FALL 2006 RAPTOR MIGRATION STUDY IN THE BRIDGER MOUNTAINS, MONTANA

HawkWatch International, Inc.
Salt Lake City, Utah

February 2007

FALL 2006 RAPTOR MIGRATION STUDY IN THE BRIDGER MOUNTAINS, MONTANA

Report prepared by:

Jeff P. Smith and Mike C. Neal

Counts conducted by:

Brian Cook and Jamie Granger

Project coordinated by:

HawkWatch International, Inc.

Principal Investigator: Dr. Jeff P. Smith

1800 S. West Temple, Suite 226, Salt Lake City, Utah 84115

(801) 484-6808

February 2007

TABLE OF CONTENTS

List of Tables iii
List of Figures iii
Introduction 1
Study Site 1
Methods 1
Results and Discussion 2
Weather Summary 2
Observation Effort 3
Flight Summary 3
Resident Raptors 4
Visitation 5
Acknowledgments 5
Literature Cited 5
Tables 6
Figures 9
Appendix A. Common and scientific names, species codes, and regularly applied age, sex, and color-morph classifications for all diurnal raptor species observed during fall migration in the Bridger Mountains, MT. 17
Appendix B. A history of primary observers for the Bridger Mountains Raptor Migration Project. 18
Appendix C. Daily observation effort, visitor disturbance ratings, weather records, and flight summaries for the Bridger Mountains Raptor Migration Project: 2006. 19
Appendix D. Daily observation effort and fall raptor migration counts by species in the Bridger Mountains, MT: 2006. 21
Appendix E. Annual observation effort and fall raptor migration counts by species in the Bridger Mountains, MT: 1991–2006. 23

LIST OF TABLES

Table 1. Annual fall-migration counts and adjusted passage rates (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) by species in the Bridger Mountains, MT: 1992–2005 versus 2006. 6

Table 2. Fall counts by age class and immature : adult ratios for selected species of migrating raptors in the Bridger Mountains, MT: 1992–2005 versus 2006. 7

Table 3. First and last observation, bulk passage, and median passage dates by species for migrating raptors in the Bridger Mountains, MT in 2006, with a comparison of 2006 and 1992–2005 average median passage dates..... 8

LIST OF FIGURES

Figure 1. Location of the Bridger Mountains Raptor Migration Project study site..... 9

Figure 2. Composition of the fall raptor migration in the Bridger Mountains by major species groups: 1992–2005 versus 2006. 10

Figure 3. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) fall-migration passage rates for Turkey Vultures, Ospreys, and Northern Harriers in the Bridger Mountains, MT: 1992–2006. Dashed lines indicate significant ($P \leq 0.10$) regressions. 11

Figure 4. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) fall-migration passage rates for Sharp-shinned Hawks, Cooper's Hawks, and Northern Goshawks in the Bridger Mountains, MT: 1992–2006. Dashed lines indicate significant ($P \leq 0.10$) regressions. 12

Figure 5. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) fall-migration passage rates for Broad-winged, Swainson's, Red-tailed, Ferruginous, and Rough-legged Hawks in the Bridger Mountains, MT: 1992–2006. Dashed lines indicate significant ($P \leq 0.10$) regressions. 13

Figure 6. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) fall-migration passage rates for Golden and Bald Eagles in the Bridger Mountains, MT: 1992–2006. Dashed lines indicate significant ($P \leq 0.10$) regressions..... 14

Figure 7. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) fall-migration passage rates for American Kestrels, Merlins, Prairie Falcons, and Peregrine Falcons in the Bridger Mountains, MT: 1992–2006. Dashed lines indicate significant ($P \leq 0.10$) regressions..... 15

Figure 8. Passage volume by five-day periods for migrating Golden and Bald Eagles in the Bridger Mountains, MT: 1992–2005 versus 2006. 16

INTRODUCTION

The Bridger Mountains Raptor Migration Project in southwestern Montana is an ongoing effort to monitor long-term population trends of raptors using this northern portion of the Rocky Mountain Flyway (Omland and Hoffman ?, Hoffman et al. 2002, Hoffman and Smith 2003). HawkWatch International (HWI) initiated full-season counts at the site in 1991, with standardized annual monitoring commencing in 1992. This flyway is noted for large concentrations of Golden Eagles (see Appendix A for scientific names of all raptor species observed at the site). To date, 18 species of raptors have been observed migrating along the Bridger Mountains, with annual counts typically ranging between 2,000 and 3,500 migrants. This report summarizes results of the 2006 count, which marked the 15th consecutive full-season autumn count of migratory raptors at the site.

STUDY SITE

The Bridger Mountains are a relatively small range that runs primarily along a north–south axis. From Sacagawea Peak (2,950 m elevation), the range extends southward for 40 km before meeting the Gallatin Valley 5 km northeast of Bozeman, Montana. Consistent westerly winds collide with the Bridger range and create the lift that attracts southbound migrating raptors each fall. The observation site is a helicopter-landing platform atop the Bridger Bowl Ski Area at an elevation of 2,610 m (45° 49.022' N, 110° 55.778' W; Figure 1). The site lies within the Gallatin National Forest on the east slope of the mountain range, about 25 km north of Bozeman and 3 km north of Saddle Peak. The helicopter pad is a 5 m x 5 m wooden platform located approximately 50 m north of an avalanche cache/ski patrol hut. The site is accessed by following a primitive dirt road for 2.5 km (780 m rise in elevation) to the top of the Bridger chairlift, then continuing a short way along a footpath to the observation site at the top of the ridge.

METHODS

Weather permitting, two official or designated observers conducted standardized daily counts of migrating raptors from a single, traditional observation site from late August through late October. Observations typically began between 0830–1000 hrs and ended between 1600–1700 hrs Mountain Standard Time (MST). This was the first full season of migration counting for both official observers Brian Cook and Jamie Granger (see Appendix B for a complete observer history). Local volunteers also occasionally assisted with spotting migrants. 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.

Calculation of "adjusted" (to standardize sampling periods and adjust for incompletely identified birds) passage rates (migrants counted per 100 hours of observation) and analysis of trends follows Hoffman and Smith (2003). In comparing 2006 annual statistics against means and 95% confidence intervals for previous seasons, we equate significance with a 2006 value falling outside the bounds of the confidence interval for the associated mean.

RESULTS AND DISCUSSION

WEATHER SUMMARY

Compared to the past nine seasons (the period during which detailed weather records have been compiled and analyzed), inclement weather and attendant difficult access conditions hampered observations much more than usual in 2006, precluding a record-high 21 full days of observation (1997–2005 average of 11 days) and reducing observations to less than 4 hours on three other days (average 6 days; Appendix C for daily weather records). This comparison is confounded by uncertainty as to which days were fully precluded by weather versus days when the weather may have been decent but heavy snow cover precluded site access. Curiously, based on weather data collected on-site during active observation periods, 2006 featured a low proportion of days where mostly cloudy or overcast skies prevailed (16% vs. 1997–2005 average of 30%), while the proportions of active days featuring predominantly fair skies (44%) and transitional skies (40%; i.e., cloud cover changed from clear or partly cloudy to mostly cloudy or overcast during the day, or vice versa) were above average (1997–2005 averages of 36% and 34%, respectively). Visibility reducing fog and especially haze (mostly due to wildfire smoke) were unusually prevalent in 2006, however (20% of the active days with otherwise fair skies, 16% of days with otherwise transitional skies, and 9% of days with otherwise mostly cloudy to overcast skies days; averages 14%, 7%, and 4%, respectively), though not sufficient to compromise estimated average visibility (82–85 km vs. average of 75–80 km).

Data collected in 2006 during active observations indicated a continued shift toward calmer winds (85% of days with predominantly light winds [<12 kph], 15% with moderate winds [12–29 kph], and none with stronger winds, compared to averages of 79%, 19%, and 2%, respectively). In particular, SW–W winds always are the dominant wind pattern at the site (long-term average prevalence of 36% of the active days), and 2006 was no exception with an above-average 42% of the active days featuring such winds; however, in 2006 this total included a record high 20% where SW–W generally prevailed but with a significant component of calm/variable winds mixed in (average 5%). Another 22% of the active days featured predominantly W winds (average 25% + 2% with a calm/variable component), 16% W–NW winds plus another 2% with a calm/variable component (average 13+2%), 9% NE–SE winds plus another 4% with a calm/variable component (average 7 + 0%), 2% more variable SW–NW winds (average 6%), and 2% entirely calm/variable winds (average 1%).

The temperature during active observation periods averaged 11.9°C (the average of daily values, which in turn were averages of hourly readings), ranging from -2.8–26.0°C. The daily average was slightly

lower than the long-term average of 12.5°C, but all temperature readings were within the range of normal variability. The on-site barometric pressure during active observation periods averaged 30.14 in Hg (the average of daily values, which in turn were averages of hourly readings). This is similar to the 2001–2005 (period of record for this measure) average of 30.20, but the range of daily values recorded in 2006 (29.64–30.65 in Hg) was among the widest yet recorded. The observers subjectively rated 61% of the active days as featuring predominantly good to excellent thermal lift conditions, which is significantly above average for the site (1997–2005 average of 38%).

In summary, inclement weather and difficult access conditions precluded observations much more often than usual in 2006, but otherwise, aside from a relatively high prevalence of hazy conditons due to wildfire smoke, a higher than average predominance of fair–transitional skies, calmer winds, average temperature and barometric pressure readings, and higher thermal ratings indicated better than average conditions during actual observation periods.

OBSERVATION EFFORT

Observations occurred on only 45 of 66 possible observation days between 27 August and 31 October in 2006. The number of observation days was a significant 12% below the 1992–2005 average of 51 ± 95% CI of 4.4 days and was the lowest number of observation days since 1997 when HWI adopted a standardized observation period of 27 August through 31 October. However, the number of observation hours (331.25) nearly matched the 1992–2005 average of 332.69 ± 31.76 hours. The last three years of effort were well below average due to an unusually high prevalence of inclement weather, with 2004–2006 standing in stark contrast to effort having been the highest to date in 2003 due to especially mild weather. The 2006 average of 2.0 observers per hour (including official and guest observers; value is mean of daily values, which are in turn means of hourly values) was a non-significant 8% above average (1.8 ± 95% CI of 0.11 observers per hour).

FLIGHT SUMMARY

The observers tallied 1,784 migrant raptors of 17 species during the 2006 season (Table 1, and see Appendix D for daily count records). The total count was a significant 30% below average, similar to 2004 and 2005 (see Appendix E for annual summaries). For the fourth year in a row, the count of Golden Eagles fell to a new record low (Appendix E). In contrast, a record high count was recorded for Prairie Falcons.

The flight was composed of 53% eagles, 23% accipiters, 7% buteos, 5% falcons, 3% harriers, and <1% each of Ospreys, vultures, and unidentified raptors. The proportion of eagles was a record low, whereas the proportions of all other species groups except buteos and falcons were significantly above average (Figure 2). The most numerous species were the Golden Eagle (48% of the total count), Sharp-shinned Hawk (19%), Cooper's Hawk (10%), Red-tailed Hawk (5%), Bald Eagle (4%), and Northern Harrier (3%). All other species each comprised 2% or less of the total.

Adjusted 2006 passage rates were significantly below average for Swainson's Hawks, Red-tailed Hawks, Golden Eagles, and American Kestrels, but were significantly above average for Turkey Vultures, Rough-legged Hawks, Merlins, and Prairie and Peregrine Falcons (Table 1, Figures 3–7). Regression analyses of data through 2006 revealed a highly significant ($P = 0.001$) linear decreasing trend for Golden Eagles, reflecting a marginally significant ($P = 0.091$) declining trend for adults and a significant ($P = 0.026$) decling trend for immatures/subadults (Figure 6). A significant linear declining trend also was indicated for Swainson's Hawks, but due primarily to a high count in 1992 (Figure 5); moreover, this species is too uncommon at this site to render trend analyses meaningful. A marginally significant ($P = 0.071$) convex quadratic trend was indicated for American Kestrels, tracking a marginal increasing pattern through 1998 followed by a mostly declining pattern (Figure 7). In contrast, a significant ($P =$

0.028) concave quadratic trend was indicated for Prairie Falcons, tracking a slight decline between 1992 and 1997, relative stability through 2004, and then a sharp jump in 2005 and at least a moderately high count in 2006 (Figure 7). No other significant trends were indicated.

Among seven species for which relevant age-specific data were available, counts of immature birds were below average for all species except both species of eagles, whereas counts of identified adults were at least slightly above average for four species (Table 2). This translated to significantly below-average immature : adult ratios for Sharp-shinned Hawks, Cooper's Hawks, and Northern Goshawks, suggesting that juvenile recruitment among Rocky Mountain source populations may have been low in 2006 for accipiters. For Golden Eagles and Bald Eagles, the relative abundance of immature/subadult birds was significantly above average, but low overall counts of adult birds suggest that this may be misleading as a potential indicator of regional productivity (Table 2).

Changes in effort before 1997 may confound interpretation of the overall trends because passage rates tend to decline with increasing effort; nevertheless, there is little doubt that the passage rates of young Golden Eagles dropped steadily between 1997 and 2002 before showing signs of a modest rebound during the past four years (Figure 6). Moreover, although a slight overall declining tendency is also evident in the annual passage rates of adults (though significantly ameliorated by a high rate in 2005), on an annual basis the passage rates of adults and immatures/subadults often have fluctuated in the opposite directions. The 2006 increase in abundance of younger birds likely reflects an increase in productivity among eagles nesting at northern latitudes where a cyclical high in the abundance of snowshoe hares is underway (P. Sherrington personal communication). Conversely, patterns in the abundance of adult migrants may be more strongly related the effects of winter severity, whereby relatively sedentary adults tend to remain farther north or migrate later during mild winters. In this regard, the spike in adult numbers in 2004 is consistent with this hypothesis, in that weather conditions turned unusually cold and snowy by late October and a marked spike in eagle activity occurred just before heavy snow shut the count down prematurely. In contrast, the count of adults was comparatively low in 2006.

The median passage date for Golden Eagles of 6 October was a significant 6 days earlier than average (Table 2), and contributed to a significantly early combined-species median passage date of 2 October (Figure 8). This undoubtedly reflects, in part, reduced observation effort throughout October, but may also reflect delayed southward passage of northern migrants in response to increasingly warm winters and and/or good prey conditions at northern latitudes. The only other species to show a significantly early passage date was the Rough-legged Hawk (Table 2), whereas, five species showed significantly late timing in 2006 (Cooper's Hawks, Red-tailed Hawks, Bald Eagles, American Kestrels, and Merlins). Age-specific data revealed other details but no other obvious group-specific or multi-species patterns (Table 3).

RESIDENT RAPTORS

Resident Golden Eagles were observed throughout the 2006 field season. During the first few weeks, observers identified at least one adult, one subadult, and one first-year eagle in the count-site area. The subadult was last seen on 14 September, preceding the first cold front. The immature was seen almost daily until 4 October, about 2 days before another front passed through. The adult bird(s) were observed regularly through the last day of the season, often performing territorial displays northwest of the count site. One non-adult, apparently resident Bald Eagle was seen twice during the season, once on 27 August flying northeast and once on 2 September flying south along the ridge.

Two light morph Red-tailed Hawks, one adult and one immature, were often observed the area near the start of the season. The immature was last seen on 19 September, prior to passage of a cold front and the first substantial snowfall. The adult was observed regularly until 12 October, four days before the largest storm of the season passed through.

A possible local Peregrine Falcon was sighted on 28 August stooping from north to the south along the west side of the ridge. A resident Prairie Falcon was seen on the first day and regularly throughout the first week of the count. A few other observations of apparently resident birds occurred in September, and then frequent sightings commenced again in October and continued through the last day of observations. A pair of American Kestrels was spotted together on 29 August, and 3 males were seen together the next day. Frequent observations of various kestrels continued through early September, with several more sightings of males recorded through the end of September.

Two immature Coopers Hawks and two immature Sharp-shinned Hawks were first observed in the area early in the season and were seen frequently through 11 September, often at the same time. Only single observations of apparenty local adult males were recorded for both species: a Coopers Hawk on 19 September and a Sharp-shinned Hawk on 23 September. One observation of a potentially local Northern Goshawk was recorded on 24 October, when a bird was seen changing course to attack a Prairie Falcon, and then moving off to the north.

An immature Northern Harrier was first seen on 3 September patrolling along the west side of the ridge. It was seen only two more times, but always behaved like a resident. The last sighting was on 19 September, one day prior to a cold front.

This is a fairly typical assemblage of resident species for the site.

VISITATION

The fall migration site along the Bridger Range is a popular destination for Bozeman locals, as well as for raptor enthusiasts from the surrounding area. Our 2006 visitor logs recorded 184 individuals, 98 during the tenth annual Bridger Raptor Festival. Visitors hailed primarily from the Bozeman area, but some folks visited from Colorado, Washington, and Oregon. The festival was very well attended again this year, with HWI's Executive Director, Thom Benedict, in attendance. Although marginal weather kept many people from actually hiking up to the watchsite, many did make the hike on the primary field trip day and were treated to a solid flight of birds.

In 2006, 355 hourly assessments by the primary observers of visitor disturbance resulted in the following ratings: 87% none, 10% low, 2% moderate, and 2% high, which indicates a average level of visitor disturbance for this site.

ACKNOWLEDGMENTS

Funding for the 2006 project was provided by the U.S. Fish and Wildlife – Neotropical Migratory Birds Conservation Act grant program, the Fanwood Foundation, and HWI private donors and members. Gallatin National Forest and Bridger Bowl Ski Area provided essential logistical support. Special thanks to Jeff Pentel, Steve Hoffman, John Parker, Bev Dixon, and Randy Elliot for their observational and/or logistical assistance.

LITERATURE CITED

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.

Omland and Hoffman

Table 1. Annual fall-migration counts and adjusted passage rates (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) by species in the Bridger Mountains, MT: 1992–2005 versus 2006.

SPECIES	COUNTS			RAPTORS/100HRS		
	1992–2005[1]	2006	%CHANGE	1992–2005[1]	2006	%CHANGE
Turkey Vulture	0.7 ± 0.86	2	180	0.4 ± 0.44	1.3	242
Osprey	6 ± 2.3	7	18	2.8 ± 1.10	3.3	15
Northern Harrier	50 ± 28.8	50	1	15.7 ± 9.31	15.9	1
Sharp-shinned Hawk	342 ± 62.9	344	1	129.5 ± 21.19	131.0	1
Cooper's Hawk	169 ± 41.4	182	8	129.3 ± 29.32	128.2	-1
Northern Goshawk	35 ± 12.3	33	-6	12.6 ± 4.97	12.6	0
Unknown small accipiter[2]	33 ± 31.2	10	-70	–	–	–
Unknown large accipiter[2]	4 ± 2.8	0	-100	–	–	–
Unknown accipiter	29 ± 8.8	0	-100	–	–	–
TOTAL ACCIPITERS	589 ± 103.3	569	-3	–	–	–
Broad-winged Hawk	9 ± 5.2	12	28	4.8 ± 2.65	5.9	24
Swainson's Hawk	2 ± 1.6	0	-100	1.2 ± 0.93	0.0	-100
Red-tailed Hawk	108 ± 28.6	89	-18	39.9 ± 9.60	29.7	-26
Ferruginous Hawk	2 ± 1.1	3	27	0.9 ± 0.35	1.1	22
Rough-legged Hawk	36 ± 11.2	21	-41	26.9 ± 7.94	16.1	-40
Unidentified buteo	13 ± 3.6	2	-85	–	–	–
TOTAL BUTEOS	171 ± 39.2	127	-26	–	–	–
Golden Eagle	1486 ± 136.4	859	-42	595.8 ± 44.70	401.9	-33
Bald Eagle	83 ± 13.2	74	-11	33.7 ± 5.42	33.3	-1
Unidentified eagle	8 ± 4.2	1	-87	–	–	–
TOTAL EAGLES	1576 ± 141.5	934	-41	–	–	–
American Kestrel	76 ± 22.2	38	-50	66.3 ± 17.88	25.9	-61
Merlin	9 ± 3.2	15	59	7.1 ± 2.13	11.4	61
Prairie Falcon	13 ± 2.1	22	68	9.1 ± 2.04	13.5	49
Peregrine Falcon	8 ± 2.7	15	78	7.0 ± 2.19	13.1	87
Gyrfalcon	0.1 ± 0.14	1	1300	–	–	–
Unknown small falcon[2]	6 ± 10.4	0	-100	–	–	–
Unknown large falcon[2]	4 ± 4.6	1	-75	–	–	–
Unknown falcon	6 ± 2.4	0	-100	–	–	–
TOTAL FALCONS	116 ± 27.0	92	-21	–	–	–
Unidentified raptor	30 ± 6.7	3	-90	–	–	–
GRAND TOTAL	2539 ± 271.2	1784	-30	–	–	–

[1] Mean ± 95% confidence interval.

[2] Designations used for the first time in 2001.

Table 2. Fall counts by age class and immature : adult ratios for selected species of migrating raptors in the Bridger Mountains, MT: 1992–2005 versus 2006.

	Total and Age-classified Counts						% Unknown Age		Immature : Adult Ratio	
	1992–2005 Average			2006						
	Total	Imm.	Adult	Total	Imm.	Adult	1992–2005[1]	2006	1992–2005[1]	2006
Northern Harrier	50	24	11	50	24	17	31 ± 6.4	18	3.9 ± 4.15	1.4
Sharp-shinned Hawk	342	64	130	344	58	175	43 ± 7.3	32	0.5 ± 0.13	0.3
Cooper's Hawk	169	47	55	182	35	98	40 ± 6.4	27	0.9 ± 0.29	0.4
Northern Goshawk	35	13	14	33	14	12	25 ± 11.4	21	1.7 ± 0.63	1.2
Broad-winged Hawk	9	2	3	12	1	2	40 ± 21.3	75	1.1 ± 1.02	0.5
Red-tailed Hawk	108	35	49	89	24	48	23 ± 5.1	19	0.7 ± 0.40	0.5
Golden Eagle	1486	562	538	859	386	290	27 ± 5.1	21	1.1 ± 0.20	1.3
Bald Eagle	83	28	52	74	40	32	3 ± 17.5	3	0.6 ± 0.11	1.3
Peregrine Falcon	8	0.5	4	15	0	4	49 ± 17.5	73	0.2 ± 0.32	0.0

[1] Mean ± 95% confidence interval. For age ratios, note that the long-term mean immature : adult ratio is an average of annual ratios and may differ from the value obtained by dividing long-term 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 observation, bulk passage, and median passage dates by species for migrating raptors in the Bridger Mountains, MT in 2006, with a comparison of 2006 and 1992–2005 average median passage dates.

	2006				1992–2005
Species	First Observed	Last Observed	Bulk Passage Dates[1]	Median Passage Date[2]	Median Passage Date[3]
Turkey Vulture	18-Sep	18-Sep	–	–	19-Sep [4]
Osprey	8-Sep	6-Oct	8-Sep – 6-Oct	18-Sep	16-Sep ± 3.4
Northern Harrier	28-Aug	14-Oct	1-Sep – 6-Oct	19-Sep	23-Sep ± 4.9
Sharp-shinned Hawk	27-Aug	29-Oct	10-Sep – 13-Oct	1-Oct	01-Oct ± 1.9
Cooper's Hawk	28-Aug	29-Oct	12-Sep – 13-Oct	2-Oct	23-Sep ± 2.7
Northern Goshawk	19-Sep	29-Oct	25-Sep – 28-Oct	12-Oct	09-Oct ± 5.8
Broad-winged Hawk	18-Sep	28-Sep	18-Sep – 24-Sep	18-Sep	20-Sep ± 2.4
Red-tailed Hawk	27-Aug	29-Oct	10-Sep – 13-Oct	27-Sep	21-Sep ± 2.6
Ferruginous Hawk	28-Sep	29-Oct	–	–	29-Sep ± 15.7
Rough-legged Hawk	2-Oct	29-Oct	11-Oct – 28-Oct	22-Oct	21-Oct ± 1.6
Golden Eagle	28-Aug	29-Oct	25-Sep – 26-Oct	11-Oct	12-Oct ± 2.4
Bald Eagle	9-Sep	29-Oct	26-Sep – 24-Oct	6-Oct	15-Oct ± 2.7
American Kestrel	27-Aug	13-Oct	28-Aug – 5-Oct	25-Sep	22-Sep ± 2.5
Merlin	26-Sep	15-Oct	28-Sep – 15-Oct	12-Oct	02-Oct ± 3.0
Prairie Falcon	30-Aug	29-Oct	6-Sep – 15-Oct	26-Sep	23-Sep ± 4.9
Peregrine Falcon	18-Sep	2-Oct	19-Sep – 2-Oct	28-Sep	25-Sep ± 3.0
Gyrfalcon	28-Oct	28-Oct	–	–	–
All species	6-Sep	29-Oct	18-Sep – 23-Oct	2-Oct	08-Oct ± 1.5

[1] Dates between which the central 80% of the flight passed; values are given only for species with annual counts ≥5 birds.

[2] Date by which 50% of the flight had passed; values are given only for species with annual counts ≥5 birds.

[3] Mean of annual values ± 95% confidence interval in days; calculated only for species with annual counts ≥5 birds for ≥3 years.

[4] Data for 1997 only.

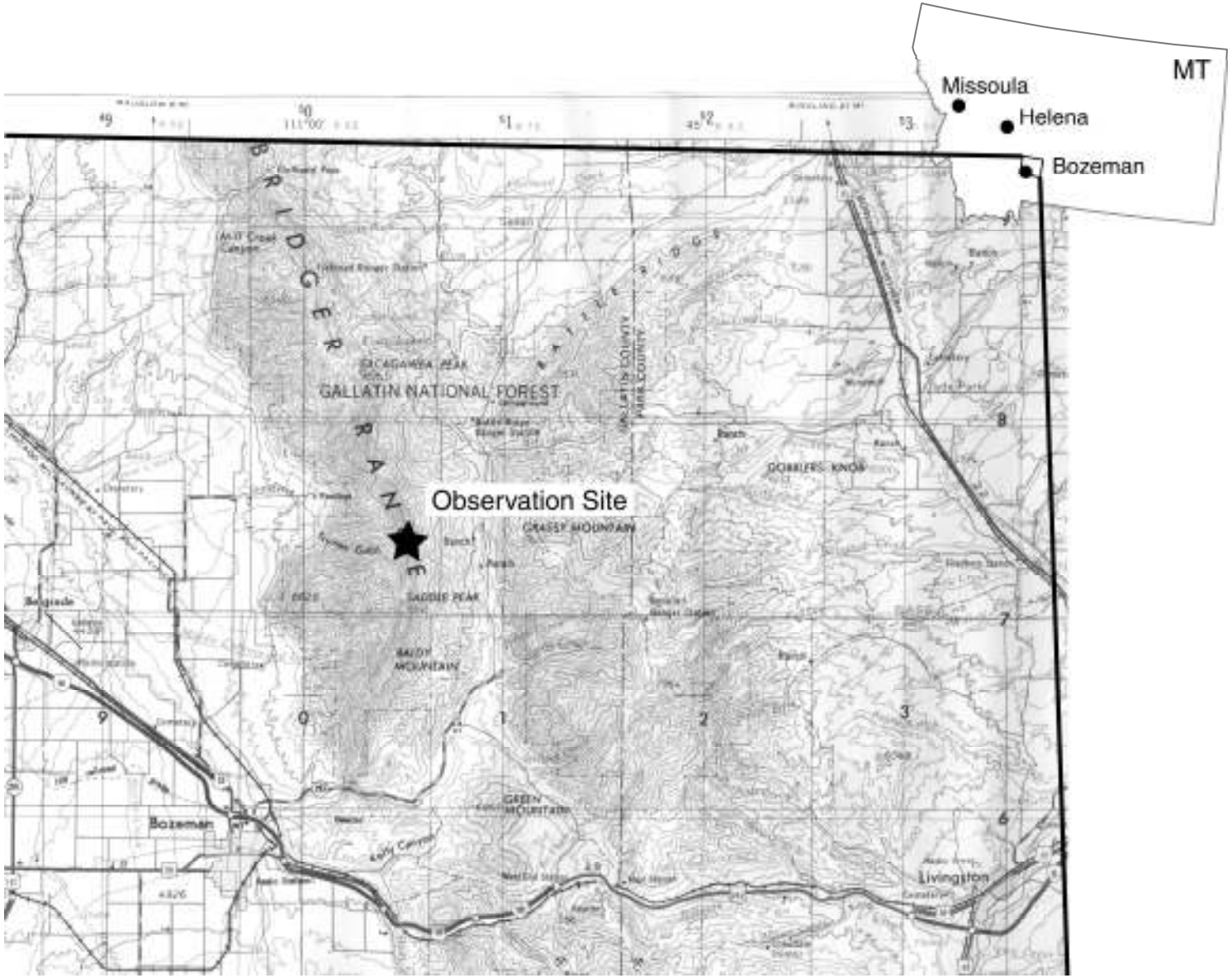

Figure 1. Location of the Bridger Mountains Raptor Migration Project study site.

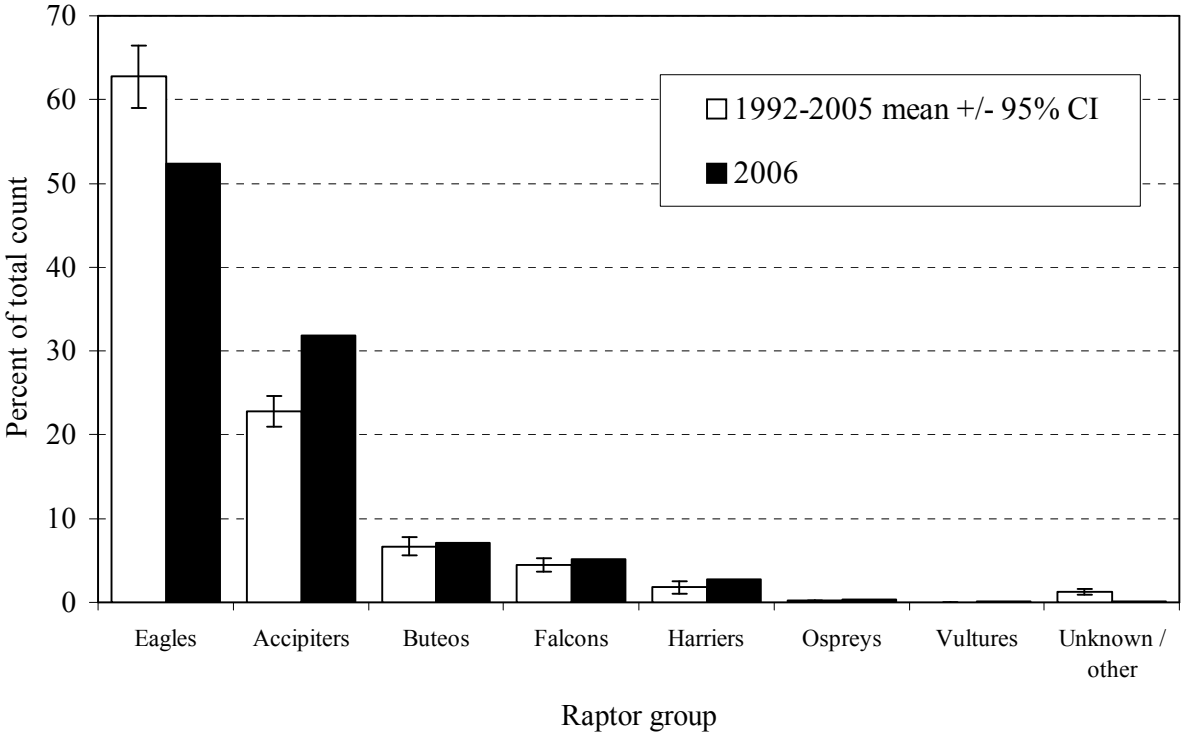

Figure 2. Composition of the fall raptor migration in the Bridger Mountains by major species groups: 1992–2005 versus 2006.

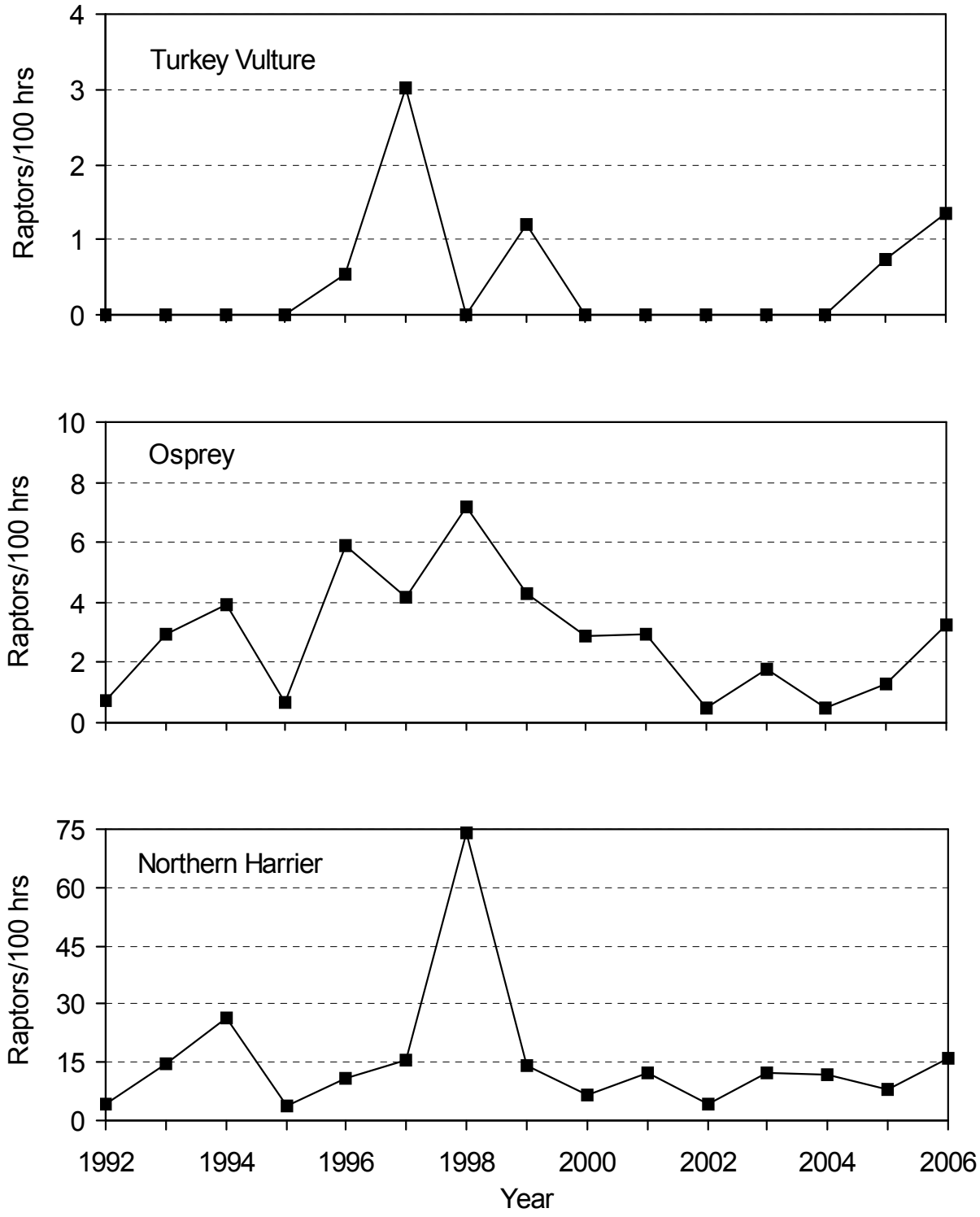

Figure 3. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) fall-migration passage rates for Turkey Vultures, Ospreys, and Northern Harriers in the Bridger Mountains, MT: 1992–2006. Dashed lines indicate significant ($P \leq 0.10$) regressions.

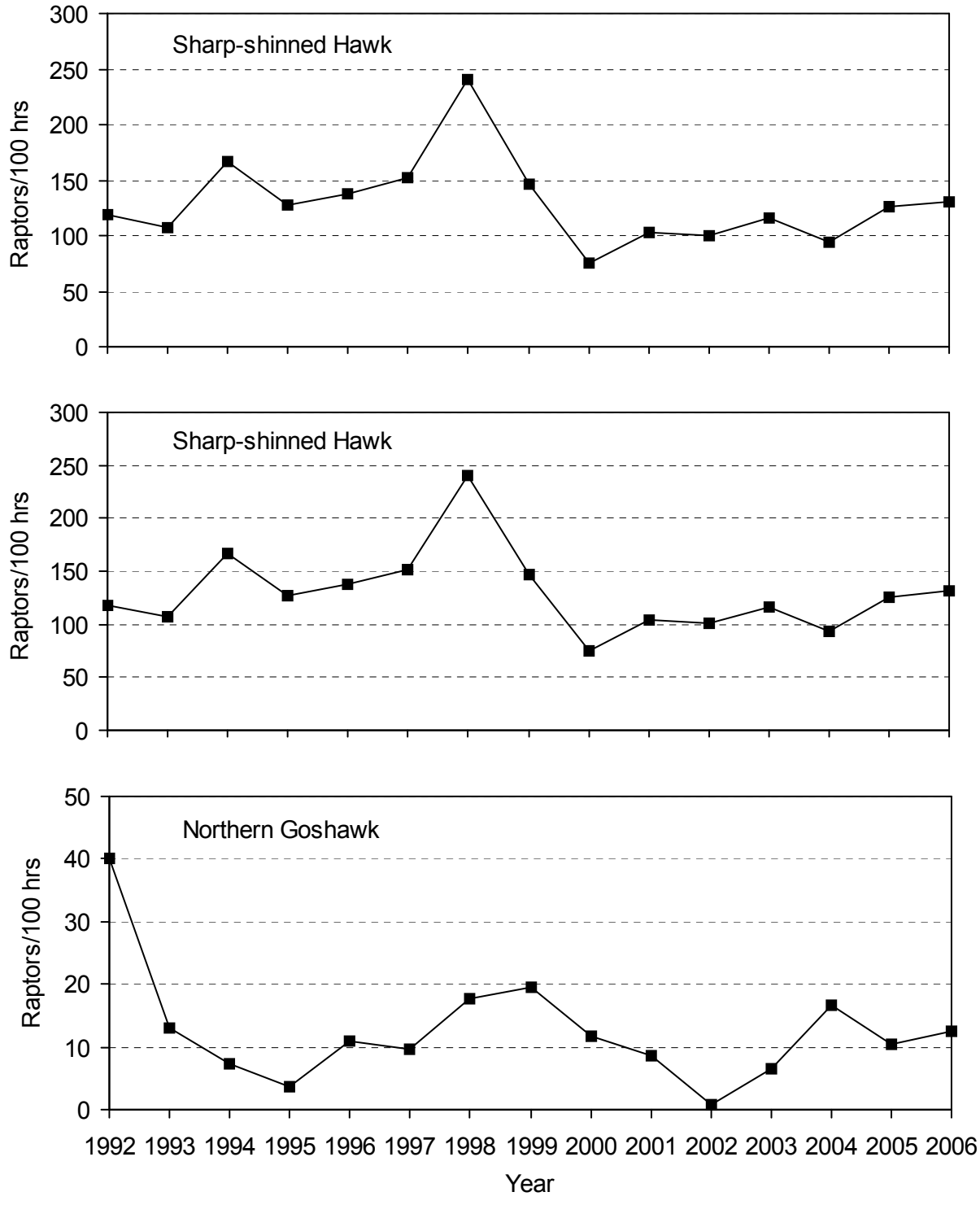

Figure 4. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) fall-migration passage rates for Sharp-shinned Hawks, Cooper's Hawks, and Northern Goshawks in the Bridger Mountains, MT: 1992–2006. Dashed lines indicate significant ($P \leq 0.10$) regressions.

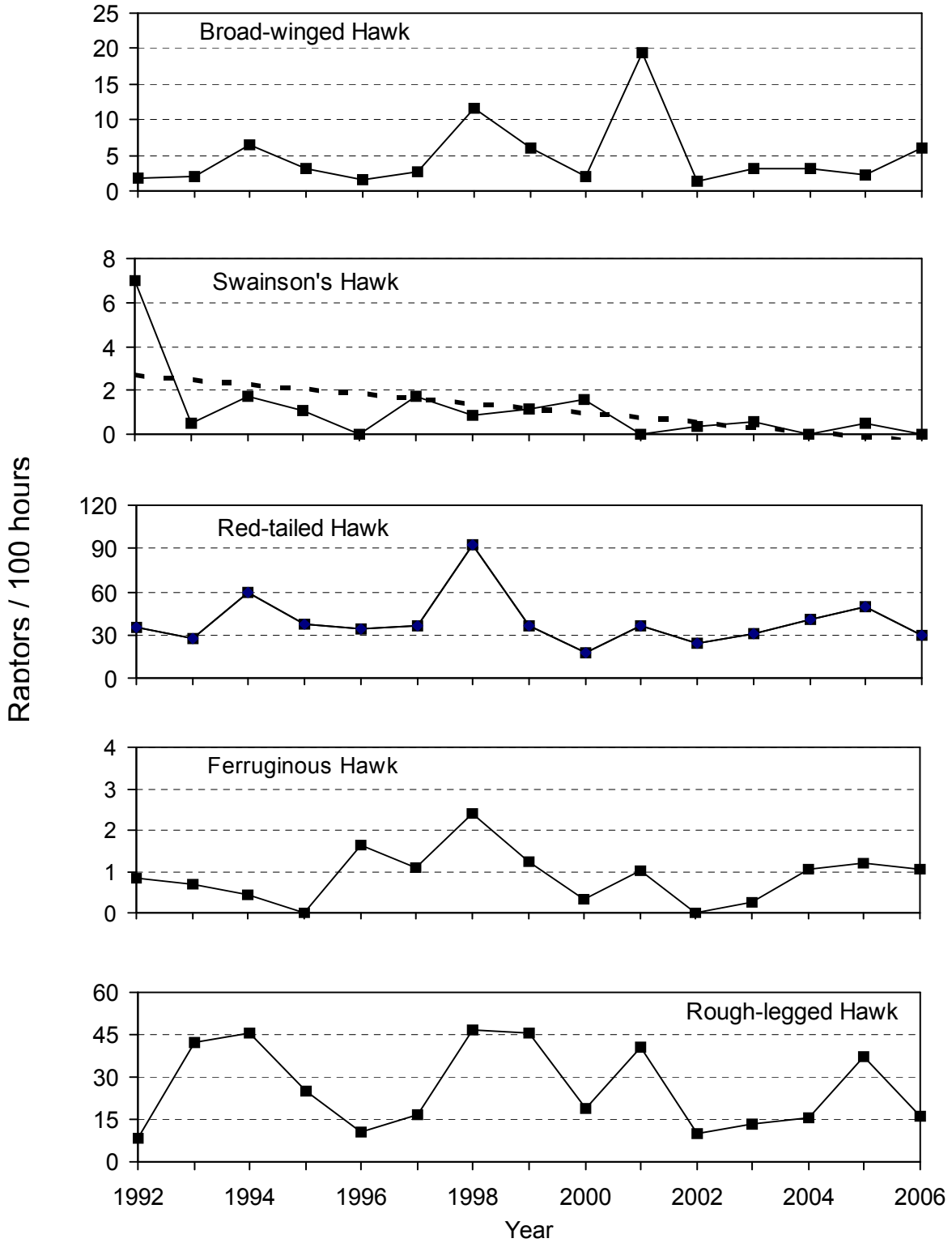

Figure 5. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) fall-migration passage rates for Broad-winged, Swainson's, Red-tailed, Ferruginous, and Rough-legged Hawks in the Bridger Mountains, MT: 1992–2006. Dashed lines indicate significant ($P \leq 0.10$) regressions.

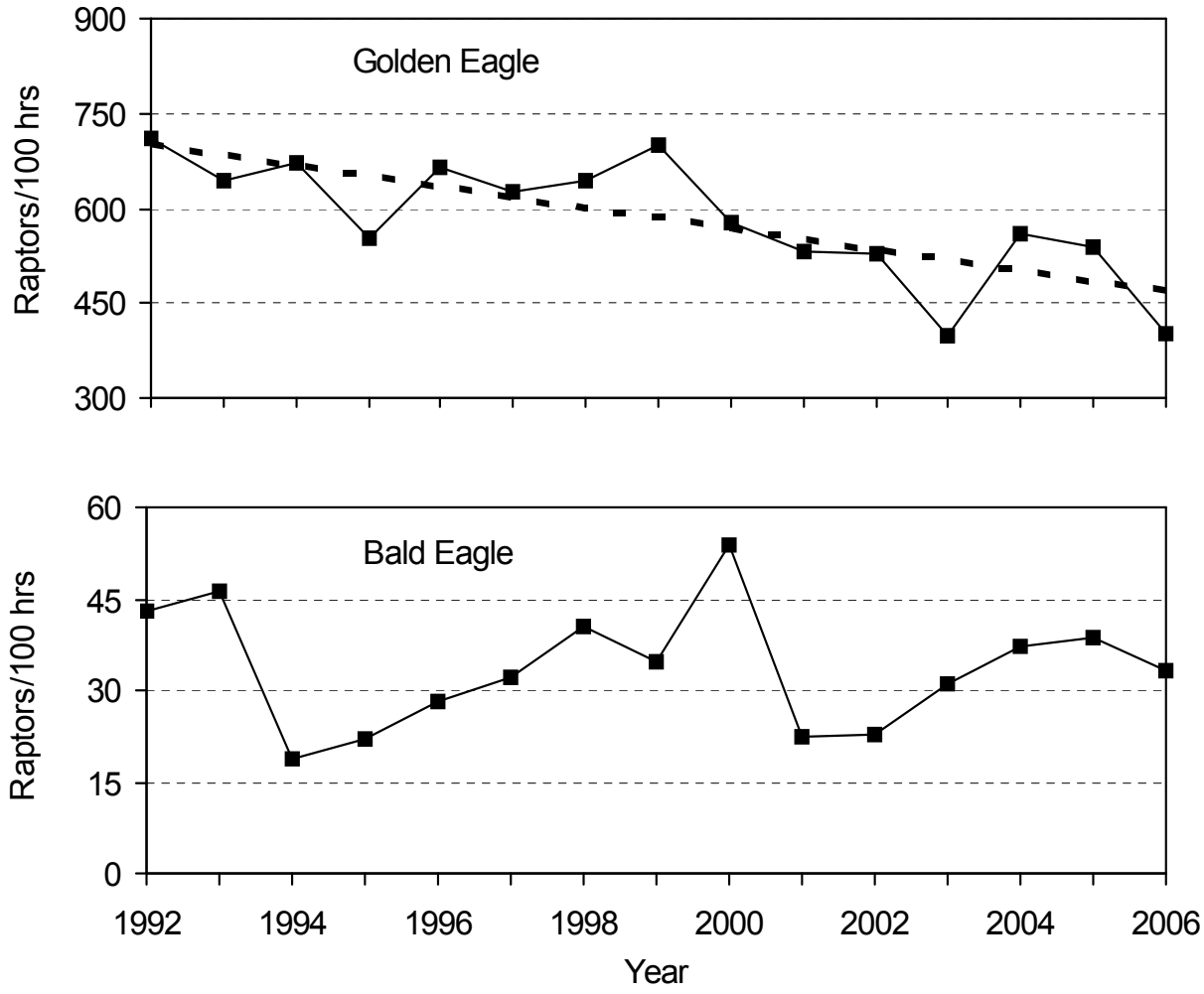

Figure 6. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) fall-migration passage rates for Golden and Bald Eagles in the Bridger Mountains, MT: 1992–2006. Dashed lines indicate significant ($P \leq 0.10$) regressions.

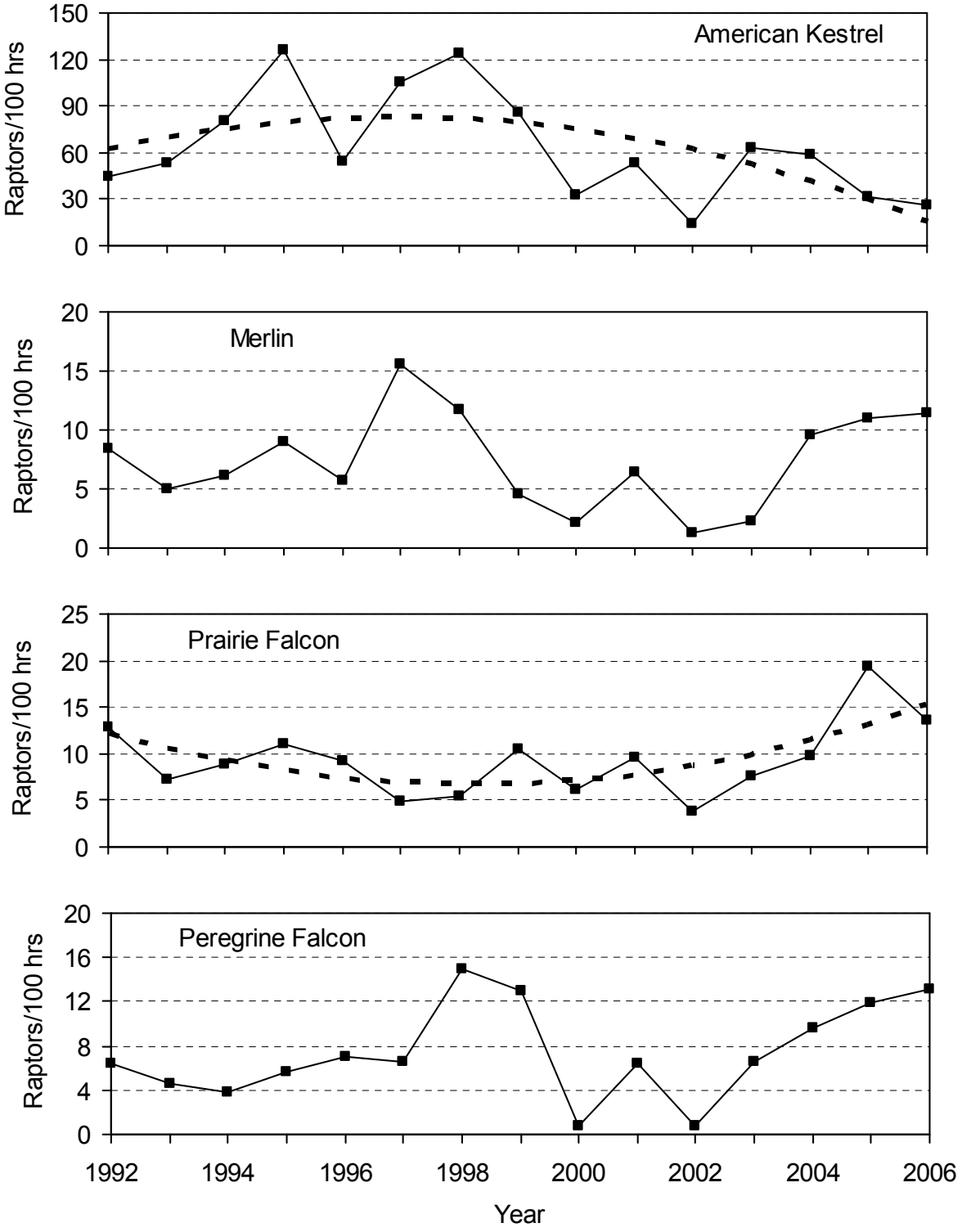

Figure 7. Adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) fall-migration passage rates for American Kestrels, Merlins, Prairie Falcons, and Peregrine Falcons in the Bridger Mountains, MT: 1992–2006. Dashed lines indicate significant ($P \leq 0.10$) regressions.

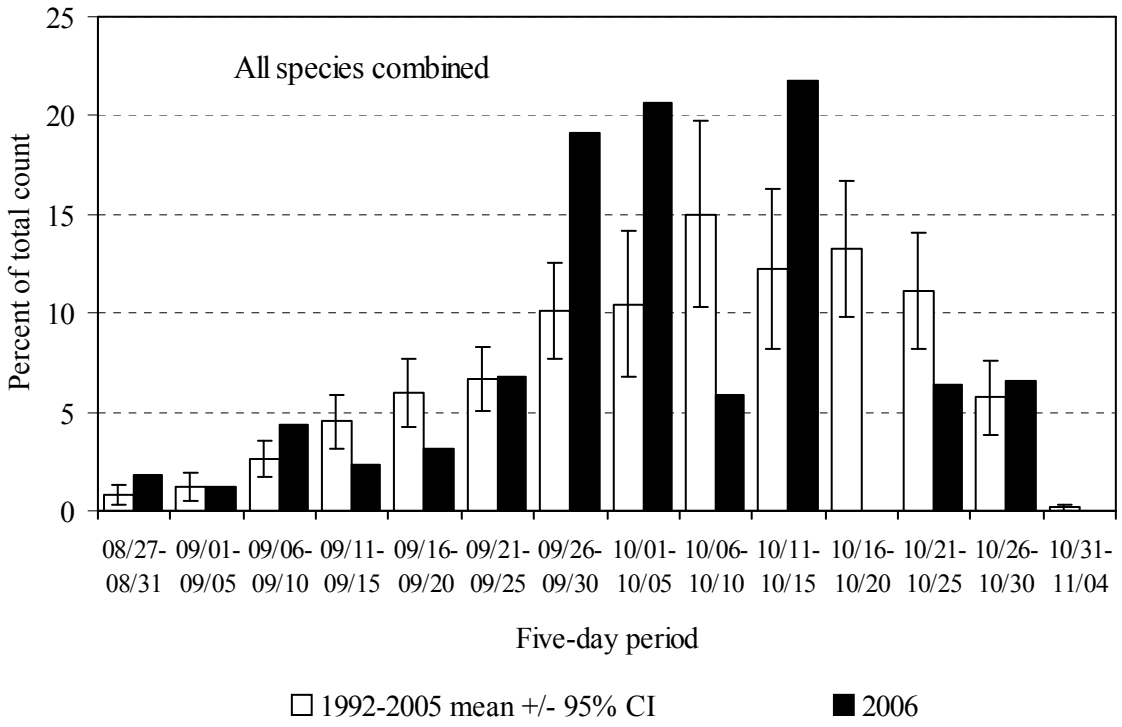

Figure 8. Passage volume by five-day periods for migrating Golden and Bald Eagles in the Bridger Mountains, MT: 1992–2005 versus 2006.

Appendix A. Common and scientific names, species codes, and regularly applied age, sex, and color-morph classifications for all diurnal raptor species observed during fall migration in the Bridger Mountains, MT.

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
Gyrfalcon	*Falco rusticolus*	GY	A I U	U	W G D
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, G = gray; L = light, W = white; 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. A history of primary observers for the Bridger Mountains Raptor Migration Project.

1991: Kristian Shawn Omland (0), Phil West (1), LisaBeth Daly (2), Craig Limpach (1)

1992: Emily Teachout (1), Phil West (2)

1993: Adam Kaufman (0), Anne-Marie Gillesberg (0)

1994: Chris Gill (0), Stephanie Schmidt (1)

1995: Scott Harris (0), Sue Thomas (0)

1996: Jason Beason (0), Niels Maumenee (0)

1997: Jason Beason (1), Patty Scifres (0)

1998: Jason Beason (2), Mike Neal (0)

1999: Mike Neal (2), Greg Levandoski (1)

2000: Ryan Wagner (1), Tracy Elsey (0)

2001: Ryan Wagner (2), Jeff Maurer (4)

2002: Matt Proett (0), Marg Lomow (2; half season), and Maureen Essen (0; half season)

2003: Samantha Burrell (0) and Carl Bullock (0)

2004: Allison Peterson (0) and John Bell (0)

2005: Corey Michell (0) and Beau Fairchild (0)

2006: Brian Cook (0) and Jamie Granger (0)

Note: Numbers in parentheses indicate number of full-seasons of previous raptor migration monitoring experience.

Appendix C. Daily observation effort, visitor disturbance ratings, weather records, and flight summaries for the Bridger Mountains Raptor Migration Project: 2006.

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. West (km)[1]	Visib. East (km)[1]	Median Flight Distance[5]	Birds / Hour
27-Aug	2.25	3.0	0	pc	3.0	wnw	26.0	30.65	2	87	77	2	1.8
28-Aug	6.00	2.5	0	clr	2.1	calm/var	24.2	30.38	1	80	87	2	1.8
29-Aug	8.00	2.0	0	clr-ovc	5.2	n, wsw	21.9	30.13	2	90	79	2	0.6
30-Aug	8.00	2.0	0	pc-ovc	4.9	wsw	19.6	29.93	1	87	51	2	1.4
31-Aug	8.00	2.0	0	clr-mc	6.0	wsw-wnw	8.8	30.22	1	96	89	2	0.1
1-Sep	8.00	1.0	0	clr, AM haze	0.5	calm, w	11.0		1	90	100	2	0.5
2-Sep	8.00	1.0	0	clr, haze	10.6	ene	16.9		2	62	63	1	0.3
3-Sep	8.00	2.0	1	clr, haze	3.7	calm, e	22.0		1	28	20	2	1.9
4-Sep	0.00			excessive smoke									
5-Sep	0.00			excessive smoke									
6-Sep	5.50	2.0	0	mc/haze	3.7	calm, sw	24.4		2	31	28	2	3.5
7-Sep	8.00	2.0	0	pc-ovc	13.1	ese	18.7		4	32	31	2	2.1
8-Sep	8.00	2.0	0	ovc/haze	4.5	calm, ssw	18.1		4	56	47	2	0.8
9-Sep	8.00	2.0	0	pc-ovc, haze, scat ts	3.8	calm, w	18.9		4	54	56	2	1.6
10-Sep	8.00	2.0	0	clr, haze	6.0	nw	17.8		1	54	54	2	2.9
11-Sep	6.50	2.0	0	clr, AM haze	6.6	calm, w	17.1		1	96	79	2	1.7
12-Sep	8.00	1.0	0	clr, haze	4.8	wnw	19.1		1	63	70	2	2.3
13-Sep	8.00	1.0	1	clr-mc/haze	9.3	wsw	21.0		3	49	48	2	0.8
14-Sep	8.00	2.0	0	mc/haze	8.8	sw	13.0	29.64	4	58	61	2	0.9
15-Sep	0.00			fog/sleet									
16-Sep	0.00			weather day									
17-Sep	0.00			weather day									
18-Sep	8.00	2.4	0	clr-mc	7.9	w	6.7	30.08	1	100	100	2	2.6
19-Sep	8.00	2.0	0	pc-ovc	1.9	calm, se	15.4	29.96	4	100	98	2	4.4
20-Sep	0.00			weather day									
21-Sep	0.00			weather day									
22-Sep	0.00			weather day									
23-Sep	4.00	2.0	0	clr-mc	5.3	sw	7.2	30.19	4	100	98	2	2.3
24-Sep	8.00	2.1	2.5	clr-pc	8.2	w	8.8	30.28	3	100	100	2	3.0
25-Sep	9.00	1.9	0	clr	8.9	w	10.2	30.25	1	100	99	2	9.8
26-Sep	8.00	2.5	0	pc-ovc	7.7	w	10.9	30.22	4	100	100	2	9.5
27-Sep	3.00	1.0	0	clr-pc	8.8	w	13.0	30.31	1	100	100	2	8.0
28-Sep	8.00	2.0	0	clr, AM haze	9.5	w	12.8	30.19	1	96	88	2	9.3
29-Sep	8.50	2.3	0	pc-ovc	6.7	wnw	13.7	30.16	4	90	88	2	10.2
30-Sep	8.00	4.1	2	clr, haze	5.4	w	15.1	30.03	1	93	86	2	10.0
1-Oct	8.50	4.3	0	clr-pc, AM haze	4.0	calm, nw	13.1	29.97	2	91	74	2	10.9
2-Oct	8.00	1.6	0	clr-ovc/haze	7.4	se	12.9	30.01	4	69	68	2	14.6
3-Oct	0.00			weather day									
4-Oct	8.50	2.4	0	clr-mc, fog/haze	7.1	calm,se	12.0	30.16	2	95	84	1	7.8
5-Oct	8.00	1.0	0	clr-ovc, AM fog	5.1	calm, sw	15.0	30.11	2	100	91	2	11.5
6-Oct	8.50	1.0	0	mc-ovc, PM rain		sw			4	100	100	2	10.8
7-Oct	0.00			weather day									
8-Oct	0.00			weather day									
9-Oct	0.00			weather day									
10-Oct	8.00	2.0	0	pc-ovc, fog	9.0	wnw			4	100	100	1	1.5
11-Oct	8.00	2.0	0	pc-ovc, fog/dust	8.4	sw			2	100	100	2	14.0
12-Oct	9.00	2.0	0	clr	9.6	w	6.7		2	100	100	2	6.7
13-Oct	8.50	2.9	0	clr-ovc	2.1	w	9.5		1	98	100	2	17.3

Appendix C. 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. West (km)[1]	Visib. East (km)[1]	Median Flight Distance[5]	Birds / Hour
14-Oct	8.50	2.2	1	clr	0.9	calm, w	9.2		1	98	100	2	5.2
15-Oct	7.00	2.9	0	ovc, dust	35.5	wnw	6.0		4	93	88	2	3.7
16-Oct	0.00			snow									
17-Oct	0.00			snow									
18-Oct	0.00			snow									
19-Oct	0.00			snow									
20-Oct	0.00			snow									
21-Oct	0.00			snow									
22-Oct	6.50	1.0	0	clr	7.1	se	3.1		1	100	100	2	1.5
23-Oct	6.00	1.1	0	clr-pc	9.0	nw	0.2		1	100	100	2	10.5
24-Oct	7.00	2.0	0	clr-ovc	7.1	w	2.1		2	100	100	2	5.9
25-Oct	0.00			weather day									
26-Oct	6.00	2.0	0	ovc, snow	19.5	sw	-2.8		4	100	100	2	5.3
27-Oct	6.50	1.0	0	ovc, snow	15.0	sw	1.3		4	100	100	2	0.6
28-Oct	6.00	2.0	0	pc	15.0	sw	2.9		3	100	100	2	6.3
29-Oct	6.00	2.0	0	clr	15.0	sw	2.7		3	100	100	2	7.3
30-Oct	0.00			weather day									
31-Oct	0.00			weather day									

[1] Average of hourly records.

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

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

[4] Median hourly rating concerning prevalence of lift-generating thermals, based on subjective assessments of solar intensity, wind speeds, and migrant behavior: 1 = excellent, 2 = good, 3 = fair, 4 = poor.

[5] Median hourly rating concerning line-of-sight distance of flight from observation site: 1 = close, detection and identification possible with naked eye; 2 = moderate, detection possible with naked eye, but binoculars needed for identification; 3 = far, binoculars needed for both detection and identification; 4 = distant, birds detected and identified only with excellent binoculars or spotting scope and by experienced observers.

Appendix D. Daily observation effort and fall raptor migration counts by species in the Bridger Mountains, MT: 2006.

		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	GY	SF	LF	UF	UU	Total	/ hour
27-Aug	2.25	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	4	1.8
28-Aug	6.00	0	0	1	1	5	0	0	0	0	0	0	1	0	0	0	1	0	0	2	0	0	0	0	0	0	0	0	11	1.8
29-Aug	8.00	0	0	1	0	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0.6
30-Aug	8.00	0	0	2	2	2	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	11	1.4
31-Aug	8.00	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	0	1	0.1
01-Sep	8.00	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	4	0.5
02-Sep	8.00	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0.3
03-Sep	8.00	0	0	3	7	1	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	15	1.9
04-Sep	0.00																													
05-Sep	0.00																													
06-Sep	5.50	0	0	1	11	1	0	0	0	0	0	0	1	0	0	0	1	0	0	3	0	1	0	0	0	0	0	0	19	3.5
07-Sep	8.00	0	0	3	5	1	0	2	0	0	0	0	1	0	0	0	3	0	0	1	0	1	0	0	0	0	0	0	17	2.1
08-Sep	8.00	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	6	0.8
09-Sep	8.00	0	0	1	4	2	0	0	0	0	0	0	1	0	0	0	3	1	0	0	0	1	0	0	0	0	0	0	13	1.6
10-Sep	8.00	0	2	3	7	1	0	0	0	0	0	0	2	0	0	0	4	1	0	2	0	1	0	0	0	0	0	0	23	2.9
11-Sep	6.50	0	0	1	6	2	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	11	1.7
12-Sep	8.00	0	0	0	5	3	0	0	0	0	0	0	0	0	0	0	8	0	0	2	0	0	0	0	0	0	0	0	18	2.3
13-Sep	8.00	0	0	1	1	0	0	0	0	0	0	0	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	6	0.8
14-Sep	8.00	0	0	1	1	3	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	7	0.9
15-Sep	0.00																													
16-Sep	0.00																													
17-Sep	0.00																													
18-Sep	8.00	2	1	0	1	4	0	1	0	0	8	0	0	0	0	0	3	0	0	0	0	0	1	0	0	0	0	0	21	2.6
19-Sep	8.00	0	0	5	7	4	2	0	0	0	2	0	3	0	0	0	8	1	0	0	0	1	2	0	0	0	0	0	35	4.4
20-Sep	0.00																													
21-Sep	0.00																													
22-Sep	0.00																													
23-Sep	4.00	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	9	2.3
24-Sep	8.00	0	0	0	7	2	1	0	0	0	1	0	5	0	0	0	7	0	0	1	0	0	0	0	0	0	0	0	24	3.0
25-Sep	9.00	0	0	1	21	8	1	0	0	0	0	0	11	0	0	0	38	1	0	4	0	0	3	0	0	0	0	0	88	9.8
26-Sep	8.00	0	0	0	13	12	1	2	0	0	0	0	11	0	0	0	31	2	0	1	1	2	0	0	0	0	0	0	76	9.5
27-Sep	3.00	0	0	0	4	2	1	0	0	0	0	0	2	0	0	0	14	1	0	0	0	0	0	0	0	0	0	0	24	8.0
28-Sep	8.00	0	0	0	19	6	1	0	0	0	1	0	2	1	0	0	34	2	0	3	1	2	2	0	0	0	0	0	74	9.3
29-Sep	8.50	0	0	0	21	6	0	0	0	0	0	0	4	0	0	1	44	4	0	2	0	2	2	0	0	0	0	1	87	10.2
30-Sep	8.00	0	0	1	24	7	1	0	0	0	0	0	1	0	0	0	39	2	0	3	0	1	0	0	0	0	0	1	80	10.0

Appendix D. 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	GY	SF	LF	UF	UU	Total	/ hour
01-Oct	8.50	0	0	0	27	9	2	1	0	0	0	0	4	0	0	0	44	2	0	1	2	0	1	0	0	0	0	0	93	10.9
02-Oct	8.00	0	2	6	26	21	3	0	0	0	0	0	10	1	2	0	34	4	0	2	1	1	4	0	0	0	0	0	117	14.6
03-Oct	0.00																													
04-Oct	8.50	0	0	7	27	23	0	0	0	0	0	0	1	0	0	0	4	2	0	1	1	0	0	0	0	0	0	0	66	7.8
05-Oct	8.00	0	0	2	29	16	0	1	0	0	0	0	5	0	0	0	29	8	0	2	0	0	0	0	0	0	0	0	92	11.5
06-Oct	8.50	0	1	2	15	7	2	1	0	0	0	0	2	0	0	0	56	6	0	0	0	0	0	0	0	0	0	0	92	10.8
07-Oct	0.00																													
08-Oct	0.00																													
09-Oct	0.00																													
10-Oct	8.00	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	12	1.5
11-Oct	8.00	0	0	0	2	2	0	0	0	0	0	0	2	0	3	0	95	6	0	1	1	0	0	0	0	0	0	0	112	14.0
12-Oct	9.00	0	0	0	5	2	2	0	0	0	0	0	1	0	2	0	41	5	0	0	1	1	0	0	0	0	0	0	60	6.7
13-Oct	8.50	0	0	2	16	9	4	2	0	0	0	0	4	0	1	1	96	6	0	1	2	1	0	0	0	1	0	1	147	17.3
14-Oct	8.50	0	0	2	16	3	0	0	0	0	0	0	0	0	2	0	17	4	0	0	0	0	0	0	0	0	0	0	44	5.2
15-Oct	7.00	0	0	0	3	4	1	0	0	0	0	0	0	0	0	0	12	0	0	0	5	1	0	0	0	0	0	0	26	3.7
16-Oct	0.00																													
17-Oct	0.00																													
18-Oct	0.00																													
19-Oct	0.00																													
20-Oct	0.00																													
21-Oct	0.00																													
22-Oct	6.50	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	6	1	0	0	0	0	0	0	0	0	0	0	10	1.5
23-Oct	6.00	0	0	0	2	0	1	0	0	0	0	0	2	0	5	0	48	4	0	0	0	1	0	0	0	0	0	0	63	10.5
24-Oct	7.00	0	0	0	2	5	2	0	0	0	0	0	2	0	1	0	28	1	0	0	0	0	0	0	0	0	0	0	41	5.9
25-Oct	0.00																													
26-Oct	6.00	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	29	1	0	0	0	0	0	0	0	0	0	0	32	5.3
27-Oct	6.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	4	0.6
28-Oct	6.00	0	0	0	0	2	2	0	0	0	0	0	0	0	1	0	27	5	0	0	0	0	0	1	0	0	0	0	38	6.3
29-Oct	6.00	0	0	0	3	4	3	0	0	0	0	0	2	1	2	0	27	1	0	0	0	1	0	0	0	0	0	0	44	7.3
30-Oct	0.00																													
31-Oct	0.00																													
Total	331.25	2	7	50	344	182	33	10	0	0	12	0	89	3	21	2	859	74	1	38	15	22	15	1	0	1	0	3	1784	5.4

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

Appendix E. Annual observation effort and fall raptor migration counts by species in the Bridger Mountains, MT: 1991–2006.

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	MEAN
Start date	15-Sep	6-Sep	9-Sep	13-Sep	10-Sep	1-Sep	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug	31-Aug
End date	3-Nov	28-Oct	31-Oct	30-Oct	2-Nov	30-Oct	31-Oct	31-Oct	31-Oct	31-Oct	31-Oct	31-Oct	31-Oct	27-Oct	31-Oct	29-Oct	29-Oct
Observation days	32	39	46	36	42	53	62	56	57	52	58	52	64	48	48	45	49
Observation hours	191.1	242.58	298.50	239.25	269.17	378.25	422.92	339.33	358.24	335.40	347.49	365.84	443.18	316.70	300.83	331.25	323.75
Raptors / 100 hours	926.7	1000.1	872.0	1025.3	824.0	808.5	796.1	1040.9	871.8	630.9	636.3	556.0	517.6	655.2	674.8	538.6	773.6
SPECIES	RAPTOR COUNT																
Turkey Vulture	3	0	0	0	0	1	6	0	2	0	0	0	0	0	1	2	1
Osprey	2	2	5	5	1	14	12	13	9	6	6	2	5	1	2	7	6
Northern Harrier	19	13	41	59	10	38	66	230	52	20	36	15	54	39	22	50	48
Sharp-shinned Hawk	88	248	279	364	304	436	480	612	442	190	274	288	416	229	228	344	326
Cooper's Hawk	87	175	124	134	131	206	347	343	149	109	120	103	132	142	153	182	165
Northern Goshawk	27	96	39	17	10	37	36	50	61	34	26	2	23	41	22	33	35
Unknown small accipiter[1]	-	-	-	-	-	-	-	-	-	-	0	11	29	32	92	10	29
Unknown large accipiter[1]	-	-	-	-	-	-	-	-	-	-	0	4	4	9	4	0	4
Unknown accipiter	70	35	27	20	33	51	53	49	39	35	27	5	0	7	27	0	30
TOTAL ACCIPITERS	272	554	469	535	478	730	916	1054	691	368	447	413	604	460	526	569	568
Broad-winged Hawk	0	2	3	11	5	5	5	20	13	3	38	3	9	6	3	12	9
Swainson's Hawk	1	11	0	3	2	0	6	2	3	3	0	1	2	0	0	0	2
Red-tailed Hawk	26	67	65	110	79	106	130	277	121	45	117	78	113	100	108	89	102
Ferruginous Hawk	3	1	1	1	0	5	4	7	4	1	3	0	1	3	2	3	2
Rough-legged Hawk	9	10	54	48	29	17	23	66	77	26	57	11	22	20	40	21	33
Unidentified buteo	14	8	19	15	18	13	20	13	3	8	6	9	6	18	27	2	12
TOTAL BUTEOS	53	99	142	188	133	146	188	385	221	86	221	102	153	147	180	127	161
Golden Eagle	1280	1579	1699	1500	1322	1871	1844	1516	1870	1429	1330	1359	1226	1196	1061	859	1434
Bald Eagle	43	95	124	41	57	79	93	95	91	128	58	55	93	79	75	74	80
Unidentified eagle	5	2	17	0	25	14	0	15	5	3	2	15	4	2	1	1	7
TOTAL EAGLES	1328	1676	1840	1541	1404	1964	1937	1626	1966	1560	1390	1429	1323	1277	1137	934	1521
American Kestrel	33	38	54	67	117	82	146	141	113	39	62	16	102	65	20	38	71
Merlin	2	10	7	7	12	9	26	17	8	3	9	2	4	11	7	15	9
Prairie Falcon	9	14	10	10	14	16	10	12	20	9	14	6	15	12	20	22	13
Peregrine Falcon	1	7	6	4	7	10	10	18	18	1	8	1	10	10	8	15	8
Gyrfalcon	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0
Unknown small falcon[1]	-	-	-	-	-	-	-	-	-	-	0	0	0	3	27	0	5
Unknown large falcon[1]	-	-	-	-	-	-	-	-	-	-	0	1	3	3	13	1	4
Unknown falcon	5	3	2	4	2	5	17	8	6	4	3	4	1	9	13	0	5
TOTAL FALCONS	50	72	79	92	152	122	209	196	166	56	96	30	135	113	108	92	111
Unidentified raptor	44	10	27	33	40	43	33	28	16	20	15	43	20	38	54	3	29
GRAND TOTAL	1771	2426	2603	2453	2218	3058	3367	3532	3123	2116	2211	2034	2294	2075	2030	1784	2444

[1] Designations used for the first time in 2001.