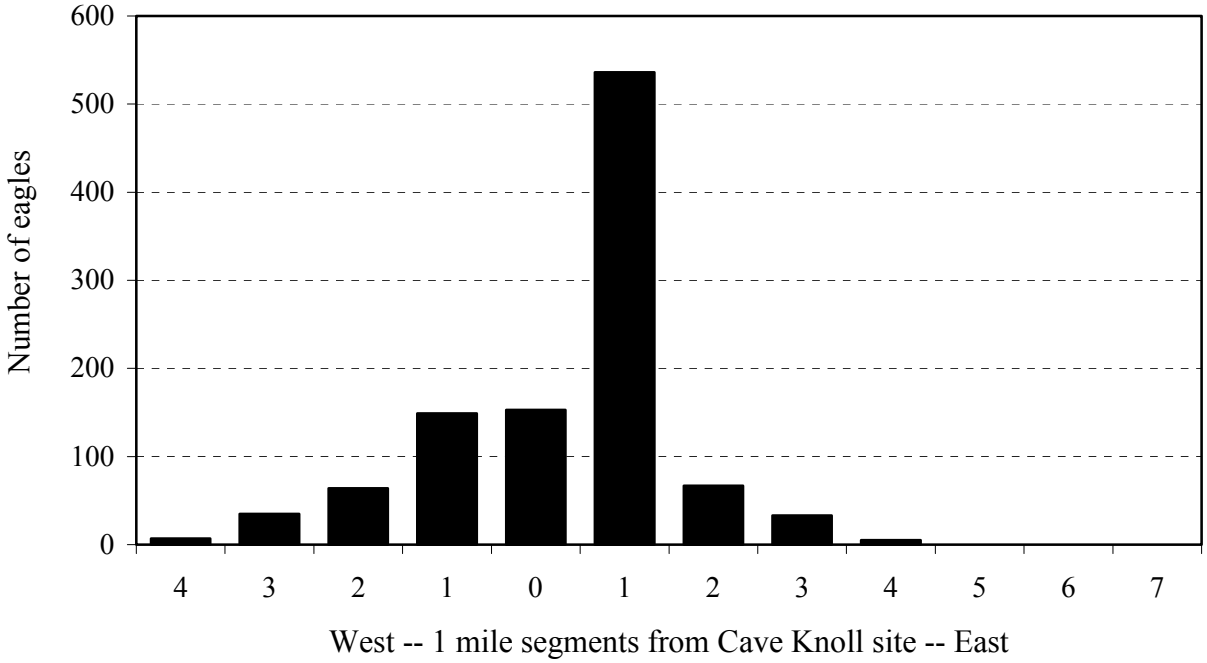

Figure 4. Lateral distribution of migrating eagles (Golden and Bald) relative to the Cave Knoll observation site near Rogers Pass, Montana during March 2002.

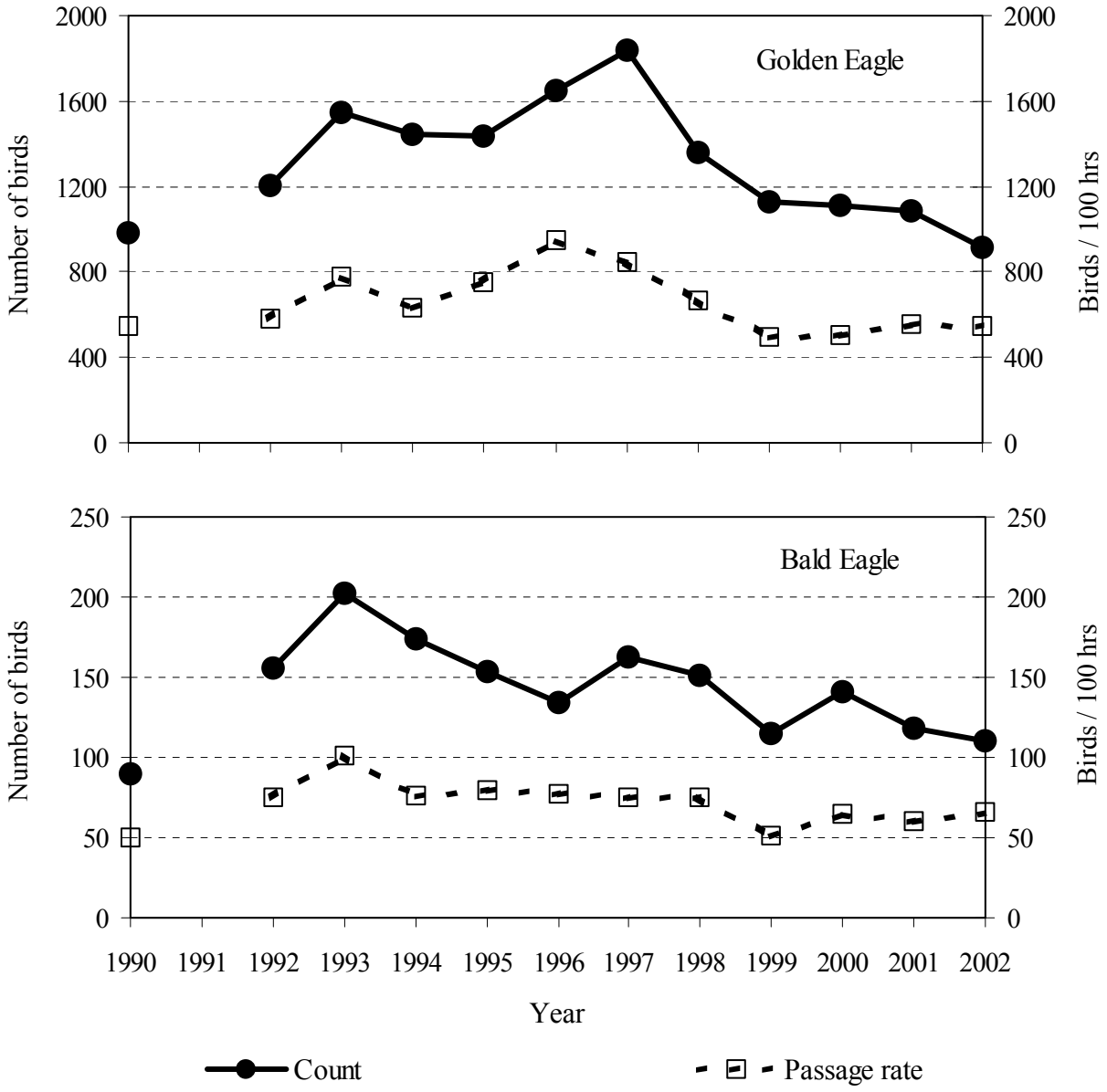

Figure 5. Annual migration counts and passage rates for Golden and Bald Eagles near Rogers Pass, Montana: 1990–2002.

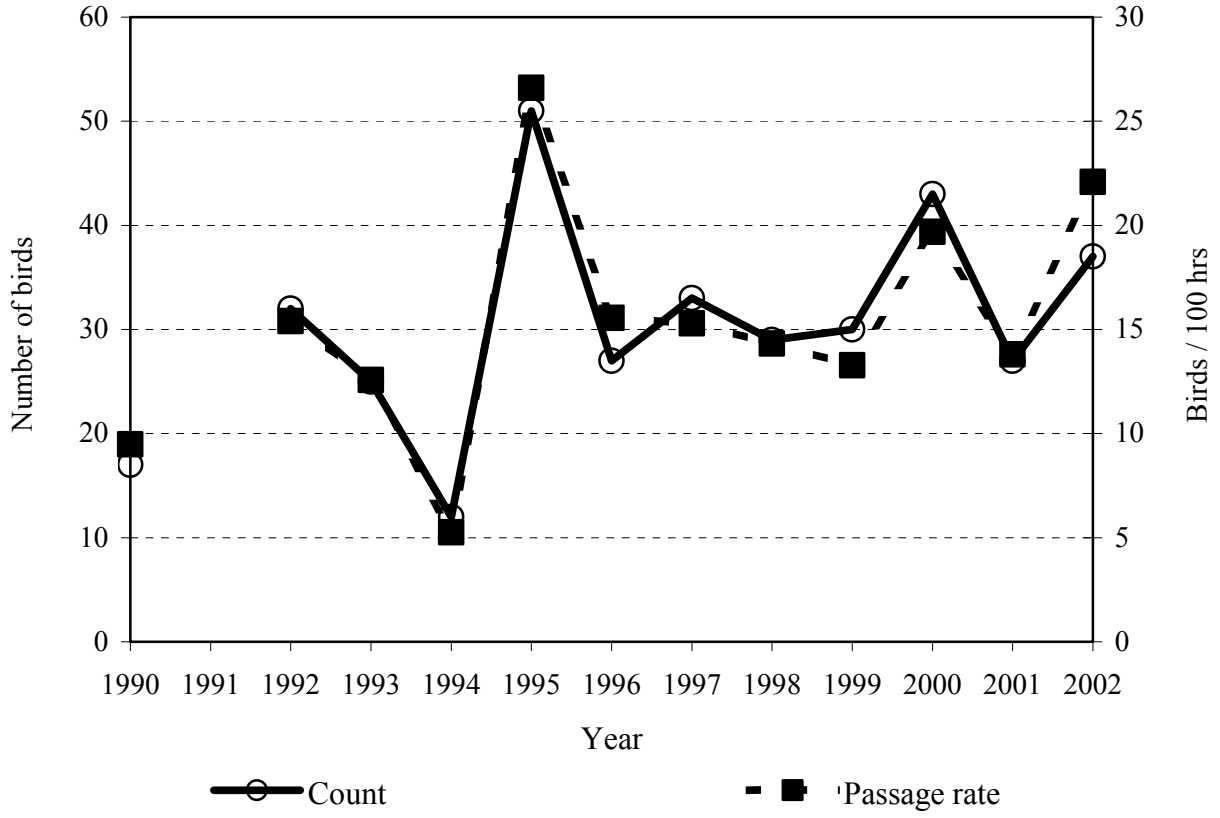

Figure 6. Annual migration counts and passage rates for Red-tailed Hawks near Rogers Pass, Montana: 1990–2002.

Appendix A. Common and scientific names, species codes, and regularly applied age, sex, and color-morph classifications for all diurnal raptor species observed during spring migration near Rogers Pass, Montana.

Common Name	Scientific Name	Species Code	Age[1]	Sex[2]	Color Morph[3]
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 accipiter	*Accipiter* spp.	UA	U	U	NA
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
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 or older immature: 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. Summary of daily weather conditions on the east side of Rogers Pass in 2002.

Date	Time (MST)	AM / PM Wind Dir – Vel. (kph)	Temperature Min / Max (°C)	AM / PM Precipitation	AM / PM % Cloud Cover	Thermal Lift[1]
1-Mar	1630-1700	N 2	-12	snow / fog	100	poor
2-Mar	920-1600	SW 3 / N 10	-1 / 4	- / snow	25 / 70	fair
3-Mar	1000-1530	SW 64	0 / 1	–	10	poor
4-Mar	930-1600	SW 29	3 / 10	–	50	fair
5-Mar	No observations		–	snow	100	poor
6-Mar	No observations		–	snow	100	poor
7-Mar	1130-1300	E 11	-13 / -11	snow	100	poor
8-Mar	930-1700	Var 0 / 11	-25 / -9	–	15 / 25	poor
9-Mar	1000-1700	SW 19 / 11	1 / 5	–	15	fair
10-Mar	930-1630	SW 32 / 19	2 / 9	–	30 / 20	fair
11-Mar	900-1515	SW 48	6 / 11	snow / rain	50	poor
12-Mar	900-1600	SW 29 / 13	3 / 5	snow	50	poor
13-Mar	845-1600	W 24	2 / 6	– / snow	40 / 70	fair
14-Mar	900-1630	SW 24 / 32	1 / 3	– / snow	50	fair
15-Mar	900-1700	SW 24 / 13	1 / 6	–	20 / 80	fair
16-Mar	No observations		–	snow	100	poor
17-Mar	1200-1500	NE 11	-10	fog / -	100 / 15	poor
18-Mar	900-1500	SW 16 / NE 19	-7 / -1	– / snow	60 / 85	poor
19-Mar	No observations		–	snow	100	poor
20-Mar	No observations		–	snow	100	poor
21-Mar	950-1630	NNE 2 / 6	-10 / -4	–	50 / 5	poor
22-Mar	900-1630	ENE 2 / 6	0 / 9	–	5	poor
23-Mar	900-1630	NNE 2 / 11	-4 / -1	–	30 / 90	poor
24-Mar	1000-1700	NE 13	0 / 6	–	4	fair
25-Mar	900-1630	SW 24 / N 8	5 / 8	- / snow	80 / 100	fair
26-Mar	830-1700	SW 29 / 40	7 / 15	–	20 / 70	fair
27-Mar	830-1630	SW 40	4 / 7	snow	20 / 60	poor
28-Mar	930-1700	SW 24 / 40	5 / 8	snow	70	fair
29-Mar	1000-1750	N 8 / SW 32	0 / 9	snow / –	85 / 20	fair
30-Mar	825-1700	SW 40 / N 16	1 / 6	snow	90	poor
31-Mar	830-1750	SW 64	7 / 16	–	90 / 20	fair

[1] Subjective ratings based on temperature, wind speed, and raptor flight behavior.

Appendix C. Daily observation effort and spring raptor migration counts by species near Rogers Pass, Montana in 2002.

DATE	SITE	OBSERVERS	HOURS	NH[1]	SS	CH	NG	UA	RT	FH	RL	UB	GE	BE	UE	AK	ML	PR	UF	UU	TOTAL
1-Mar	Canyon Mouth	1	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
2-Mar	Cave Knoll	2	6.7	-	-	-	-	-	-	-	1	-	13	2	-	-	-	-	-	-	16
3-Mar	Cave Knoll	2	5.5	-	-	-	-	-	1	-	-	-	9	-	-	-	-	-	-	-	10
4-Mar	Cave Knoll	2	6.5	-	-	-	-	-	-	-	1	-	12	1	-	-	-	-	1	-	15
5-Mar	No observations - snow all day																				
6-Mar	No observations - snow all day																				
7-Mar	Canyon Mouth	1	1.5	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	2
8-Mar	Canyon Mouth	1	7.5	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	5
9-Mar	Canyon Mouth	2	7.0	-	-	-	-	-	1	-	-	-	35	3	2	-	-	-	-	-	41
10-Mar	Cave Knoll	2	6.8	-	-	-	-	-	-	-	-	-	26	2	-	-	1	1	-	-	30
11-Mar	Upper Canyon	1	6.3	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	1	5
12-Mar	Canyon Mouth	1	7.0	-	-	-	-	-	-	-	-	-	12	3	1	-	-	-	-	-	16
13-Mar	Cave Knoll	2	7.3	-	-	-	-	-	-	-	-	-	17	-	-	-	-	-	-	-	17
14-Mar	Cave Knoll	2	7.5			-	-	-	-	-	1	-	38	4	-	-	-	-	-	-	43
15-Mar	Cave Knoll	1	8.0	-	2	1	-	-	-	-	-	-	41	2	1	-	-	-	-	-	47
16-Mar	No observations - snow all day																				
17-Mar	Canyon Mouth	2	3.0	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	3
18-Mar	Upper Canyon	1	6.0	-	-	-	-	-	-	-	-	-	11	-	-	-	-	-	-	-	11
19-Mar	No observations - snow all day																				
20-Mar	No observations - snow all day																				
21-Mar	Canyon Mouth	2	6.7	-	-	-	-	-	-	-	-	-	58	4	5	-	-	-	-	-	67
22-Mar	Upper Canyon	2	7.0	-	1	-	-	-	-	-	1	-	29	3	-	-	-	-	-	1	35
23-Mar	Upper Canyon	2	7.5	-	-	-	-	-	-	-	1	-	47	2	4	-	-	-	-	-	54
24-Mar	Cave Knoll	1	7.0	-	-	-	-	-	-	1	-	-	131	5	6	-	1	-	-	-	144
25-Mar	Canyon Mouth	2	7.5	-	-	-	-	-	-	-	-	-	40	6	-	-	-	-	-	-	46
26-Mar	Cave Knoll	2	8.5	-	-	-	2	-	1	-	2	-	114	39	2	-	-	-	-	1	161
27-Mar	Upper Canyon	2	8.0	-	-	-	1	-	3	-	1	-	74	1	-	-	-	-	-	-	80
28-Mar	Upper Canyon	2	7.5	-	1	-	-	-	-	1	-	1	49	-	-	-	-	-	-	-	52
29-Mar	Cave Knoll	2	7.8		-	-	1	-	15	-	-	-	85	21	1	-	-	-	-	-	123
30-Mar	Cave Knoll	2	3.6	-	-	-	-	-	4	-	-	-	8	1	2	-	-	-	-	-	15
31-Mar	Upper Canyon	2	9.3	-	1	-	-	-	12	-	1	-	53	11	-	1	-	1	-	-	80
Totals			167.50	0	4	1	4	0	37	2	9	1	916	110	24	1	2	2	1	3	1118

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

Appendix D. Annual observation effort and spring raptor migration counts near Rogers Pass, Montana: 1988–2002.

	1988[1]	1990[1]	1992[1]	1993[2]	1994[2]	1995[2]	1996[2]	1997[2]	1998[2]	1999[2]	2000	2001	2002	Mean
Start date	March	1-Mar	20-Feb	1-Mar	1-Mar	1-Mar	1-Mar	1-Mar	1-Mar	1-Mar	1-Mar	1-Mar	1-Mar	1-Mar
End date	March	31-Mar	31-Mar	31-Mar	31-Mar	31-Mar	31-Mar	31-Mar	31-Mar	31-Mar	31- Mar	31-Mar	31-Mar	31-Mar
Observation days	16	28	41	31	30	29	26	29	28	29	29	26	26	28
Observation hours	90.0	179.2	279.6	198.8	228.5	191.7	173.6	215.9	202.5	225.9	218.4	195.7	167.5	192.0
Raptors / 100 hours	1130.0	693.6	593.3	954.7	752.3	908.7	1088.7	995.4	793.1	593.6	627.7	652.5	667.5	827.5
SPECIES	RAPTOR COUNTS													
Osprey	0	0	0	0	0	0	2	0	0	0	0			
Northern Harrier	4	1	3	3	2	8	3	3	2	8	2	0	0	0.2
Sharp-shinned Hawk	9	3	13	8	6	7	18	11	7	11	7	2	0	3.2
Cooper's Hawk	1	5	2	1	5	2	2	4	2	0	4	5	4	8.4
Northern Goshawk	7	6	11	14	5	2	6	14	3	3	6	1	1	2.3
Unidentified accipiter	2	2	2	3	0	2	1	2	1	1	0	7	4	6.5
Red-tailed Hawk	13	17	32	25	12	51	27	33	29	30	43	0	0	1.2
Ferruginous Hawk	0	0	4	5	4	5	1	0	3	3	5	27	37	28.9
Rough-legged Hawk	10	11	15	5	19	14	9	17	13	15	12	2	2	2.6
Unidentified buteo	1	7	14	9	1	1	0	3	2	2	4	2	9	11.4
Golden Eagle	818	980	1299	1549	1448	1437	1653	1836	1355	1129	1110	1	1	3.5
Bald Eagle	129	90	170	202	174	153	134	162	151	115	141	1089	916	1271.0
Unidentified eagle	20	114	81	58	42	55	31	52	31	19	29	118	110	141.2
American Kestrel	0	0	2	1	0	0	0	0	0	0	1	22	24	44.2
Merlin	0	0	2	1	0	0	1	5	2	2	3	0	1	0.4
Prairie Falcon	2	2	2	2	0	4	2	2	0	1	4	1	2	1.4
Gyrfalcon	0	0	0	0	0	0	0	0	1	0	0	0	2	1.8
Unidentified falcon	0	0	0	3	0	0	0	1	1	0	0	0	0	0.1
Unidentified raptor	1	5	7	9	1	1	0	4	3	2	0	0	1	0.5
Grand Total	1017	1243	1659	1898	1719	1742	1890	2149	1606	1341	1371	0	3	2.7

[1] Counts conducted at Route 200 site.

[2] Counts conducted at Blacktail Ranch site.