FALL 2016 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 this site in 1991, with standardized, full-season annual monitoring commencing in 1992. Beginning in 2009 Montana Audubon took the lead in funding and coordinating these annual counts. This flyway is renowned for large numbers of migrating Golden Eagles (Appendix A provides scientific names of all raptor species observed at this site). To date, 18 species of raptors have been documented migrating along the Bridger Mountains, with annual counts typically ranging between 2,000 and 3,500 migrants. This report summarizes count results for the 2016 season, the 25th consecutive full-season autumn count of migratory raptors at this site.

The Bridger Project is one of eight long-term, annual fall migration counts conducted or co-sponsored by HWI in North America during autumn 2016 (and it is one of five raptor migration monitoring sites in western Montana). The primary objective of these efforts is to track long-term trends of diurnal raptor populations in western North America (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 & 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 impressive numbers and diversity of 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; Fig. 1). The site is situated within the Custer 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 5m x 5m concrete platform located approximately 50m north of an avalanche cache/ski patrol hut. The site is accessed by walking along a primitive dirt road on the east-facing slope for 3 km (780m rise in elevation) to the top of the Bridger chairlift, then continuing westward a few hundred meters along a narrow footpath to the crest of the Bridger Ridge, and then north for 50m to the observation site.

METHODS

Since this project's inception two official, well-qualified observers have conducted standardized daily counts of migrating raptors from a designated observation site from late August/early September through late October/early November. In 2016 Bret Davis returned to the Bridger Hawk Watch for his 4th season (the most ever for any Bridger observer), after conducting the inaugural count at the Big Belts Hawk Watch in 2015 (see Appendix B for a complete history of official observers for this project). Bret was accompanied by Jess Cosentino, who was observing in the Bridgers for the first time. (Jess brought to the project three full seasons of hawk migration observation experience in New Hampshire.) In 2016 daily observations began on 27 August and continued through 5 November. This was a return to an earlier start date that was the norm between 1997 through 2008 (the start date returned to 1 September in 2009). In the absence of typical, early November winter-like weather conditions, observations atop the Bridgers continued uninterrupted through 5 November. Counts typically began at 0900 H and ended at 1700 H Mountain Standard Time (MST). Both observers received onsite training with Montana Audubon

Executive Director, Steve Hoffman. Local enthusiast (and expert observer) Matt Keefer frequently contributed full days to the hawk watch effort as a volunteer, substituting for one of the full-time observers, as did a handful of other expert local birders (see Acknowledgments section for a list of volunteer-substitute observers at the end of this report).

The observation site was accessed daily by the observers, either by hiking two miles with a 2000-foot elevation gain from the lower parking area, or from the ski patrol hut on the ridge nearby the observation site that occasionally served as overnight lodging. It was always a joy to have full-season access to the hut and wake up to the birds and sunrise on Bridger Ridge, and we wish to graciously acknowledge Bridger Bowl Ski Area for the use of this facility.

Two "bobble-head" owl decoys were used in 2016 to attract passing migrant raptors; both were elevated about 7m above the ground using long poles fastened to trees. The near-owl was situated 5m directly to the north of the observation point, and the far-owl was situated 600m to the north at the far (north) end of "Tilly Peak". The near-owl was erected on 30 August, and the far-owl became operational on 7 September. Both owls remained up through the conclusion of the count season.

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 various age, sex, and color morph distinctions, and two-letter codes used for 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 (i.e., excellent, good, fair & poor) for each hour of observation (assessed on the half-hour).

4. Predominant direction, altitude, and horizontal distance from the observation point of the migratory flight for each hour.

5. Total minutes observed, and the mean number of observers present during each hour (which included designated observers plus volunteers/visitors who contributed substantially to the count [actively scanning, pointing out birds, recording data, etc.] for at least 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 observer.

For the 2016 season the field crew took advantage of a weather station maintained by Bridger Bowl at the top of the Poma lift on the ridgeline directly above the observation point. This weather station measured temperature as well as wind speed and direction. The information was obtained online at *MTavalanche.org* and was transcribed onto the official weather data sheets at the end of each day.

Daily raptor count totals and a weather summary were posted on HMANA's (Hawk Migration Association of North America) website, hawkcount.org, on a daily basis.

Calculation of "adjusted" (to standardize sampling periods) passage rates (migrants counted per 100 hours of observation) and analysis of trends, updated through 2016, generally follows Hoffman and Smith

(2003), using standard linear and quadratic regression statistical techniques. In comparing 2016 data (for each species) with annual means and 95% confidence intervals for all previous seasons, we determined significance when the 2016 value fell outside the 95% confidence interval of the associated mean for 1992-2015 passage rates.

RESULTS AND DISCUSSION

OBSERVATION EFFORT AND WEATHER SUMMARY:

In 2016 observers conducted counts on 54 of 71 possible days between 27 August and 5 November, for a total of 385.2 observation hours. Total observation hours were 10% above the 1992-2015 mean of 350.6 (± 22.5) hours. Since 2009 the count has typically run from 1 September through 5 November, and in 2016 the start date was moved up five days to 27 August (to account for the likelihood of a progressively earlier raptor migration, presumably due to climate change; J.-F. Therrien, pers. comm.).

Inclement weather and/or difficult access fully precluded any observations on 17 days during the 2016 season. In addition, inclement weather reduced the total daily observation period to less than four hours on three additional days. The 2016 season saw multiple long-lasting storms that obscured the ridge due to pervasive cloudiness, rain, and/or snow, eliminating visibility. These occurred from 3 – 5, 12 – 14, and 21 – 24 September, and 2 – 6 and 28 – 29 October. Trace amounts of snow fell on the ridge during the 3 – 5 and 12 – 14 September storms, but melted quickly. Approximately two feet of snow fell during the 2 – 6 October storm, a somewhat unusual early-season snowstorm for the Bridgers. This snow, however, melted quickly, but was replaced by multiple several-inch snow showers during the latter half of October. After rain showers and warmer temperatures in late October, snow accumulation was patchy on the Bridger Ridge for the remainder of the season.

During periods of active observation skies were recorded as clear 18% of the time, partly cloudy (19%), mostly cloudy (19%), and overcast (44%). The 1992-2015 mean values are 33% clear, 21% partly cloudy, 17% mostly cloudy, 29% overcast. Fog was reported during 1% of active observation time in 2016. This is lower than the long-term average of 6%. Rain or snow was reported during 6% of active observation time in 2016, which is very close to the long-term average (5%). As is typical of this site, winds were primarily from the west and southwest throughout the 2016 season. East winds were rare, and generally occurred for short periods, and for never longer than a day at a time, usually just prior to or immediately following the passage of a frontal system. East winds occurred on only 6 days (6%) of active observation in 2016.

Overall, the 2016 season was relatively mild, but cloudier than usual, through mid-October. After mid-October temperatures dipped below freezing on 11 of the remaining days of the season. Intermittent rain was recorded periodically throughout much of the season, with thunderstorms occurring during the 2 – 6 October storm system. Haze from local forest fires was present during 9% of active observation days (primarily during the early part of the season). The frequency of haze was much lower than what we have experienced over the previous decade, which generally has been characterized by persistent, far more severe late-summer forest fire activity.

FLIGHT SUMMARY:

The fall 2016 raptor migration count total was the 5th highest on record, with 3,074 diurnal raptors tallied (Table 1). This is 25% above the 1992-2015 mean of 2,464 (∓ 220). Species recorded in average numbers (within the 95% confidence interval about the long-term mean) were: American Kestrel, Bald

Eagle, Cooper's Hawk, Ferruginous Hawk, Golden Eagle, Northern Harrier, Prairie Falcon and Swainson's Hawk. Species recorded in higher than average numbers (above the 95% confidence interval about the long-term mean) were: Broad-winged Hawk, Merlin, Northern Goshawk, Osprey, Peregrine Falcon, Rough-legged Hawk, Red-tailed Hawk, Sharp-shinned Hawk and Turkey Vulture. No raptor species was recorded in numbers below the 95% confidence interval about the mean, and no species was counted in record high numbers.

The two species of eagles represented the largest proportion of any raptor group this season (49%; Fig. 2), although numbers this year were below the 95% confidence interval about the mean for the proportion of the total raptor count that was comprised of eagles (54.3%). Accipiters were the next largest group tallied (31%, which is above average), followed by buteos (11%, also above average), and falcons (6%, which is average). Harriers, vultures, ospreys and unidentified raptors comprised <2% each. Vultures were noted in especially high numbers (14 individuals, or 0.5%, compared to the long-term average of 0.1%), and Northern Harriers were counted in extremely low numbers (44, or 1.4% compared to an average of 2.2%).

Golden Eagles were the most numerous species, making up 47% of the total count, followed by Sharp-shinned Hawks (20%), Red-tailed Hawks (7%), Cooper's Hawks (6%), American Kestrels (3%), Rough-legged Hawks (3%), and Bald Eagles (3%), with the remaining nine species together collectively comprising the remaining 11% (and less than 3% each).

LONG TERM TRENDS:

The most worrisome trend documented by the Bridger Mountain Hawk Watch over the past 25 count seasons is the significant long-term decline in total Golden Eagle numbers ($p<0.001$; Fig. 3e). This trend is consistent with most other long-term Golden Eagle migration surveys across western North America. However, there is a silver lining: since 2009 the passage rate of Golden Eagles along the Bridger Ridge has stabilized, indicating that the long-term decline of this species may have arrested. In fact, the recent, slight upward quadratic trend in the long-term passage rates of adult, non-adult, and total Golden Eagles may even suggest a recent uptick in Golden Eagle numbers using this Rocky Mountain Front flyway. These graphs of long-term trends show lows in passage rates of all age-classes of Golden Eagles in 2009. Our 2016 count gives reason for some optimism – ***this season we tallied the highest number of Golden Eagles (1437) since 1998 (1516)***. Causes for the long-term decline are not fully understood, and are not addressed by this study (although habitat degradation and a concomitant reduction in the densities of their favored prey are very likely contributing factors).

We are pleased to report that accipiter populations seem to be rebounding strongly in recent years, with upswings in Sharp-shinned Hawks and Northern Goshawks from extreme lows in passage rates that occurred in 2002 (goshawk) and 2008 (Sharp-shinned Hawk; Fig. 3c). Extremely low immature:adult ratios in 2016 across the board for accipiters suggest poor breeding success in 2016, which could lead to lower counts in 2017.

A remarkable increase in Turkey Vultures recorded at the Bridgers over the past five years suggests these birds may be expanding their range northward in response to a warming climate (Fig. 3b). This phenomenon has been documented at other Rocky Mountain migration sites as well as sites throughout the Midwest and eastern part of North America (as shown by *hawkcount.org* and *rpi-project.org*. We predict this continent-wide trend in Turkey Vulture abundance will continue for decades to come.

We are pleased to report generally positive Bridger count trends for Red-tailed Hawks, Broad-winged Hawks, Peregrine Falcons and Merlins (Figs. 3d & 3g). The Red-tailed Hawk has experienced a recent upswing since a low in 2000. Last year was a record count, but in 2016 we saw a return to numbers more typical of the previous six years. Merlins, Peregrine Falcons and Broad-winged Hawks have also shown

significant long-term increases, although we have less confidence in these trends due to small sample sizes for these three species (under 15 birds/100 hrs.). It is notable that nationwide count trends generally show gradual long-term declines in Broad-winged Hawk counts in eastern North America (Bildstein et al. 2008), but an increasing trend over the past 20 years in the West (Smith et al. 2008). The reason(s) for the increase in Broad-winged Hawks in western North America is unknown. Peregrine Falcons are continuing their comeback from historic lows in the early 1970s; their decline (from 1946-1975) was caused by the pervasive use of DDT throughout the Americas.

Of the remaining nine species, five (Bald Eagles, Cooper's Hawks, American Kestrels, Northern Harriers, and Rough-legged Hawks) exhibited passage rates exceeding 10 birds/100 hours, and none showed significant long-term count trends in either direction. Ferruginous and Swainson's hawks, Ospreys and Prairie Falcons are all infrequently observed, and low counts preclude meaningful analyses of trends (see Figs. 3b, 3d & 3g for trend graphs of these species). Bald Eagles have shown a significant downward linear trend in recent years, but no significant long-term trend was evident after the 2016 season (Fig. 3f). The significant long-term trend for total raptors ($p < 0.001$, see Fig. 3a) illustrates a recent upswing from a low point in 2006, and is an indication that raptor populations generally have been doing much better across western North America over the past 6-7 years.

Smith et al. (2008a) presented trend analyses for data collected through 2005 for most of the long-term autumn migration studies in western North America, including the Bridger Mountains. These and subsequent analyses (reported by the Raptor Population Index or "RPI" project; see http://www.rpi-project.org for updated trend graphs) are based on a more complex analytical approach (see Farmer et al. 2007, and T. Crewe, pers. comm.) than what was reported in Hoffman and Smith (2003) and used herein to present trend analyses through 2016. With few notable exceptions the overall long-term patterns of population change and trend estimates for each species as calculated by this more complex method generally yield similar results to those obtained from the simpler methodology used herein (and described more fully in Hoffman and Smith (2003).

AGE RATIOS:

Overall low immature-to-adult ratios this season suggest a less productive 2016 breeding season for most species (see Table 2). These results contrast strongly with very high immature-to-adult ratios and record counts for several species during the 2015 Bridger season (Eberly et al. 2016). Five of the eight species for which we can visually differentiate age classes revealed immature:adult age ratios significantly below the 1992-2015 mean. All three species of accipiters were well below average, once again suggesting an especially poor breeding season. Also significantly below average were Red-tailed and Broad-winged Hawks. Golden Eagles had an immature:adult ratio of 1.1, well within the long-term average (1.2 ∓ 0.80). It is important to note, however, that this does not reflect the true ratio of first-year birds to adult birds, as the immature category used for the age-ratio analysis actually pools all non-adult age classes.

RESIDENT RAPTORS:

This year the observers recorded nine raptor species that consistently displayed resident behavior around the observation site. This includes not only the eight species typically identified as residents in most past years (Sharp-shinned Hawk, Cooper's Hawk, Northern Goshawk, Red-tailed Hawk, American Kestrel, Prairie Falcon, Peregrine Falcon and Golden Eagle), but the addition of the Turkey Vulture. A single Northern Harrier also showed behavior typical of a resident on 30 August, but was not seen again.

Sharp-shinned Hawk – Resident Sharp-shinned Hawks were regularly seen from the start of the season until the prolonged storm of 21 – 24 September. A pair of immature birds, presumably siblings, was often

seen hunting, playing and mobbing the decoy owl together throughout this time. From mid-late September a single adult was spotted on several occasions flying north or mobbing the decoy owls.

Cooper's Hawk – A single immature Cooper's Hawk was identified as a resident at the start of the season, and was seen regularly through early September. A single adult also exhibited resident-like behavior on 16 September. These birds were observed hunting low in the trees around the observation point and/or mobbing the decoy owl.

Northern Goshawk – Resident Northern Goshawks were absent from the observation point until the end of the season, when a large adult female was seen regularly between 30 October and 5 November. This individual mobbed the decoy owl and interacted with passing migrants, putting on an impressive show.

Red-tailed Hawk – Resident Red-tailed Hawks were ubiquitous throughout the early part of the season, but dropped precipitously after mid-September. An adult light-morph and adult dark-morph were clearly identified as locals, as well as at least one immature light-morph. However, a pair of unidentifiable Red-tailed Hawks was seen at a distance on a number of occasions throughout this period. The redtails would often kite above the ridgeline hunting, or escort passing migrants out of their territory before flying back to the north. A beautiful rufous-morph adult bird showed resident-like behavior on 19 September, but this may have been a stopover migrant, since it was only seen once.

American Kestrel – A group of at least three different American Kestrels, presumably a pair with young, was seen regularly near the observation point and on the hike up, from the start of the season until the first storm on 3 September. They were seen intermittently after that until 16 September. These birds close to the ridgeline were often observed mobbing the decoy owl and hunting migrating butterflies and dragonflies. It should also be noted that several American Kestrels were seen much lower on the east side of the ridge during our daily morning hikes throughout the first few weeks of the season. These kestrels were feasting on the abundant grasshopper population that was thriving amongst the grassy ski-runs.

Prairie Falcon – On 31 August a resident Prairie Falcon was first seen hunting along the west slope of the ridgeline. After that it was regularly seen slowly heading south or north, periodically kiting in the wind. Sometimes it would actively hunt the west slope of "Tilly", mob the decoy owl, or harass a passing migrant raptor. This resident remained in the area until early October, when its near-daily occurrence ceased. On 2 November a pair of Prairie Falcons was observed, but only on this one day, hunting the ridgeline together.

Peregrine Falcon – Single immature and adult Peregrine Falcons were confirmed as residents. These birds hunted the steep slopes and cliff faces around Tilly Peak, frequently mobbing the decoy owl. The immature was first seen on 30 August after cruising in from the south, flying over the observers' heads and mobbing the near decoy owl in an impressive display. It was seen a few more times until mid-September. The adult was positively identified on 16-17 September, but not again, although an unidentifiable resident Peregrine was seen on 18 September as well.

Turkey Vulture – In past years Turkey Vultures have only rarely been documented as residents on the Bridger Ridge. However, in 2016 there was a flock of 10 – 12 individuals that frequently cruised up and down the ridgeline near the observation point. They were also observed soaring together to the east in the vicinity of the Bangtail Range. These thermal-loving scavengers remained in the area 29 – 31 August before disappearing.

Golden Eagle – Resident Golden Eagles were common throughout the season. It was confirmed that there was at least one territorial pair, with probably two immatures. They often flew as single individuals, or as a pair or group of three or four. Often the adults displayed to passing migrants with the well-known

"rollercoaster" maneuver. The younger eagles also gave this a try on occasion. In addition, the resident Golden Eagles would escort passing migrants, vocalize, hunt, perch, and soar together as a family unit.

Northern Harrier – A single Northern Harrier was seen only on 30 August, clearly flying north along the ridgeline before vanishing in the distance. It was assumed that this bird generally resided in the open fields along the lower slopes of the ski resort, using the updrafts along the ridge to efficiently move among widely-scattered hunting areas, both north and south of the observation point.

VISITATION:

Our balmy fall 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. Of course most visitors were from Bozeman or Belgrade; of the approximately 70 people who signed our visitor log, several joined us on multiple occasions, eager for a good raptor day. A few folks hiked to the top almost every weekend to sit for a few hours, hoping to see an eagle or two pass by. Others visited almost daily late in the season, trekking over ice and snow for 90 minutes each way. The official observers were always gracious to have the company of other outdoor enthusiasts to share their love of raptor migration!

The 20th annual Bridger RaptorFest (7 – 9 October), run primarily by volunteers, drew a record 5,000 (estimated) visitors. We had excellent weather during this weekend, bringing strong flights and many visitors to the observation point, despite heavy snowfall during the preceding days. Twenty-nine visitors signed our guest log, and we estimate this number comprises only half the total visitors for the weekend (~ 60). During the festival weekend the observers counted a total of 220 raptors of 11 species, including 129 Golden Eagles! Below, at festival headquarters, folks participated in a wide range of raptor-related activities (kestrel box-building, binocular-viewing, raptor identification workshops, live-raptor demonstrations, and a Friday-night keynote address by raptor-legend Dr. Marco Restani).

During the festival (and throughout the season) raffle tickets for two all-season ski passes at Bridger Bowl were sold by Sacajawea Audubon volunteers and Montana Audubon staff. The two ski passes, generously donated by Bridger Bowl, generated revenues of $3,000. These funds provided much-needed support for the 2016 Bridger count.

OTHER WILDLIFE:

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

Early in the season the observers witnessed large swarms of tiny flying insects that attracted a variety of songbirds to the Bridger Ridge. Especially prevalent during these times were Townsend's, Yellow-rumped, Orange-crowned and Wilson's warblers, and Ruby-crowned Kinglets. Other songbirds that took advantage of the insect hatch included Mountain Chickadees, Rock Wrens and Red-breasted Nuthatches.

Dragonflies were observed migrating throughout September, and these were preyed upon by several raptor species, most notably American Kestrels. An impressive migration of butterflies also occurred over the ridge during the early, warmer fall days. Ladybugs were sometimes seen emerging from the rocks during especially warm days early in the season.

Most ubiquitous of the resident birds on the ridge and below were corvids. Daily observations were made of Common Ravens and Clark's Nutcrackers. Ravens would often mingle with the migrating raptors, play among themselves, or harass the decoy owls, always accompanied by a vast array of vocalizations. Steller's Jays, American Crows and Black-billed Magpies were also observed periodically. Throughout the season flocks of up to 30 individuals of Clark's Nutcrackers, Ravens, and American Crows were observed flying south, likely migrating. In mid-October a single Clark's Nutcracker was observed feeding on a wasp nest attached to the side of a cliff below the ridge, demonstrating the foraging versatility of these corvids.

Other birds observed along Bridger Ridge were woodpeckers (including Northern Flicker, Hairy and Downy Woodpecker, and sapsuckers), thrushes (American Robin, Townsend's Solitaire and Swainson's Thrush), Cassin's Finch, Dusky Grouse, Dark-eyed Junco and Chipping Sparrow. A Northern Pygmy-Owl was heard calling on the morning of 16 September, a rare treat for the observers!

In the first half of the season Mountain Bluebirds, American Pipits, and White-throated Swifts migrated along the ridge in large flocks, often numbering between 10 and 50 individuals. The swifts would often surprise the observers by suddenly appearing, accompanied by an audible "whoosh". On a few occasions Violet-green Swallows were also seen migrating in small groups.

During the latter half of the season a different variety of migrating songbirds, primarily finches, dominated the observed avian activity. These included Pine Grosbeaks, Pine Siskins and Red Crossbills. Most impressive were the large flocks of Bohemian Waxwings, which started moving south daily in the hundreds in mid-October, along with even more impressive flocks of Gray-crowned Rosy-finches that flew in flocks that sometimes numbered more than two-thousand individuals! On several occasions the massive Rosy-finch flocks landed nearby the observation point, providing spectacularly close views!.

A group of seven Common Loons were seen migrating on 1 November, with an additional group of six on 3 November. A flock of four unidentified gulls were also seen migrating on 3 November. A single flock of 12 Snow Buntings was observed migrating on 4 November.

At least one weasel (long-tailed or short-tailed) was observed frequently and may have resided beneath the heli-platform. It hunted among the surrounding rocks, and on one occasion was observed carrying a freshly-killed vole. The weasel, brown at first, disappeared for about a week during mid-season; the next time we observed this weasel it was almost totally white!

Black bears were observed twice. One individual was seen on the ridgeline on 27 August, and another in early October loping through deep snow in the open meadows well below the ridge. Mule deer were a common sight around Bridger Bowl, sometimes observed within a few hundred feet of the ridgeline. On several occasions in September a coyote was heard from the observation point in the early morning or late evening. The local red squirrels were a near-constant source of entertainment as they harvested pine cones for their winter caches throughout the season.

Mountain goats were often seen, mostly in groups of 5-6 to the north of the platform. At times they would occupy the west face of Tilly Peak for days at a time. In mid-October we counted 17 individuals moving single file across the mountain in a long caravan; it included both adults and young.

RECOMMENDATIONS

The wisdom of initiating the count on August 27th was clearly borne out by our counts during these first five days of the count. We tallied a total of 155 raptors (>5% of the seasonal raptor total) of 11 species, including 30 Red-tailed Hawks, 24 Golden Eagles and 18 American Kestrels (this count represented 20% of the seasonal kestrel total!). ***Hence, we recommend strongly that the Bridger count be initiated NO LATER than 27 August each year***. There are a growing number of studies in North America showing a trend toward earlier raptor movements, presumably due to climate change (J-F Therrien, pers. comm.). The primary hypothesis is that, with earlier breeding and earlier fledging, and with some prey species becoming less abundant earlier in the late summer/early fall period, many raptors are choosing to move south earlier compared to the seasonality of the raptor migration that has been documented over the past several decades.

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_____, C J. Farmer, S.W. Hoffman, C.A. Lott, L.J. Goodrich, J. Simon, C. Riley, and E. Ruelas Inzunza. 2008b. *Trends in autumn counts of migratory raptors around the Gulf of Mexico, 1995–2005*. Pages 253–278 *In:* K. L. Bildstein, J. P. Smith, E. Ruelas Inzunza, and R.R. Veit (Editors), *State of North America's Birds of Prey*. Series in Ornithology No. 3. Nuttall Ornithological Club, Cambridge, MA, and American Ornithologists' Union, Washington, DC.

Zalles, J.I., and K.L. Bildstein (Editors). 2000. *Raptor Watch: a Global Directory of Raptor Migration sites*. BirdLife Conservation Series No. 9. BirdLife International, Cambridge, U.K., and Hawk Mountain Sanctuary Association, Kempton, PA.

Table 1. Species-specific average counts and historic record high counts of fall migrating raptors in the Bridger Mountains, MT, 1992-2016.

		1992-2015					All-time Historic Records	
	Species	Mean Count	±	95 % CI	2016	% Change	Record Count	Year
	Turkey Vulture	4.4	±	1.8	14	217	16	2013
	Osprey	7.3	±	2.1	13	78	22	2015
	Northern Harrier	56.7	±	19.0	44	-22	230	1998
Accipiters								
	Sharp-shinned Hawk	360.4	±	51.3	617	71	658	2015
	Cooper's Hawk	175.3	±	27.8	198	13	347	1997
	Northern Goshawk	32.3	±	8.0	62	92	96	1992
	Unidentified accipiter	45.2	±	10.5	61	35	123	2005
	TOTAL ACCIPITERS	*613.2*	±	*81.3*	*938*	*53*	*1096*	*2015*
Buteos								
	Red-shouldered Hawk	0.0	±	0.0	0		0	
	Broad-winged Hawk	14.2	±	5.4	31	118	48	2013
	Swainson's Hawk	3.8	±	1.1	4	6	11	1992
	Red-tailed Hawk	138.0	±	32.5	215	56	389	2015
	Ferruginous Hawk	3.2	±	0.8	3	-6	8	2014
	Rough-legged Hawk	38.2	±	9.3	77	102	96	2015
	Unidentified buteo	14.0	±	3.4	16	15	37	2014
	TOTAL BUTEOS	*210.0*	±	*44.7*	*346*	*65*	*552*	*2015*
Eagles								
	Golden Eagle	1329.8	±	122.7	1437	8	1871	1996
	Bald Eagle	77.6	±	10.0	77	-1	128	2000
	Unknown eagles	7.5	±	2.8	1	-87	25	1995
	TOTAL EAGLES	*1413.6*	±	*128.4*	*1515*	*7*	*1966*	*1999*
Falcons								
	American Kestrel	82.8	±	18.3	89	7	181	2015
	Merlin	12.5	±	3.4	33	164	36	2015
	Prairie Falcon	13.8	±	1.8	14	1	22	2006
	Peregrine Falcon	12.8	±	3.6	30	134	34	2012
	Unidentified falcon	8.2	±	4.2	4	-51	53	2005
	TOTAL FALCONS	*130.3*	±	*23.0*	*170*	*31*	*251*	*2015*
	Unidentified Raptor	30.7	±	7.0	30	-2	77	2012
	GRAND TOTAL	**2463.9**	**±**	**220.2**	**3074**	**25**	**3532**	**1998**

Table 2. Fall counts by age class and immature[1]: adult ratios for selected species of migrating raptors in the Bridger Mountains, MT: 1992–2015 versus 2016.

	Total and Age-classified Counts						% Unknown Age		Immature : Adult Ratio	
	2016			1992-2015 average						
	Imm	Adult	Total	Imm.	Adult.	Total	1992–2015[2]	2016	1992–2015[1]	2016
Northern Harrier	14	13	44	26	7	57	33 ± 6.3	39	3.2 ± 2.45	1.1
Sharp-shinned Hawk	54	237	617	75	136	360	42 ± 7.3	53	0.6 ± 0.10	0.2
Cooper's Hawk	25	74	198	49	57	175	39 ± 7.7	50	0.9 ± 0.22	0.3
Northern Goshawk	15	20	62	13	12	32	27 ± 6.3	44	1.8 ± 0.50	0.8
Broad-winged Hawk	9	4	31	3	6	14	38 ± 17.5	58	0.5 ± 0.16	2.2
Red-tailed Hawk	47	119	215	44	64	138	22 ± 5.1	23	0.7 ± 0.25	0.4
Golden Eagle	487	451	1437	509	479	1330	26 ± 4.2	35	1.2 ± 0.80	1.1
Bald Eagle	34	42	77	27	48	78	5 ± 2.0	1	0.6 ± 0.51	0.8

[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 and Bald eagles, values for the "immature" category represent the 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.

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

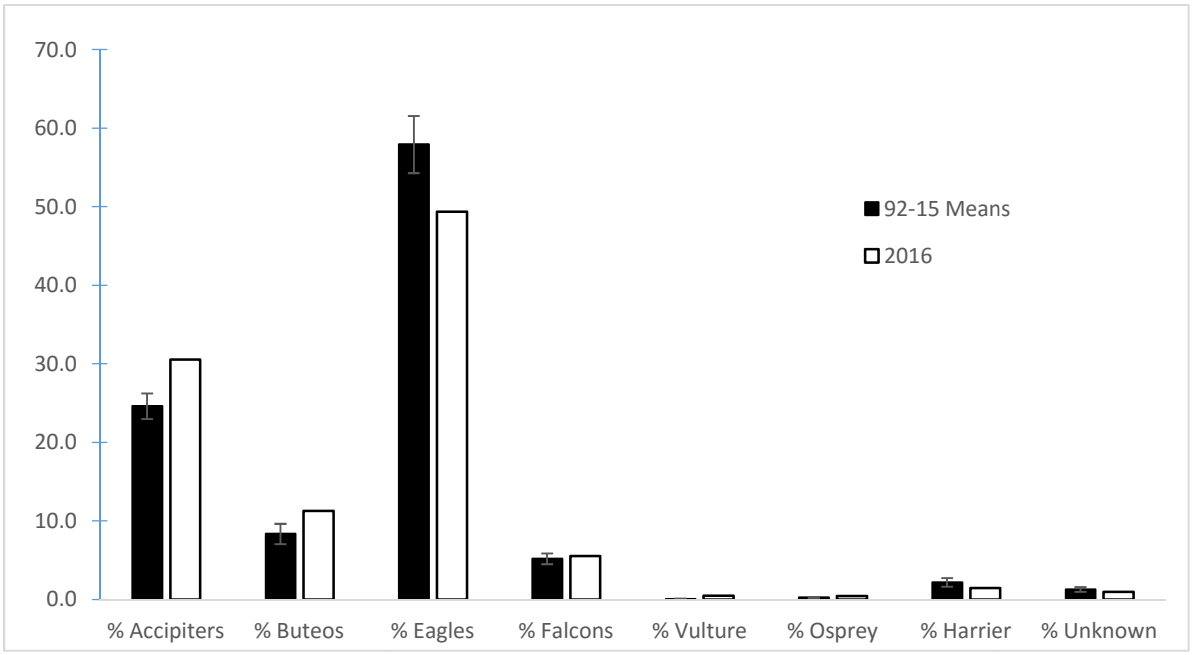


Figure 2. Fall raptor migration flight composition by major species groups in the Bridger Mountains, MT: 2016 versus 1992-2015 mean. (Note: error bars are one standard deviation.)

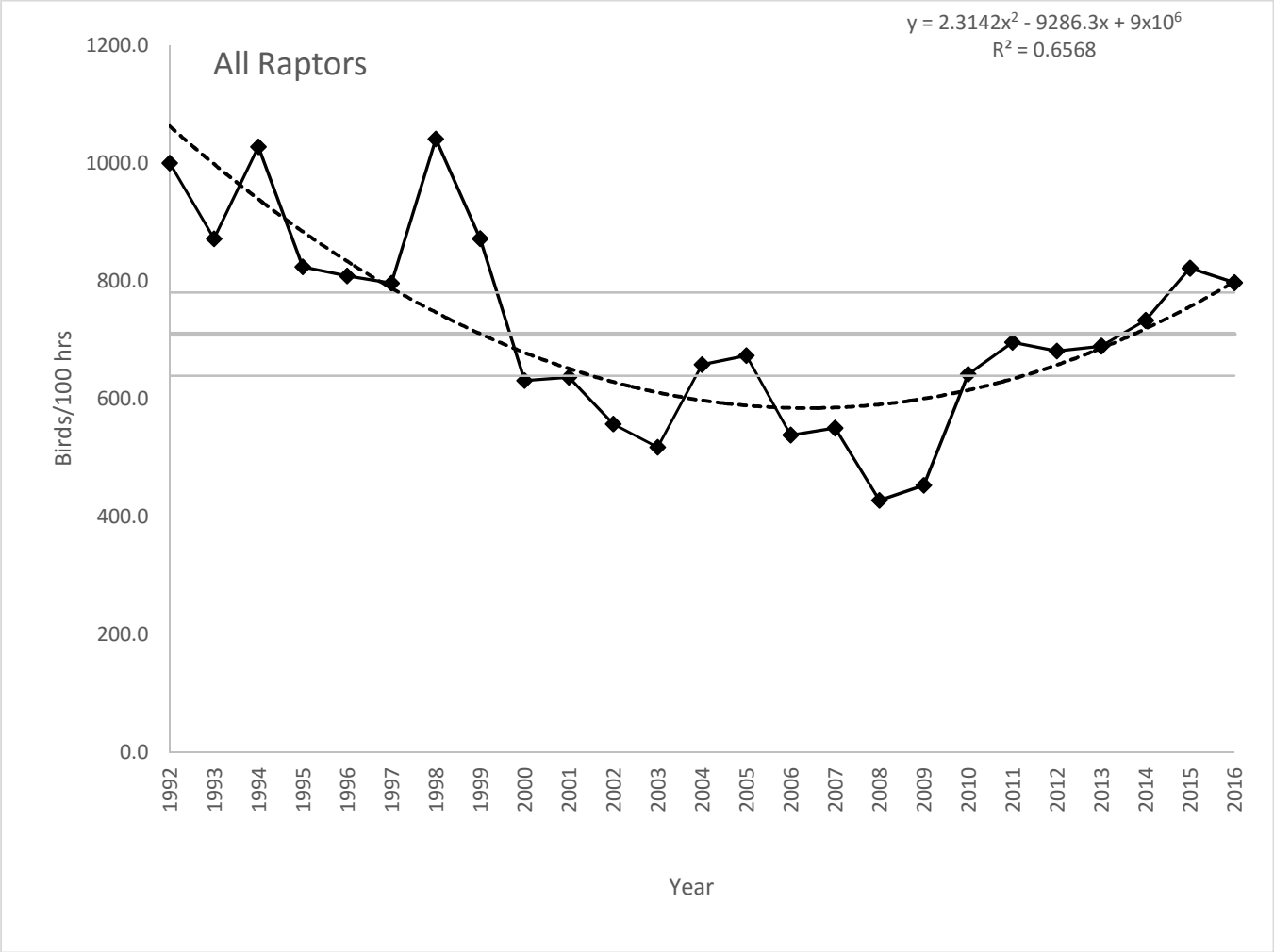
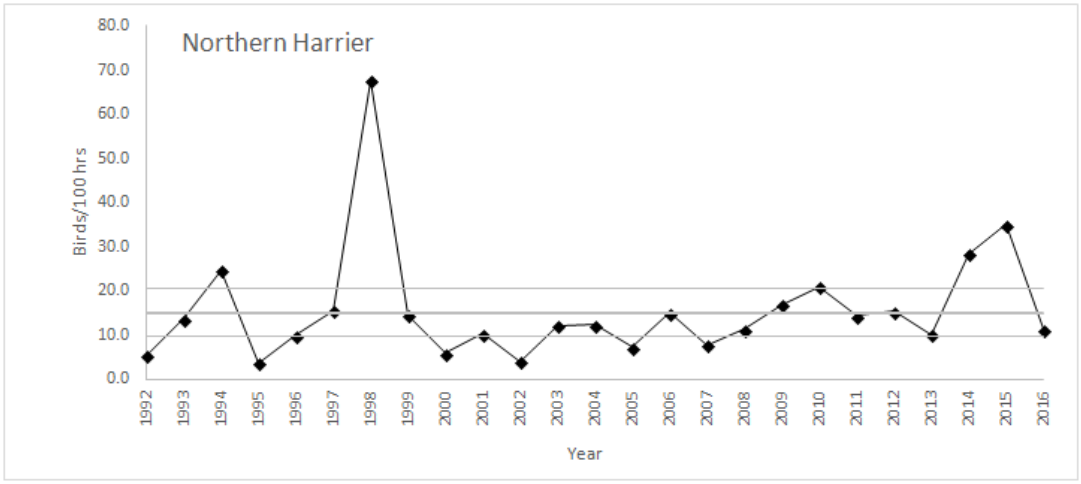
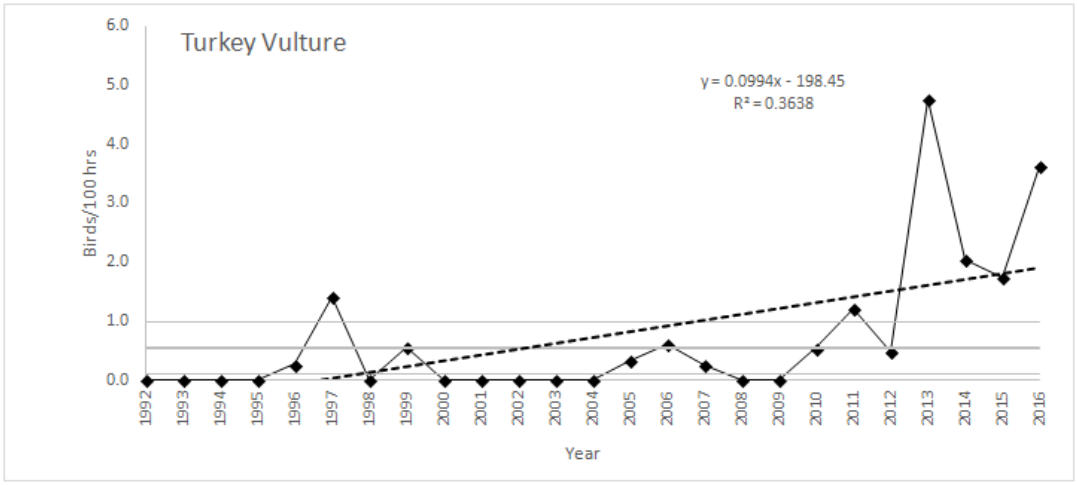


Figure 3a. Effort-adjusted fall migration passage rates for all diurnal raptors in the Bridger Mountains, MT. Dashed line indicates significant ($p < 0.05$) population trend based on quadratic regression. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historical counts (1992-2016).





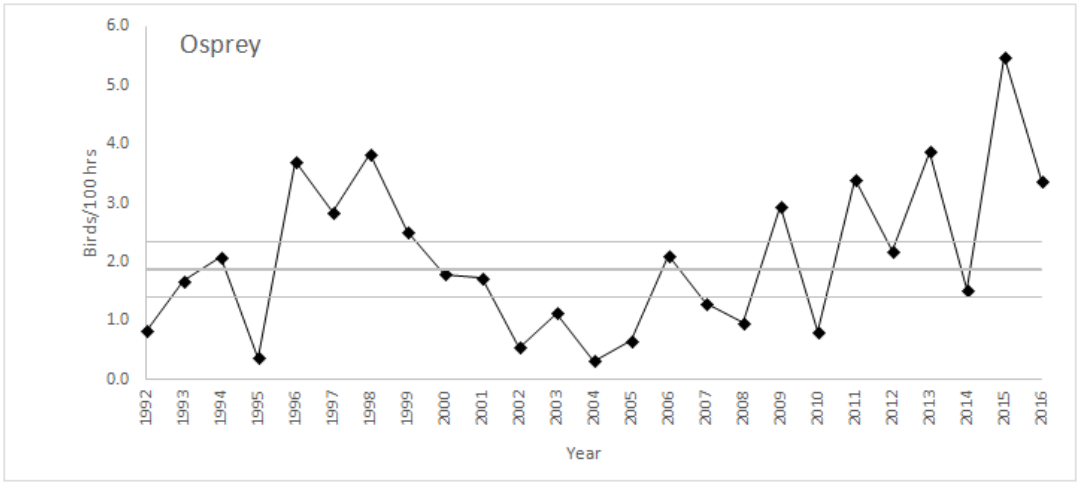


Figure 3b. Effort-adjusted fall migration passage rates for Turkey Vultures, Ospreys and Northern Harriers in the Bridger Mountains, MT. Dashed lines indicates significant ($p < 0.05$) population trend based on linear regression. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historical counts (1992-2016).

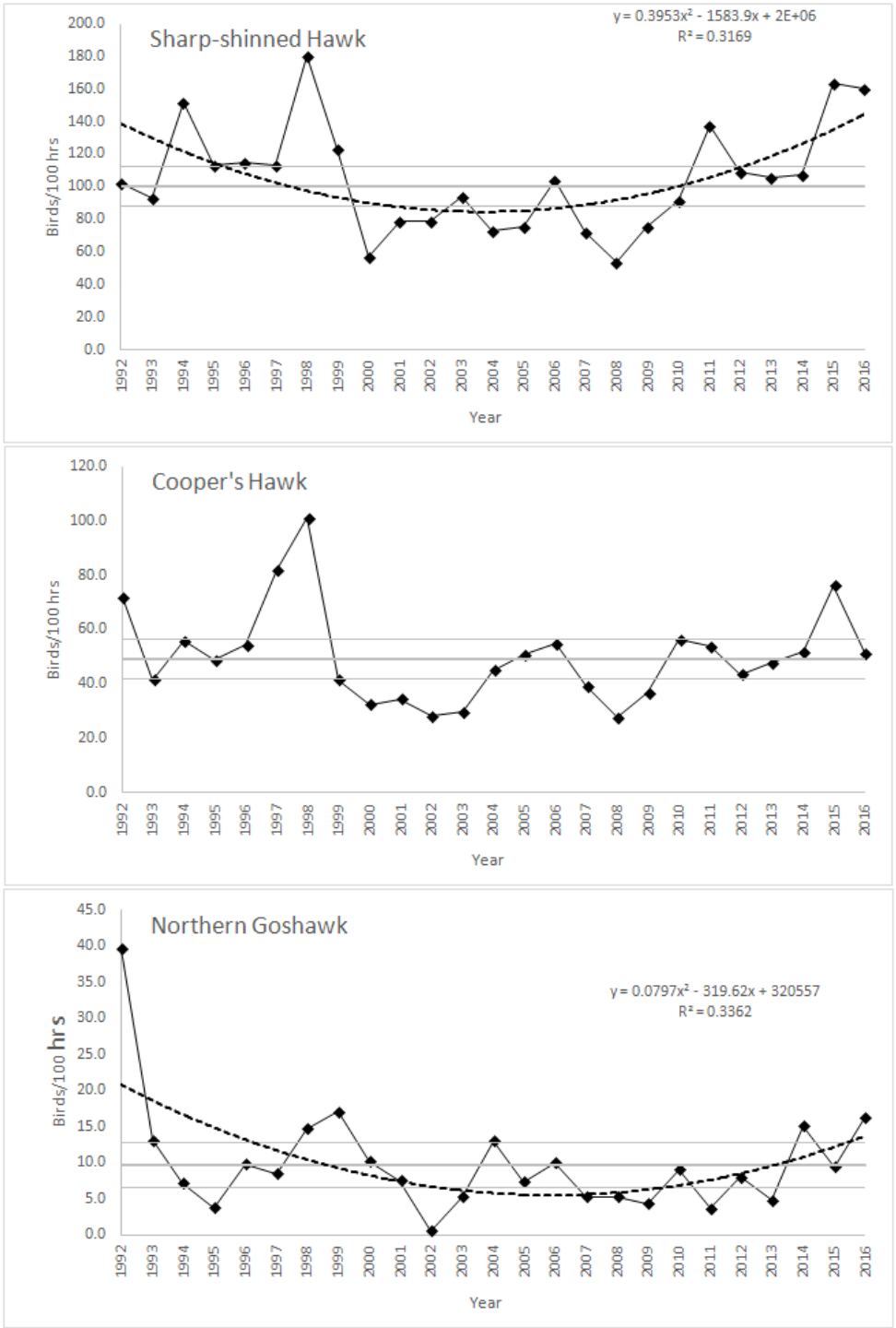


Figure 3c. Effort-adjusted fall migration passage rates for Sharp-Shinned Hawks, Cooper's Hawks and Northern Goshawks in the Bridger Mountains, MT. Dashed line indicates significant ($p < 0.05$) population trend based on quadratic regressions. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historical counts (1992-2016).

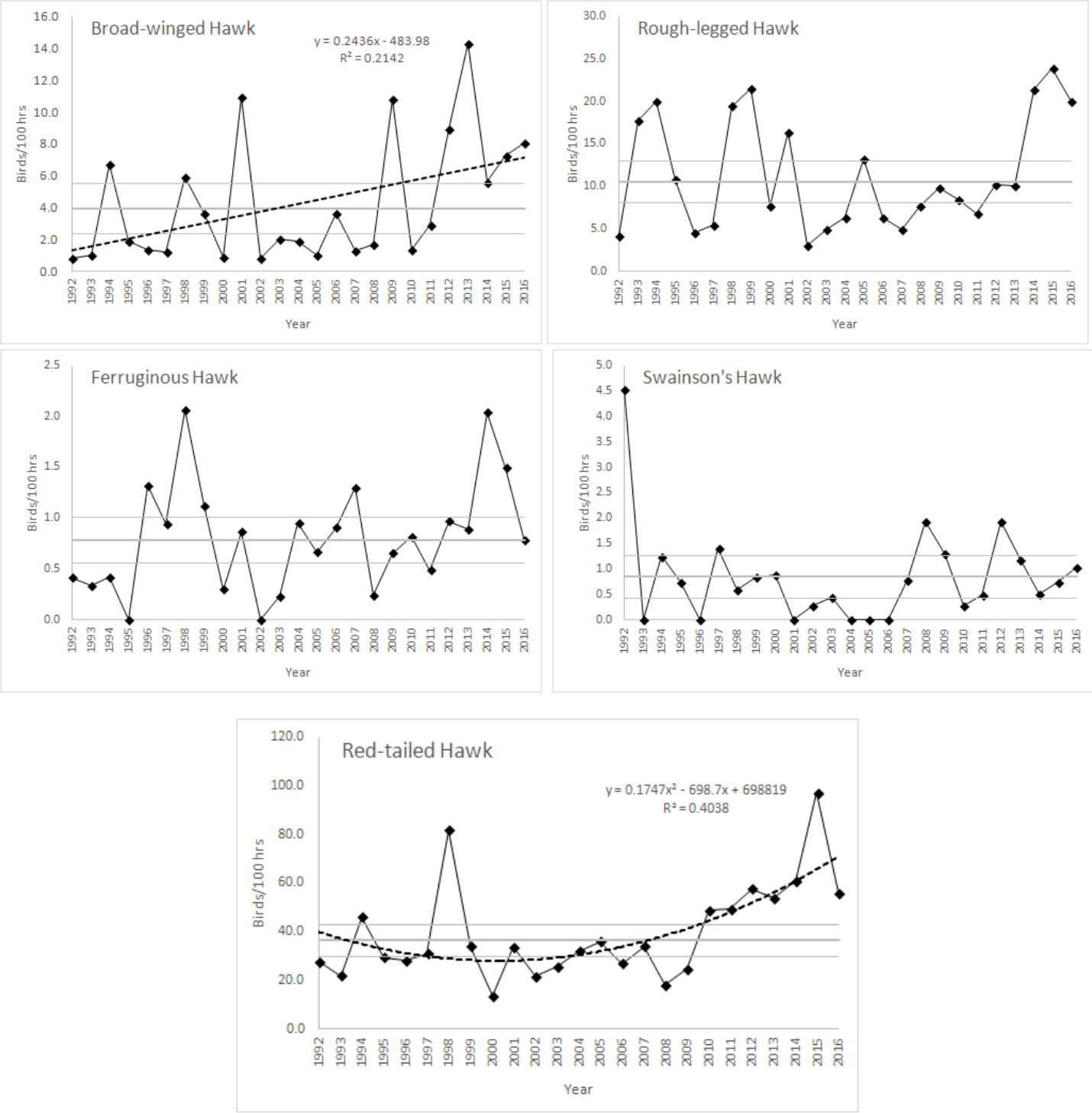
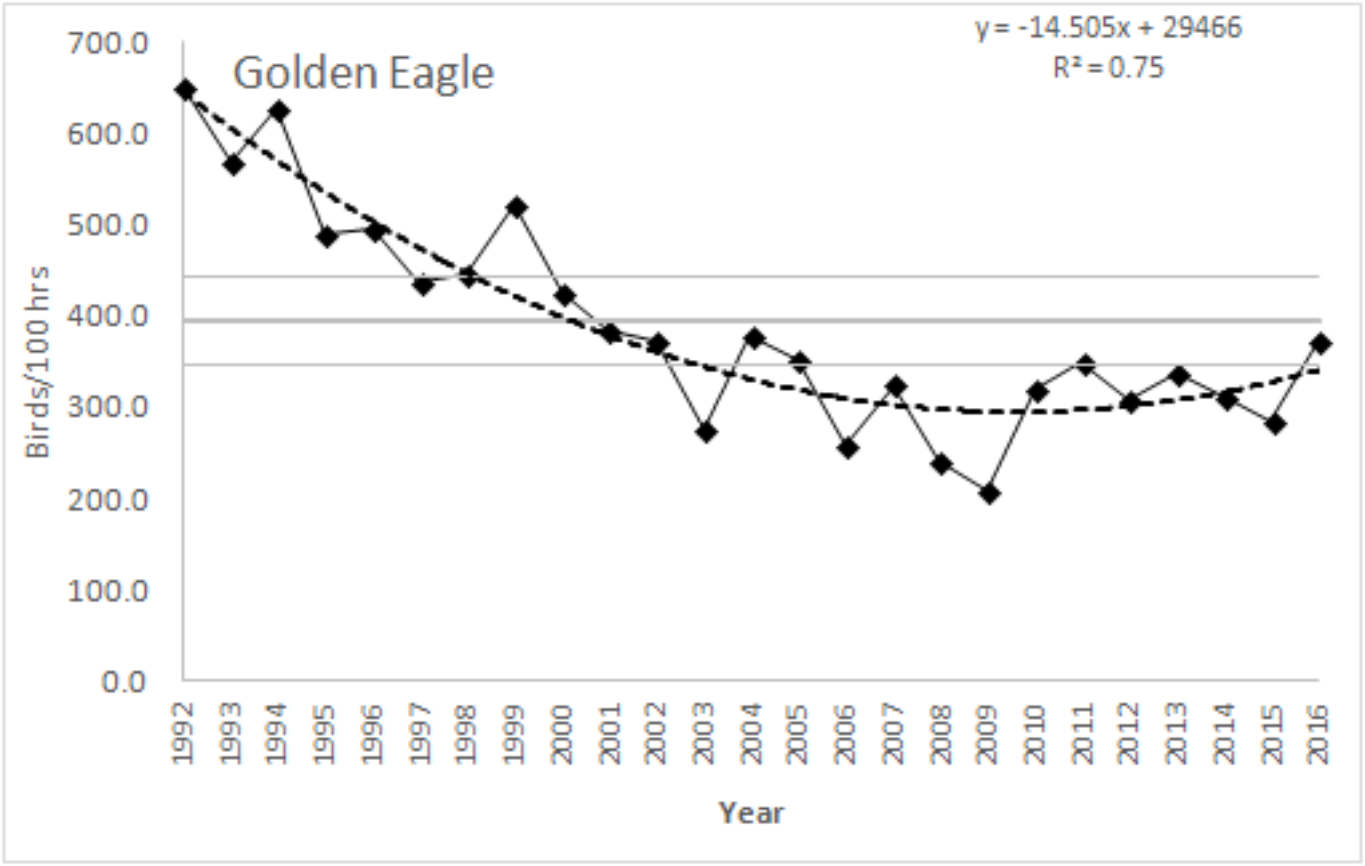
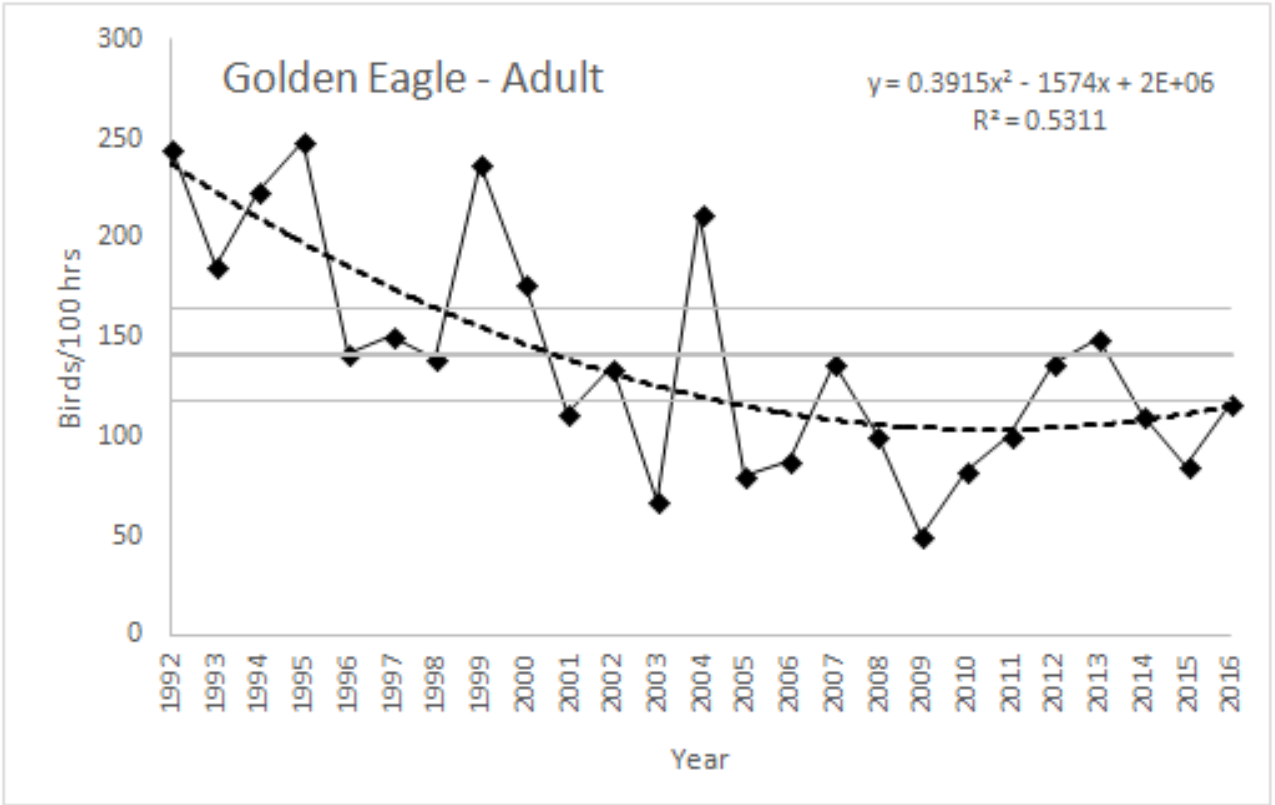


Figure 3d. Effort-adjusted fall migration passage rates for Red-tailed, Broad-winged, Rough-legged, Ferruginous and Swainson's hawks in the Bridger Mountains, MT. Dashed line indicates significant ($p < 0.05$) population trend based on quadratic (Red-tailed Hawk) and linear (Broad-winged Hawk) regression analyses. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historical counts (1992-2016).


Golden Eagle
y = -14.505x + 29466
R² = 0.75
Birds/100 hrs
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
Year


Golden Eagle - Adult
y = 0.3915x² - 1574x + 2E+06
R² = 0.5311
Birds/100 hrs
300
250
200
150
100
50
0
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
Year

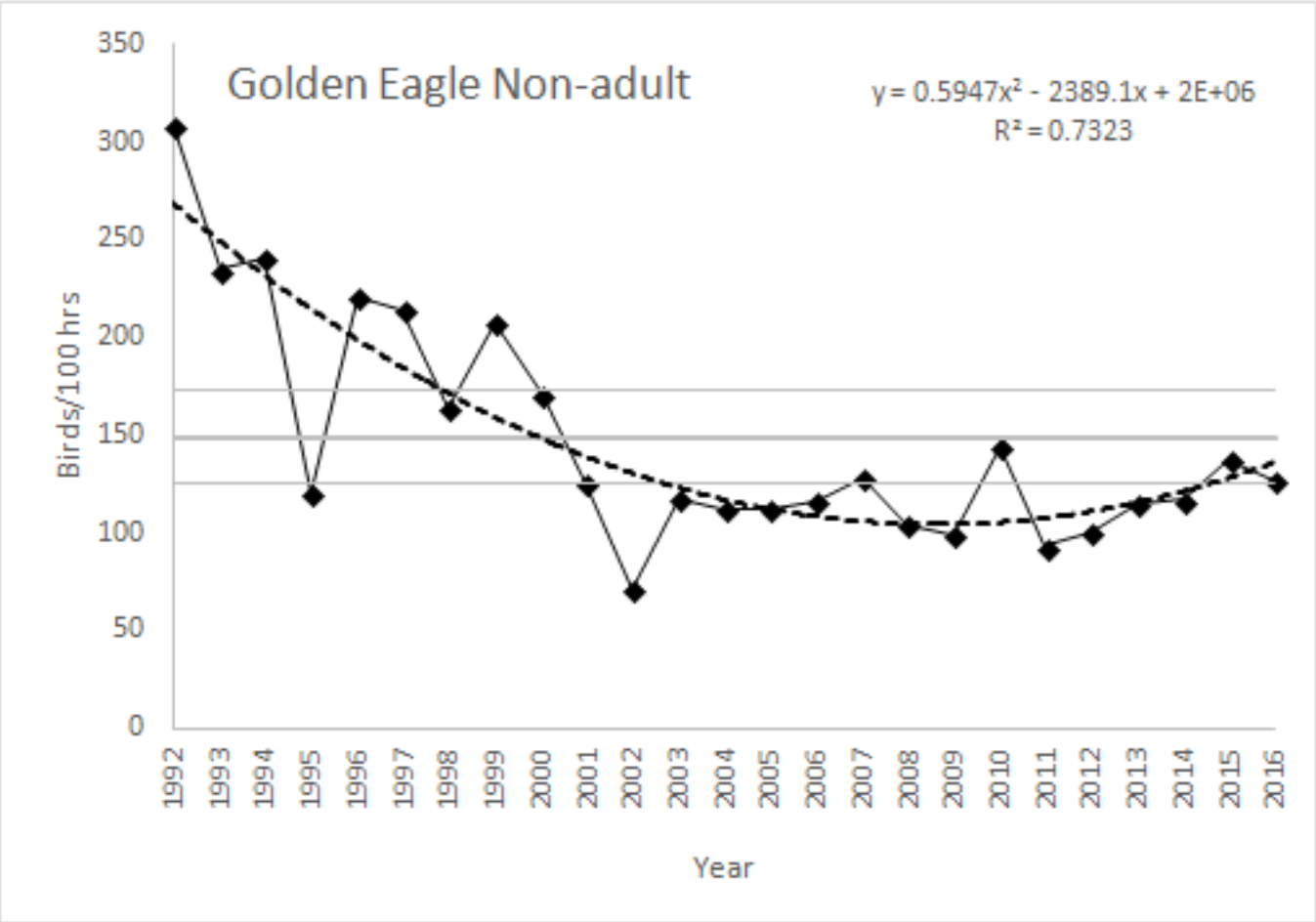


Figure 3e. Effort-adjusted fall migration passage rates for all Golden Eagles, adult Golden Eagles, and non-adult Golden Eagles (includes subadult, immature and non-adult birds) in the Bridger Mountains, MT. Dashed line indicates significant ($p < 0.05$) population trend based on quadratic regressions. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historical counts (1992-2016).

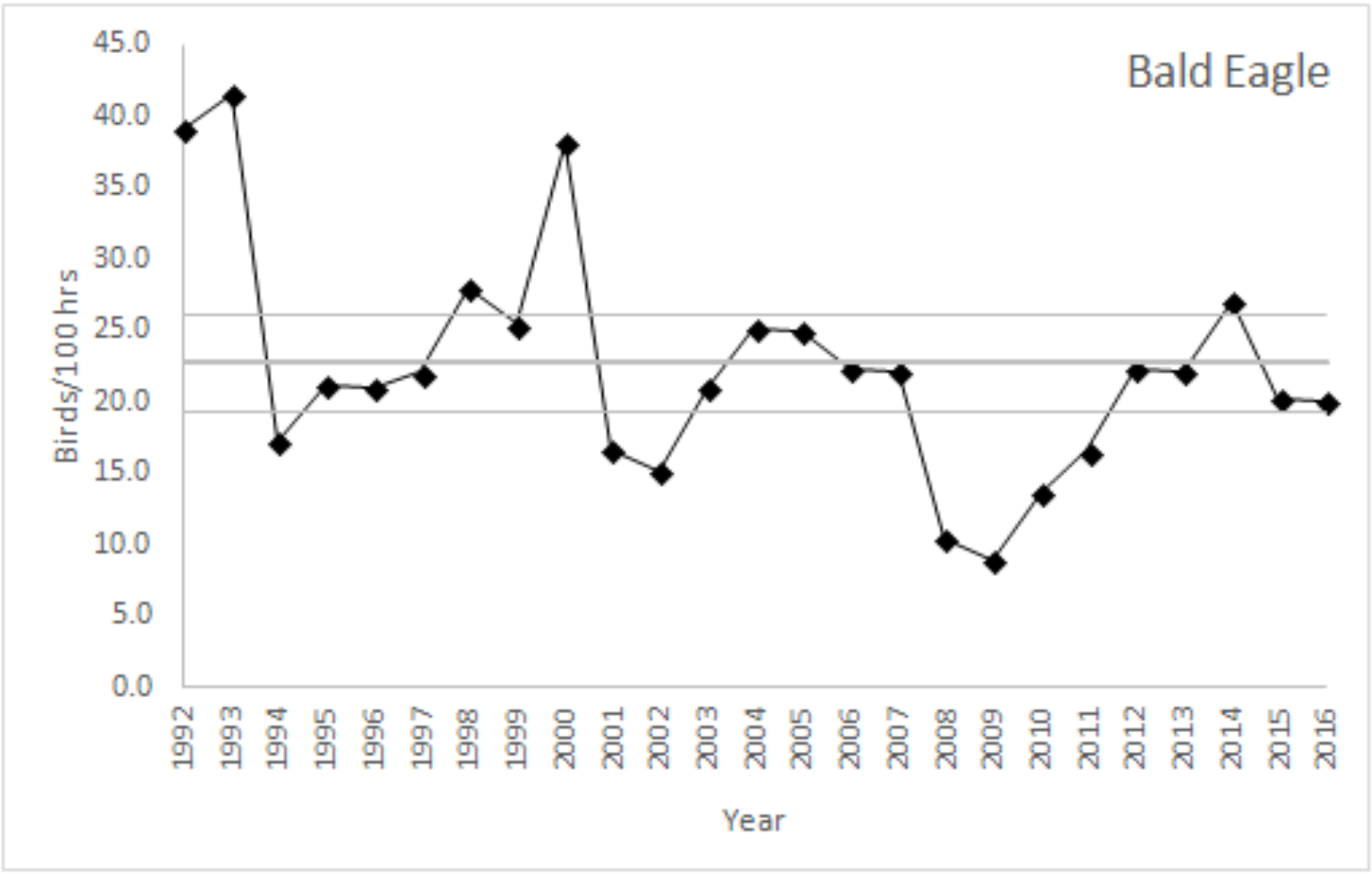
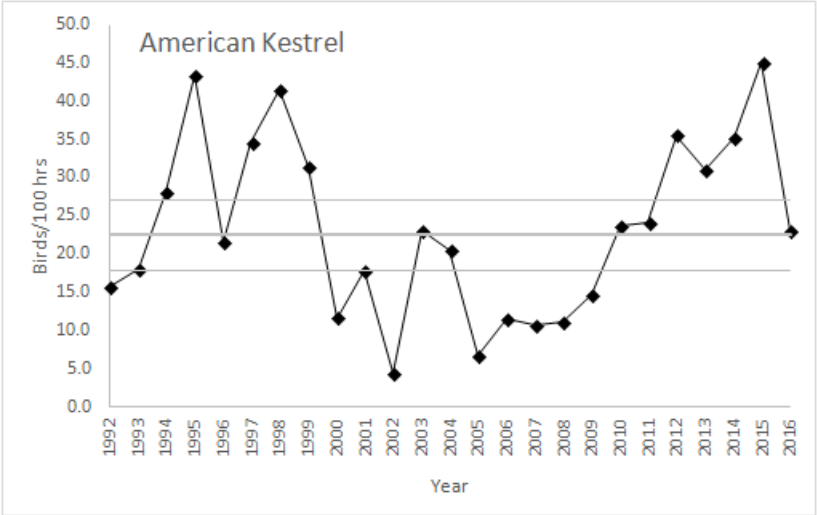
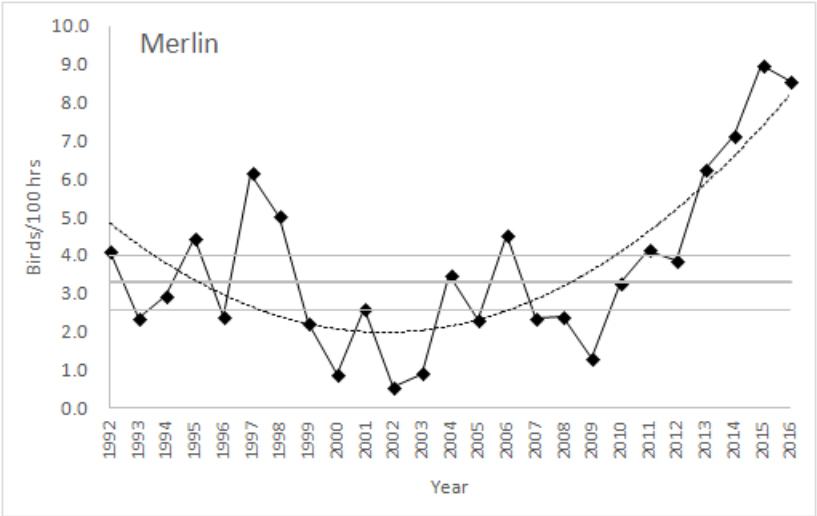
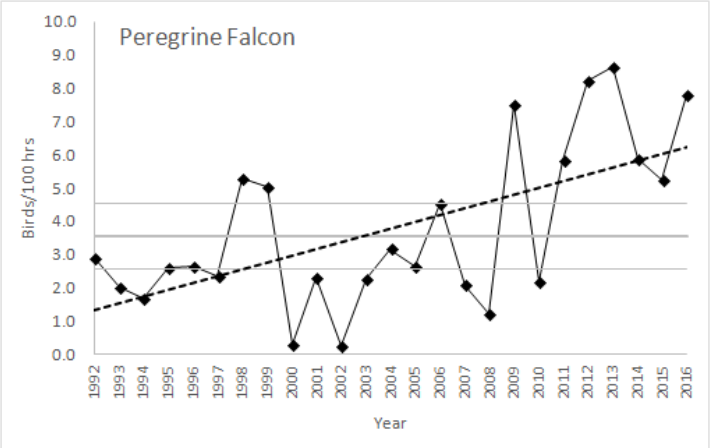


Figure 3f. Effort-adjusted fall migration passage rates for Bald Eagles in the Bridger Mountains, MT. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historical counts (1992-2016).







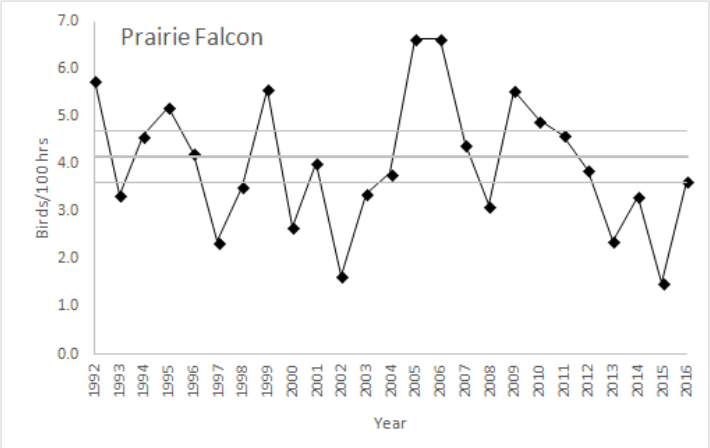


Figure 3g. Effort-adjusted fall migration passage rates for Merlins, Peregrine Falcons, Prairie Falcons and American Kestrels in the Bridger Mountains, MT. Dashed line indicates significant ($p < 0.10$) population trend based on quadratic (Merlin) or linear (Peregrine Falcon) regressions. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historical counts (1992-2016).

Appendix A. Common and scientific names, species codes, and 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 peregrines*	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 *peregrines*	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 (1991-2016). Numbers given in parentheses indicate the number of full seasons of previous raptor migration counting experience.

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)
2012: 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)
2016: Two observers throughout: Bret Davis (5), Jess Cosentino (3)

Appendix C. Daily observation effort and raptor migration counts by species in the Bridger Mountains, MT, Fall 2016 (see Appendix A for species codes).

Date	Obs. Hours	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
27-Aug	8.0	1	1	0	0	0	2	0	0	0	0	0	0	0	0	0	5	0	0	0	0	1	0	0	0	0	0	10	1.3
28-Aug	8.3	1	0	0	1	0	8	0	0	0	1	0	0	1	1	0	1	0	0	5	0	0	0	0	0	0	0	19	2.3
29-Aug	8.0	16	2	1	3	1	4	2	0	0	0	10	2	1	1	0	10	0	0	7	0	1	0	1	0	0	0	62	7.8
30-Aug	8.0	5	0	0	4	0	1	0	0	0	0	1	0	0	1	0	9	0	0	11	1	1	0	0	0	0	1	35	4.4
31-Aug	8.0	3	0	0	2	0	9	0	0	0	1	0	1	0	0	0	5	1	0	5	0	1	0	1	0	0	0	29	3.6
1-Sep	8.2	5	1	0	5	0	4	1	0	0	0	0	0	2	0	0	11	0	0	10	0	3	0	0	0	0	1	43	5.3
2-Sep	8.0	2	0	0	8	1	3	1	0	0	0	0	0	0	0	0	4	0	0	4	0	0	0	1	0	0	0	24	3.0
3-Sep	1.5	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	2.0
4-Sep	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	-
5-Sep	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	-
6-Sep	8.0	2	2	0	5	0	8	1	0	1	0	0	3	2	0	0	11	0	0	6	0	0	0	0	0	0	1	42	5.3
7-Sep	4.0	0	2	0	4	0	1	0	0	0	0	1	0	0	0	0	4	0	0	3	0	0	1	0	0	0	0	16	4.0
8-Sep	8.0	0	2	0	2	0	1	0	0	0	3	2	1	0	1	0	1	0	0	3	1	1	0	0	0	0	1	19	2.4
9-Sep	5.5	2	0	0	3	0	1	0	0	0	0	0	0	0	0	0	3	0	0	1	0	0	0	0	0	0	1	11	2.0
10-Sep	8.0	9	0	1	19	0	16	3	0	0	2	0	1	3	0	0	21	1	0	16	1	0	0	1	0	0	2	96	12.0
11-Sep	8.0	4	2	0	15	0	9	2	2	1	3	1	0	0	0	0	3	0	0	13	0	0	0	3	0	2	2	62	7.8
12-Sep	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	-
13-Sep	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	-
14-Sep	2.5	1	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	0.4
15-Sep	4.8	0	2	12	12	1	24	0	0	0	2	0	0	2	0	0	2	0	0	13	1	1	1	0	0	0	2	75	15.8
16-Sep	8.0	2	0	12	11	0	20	0	0	0	1	0	1	1	2	0	13	3	0	27	0	0	0	1	0	0	3	97	12.1
17-Sep	8.0	1	0	0	2	0	18	0	0	0	2	1	0	2	0	0	2	1	0	15	0	0	2	0	0	0	0	46	5.8
18-Sep	7.8	3	2	0	13	0	9	0	0	0	2	0	1	1	0	0	13	1	0	35	0	0	3	1	0	0	1	85	11.0
19-Sep	8.0	3	2	0	14	0	12	1	0	2	0	0	2	3	1	0	7	3	0	26	0	0	0	0	0	0	0	76	9.5
20-Sep	7.5	0	0	0	4	0	8	0	1	0	1	3	0	2	0	0	1	0	0	7	0	0	0	0	0	1	1	29	3.9
21-Sep	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	-
22-Sep	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	-
23-Sep	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	-
24-Sep	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	-
25-Sep	8.0	3	2	1	11	0	75	0	0	1	2	1	0	1	1	1	7	4	0	25	0	0	0	2	0	0	3	140	17.5

Appendix C. (continued)

Date	Obs. Hours	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
26-Sep	8.0	7	0	1	7	0	23	0	0	0	0	0	0	1	0	0	13	0	0	32	0	0	0	2	0	0	0	86	10.8
27-Sep	8.0	2	0	0	4	0	90	0	0	1	2	0	0	0	1	0	7	3	0	29	0	4	1	0	0	0	1	145	18.1
28-Sep	8.0	5	1	0	7	0	36	0	0	1	1	4	0	1	0	0	5	1	0	23	0	0	2	0	0	0	1	88	11.0
29-Sep	8.0	3	2	3	4	0	43	0	0	0	2	3	0	1	0	1	3	2	1	32	0	0	0	0	0	1	2	103	12.9
30-Sep	8.0	3	2	0	9	0	23	0	0	0	2	1	0	1	0	0	4	3	0	29	0	1	1	0	0	0	0	79	9.9
1-Oct	5.0	1	1	0	3	0	22	0	0	0	0	1	0	1	0	0	1	1	0	24	0	0	0	0	0	0	0	55	11.0
2-Oct	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	-
3-Oct	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	-
4-Oct	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	-
5-Oct	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	-
6-Oct	1.0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	3.0
7-Oct	6.8	0	0	0	0	0	25	1	0	0	1	0	0	0	0	0	1	0	0	5	0	0	0	0	0	0	0	33	4.9
8-Oct	8.0	0	4	0	3	0	70	0	0	1	2	0	0	0	0	4	7	0	0	19	0	0	0	0	0	0	5	115	14.4
9-Oct	8.0	1	2	0	4	0	59	2	0	2	1	3	0	1	0	0	5	1	0	22	0	0	1	1	0	0	0	105	13.1
10-Oct	7.0	0	1	0	3	0	16	1	0	0	3	2	0	0	1	3	5	0	0	6	0	0	0	0	0	0	0	41	5.9
11-Oct	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	-
12-Oct	8.0	0	4	0	0	0	29	0	0	0	0	0	1	0	0	0	1	0	0	3	0	0	0	0	0	0	0	38	4.8
13-Oct	8.0	2	4	0	2	0	88	0	0	0	0	0	0	0	0	1	1	0	0	9	0	0	0	0	0	0	1	108	13.5
14-Oct	4.0	0	3	0	0	0	51	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	57	14.3
15-Oct	8.0	1	3	0	2	0	74	0	0	2	1	0	0	0	0	8	4	2	0	25	0	0	0	1	0	0	1	124	15.5
16-Oct	6.3	0	0	0	0	0	119	0	0	1	1	0	0	0	1	4	5	0	0	5	0	0	0	0	0	0	0	136	21.8
17-Oct	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	-
18-Oct	8.0	0	1	0	0	0	71	0	0	1	1	1	0	0	0	0	1	0	0	4	0	0	0	0	0	0	0	80	10.0
19-Oct	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	-
20-Oct	8.0	0	4	0	1	0	33	0	0	0	0	0	0	0	0	4	1	0	0	2	0	0	0	0	0	0	0	45	5.6
21-Oct	7.8	0	1	0	0	0	27	0	0	1	1	0	0	0	1	6	2	0	0	12	0	0	0	0	0	0	0	51	6.6
22-Oct	7.0	0	1	0	0	0	41	0	0	0	2	0	0	2	0	1	2	0	0	4	0	0	0	0	0	0	0	53	7.6
23-Oct	7.8	0	3	0	1	0	26	0	0	2	2	0	0	0	0	8	2	1	0	17	0	0	0	0	0	0	0	62	8.0
24-Oct	7.5	1	0	0	1	0	22	0	0	1	1	3	0	0	0	9	0	0	0	10	0	0	1	0	0	0	0	49	6.5
25-Oct	7.5	0	0	0	2	0	78	0	0	1	2	1	0	0	0	0	3	0	0	20	0	0	0	0	0	0	0	107	14.3
26-Oct	8.0	0	0	0	1	0	17	1	0	2	1	1	0	0	0	0	1	0	0	12	0	0	0	0	0	0	0	36	4.5
27-Oct	7.5	0	4	0	2	0	27	0	0	3	2	1	0	1	1	4	0	2	0	17	0	0	0	0	1	0	0	65	8.7
28-Oct	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	-
29-Oct	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	-
30-Oct	7.3	0	4	0	0	0	14	0	0	1	2	0	0	0	1	3	2	0	0	3	0	0	0	0	0	0	0	30	4.1

Appendix C. (continued)

Date	Obs. Hours	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-Nov	8.0	0	3	0	0	0	24	0	0	0	3	0	0	0	0	2	0	0	0	5	0	0	0	0	0	0	0	37	4.6
2-Nov	7.5	0	3	0	0	0	12	0	0	3	2	1	0	0	0	4	1	0	0	2	0	0	0	0	0	0	0	28	3.7
3-Nov	8.0	0	2	0	0	0	8	0	0	1	1	0	0	0	0	4	0	1	0	4	0	0	0	0	0	0	0	21	2.6
4-Nov	7.5	0	1	0	1	0	12	0	0	3	2	1	0	0	0	6	0	1	0	4	0	0	0	0	0	0	0	31	4.1
5-Nov	8.0	0	3	0	1	0	21	0	0	1	4	1	0	0	0	4	2	0	0	3	0	0	0	0	0	0	0	40	5.0
TOTAL	**385.2**	**89**	**77**	**31**	**198**	**3**	**1437**	**16**	**3**	**33**	**62**	**44**	**13**	**30**	**14**	**77**	**215**	**32**	**1**	**617**	**4**	**14**	**13**	**16**	**1**	**4**	**30**	**3074**	**8.0**

Appendix D. Annual observation effort and fall raptor migration counts by species in the Bridger Mountains, MT: 1991–2016.

	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
Sharp-shinned Hawk	612	442	190	274	288	416	229
Cooper's Hawk	343	149	109	120	103	132	142
Northern Goshawk	50	61	34	26	2	23	41
Unidentified Accipiter	49	39	35	27	20	33	48
Total Accipiters	1054	691	368	447	413	604	460
Broad-winged Hawk	20	13	3	38	3	9	6
Swainson's Hawk	2	3	3	0	1	2	0
Red-tailed Hawk	277	121	45	117	78	113	100
Ferruginous Hawk	7	4	1	3	0	1	3
Rough-legged Hawk	66	77	26	57	11	22	20
Unidentified 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
Unidentified Eagle	15	5	3	2	15	4	2
Total Eagles	1626	1966	1560	1390	1429	1323	1277
American 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
Peregrine Falcon	18	18	1	8	1	10	10
Gyrfalcon	0	1	0	0	0	0	0
Unidentified Falcon	8	6	4	3	5	4	15
Total Falcons	196	166	56	96	30	135	113
Unidentified 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	2016	Mean
Start date	1-Sep	1-Sep	1-Sep	29-Aug	27-Aug	31-Aug
End date	5-Nov	5-Nov	8-Nov	2-Nov	5-Nov	30-Oct
Observation days	58	50	57	55	54	51
Observation hours	414.38	335.76	399.67	401.33	385.2	348.36
Raptors / 100 hours	680.0	688.9	720.4	822.0	798.1	714.53
SPECIES			RAPTOR COUNTS			
Turkey Vulture	2	16	8	7	14	2
Osprey	9	13	6	22	13	7
Northern Harrier	64	34	112	141	44	53
Sharp-shinned Hawk	452	354	422	658	617	347
Cooper's Hawk	180	160	203	306	198	170
Northern Goshawk	33	16	59	38	62	32
Unidentified Accipiter	58	35	66	94	61	46
Total Accipiters	723	565	750	1096	938	592
Broad-winged Hawk	37	48	22	29	31	14
Swainson's Hawk	8	4	2	3	4	3
Red-tailed Hawk	238	180	239	389	215	127
Ferruginous Hawk	4	3	8	6	3	3
Rough-legged Hawk	42	34	84	96	77	36
Unidentified Buteo	12	17	37	29	16	13
Total Buteos	341	286	392	552	346	195
Golden Eagle	1272	1131	1222	1138	1437	1338
Bald Eagle	92	74	106	81	77	77
Unidentified Eagle	12	3	11	2	1	6
Total Eagles	1376	1208	1339	1221	1515	1422
American Kestrel	147	104	138	181	89	79
Merlin	16	21	28	36	33	11
Prairie Falcon	16	8	13	6	14	14
Peregrine Falcon	34	29	23	21	30	12
Gyrfalcon	0	0	0	0	0	0
Unidentified Falcon	13	3	7	7	8	8
Total Falcons	226	165	209	251	174	125
Unidentified Raptor	77	28	63	9	30	32
Grand Total	2818	2315	2879	3299	3074	2428