FALL 2015 RAPTOR MIGRATION STUDY IN THE BRIDGER MOUNTAINS, MONTANA

Montana Audubon, Helena, Montana
&
HawkWatch International, Salt Lake City, Utah

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INTRODUCTION

The Bridger Mountains Raptor Migration Project in southwestern Montana is an ongoing effort to monitor long-term population trends of raptors using this portion of the Rocky Mountain Flyway (Omland and Hoffman 1996, Hoffman and Smith 2003, Smith et al. 2008a). HawkWatch International (HWI) initiated a partial-season count at the site in 1991, with standardized, full-season annual monitoring commencing in 1992. Beginning in 2009 Montana Audubon took the lead in coordinating these annual counts. This flyway is noted for large concentrations of Golden Eagles (Appendix A provides scientific names of all raptor species observed at this 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 count results for the 2015 season, which marked the 24th consecutive full-season autumn count of migratory raptors at this site.

The Bridger Mountains Project was one of seven long-term, annual fall migration counts conducted or co-sponsored by HWI in North America during 2015. The primary objective of these efforts is to track long-term population trends of diurnal raptors in western North America and the Gulf Coast region (Hoffman et al. 2002, Hoffman and Smith 2003, Smith et al. 2008a&b). Raptors serve as important biological indicators of ecosystem health (Bildstein 2001), and long-term migration monitoring is the most cost effective and efficient method for assessing regional population status and trends of multiple raptor species (Zalles and Bildstein 2000, Bildstein et al. 2008).

STUDY SITE

The Bridger Mountains is a relatively narrow range that runs primarily along a north–south axis. From Sacajawea 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 predictable lift, attracting 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 is situated within the Gallatin National Forest on the crest of the Bridger Ridge, about 25 km northeast of Bozeman and 3 km north of Saddle Peak. The helicopter pad is a 5 m x 5 m concrete platform located approximately 50 m north of an avalanche cache/ski patrol hut. The site is accessed by walking along a primitive dirt road up the eastern face of the ridge for 2.5 km (780 m rise in elevation) to the top of the Bridger chairlift, then continuing westward a few hundred meters along a footpath to the crest of the ridge, and then north for 50 meters to the observation site.

METHODS

Since this project's inception, two designated observers have conducted standardized daily counts of migrating raptors from a single, traditional observation site from approximately late August/early September through late October/early November. In 2015 daily observations began on 1 September (with two additional observation hours conducted on 29 August) and continued through 2 November 2015. The observation period was dampened three days before the planned final count day (November 5th) due to heavy snowfall and poor visibility (persistent low cloud cover). Observations typically began at 0900 H and ended at 1700 H Mountain Standard Time (MST). Both observers received on-site training with Montana Audubon Executive Director, Steve Hoffman. Local enthusiast (and expert observer) Matt Keefer frequently volunteered full days to the hawkwatch effort, standing in for one of the full-time observers, as did a handful of other local birders who are thanked individually in the Acknowledgments section.

Two owl decoys with bobble-heads were used in 2015, one near and one far. The near-owl was approximately 5 m to the north of the counting platform, raised on a 3 m pole. Unfortunately, the near-owl was blown over during a windstorm 3 weeks into the season and went rocketing down the east side of the ridge, losing its head along the way. Thus it was out of commission until mid-October when the head was discovered and thoroughly re-duct-taped. However, the far-owl, which was approximately 600 m to the north atop Tilly Peak, remained standing throughout the season (it was perched on a shorter pole - around 1.5 m high).

The observers routinely recorded the following data each day:

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 each species).

2. Hour of passage for each migrant; e.g., the 1000–1059 H, etc. (Mountain Standard Time).

3. Wind speed and direction, air temperature, percent cloud cover, predominant cloud type(s), presence of precipitation (and type), visibility, and a subjective assessment of thermal lift conditions for each hour of observation on the half-hour.

4. Predominant direction, altitude, and horizontal distance from the lookout of the migratory 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 contributed substantially to the count [actively scanning, pointing out birds, recording data, etc.] for more than 10 minutes in a given hour).

6. A subjective visitor-disturbance rating (high, moderate, low, none) for each hour.

7. Observation start and end times for each official observer.

Calculation of "adjusted" (to standardize sampling periods and adjusted for incompletely identified birds) passage rates (migrants counted per 100 hours of observation) and analysis of trends, updated through 2015, follows Hoffman and Smith (2003). In comparing 2015 annual statistics against means and 95% confidence intervals for previous seasons, we determined significance when a 2015 value fell outside the 95% confidence interval of the associated mean.

RESULTS AND DISCUSSION

OBSERVATION EFFORT AND WEATHER SUMMARY:

In 2015 observers were able to count on 54 of 66 possible days between September 1st and November 5th for a total of 401.35 observation hours. Total observation hours were 21% above the 1992-2014 mean of 332.6 (± 21.3) hours. The count typically runs from September 1st through November 5th and in 2015 a partial, 2-hour count was conducted on a preliminary trip to the site on August 29th.

Inclement weather and/or difficult access fully precluded observation on 12 days during the 2015 season. In addition, inclement weather was a factor in reducing the total daily observation period to less than 4

hours on 3 additional days. During periods of active observation, skies were recorded as clear 29% of the time, partly cloudy 31% of the time, mostly cloudy 17% of the time, and overcast 24% of the time. The 1992-2014 mean values are 33% clear, 21% partly cloudy, 17% mostly cloudy, 29% overcast. Fog was reported during 2% of active observation time in 2015. This is low compared with the long-term average of 6%. Rain or snow was reported during 6% of active observation time in 2015. This is close to the long-term average of 5%. As is typical of this site, winds were primarily from the W and SW during the 2015 season. East winds were rare and tended to occur for only one day at a time, usually just prior to, or immediately after the passage of a frontal system. East winds dominated on only 9% (5 days) of active observation during 2015.

Overall the 2015 season was relatively mild and sunny from early September through mid-October. It is noteworthy that, due exceptionally warm weather, snow cover along the Bridger ridgetop was essentially non-existent throughout most of the season. Through mid-October there were only three storm systems, the second of which brought light snow accumulations between 9/15 and 9/17. A substantial storm system arriving on 10/19 introduced consistently cloudier, wetter, and colder conditions for the remainder of the season. The count ended with the onset of a multi-day snowstorm beginning on 11/2.

FLIGHT SUMMARY:

The fall 2015 raptor migration was the 3rd largest on record, with a total of 3,299 diurnal raptors counted (see Table 1). This is 36% above the 1992-2014 mean total of 2410.3 (∓ 215.5). Six of the 17 species were counted this year appeared in record numbers: Osprey (22), Red-tailed Hawk (389), Rough-legged Hawk (96), Sharp-shinned Hawk (658), American Kestrel (181), and Merlin (36). all passed through in numbers more than 50% above the mean values for the last 22 years (numbers in parentheses represent totals for the 2015 season).

The two species of eagles represented the largest chunk of raptors this season (37%; Figure 2.), although this year was far below average for Golden Eagles (1138 this season, compared to the 22-year average of 1335). In fact 6 of the 8 western HWI sites (Bridgers included) recorded below average Golden Eagle counts in 2015. Accipiters were the next largest group riding the ridge (33%), followed by buteos (17%), falcons (8%), and harriers (4%), with vultures, ospreys and unidentified raptors each comprising <2%.

Again, despite their relatively low numbers, Golden Eagles were the most numerous species, making up 34% of the total count (which is more than 10% lower than any previous year in the 24-year history of the Bridger count), followed by Sharp-shinned Hawks (20%), Red-tailed Hawks (12%), Cooper's Hawks (9%), American Kestrels (5%), Northern Harriers (4%), Rough-legged Hawks (3%), and Bald Eagles (2%), with the remaining 9 species combined comprising the last 9%.

LONG TERM TRENDS:

The most captivating and worrisome trend that the Bridger Mountain Hawk Watch has revealed is the precipitous drop in Golden Eagle numbers, primarily since 2000 ($p<0.001$) (Figure 3e). The Bridgers, famous for massive Golden Eagle flights, is experiencing significant decline in both adult and non-adult passage rates. The rate of decline for both age classes is roughly the same, though the non-adult Golden Eagles are declining slightly faster (by 0.5 birds/100 hours/year) than adults. Causes for the declining Golden Eagle population are not addressed by this study, though habitat degradation and lowered prey densities have likely been contributing factors.

The only other species showing significant declines are Bald Eagles and Northern Goshawks (Figures 3c and 3f). Bald Eagles are late-season migrants, thus the bulk of them do not pass the Bridgers until long after the count has typically ended. Bald Eagle populations have rebounded continent-wide, beginning in

the 1980's after DDT was banned in 1972, thus the downward trend in the Bridgers is likely indicative of the birds moving south later in the season due to a gradually warming climate (and ice-free fishing to the north lasting considerably later in the season).

As for Northern Goshawks, first it is important to note that the significant downward trend is supported by a relatively small sample size (long-term passage rates averaging only 10 birds/100 hours ∓ 3.2). In addition, since goshawks are well known to be both "irruptive migrants" and "partial migrants" (they migrate irregularly, and primarily in response to a crash in populations of their principal prey, snowshoe hares and Ruffed Grouse; and, only a percentage of the breeding population migrates at all, and those that do migrate generally do not travel more than a few hundred miles from their breeding grounds to their wintering areas), it may be difficult to infer regional population trends from goshawk migration counts with a high degree of confidence.

It is also possible that our goshawk counts may be an over-estimate (based on this year's observations of resident birds), since resident birds can be mistaken for migrants, often seeming to make long foraging flights around the entire ridge.

We are pleased to report generally good news for Bridger count trends for Red-tailed Hawks and Peregrine Falcons. The redtail has experienced an upward trend in numbers, particularly during the past 6 years (Figure 3d). Counts for the Peregrine Falcon show a significant long-term positive trend (Figure 3g). Merlins and Broad-winged Hawks also demonstrate significant long-term increases (Figures 3g and 3d), although passage rates for both species are under 10 birds/100 hours. It is notable that nationwide count trends suggest Broad-winged Hawk declines in eastern North America, but an increasing trend for the past 20 years in the West (Smith et al. 2008). The reason(s) for an increase in broadwings in western North America is unknown.

Of the remaining 11 species, only 5 (both small accipiters, American Kestrels, Northern Harriers, and Rough-legged Hawks) exhibit passage rates exceeding 10 birds/100 hours, and none show significant long-term population trends. Turkey Vultures, Ferruginous Hawks, Swainson's Hawks, Ospreys and Prairie Falcons were all infrequently observed and these low counts prevented meaningful trend analyses (see Figure 3 for historic passage rates).

Smith et al. (2008a) present trend analyses for data collected through 2005 for most of the long-term, ongoing autumn migration studies in western North America, including the Bridger Mountains. These and subsequent analyses (reported as part of the Raptor Population Index or "RPI" analyses; see http://www.rpi-project.org for updated trend graphs using this more complex method) are based on a more complex analytical approach (also see Farmer et al. 2007) than what was reported in Hoffman and Smith (2003) and used herein to present trend analyses through 2015. Among other refinements, this new approach fits polynomial trajectories to the complete series of annual count indices, providing estimates of rates of change between various periods while also providing assessments of trend significance and precision. Please note, however, that restrictions related to the mathematical assumptions behind this approach precludes analyzing data for rare species, which in this case includes Turkey Vultures, Ospreys, all buteos except Red-tailed and Rough-legged Hawks, and all falcons except American Kestrels. However, with few notable exceptions the overall patterns of population change and derived trend estimates for each species as calculated by this more complex method generally yield similar trends to those derived from the simpler methodology used herein (and described more fully in Hoffman and Smith (2003).

AGE RATIOS:

Overall high immature to adult ratios (and record-breaking counts) this season suggest a highly productive 2015 breeding season for most species (see Table 2). Six of the 8 species for which we can

visually differentiate ages showed an age ratio significantly above the 1992-2014 mean. All three species of accipiters were above average, as were Red-tailed Hawks and both eagle species. Golden Eagles, despite suffering a long-term population decrease and having one of the poorest years on record (in terms of passage rate), had a substantially higher immature-to-adult ratio (1.6) than average (1.1∓0.16). However, this may not reflect the true ratio of first-year birds to adult birds, as the immature category used for the age-ratio comparison lumps immatures, subadults, and "non-adults". Regardless, the ratio of purely first-year birds to adults for 2015 (0.83) is still outside of the 95% confidence interval of the 2001-2014 average (0.6 ∓0.12; prior to 2001 Golden Eagles were not broken into categories beyond adult and not-adult).

RESIDENT RAPTORS:

This year's observers recorded a total of 9 species of raptors that consistently displayed resident behavior around the observation site. This includes all 8 species typically identified as residents in past years, including Sharp-shinned Hawk, Cooper's Hawk, Northern Goshawk, Red-tailed Hawk, American Kestrel, Prairie Falcon, Peregrine Falcon and Golden Eagle, with the addition of Northern Harrier.

Sharp-shinned Hawk – Resident Sharp-shinned Hawks were consistently seen almost daily for the first half of the count season. At least 1 immature often made close passes to both owl decoys and was seen on numerous occasions chasing Clark's Nutcrackers and flocks of other passerines just to the north of the platform.

Cooper's Hawk – An adult male Cooper's Hawk was identified as a resident on 3 Sept. and was seen periodically during early September, often hunting low and to the east of the platform.

Northern Goshawk – An immature Northern Goshawk was first seen on 9/6, and frequently thereafter. This bird would often appear from behind Tilly Peak to the north of the platform and fly southward along the west side of the ridge, returning a few hours later. It often mobbed Common Ravens and other migrant raptors, as well as the resident Redtails. It made a few passes at the close owl decoy and at one point came within 2-3 feet of the startled observers. An adult goshawk was first identified as a migrant on 9/14 as it passed close owl decoy and then proceeded north and out of sight. However, what was believed to be the same bird was later seen returning and thus was erased from the data sheet and marked as a resident. This bird was seen on a few other occasions, mainly after 10/18.

Red-tailed Hawk – Resident Red-tailed Hawks were seen almost every day throughout the season. At least 3 immatures were identified positively as residents. These 3 were seen frequently until 9/21, after which only 1 immature was seen hunting along the ridgeline throughout the day. At least 2 adult Redtails were present, with the possibility that migrants joined the local crew for a few days at a time during the middle of the season. One adult was often seen flying with one of the immatures north of the observation platform and another, very ragged-looking adult, often circled up from the Northeast and scolded the other locals for awhile, then returned east again.

American Kestrel – A group of at least 3 different American Kestrels, presumably a pair with young, was seen on 8/29 on the hike up to the platform and then throughout the day from the top. From 9/2 until 9/9 at least 2 were seen in the area, usually flying above the ski resort east of the platform. No resident kestrels were recorded after 9/9.

Prairie Falcon – On 9/5 a resident Prairie Falcon was first seen hunting along the west slope of the ridgeline. The next day it was seen heading slowly south, periodically kiting in the wind at certain locations and then returning north a few hours later. The departure and return of the local prairie became an almost daily occurrence; this was probably our most regular resident bird.

Peregrine Falcon – Resident peregrines first made an appearance and 9/14, with a single bird seen hunting to the north. A male and female were seen together on 9/24. One or both of these birds were seen sporadically through early October, often coming from the direction of Ross Peak and heading toward Saddle Mountain.

Golden Eagle – Resident Golden Eagles were a common site, especially early in the season. They often flew singly or as pairs or groups of 3. A common situation during September was for a pair of Golden Eagles to display near one another far to the north over Ross Peak, and another pair would then fly in from the south and display closer to the platform. Confrontations were common as well. Overall, it was thought that there were 5 resident Golden Eagles present at least until late September, and then 1 subadult stayed for the remainder of the season.

Northern Harrier – After much debate we concluded that the mysterious immature harrier that was at-first counted as a migrant flying close to the ridgeline to the east, then returning northward shortly thereafter(a frequent occurrence for much of the season), was indeed a resident bird. It was decided that this bird generally resided in the open fields along the lower slopes of the ski resort, and used the updrafts along the ridge as a way to efficiently move to widely scattered hunting grounds to the north and south of the area.

VISITATION:

Our balmy fall migration season meant a long period of outdoor recreation pursuits for Bozeman residents, thus weekends on the Bridger Ridge were generally bustling with runners, hikers and birdwatchers alike. A handful of people summering in Bozeman from Washington, Texas and Florida came up regularly early in the season before returning home again. Of course, most visitors were from Bozeman or Belgrade, and of the 104 people to sign our guest log, there were 12 that came up on multiple occasions eager for a good raptor day. Some hiked to the top every weekend to sit for a few hours in the hopes of seeing an eagle or two. Others came almost every day toward the end of the season, climbing the hour-and-a-half trail over ice and snow.

The 19th annual Bridger RaptorFest (2nd- 4th of October), run primarily by volunteers, attracted an estimated 4,000 visitors. Despite the shroud of low clouds obscuring the view from the ridge, a few braved the hike to the mountain crest and enjoyed a chat and hot tea at the top. Down below folks participated in a wide range of raptor-related activities (kestrel box building, binocular viewing and raptor I.D. workshops, live-raptor demonstrations, and a keynote address by raptor legend, Kate Davis).

During the festival (and throughout the season) raffle tickets for two season passes at Bridger Bowl were sold by Sacajawea Audubon volunteers and Montana Audubon staff. The two tickets, generously donated by Bridger Bowl, generated a total of $2700. These funds went toward the 2015 count.

As for publicity, RaptorFest made NBC Montana news on October 2nd, and the Bridger Hawk Watch was highlighted in an article in the online version of Audubon Magazine in January 2016.

OTHER WILDLIFE:

Sitting on a prominent ridgetop for 8 hours every day during the fall is not only a good way to observe large numbers of diurnal raptors, but many other animal species as well. Several species of mammals along with numerous resident and migrant songbirds were observed throughout the season.

The attributes that make Bridger Ridge a great pathway for migrating raptors appear to make it ideal for migrating passerines as well. During the warmer part of the season, especially in mid – late September,

small flocks of passerines were seen heading south. These flocks were most numerous early in the morning. Yellow-rumped Warbler, Mountain Bluebird, American Pipit, Townsend's Solitaire, Cedar Waxwing, Dark-eyed Junco and American Robin were all commonly-observed migrants early on. Wilson's and Orange-Crowned warblers both made an appearance on the ridgetop during this time.

On 9/19 Bohemian Waxwings made their first appearance as migrants along the ridge, and these were followed the next day by the first of many large flocks of Gray-crowned Rosy-Finches. While the abundance of the earlier migrants quickly dropped off in late September, huge flocks of mainly Gray-crowned Rosy-Finches, sometimes more than 400 at a time, began moving through almost daily. Often these flocks would settle along the ridge near the platform, or below in the ski area's open meadows, often attracting the attention of passing raptors. A few flocks of Common Redpolls and one Snow Bunting were also noted once colder weather arrived. A group of 3 Common Loons was seen flying southward overhead on 10/7, and 12 Sandhill Cranes migrated over on 10/11.

The corvids were a constant source of entertainment throughout the season. Common Ravens were abundant, and often engaged in aerobatics with other ravens as well as many resident and migrant raptors. Clark's Nutcrackers were always flying back and forth between feeding areas and occasionally a Black-billed Magpie would fly up to the ridgetop.

Dusky Grouse were common companions around the observation platform. An American Three-toed Woodpecker and several Pine Grosbeaks also showed up on occasion. Mountain Chickadee, Brown Creeper, Northern Flicker, Ruby-crowned Kinglet, Pine Siskin, American Goldfinch, and Cassin's Finch were common residents throughout the season.

At least one weasel (long-tailed or short-tailed) was seen frequently, and generally lived underneath the platform. It hunted among the surrounding rocks, and on two occasions it was observed carrying freshly-killed voles. The weasel, brown at first, disappeared for about a week during the middle of the season and was almost totally white the next time it was seen.

Black bears were observed on several occasions along the rocky slope immediately to the Northwest of the platform. A mother and two cubs were observed on one occasion and a single individual was seen several other times digging on the scree slope.

Mountain goats were often seen, mostly in groups of 2-3 to the north of the platform. In mid-October we counted 18 individuals moving in a long caravan, including both adults and young. Eventually this group walked past the platform, to the east about 50 meters away.

ACKNOWLEDGMENTS

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Table 1. 2015 count summary and historic records of fall migrating raptors at the Bridger Mountains, MT.

		1992-2014				All-time Historic Records	
	Species	Mean Count ± 95 % CI		2015	% Change	Record Count	Year
	Turkey Vulture	4.2	± 1.9	7	67	16	2013
	Osprey	6.5	± 1.8	22	240	22	2015
	Northern Harrier	51.4	± 17.3	141	174	214	1998
Accipiters							
	Sharp-shinned Hawk	345.4	± 46.6	658	90	655	2015
	Cooper's Hawk	167.6	± 25.9	306	83	347	1997
	Northern Goshawk	31.9	± 8.3	38	19	96	1992
	Unidentified accipiter	42.4	± 10.1	94	122	122	2005
	TOTAL ACCIPITERS	*587.3*	± *72.7*	*1096*	*87*	*1093*	*2015*
Buteos							
	Red-shouldered Hawk	0.0	± 0.0	0		0.0	
	Broad-winged Hawk	13.5	± 5.5	29	114	48	2013
	Swainson's Hawk	3.8	± 1.2	3	-20	11	1992
	Red-tailed Hawk	123.0	± 24.5	389	216	382	2015
	Ferruginous Hawk	3.0	± 0.8	6	97	8	2014
	Rough-legged Hawk	35.7	± 8.2	96	169	96	2015
	Unidentified buteo	13.1	± 3.3	29	122	37	2014
	TOTAL BUTEOS	*190.8*	± *34.1*	*552*	*189*	*544*	*2015*
Eagles							
	Golden Eagle	1335.1	± 127.0	1138	-15	1871	1996
	Bald Eagle	77.2	± 10.3	81	5	128	2000
	Unknown eagles	7.7	± 2.9	2	-74	25	1995
	TOTAL EAGLES	*1418.7*	± *133.0*	*1221*	*-14*	*1964*	*1999*
Falcons							
	American Kestrel	77.2	± 16.9	181	135	180	2015
	Merlin	11.4	± 2.7	36	216	36	2015
	Prairie Falcon	13.7	± 1.6	6	-56	20	2006
	Peregrine Falcon	12.5	± 3.7	21	68	34	2012
	Unidentified falcon	8.1	± 4.4	7	-13	53	2005
	TOTAL FALCONS	*122.9*	± *21.3*	*250*	*103*	*250*	*2015*
	Unidentified Raptor	30.7	± 7.3	9	-71	77.0	2012
	GRAND TOTAL	**2410.3**	**± 215.5**	**3299**	**37**	**3432.0**	**1998**

Table 2. Fall counts by age class and immature[1]: adult ratios for selected species of migrating raptors in the Bridger Mountains, MT: 1992–2014 versus 2015.

	Total and Age-classified Counts								Immature : Adult	
	2015			1992-2014 average			% Unknown Age		Ratio	
	Imm	Adult.	Total	Imm.	Adult.	Total	1992–2014[2]	2015	1992–2014[1]	2015
Northern Harrier	70	28	141	24	13	55	32 ± 6.3	30	3.2 ± 2.55	2.5
Sharp-shinned Hawk	182	202	658	70	133	348	42 ± 5.3	42	0.6 ± 0.11	0.9
Cooper's Hawk	102	85	306	47	56	170	39 ± 4.4	39	0.9 ± 0.23	1.2
Northern Goshawk	31	7	38	12	12	32	27 ± 8.1	0	1.7 ± 0.46	4.4
Broad-winged Hawk	7	11	29	3	6	14	36 ± 14.1	38	0.5 ± 0.16	0.6
Red-tailed Hawk	170	174	389	38	59	127	23 ± 3.6	12	0.7 ± 0.26	1.0
Golden Eagle	551	345	1138	641	485	1338	26 ± 4.0	21	1.1 ± 0.16	1.6
Bald Eagle	34	44	81	28	48	78	4 ± 1.8	4	0.6 ± 0.11	1.8

[1] Northern Harrier immature counts were only from birds positively identified as being immatures (a "brown" category is recorded when immatures are indistinguishable from adult females and used in this table as "unknown age"), and adult values are the sum of adult males and adult females. For Golden Eagles and Bald Eagles, values for the "immature" category represent combined totals for subadult, non-adult, and immature counts.

[2] 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 total numbers of immatures and adults. Discrepancies in the two values reflect high annual variability in both total numbers and the observed age ratios.

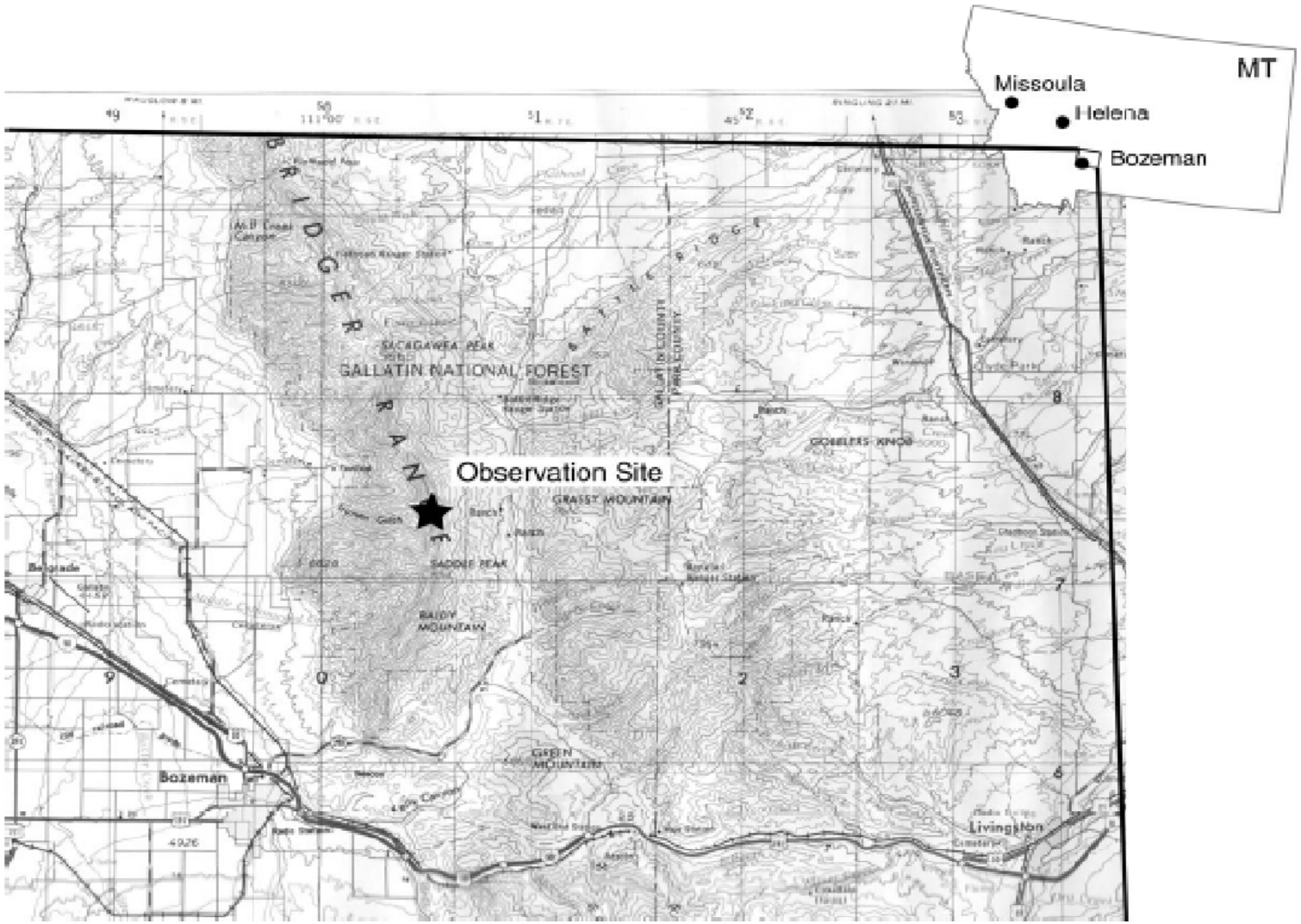

MT
Missoula
Helena
Bozeman
BRIDGER RANGE
GALLATIN NATIONAL FOREST
Observation Site
SACAGAWEA PEAK
GRASSY MOUNTAIN
SADDLE PEAK
BALDY MOUNTAIN
GOBBLERS KNOB
GREEN MOUNTAIN
Bozeman
Livingston

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

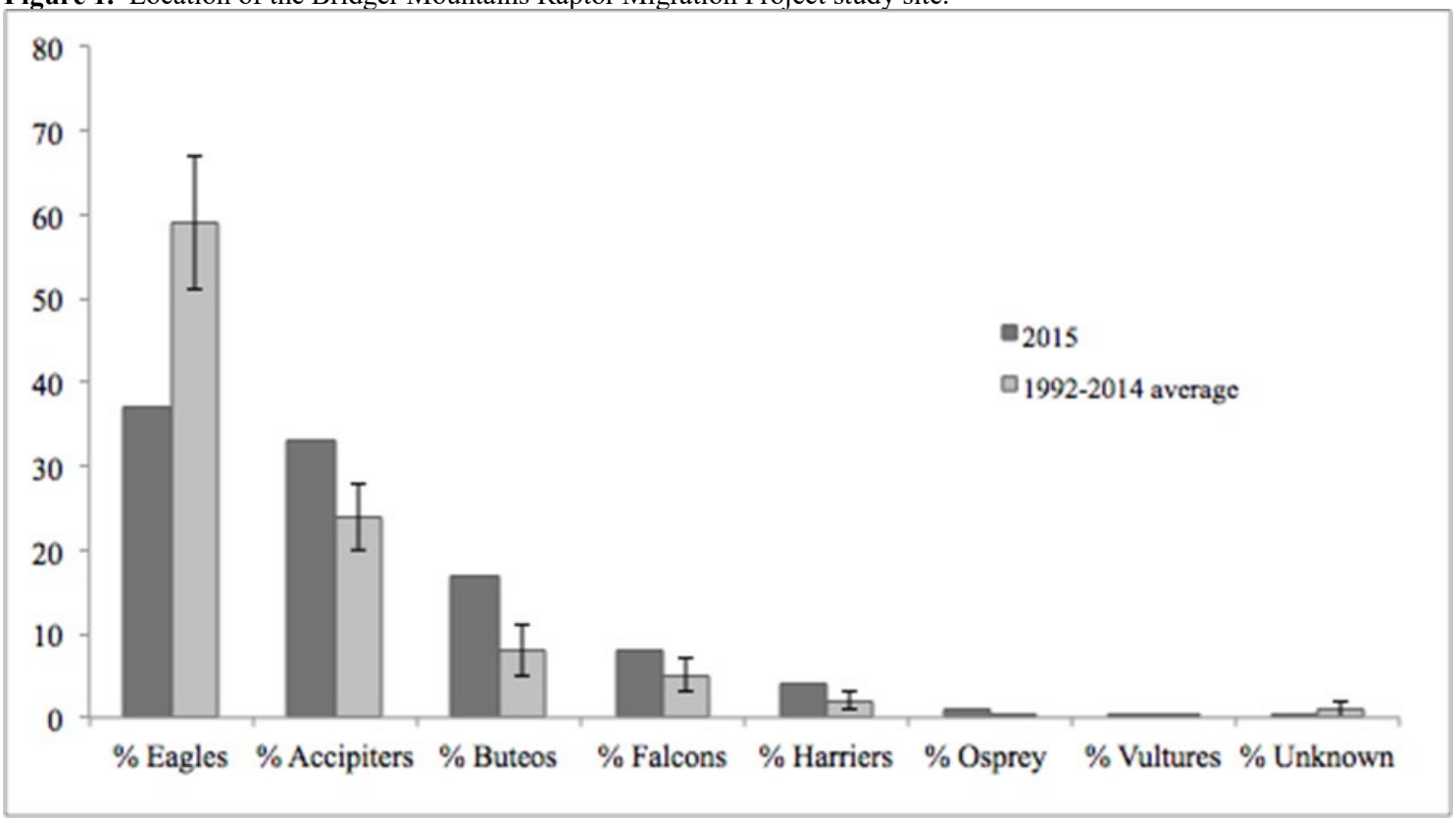
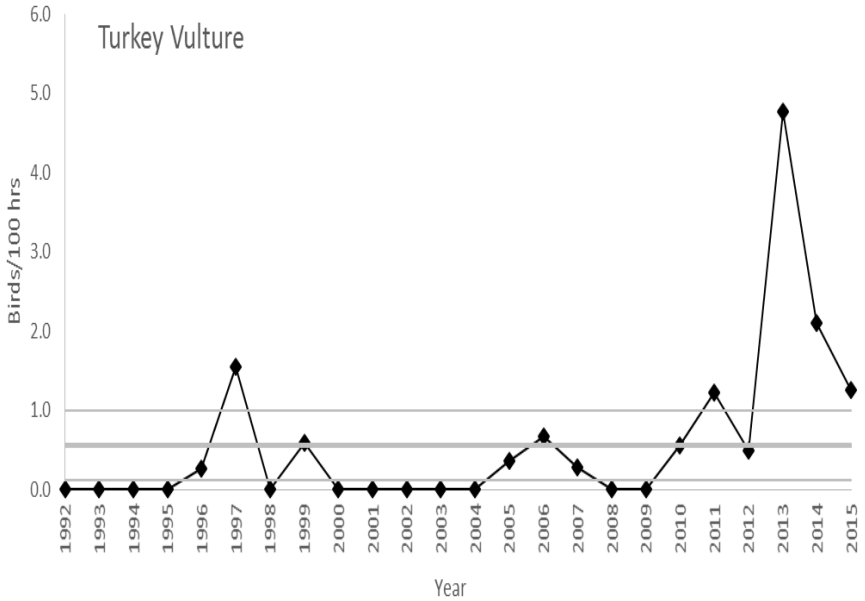


Figure 2. Fall raptor migration flight composition by major species groups at Bridger Ridge, MT: 2015 versus 1992-2014 mean. (Note: error bars are one standard deviation.)



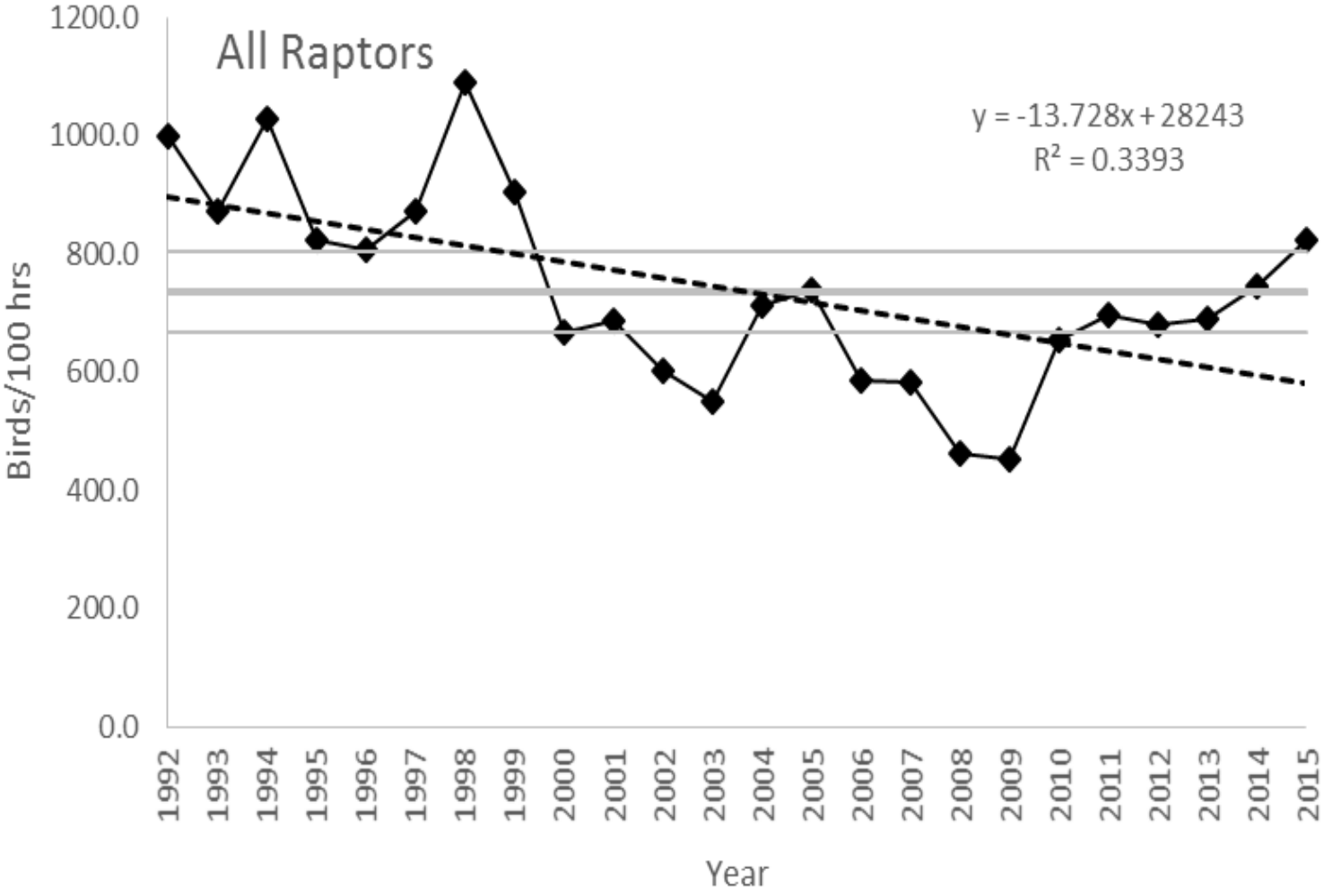


Figure 3a. Effort-adjusted fall migration passage rates for all diurnal raptors in the Bridger Mountains, MT. 1992–2015. Dashed line indicates significant ($p < 0.05$) population trend based on linear regression. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historical counts (1992-2015).

Figure 3b. Effort-adjusted fall migration passage rates for Turkey Vultures, Osprey and Northern Harriers in the Bridger Mountains, MT. 1992–2015. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historical counts (1992-2015).

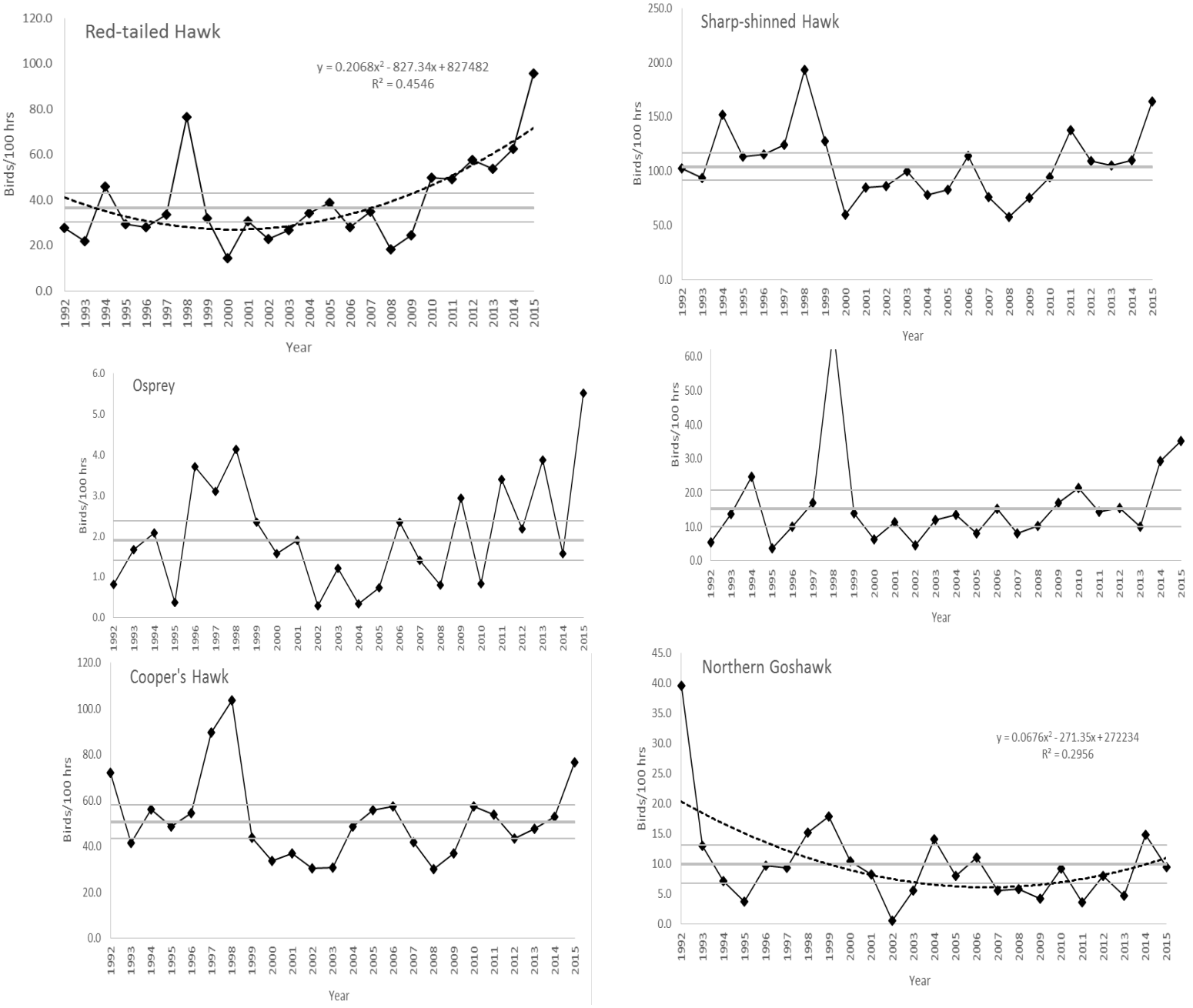
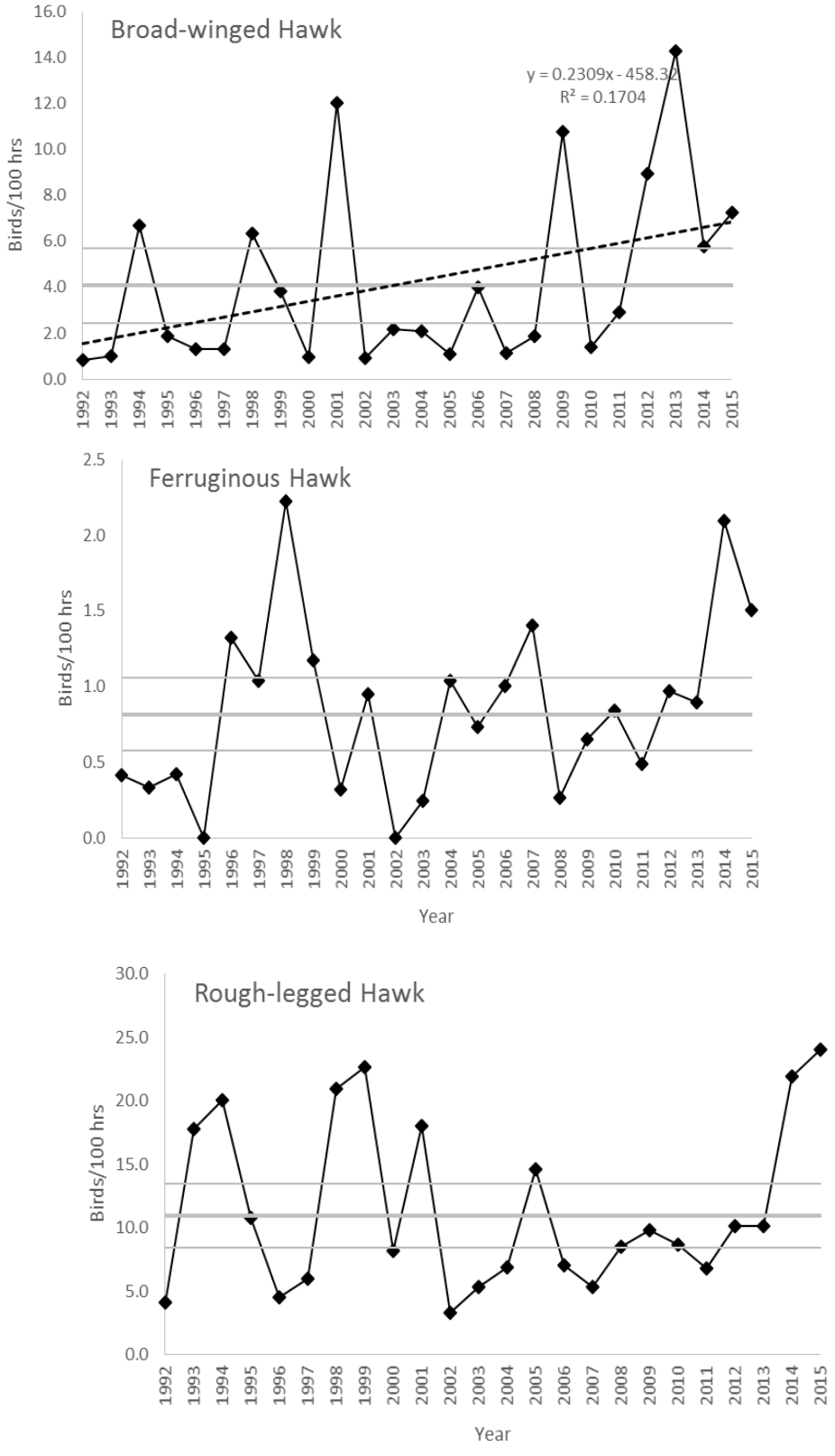


Figure 3c. Effort-adjusted fall migration passage rates for Sharp-Shinned Hawks, Cooper's Hawks and Northern Goshawks in the Bridger Mountains, MT. 1992–2015. Dashed line indicates significant ($p < 0.05$) population trend based on quadratic regression. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historical counts (1992-2015).



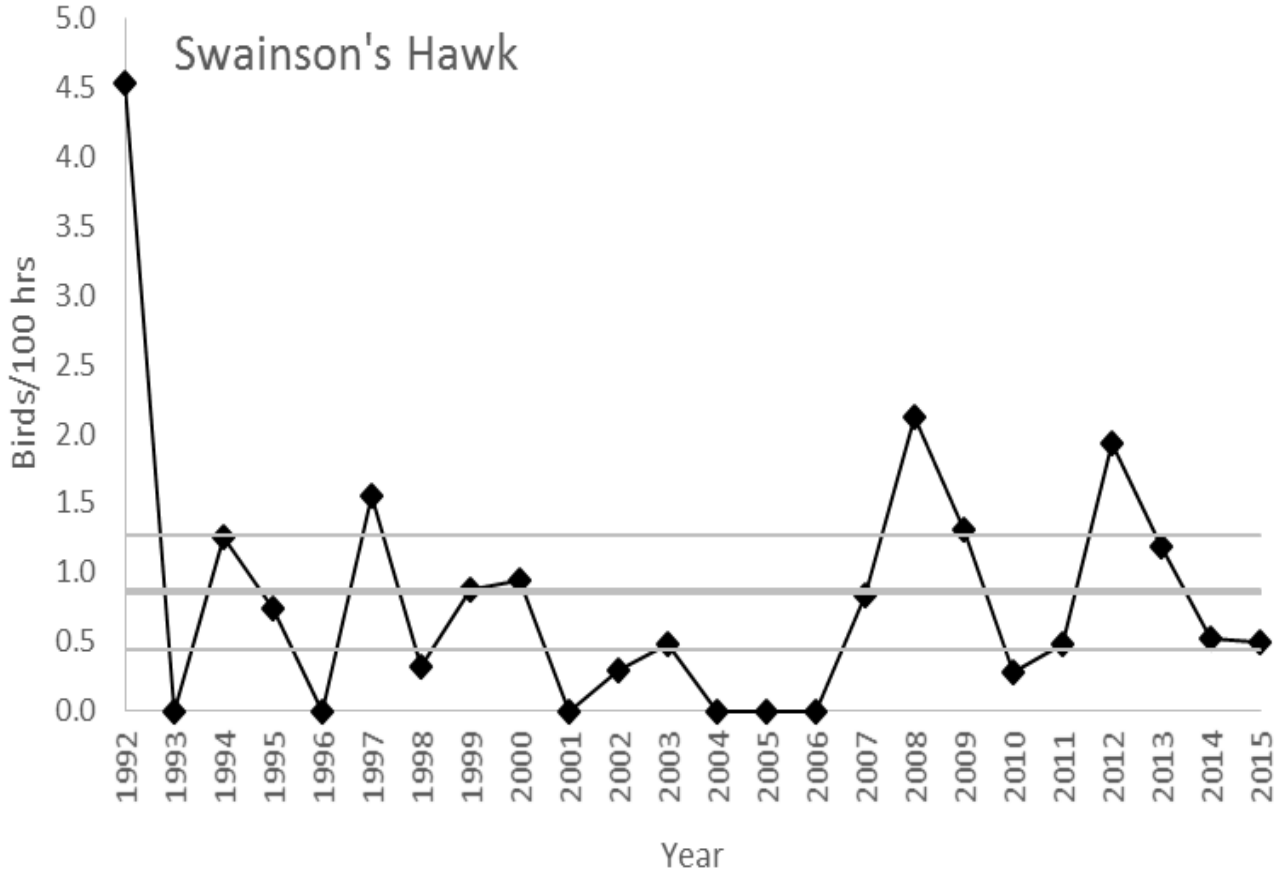
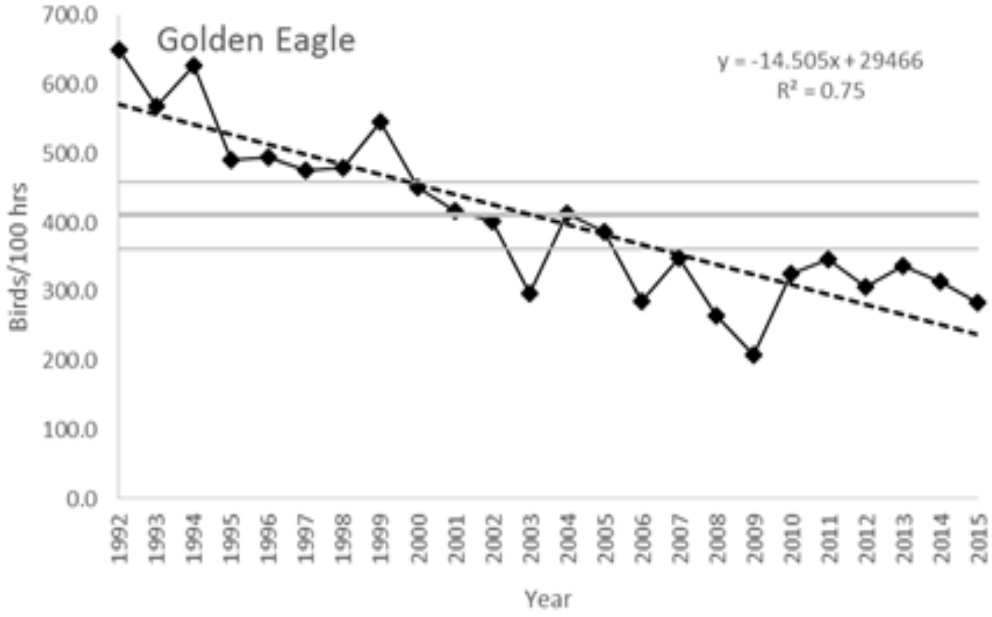
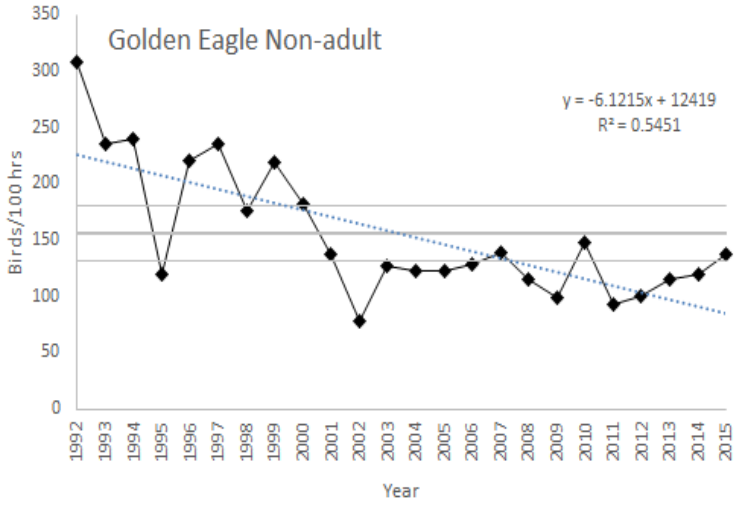


Figure 3d. Effort-adjusted fall migration passage rates for Red-tailed, Broad-winged, Ferruginous and Rough-legged and Swainson's Hawks in the Bridger Mountains, MT. 1992–2015. Dashed line indicates significant ($p < 0.05$) population trend based on quadratic (Red-tailed) and linear (Broad-winged) regressions. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historical counts (1992-2015).





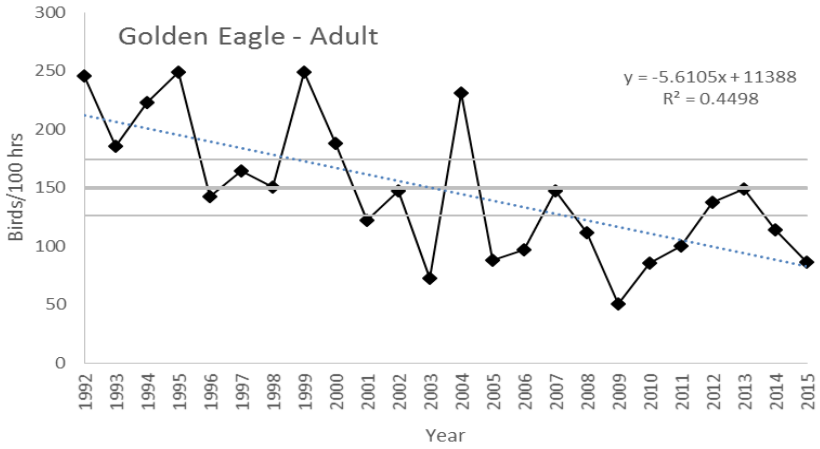


Figure 3e. Effort-adjusted fall migration passage rates for all Golden Eagles (1992-2015), adult Golden Eagles (1992-2015) and immature (includes subadult, immature and non-adult birds) Golden Eagles (1992-2015) in the Bridger Mountains, MT. Dashed line indicates significant ($p < 0.05$) population trend based on linear regressions. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historical counts.

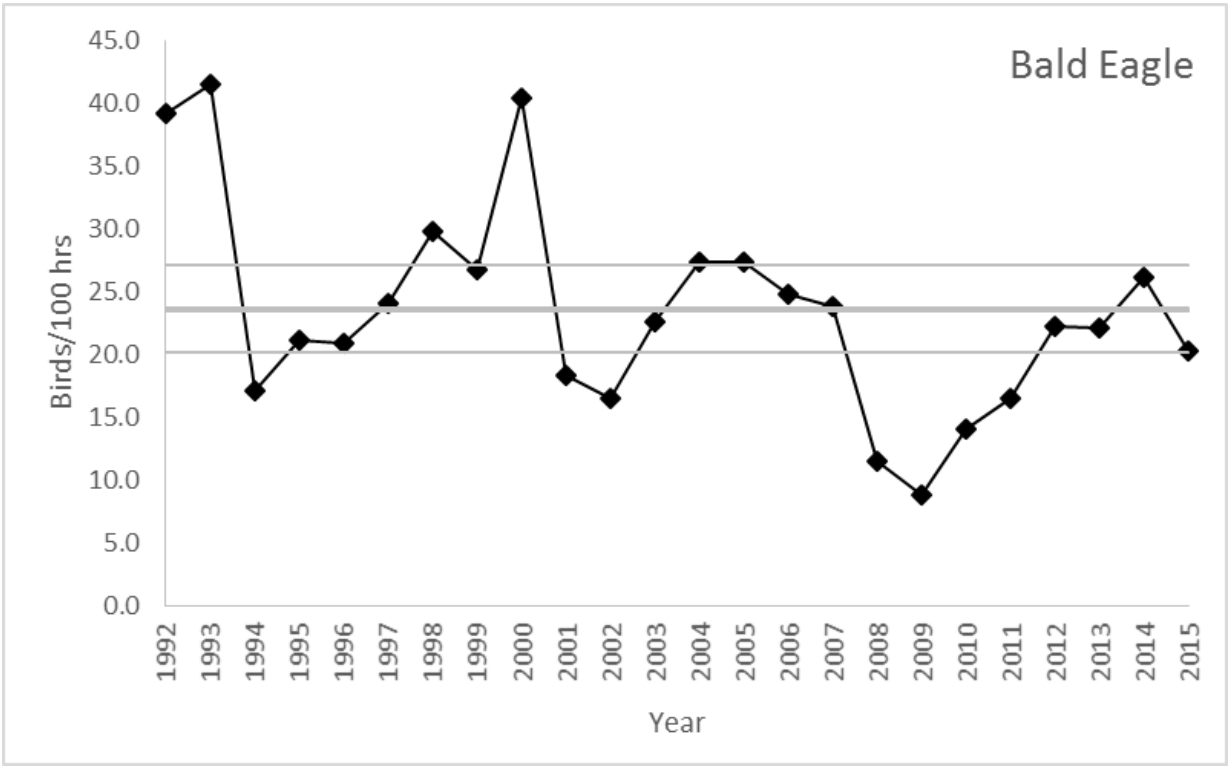


Figure 3f. Effort-adjusted fall migration passage rates for Bald Eagles in the Bridger Mountains, MT. 1992–2015. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historical counts (1992-2015).

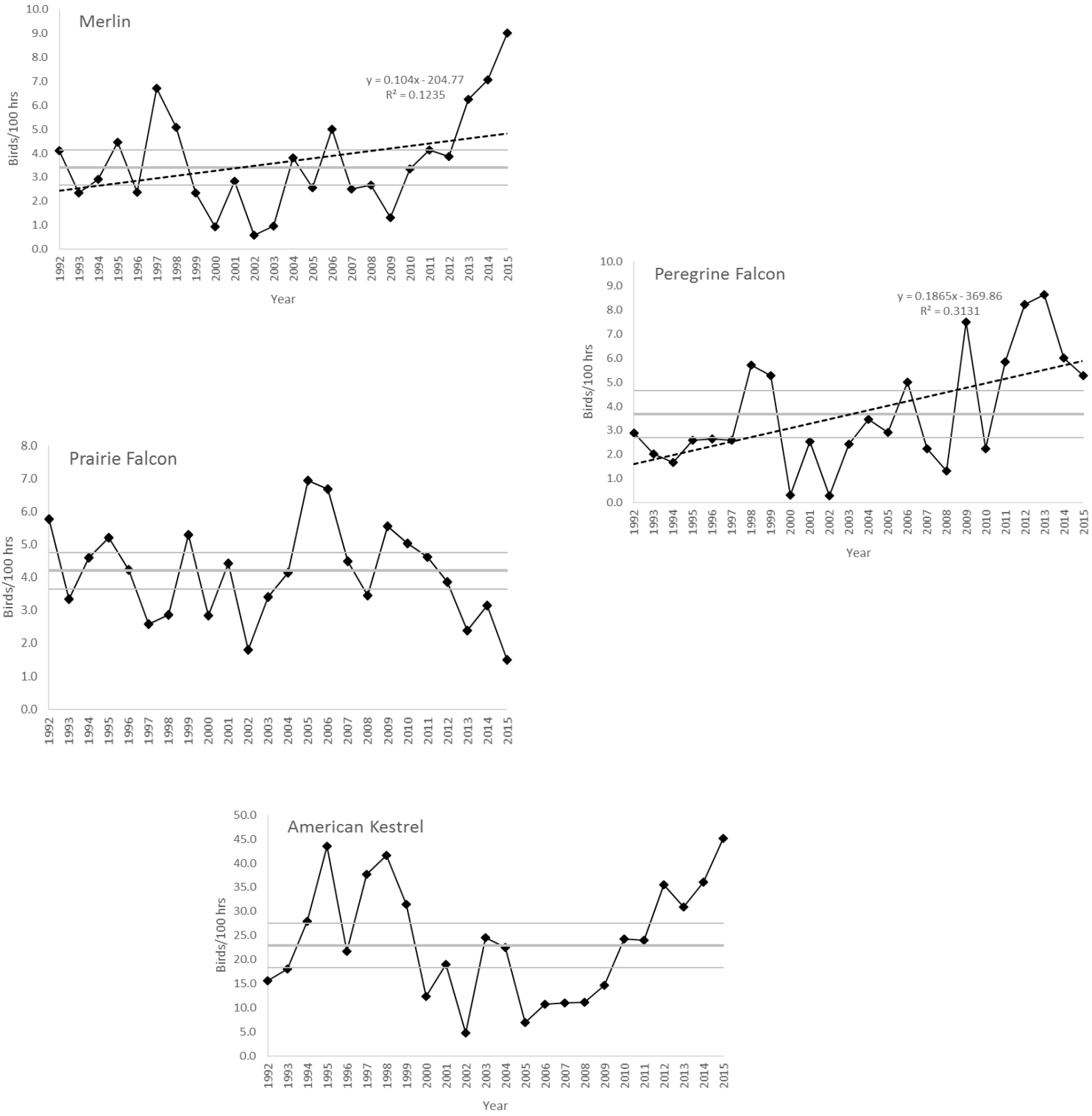


Figure 3g. Effort-adjusted fall migration passage rates for Merlins, Peregrine Falcons, Prairie Falcons and American Kestrels in the Bridger Mountains, MT. 1992–2015. Dashed line indicates significant ($p < 0.10$) population trend based on linear regression. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historical counts (1992-2015).

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, 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 weak 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 usually a dark terminal band on tail; NA = Not adult: unknown age immature/subadult; A = Adult: includes near adult with dark flecks in head and weak dark tail tip, and adult with completely white head and tail; U = Unknown.

Appendix B. A complete history of primary observers for the Bridger Mountains Raptor Migration Project.

1991: Variable teams throughout: Kristian Shawn Omland (0), Phil West (1), LisaBeth Daly (2), Craig Limpach (1)
1992: Two observers throughout: Emily Teachout (1), Phil West (2)
1993: Two observers throughout: Adam Kaufman (0), Anne-Marie Gillesberg (0)
1994: Two observers throughout: Chris Gill (0), Stephanie Schmidt (1)
1995: Two observers throughout: Scott Harris (0), Sue Thomas (0)
1996: Two observers throughout: Jason Beason (0), Niels Maumenee (0)
1997: Two observers throughout: Jason Beason (1), Patty Scifres (0)
1998: Two observers throughout: Jason Beason (2), Mike Neal (0)
1999: Two observers throughout: Mike Neal (2), Greg Levandoski (1)
2000: Two observers throughout: Ryan Wagner (1), Tracy Elsey (0)
2001: Two observers throughout: Ryan Wagner (2), Jeff Maurer (4)
2002: Two observers throughout: Matt Proett (0), Marg Lomow (2; half-season), Maureen Essen (0; half-season)
2003: Two observers throughout: Samantha Burrell (0), Carl Bullock (0)
2004: Two observers throughout: Allison Peterson (0), John Bell (0)
2005: Two observers throughout: Corey Michell (0), Beau Fairchild (0)
2006: Two observers throughout: Brian Cook (0), Jamie Granger (0)
2007: Two observers throughout: Jody Vogeler (0), Brenden McGugin (0)
2008: Two observers throughout: Amy Seaman (0), Michaela Hitchcock (0), John Bell (2)
2009: Two observers throughout: Caitlin Kroeger (0), Jason Minné (0)
2010: Two observers throughout: Jamie Hogberg (0), David Laufenberg (0)
2011: Two observers throughout: Brian Connelly (3), John Martineau (0)
2013: Two observers throughout: Bret Davis (0), Kalon Baughan (0)
2013: Two observers throughout: Bret Davis (1), Kalon Baughan (1)
2014: Two observers throughout: Bret Davis (2), Mikaela Howie (0)
2015: Two observers throughout: Andrew Eberly (2), Bridget Bradshaw (1)

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

Appendix C

Date	Hours Obs	AK	BE	BW	CH	FH	GE	LA	LF	ML	NG	NH	OS	PG	PR	RL	RT	SA	SF	SS	SW	TV	UA	UB	UE	UF	UU	Grand Total	Birds per Hour
29-Aug	2.25	1	0	0	0	0	4	0	0	0	0	0	0	0	0	0	7	0	0	3	1	2	0	0	0	0	0	18	8
1-Sep	8.0	8	0	0	5	0	7	0	0	0	0	1	1	0	0	0	14	1	0	7	0	0	1	3	0	0	0	48	6.0
2-Sep	8.0	3	1	0	6	0	5	0	1	0	0	2	1	0	0	0	4	1	1	3	1	0	0	2	0	0	0	31	3.9
3-Sep	8.0	25	0	0	16	0	2	0	0	0	2	22	2	0	0	0	53	4	0	15	0	0	0	1	0	0	0	142	17.8
5-Sep	4.0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	5	1.3
6-Sep	8.0	2	1	0	4	0	3	1	0	0	0	0	2	1	0	0	7	0	0	5	0	0	0	0	0	0	0	26	3.3
7-Sep	8.0	2	0	0	3	1	3	0	1	0	1	1	0	0	0	0	5	0	0	2	0	0	0	1	0	0	0	20	2.5
8-Sep	8.0	5	0	0	7	0	3	1	0	0	0	0	1	0	0	0	9	0	0	6	0	0	0	1	0	0	0	33	4.1
9-Sep	8.0	9	2	0	6	0	4	2	0	0	1	5	1	0	0	0	7	1	0	9	0	0	0	1	1	0	0	49	6.1
10-Sep	8.0	6	0	0	7	0	3	0	0	0	2	1	0	0	0	0	7	3	0	7	0	1	0	0	0	0	0	37	4.6
11-Sep	8.0	6	0	2	10	1	4	0	0	0	1	7	1	0	0	0	16	4	0	10	0	0	0	1	0	0	0	63	7.9
12-Sep	8.0	4	0	0	4	0	5	1	0	1	1	1	0	0	1	0	9	6	0	8	0	1	1	0	0	0	0	43	5.4
13-Sep	8.0	7	0	3	6	0	4	0	0	0	1	0	1	1	0	0	7	4	0	15	0	0	1	0	0	0	2	52	6.5
14-Sep	8.0	6	0	0	5	0	3	0	0	0	0	1	1	0	1	0	4	1	0	6	0	0	0	0	0	0	0	28	3.5
15-Sep	2.2	1	2	0	0	0	2	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	7	3.2
18-Sep	6.0	4	1	0	6	0	13	0	0	0	1	1	0	2	0	0	14	0	0	9	0	0	0	2	0	0	0	53	8.8
19-Sep	8.0	6	0	0	25	0	17	1	0	0	0	2	0	3	0	0	10	7	0	27	0	0	0	1	0	0	0	99	12.4
20-Sep	8.0	9	1	1	14	1	10	0	0	3	0	1	1	1	0	0	13	6	1	28	0	0	1	3	0	1	0	95	11.9
21-Sep	8.0	9	1	0	12	0	6	0	0	1	1	2	0	0	0	0	7	1	0	16	0	2	2	1	0	0	0	61	7.6
22-Sep	8.0	2	1	1	10	0	2	0	0	0	1	12	0	0	0	0	15	1	1	19	0	0	0	1	0	0	1	67	8.4
23-Sep	8.0	3	2	0	7	0	8	0	0	1	1	5	2	0	0	0	8	1	0	7	0	0	0	0	0	0	1	46	5.8
24-Sep	8.0	10	0	4	15	1	23	1	0	5	3	10	2	0	0	0	19	0	0	34	0	0	1	0	0	0	1	129	16.1
25-Sep	8.8	10	0	6	27	1	30	1	0	0	0	6	0	2	0	0	25	2	0	48	0	0	0	1	0	0	0	159	18.2
26-Sep	8.0	23	0	4	38	0	52	0	0	4	0	1	4	6	0	0	19	3	0	64	1	0	2	2	0	1	0	224	28.0
27-Sep	8.0	7	0	3	20	0	20	1	0	0	1	12	0	1	0	2	22	3	0	55	0	1	0	1	0	0	0	149	18.6
28-Sep	8.3	1	1	1	4	0	23	0	0	0	2	3	0	2	1	0	19	1	0	18	0	0	0	0	0	0	0	76	9.2
29-Sep	8.0	0	3	4	3	1	50	0	0	1	1	0	1	1	0	0	7	2	0	12	0	0	0	1	0	0	1	88	11.0
30-Sep	8.0	2	0	0	6	0	21	0	0	0	2	3	0	0	2	0	4	1	0	12	0	0	0	0	0	0	0	53	6.6

Appendix C. (continued)

Date	Hours Obs	AK	BE	BW	CH	FH	GE	LA	LF	ML	NG	NH	OS	PG	PR	RL	RT	SA	SF	SS	SW	TV	UA	UB	UE	UF	UU	Grand Total	Birds per Hour
1-Oct	8.0	0	0	0	0	0	11	0	0	2	0	1	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	16	2.0
2-Oct	5.0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	1	0	0	4	0	0	0	0	0	0	0	12	2.4
5-Oct	8.0	4	0	0	5	0	29	0	0	0	1	5	0	0	1	2	3	1	0	22	0	0	0	0	0	0	0	73	9.1
6-Oct	8.0	1	2	0	4	0	42	0	0	0	0	11	0	0	0	2	11	4	0	16	0	0	0	1	0	0	0	94	11.8
7-Oct	8.0	0	0	0	1	0	26	0	0	1	1	0	0	0	0	2	1	2	0	9	0	0	0	0	0	0	1	44	5.5
9-Oct	8.0	1	3	0	3	0	87	0	0	2	0	1	0	0	0	4	7	2	0	14	0	0	0	1	0	0	0	125	15.6
10-Oct	7.8	2	0	0	5	0	92	0	0	0	0	0	0	0	0	0	2	1	0	11	0	0	0	1	0	0	0	114	14.7
11-Oct	8.0	0	2	0	3	0	38	0	0	0	0	3	0	0	0	1	0	3	0	9	0	0	0	0	0	0	2	61	7.6
12-Oct	8.0	0	2	0	2	0	47	0	0	1	3	2	0	0	0	3	1	0	0	7	0	0	1	1	0	0	0	70	8.8
13-Oct	8.0	0	1	0	4	0	73	0	0	1	3	2	0	0	0	2	3	1	0	11	0	0	0	1	1	0	0	103	12.9
14-Oct	8.3	0	1	0	2	0	29	0	0	1	0	1	0	0	0	7	7	1	0	6	0	0	0	0	0	0	0	55	6.7
15-Oct	8.0	0	5	0	2	0	25	0	0	0	0	2	0	0	0	9	2	0	0	12	0	0	0	0	0	0	0	57	7.1
16-Oct	8.0	0	6	0	1	0	26	0	0	2	0	2	0	0	0	8	2	0	0	17	0	0	0	0	0	0	0	64	8.0
17-Oct	8.0	0	7	0	2	0	24	0	0	0	0	3	0	0	0	7	1	0	0	14	0	0	0	0	0	0	0	58	7.3
18-Oct	8.0	0	4	0	2	0	34	0	0	4	2	0	0	0	0	0	1	2	0	7	0	0	1	1	0	0	0	58	7.3
19-Oct	8.0	0	1	0	2	0	16	0	0	2	1	2	0	0	0	2	0	0	0	13	0	0	0	0	0	0	0	39	4.9
21-Oct	7.3	2	9	0	1	0	53	0	0	1	1	2	0	0	0	16	3	2	0	22	0	0	0	0	0	0	0	112	15.4
22-Oct	8.0	0	7	0	0	0	38	0	0	1	1	0	0	0	0	11	8	1	0	8	0	0	0	0	0	0	0	75	9.4
23-Oct	8.0	0	2	0	0	0	24	0	0	1	1	1	0	0	0	2	1	0	0	3	0	0	0	0	0	0	0	35	4.4
24-Oct	8.0	0	2	0	0	0	22	0	0	1	1	4	0	0	0	3	0	0	0	3	0	0	0	0	0	0	0	36	4.5
25-Oct	8.0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	9	1.1
26-Oct	2.0	0	2	0	0	0	9	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	12	6.0
28-Oct	8.0	0	4	0	0	0	25	0	0	0	1	0	0	0	0	5	0	0	0	1	0	0	0	0	0	0	0	36	4.5
30-Oct	6.5	0	2	0	0	0	5	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	8	1.2
31-Oct	3.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
1-Nov	4.8	0	3	0	0	0	18	0	0	0	0	0	0	0	0	3	2	0	0	1	0	0	0	0	0	0	0	27	5.7
2-Nov	5.2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0	0	0	1	0	0	0	0	0	0	0	5	1.0
TOTAL	**401**	**181**	**81**	**29**	**306**	**6**	**1138**	**9**	**2**	**36**	**38**	**141**	**22**	**21**	**6**	**96**	**389**	**73**	**3**	**658**	**3**	**7**	**12**	**29**	**2**	**2**	**9**	**3299**	**431**

[1] See Appendix A for species codes.

Appendix D. Annual observation effort and fall raptor migration counts by species in the Bridger Mountains, MT: 1991–2015.

	1991	1992	1993	1994	1995	1996	1997
Start date	15-Sep	6-Sep	9-Sep	13-Sep	10-Sep	1-Sep	27-Aug
End date	3-Nov	28-Oct	31-Oct	30-Oct	2-Nov	30-Oct	31-Oct
Observation days	32	39	46	36	42	53	62
Observation hours	191.1	242.58	298.50	239.25	269.17	378.25	422.92
Raptors / 100 hours	926.7	1000.1	871.7	1027.8	824.0	808.5	796.1
SPECIES			RAPTOR COUNTS				
Turkey Vulture	3	0	0	0	0	1	6
Osprey	2	2	5	5	1	14	12
Northern Harrier	19	13	41	59	10	38	66
Sharp-shinned Hawk	88	248	279	364	304	436	480
Cooper's Hawk	87	175	124	134	131	206	347
Northern Goshawk	27	96	39	17	10	37	36
Unidentified Accipiter	70	35	27	20	33	51	53
Total Accipiters	272	554	469	535	478	730	916
Broad-winged Hawk	0	2	3	16	5	5	5
Swainson's Hawk	1	11	0	3	2	0	6
Red-tailed Hawk	26	67	65	110	79	106	130
Ferruginous Hawk	3	1	1	1	0	5	4
Rough-legged Hawk	9	10	53	48	29	17	23
Unidentified Buteo	14	8	19	15	18	13	20
Total Buteos	53	99	141	193	133	146	188
Golden Eagle	1280	1579	1699	1500	1322	1871	1844
Bald Eagle	43	95	124	41	57	79	93
Unidentified Eagle	5	2	17	0	25	14	0
Total Eagles	1328	1676	1840	1541	1404	1964	1937
American Kestrel	33	38	54	67	117	82	146
Merlin	2	10	7	7	12	9	26
Prairie Falcon	9	14	10	11	14	16	10
Peregrine Falcon	1	7	6	4	7	10	10
Gyrfalcon	0	0	0	0	0	0	0
Unidentified Falcon	5	3	2	4	2	5	17
Total Falcons	50	72	79	93	152	122	209
Unidentified Raptor	44	10	27	33	40	43	33
Grand Total	1771	2426	2602	2459	2218	3058	3367

Appendix D. (continued)

	1998	1999	2000	2001	2002	2003	2004
Start date	28-Aug	29-Aug	29-Aug	27-Aug	27-Aug	27-Aug	27-Aug
End date	31-Oct	31-Oct	29-Oct	31-Oct	27-Oct	31-Oct	27-Oct
Obs. days	56	57	52	58	52	64	48
Obs. hours	339.33	358.24	335.40	347.49	365.84	443.18	316.70
Raptors/100 hrs	1040.9	871.8	630.9	636.3	556.0	517.6	655.2
SPECIES			RAPTOR COUNTS				
Turkey Vulture	0	2	0	0	0	0	0
Osprey	13	9	6	6	2	5	1
Northern Harrier	230	52	20	36	15	54	39
SS Hawk	612	442	190	274	288	416	229
Cooper's Hawk	343	149	109	120	103	132	142
N. Goshawk	50	61	34	26	2	23	41
Unid. Accip.	49	39	35	27	20	33	48
Total Accipiters	1054	691	368	447	413	604	460
BW Hawk	20	13	3	38	3	9	6
SW Hawk	2	3	3	0	1	2	0
RT Hawk	277	121	45	117	78	113	100
FH Hawk	7	4	1	3	0	1	3
RL Hawk	66	77	26	57	11	22	20
Unid. Buteo	13	3	8	6	9	6	18
Total Buteos	385	221	86	221	102	153	147
Golden Eagle	1516	1870	1429	1330	1359	1226	1196
Bald Eagle	95	91	128	58	55	93	79
Unid. Eagle	15	5	3	2	15	4	2
Total Eagles	1626	1966	1560	1390	1429	1323	1277
Amer. Kestrel	141	113	39	62	16	102	65
Merlin	17	8	3	9	2	4	11
Prairie Falcon	12	20	9	14	6	15	12
Peregr. Falcon	18	18	1	8	1	10	10
Gyrfalcon	0	1	0	0	0	0	0
Unid. Falcon	8	6	4	3	5	4	15
Total Falcons	196	166	56	96	30	135	113
Unid.Raptor	28	16	20	15	43	20	38
Grand Total	3532	3123	2116	2211	2034	2294	2075

Appendix D. (continued)

	2005	2006	2007	2008	2009	2010	2011
Start date	27-Aug	27-Aug	27-Aug	27-Aug	6-Sep	28-Aug	2-Sep
End date	31-Oct	29-Oct	29-Oct	31-Oct	31-Oct	1-Nov	4-Nov
Observation days	48	45	56	56	44	54	57
Observation hours	300.83	331.25	384.59	415.49	306.25	366.00	411.42
Raptors / 100 hours	674.8	538.3	550.5	427.7	453.2	641.8	695.9
SPECIES			RAPTOR COUNTS				
Turkey Vulture	1	2	1	0	0	2	5
Osprey	2	7	5	4	9	3	14
Northern Harrier	22	50	30	47	52	77	59
Sharp-shinned Hawk	228	344	277	222	230	336	565
Cooper's Hawk	153	182	151	115	113	207	221
Northern Goshawk	22	33	20	22	13	33	15
Unidentified Accipiter	123	10	29	56	19	87	37
Total Accipiters	526	569	477	415	375	663	838
Broad-winged Hawk	3	12	5	7	33	5	12
Swainson's Hawk	0	0	3	8	4	1	2
Red-tailed Hawk	108	89	130	75	75	178	202
Ferruginous Hawk	2	3	5	1	2	3	2
Rough-legged Hawk	40	21	19	32	30	31	28
Unidentified Buteo	27	2	11	10	10	20	4
Total Buteos	180	127	173	133	154	238	250
Golden Eagle	1061	859	1247	1003	638	1171	1431
Bald Eagle	75	74	85	43	27	50	68
Unidentified Eagle	1	1	0	10	4	1	0
Total Eagles	1137	934	1332	1056	669	1222	1499
American Kestrel	20	38	41	46	45	87	99
Merlin	7	15	9	10	4	12	17
Prairie Falcon	20	22	17	13	17	18	19
Peregrine Falcon	8	15	8	5	23	8	24
Gyrfalcon	0	0	0	0	0	0	0
Unidentified Falcon	53	1	7	10	10	5	2
Total Falcons	108	91	82	84	99	130	161
Unidentified Raptor	54	3	17	38	30	14	37
Grand Total	2030	1783	2117	1777	1388	2349	2863

Appendix D. (continued)

	2012	2013	2014	2015	Mean
Start date	1-Sep	1-Sep	1-Sep	29-Aug	31-Aug
End date	5-Nov	5-Nov	8-Nov	2-Nov	30-Oct
Observation days	58	50	57	55	51
Observation hours	414.38	335.76	399.67	401.33	348.36
Raptors / 100 hours	680.0	688.9	720.4	822.0	714.53
SPECIES					RAPTOR COUNTS
Turkey Vulture	2	16	8	7	2
Osprey	9	13	6	22	7
Northern Harrier	64	34	112	141	53
Sharp-shinned Hawk	452	354	422	658	347
Cooper's Hawk	180	160	203	306	170
Northern Goshawk	33	16	59	38	32
Unid. Accipiter	58	35	66	94	46
Total Accipiters	723	565	750	1096	592
Broad-winged Hawk	37	48	22	29	14
Swainson's Hawk	8	4	2	3	3
Red-tailed Hawk	238	180	239	389	127
Ferruginous Hawk	4	3	8	6	3
Rough-legged Hawk	42	34	84	96	36
Unidentified Buteo	12	17	37	29	13
Total Buteos	341	286	392	552	195
Golden Eagle	1272	1131	1222	1138	1338
Bald Eagle	92	74	106	81	77
Unidentified Eagle	12	3	11	2	6
Total Eagles	1376	1208	1339	1221	1422
American Kestrel	147	104	138	181	79
Merlin	16	21	28	36	11
Prairie Falcon	16	8	13	6	14
Peregrine Falcon	34	29	23	21	12
Gyrfalcon	0	0	0	0	0
Unidentified Falcon	13	3	7	7	8
Total Falcons	226	165	209	251	125
Unidentified Raptor	77	28	63	9	32
Grand Total	2818	2315	2879	3299	2428