Raptor Migration Monitoring in the Jewel Basin
Autumn 2020 – Annual Report

31 March 2021

D. Casey photo

A Report to:

USDA Forest Service: Flathead National Forest

Agreement #20-CS-11011000-026
Flathead Audubon Society

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Executive Summary.

Flathead Audubon volunteers and one paid technician were able to conduct 41 surveys at the Jewel Basin Hawk Watch during the 2020 monitoring season (25 Aug – 15 Oct). Early snows in October precluded safe access to the site after 15 Oct, but a strong early flight rewarded the many volunteers who participated in the surveys.

Our total count of 3,088 made this our third best season ever, due in part to a record season-long passage rate of 11.7 birds/hr. We established new season-long high counts for Broad-winged Hawk (43) and Merlin (39), and we had our two best single day counts, including a remarkable 595 birds counted on 21 September. That day we averaged more than one bird per minute all day, and one bird every 23 seconds during our best hour (161 birds), setting new one-day high count totals for Sharp-shinned Hawks (351), Cooper's Hawks (132), Red-tailed Hawks (61), and Broad-winged Hawks (21). Two days later, another 390 birds were counted, our second highest one-day total. We have now counted 32,767 raptors over 13 seasons at the Jewel Basin site. This year we recorded our 15,000th Sharp-shinned Hawk, our 20,000th Accipiter, and our 5,000th Golden Eagle.

As always, the success of the Jewel Basin Hawk Watch depended on a large number of Flathead Audubon members and others who volunteered their time to help spot and tally passing birds. This year 11 people served as primary observers for at least one day (in addition to our paid technician), and at least 43 others served as additional observers. These volunteers provided 1,049.8 hours of in-kind support to the project, which in addition to additional travel and administrative efforts resulted in a total donated in-kind donation of $23,382 to the project.

Introduction. The purpose of this project was to continue (for the 13th consecutive year) annual season-long surveys of autumn raptor migration above Jewel Basin along the Swan Range near Mount Aeneas, on the Flathead National Forest northeast of Bigfork, MT. In addition to providing data to a network of migration monitoring sites in the region, our efforts continue to energize a citizen science base that can be used to conduct annual surveys during future migration seasons, providing valuable educational outreach to the surrounding communities.

This annual report summarizes the extent and results of our efforts during the 2020 field season (25 August – 15 October) and includes data summaries for the last 14 years (including our pilot year in 2007) and recent photos from the site. Thirteen-yr trend data are also briefly summarized. Additional data and photos may be requested from Flathead Audubon through Gael Bissell. Data from the last four survey years are also stored by the Hawk Migration Association of North America (HMANA) at www.Hawkcount.org .

The Jewel Basin Hawk Watch site, at an elevation of 7,100 ft on the northwest flank of Mt. Aeneas in the Flathead National Forest northeast of Bigfork (Figure 1), is uniquely situated for stunning views of passing migrant raptors. The site that serves to concentrate large numbers of raptors, particularly hawks in the genus *Accipiter*. These forest-dwelling species are relatively poorly represented at other Northern Rocky Mountain raptor monitoring sites (i.e., Bridger Mountains site near Bozeman, MPG Ranch in the Bitterroot Valley, and the Rogers Pass/Nora Ridge site east of Lincoln). These species are also poorly monitored by other standardized monitoring programs such as the Integrated Monitoring by Bird Conservation Region (Bird Conservancy of the Rockies, Avian Science Center at the University of Montana, Intermountain Bird Observatory), or the Breeding Bird Survey (USFWS). The Jewel Basin Hawk Watch site has shown potential to assess the long-term health and status of all forest-dwelling diurnal raptors inhabiting the northern Rocky Mountains and boreal areas to the north. This information could prove useful in evaluating long-term changes in raptor populations in respect to forest health and productivity. In addition, this site clearly has good potential for public viewing and education, since the site is relatively accessible to the residents of Flathead Valley and adjacent areas.

Background. Preliminary observations in 2007 suggested that the Jewel Basin site (Figure 1) was an exceptionally narrow pathway for a great diversity of migrating raptors, with more than 200 birds of 10 species seen in less than 10 hours of observation. With the help of a grant from the Plum Creek Foundation, a collaboration of volunteers and paid observers worked with the American Bird Conservancy to initiate the Jewel Basin Hawk Watch from late August through October of 2008 (Casey 2008). Using grants, donations, and other funds from the USDA Forest Service (Flathead National Forest), Flathead Audubon Society (Flathead Audubon), Montana Fish, Wildlife & Parks, individuals, and other organizations, we have continued to conduct annual season-long surveys, counting 1,638 – 3,411 raptors of 15-17 species over 36-53 days of surveys during the fall migration periods of 2008 through 2020 (Casey 2009, Casey 2010, Casey 2012, Casey 2013, Casey 2014, Casey et al. 2015, Casey et al. 2016, Casey et al 2017, Casey et al 2018, Casey et al 2019). Our results have continued to confirm the value of the site for monitoring accipiters, which have comprised nearly 65% of all birds seen. More importantly, the proximity of the passing birds allowed us to classify more than 80% of the birds by age class (immature vs. adult), which gives us an index to reproductive performance in these populations.

Partners, Funding, and Match. Annual surveys at the Jewel Basin have been greatly facilitated by a series of grants and administrative or financial support from the Region One Forest Service, Plum Creek Foundation (2008) Flathead Audubon, (2009 – 2020), Wings In Nature (2016 - 2018), Montana Audubon (2020) and the Nongame Wildlife program at Montana Fish, Wildlife & Parks (2016-2019). Flathead Audubon, a 501(c)(3) non-profit organization based in the Flathead Valley, assumed primary responsibility of the Jewel Basin Hawk Watch beginning in 2015, through a 5-year cost-share agreement (#15-CS-11011000-043) with the Flathead National Forest. A second five-year non-funded agreement was signed by both the Forest Service and Flathead Audubon Society in June 2020. Together these organizations have provided up to $3,000 needed annually over the past 13 years to fund contracted qualified primary observers by providing per diem, mileage, meals, and transportation.

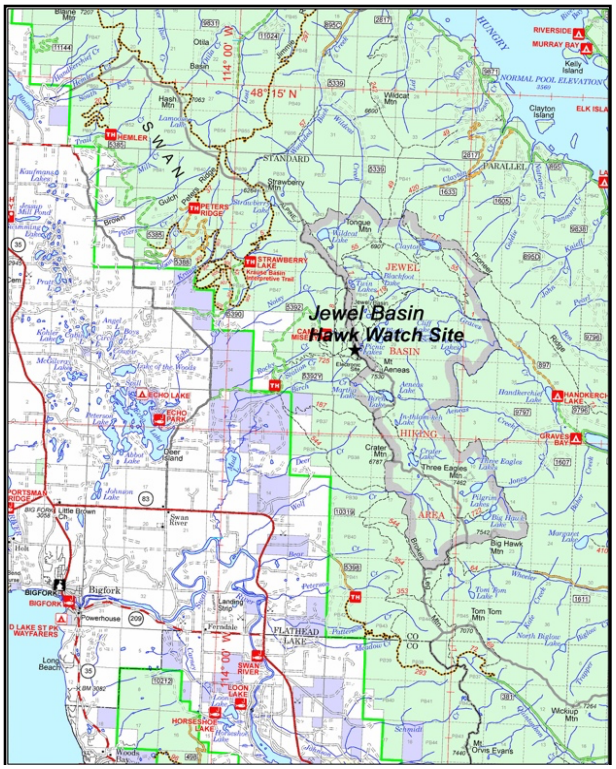

Figure 1. Location of the Jewel Basin Hawk Watch site, Flathead Co., Montana, northwest of Mt. Aeneas, Jewel Basin Hiking Area, Flathead National Forest (48.1552°N, -113.93294°W).

Flathead Audubon contracted with one experienced technician, Joshua Covill to complete up to 30 raptor survey days, depending on weather, during the 2020 field season at the Jewel Basin site. We relied on other experienced volunteers to survey on intervening days. Flathead Audubon reimbursed Joshua $50/day via stipend plus approximately another $50/day reimbursement for personal car mileage and per diem. The Flathead National Forest provided bear and driver training and use of a vehicle from their District Office in Bigfork to the Jewel Basin parking lot for some of the primary observers. Flathead Audubon members Dan Casey, Barbara Summer, Denny Olsen and Kathy Ross provided in depth field training in addition to each serving as primary observers for one or more surveys. Other local volunteer primary observers included bj Worth, Diane Lundgren, Lisa Bate, Nickie Broesel, Jake Bramante, and Rod Wallette. Amy Seaman and Bo Crees of Montana Audubon each also served as primary observers on one or more survey. This year's Jewel Basin Hawk Watch project could not have been undertaken without all the support provided from these organizations and volunteers and, for this, Flathead Audubon is deeply grateful.

This year, primary observers committed a total of 445.9 hours (counting travel time) over 41 successful days of observation at the Jewel Basin observation site. Joshua served as the contract primary observer for eight days (90.5 hours and $839 in contracted expenses) and assisted other primary observers for one additional day (10.5 hours). Eleven other experienced volunteers served as primary observers on 33 days, contributing 355.4 primary hours. No fewer than 43 additional community volunteer/citizen scientists helped the primary observers complete the surveys at the site, donating a total of 693.5 additional observation hours. A full accounting of donated and billed time is available upon request.

Flathead Audubon members Gael Bissell, Dan Casey, and Rod Wallette donated 180 hours for project coordination, training, data analyses, and report preparation. Altogether, volunteers donated more than 1,239 hours in survey time, travel, training, administration, and reporting, with an in-kind match value of $23,382, the largest single-season in-kind match provided to this project since its inception.

Methods. As in past years, our intent was to survey on as many of the 75 days between 25 August and 7 November as weather, access to the site, and availability of observers would allow. This year we began on 25 August, and our "survey window" closed after our last count on 15 October, when snow and ice precluded safe travel on the road and trail to the site. Increased interest, communication and availability of trained primary observers has helped us improve coverage, and this year we missed only four days during the survey window where conditions were suitable, but no observer was available. Surveys varied in length depending on apparent passage rates, weather conditions, and volunteer availability, ranging from 1.8 to 8.7 (average 6.35) hours per survey, totaling 267.6 survey hours for the season. All surveys were conducted from the primary observation point selected based on preliminary (2007) data (Figure 1), a site at 7,100 ft in elevation on the northwest flank of Mt. Aeneas (48.1552°N, -113.93294°W). Primary (and additional) observers for each survey were identified through an email network of Flathead Audubon and through a Yahoo Group (http://pets.groups.yahoo.com/group/Jewel_Basin_Hawk_Watch/) in past years, but now through a gmail network. This was the fourth year that we used on-site electronic data entry. Flathead Audubon provided training to primary technicians in the use of Dunkadoo data entry software (www.dunkadoo.org) prior to the season start. Primary observers had use of their personal cell phones or an I-pad (with extra batteries) that was linked to the internet via cell towers so that data could be entered directly into the Dunkadoo website in real time. Dan Casey provided significant field support via phone and email.

Count and weather data were entered during each survey using the Dunkadoo interface. All raptors passing by in a southerly direction were identified to species, age and sex where feasible, with apparent local birds (identified by their hunting behavior, and/or local movements) excluded from daily and seasonal totals. A plastic owl decoy on a pole (Figure 2) was placed in a prominent point above the counters during most surveys, which attracted many birds closer to the viewpoint and allowed closer study for identification and classification. Accipiters and falcons

responded most frequently to the presence of the owl, although these species in general were also most prone to migrating directly along the crest of the ridge.

Figure 2. Sharp-shinned Hawk attacking the plastic owl decoy used to attract migrant raptors for ease in identification and classification, Jewel Basin Hawk Watch (D. Casey photo).

Count data were recorded for each hourly period beginning and ending on the hour, with weather variables (e.g. wind speed and direction, ambient temperature, cloud cover, visibility) recorded every hour on the half hour. We also recorded characteristics of the flight according to HWI protocols, using codes developed by the Hawk Migration Association of North America (HMANA), for the majority of passing birds during each hourly survey period. These included the average height above, direction to, and distance from the hawk watch site. All 2020 survey data were entered into the database that is automatically linked via Dunkadoo to Hawk Migration Association of North America's interactive database on the Hawk Count website (www.hawkcount.org). This site allows interested parties to review data not only from this site, by year and date; but data from other sites across the continent. We are working to update the site with data from past years at the Jewel Basin site.

Results. Our total count of 3,088 raptors for 2020 was well above our 12-year average of 2,510 total birds/year (Table 1), in spite of our earliest ever final survey date (15 Oct). We counted 16 different raptor species during the 2020 migration season. Our season-long passage rate of 11.7 birds per hour was our highest ever, and we had our two highest one-day survey totals on 21 Sept (595) and 23 Sept (390). These dates are consistent with seasonal peak dates from prior years at this site.

Accipiters again comprised the majority of the raptor flight (67.7%) with 2,092 birds counted. Eagles comprised 12.7 % of the birds recorded, buteos 12.2%, and falcons 5.3% (Figure 3). We saw new record numbers of Broad-winged Hawks (43) and Merlins (39), and well-above average numbers of Sharp-shinned, Cooper's and Red-tailed Hawks, as well as American Kestrels. But our Golden Eagle total (324) was well below average, based in part on the early end of our 2020 survey season. Complete daily survey results for the 2020 season, by species, are included in Appendix A.

Species Accounts. The brief species accounts that follow describe the extent and nature of the migration data we collected in 2020, with comparisons to (and summaries of) our data from previous 12 years (Table 1). We have included adjustment of totals per unit effort (e.g. birds per 10hr, or birds per 100hr). We include cursory analysis of sex and age ratios, timing and proportion of the flight, and any indication of trends revealed by this year's data. Daily count data by species are presented in full in Appendix A.

Table 1. Season totals for raptors counted at the Jewel Basin Hawk Watch site, 2008-2020. Minimum, maximum and mean season totals 2008-2019, plus 2020 and all-time (14-yr) totals. All-time totals include limited preliminary totals from 2007. All surveys were conducted between 25 Aug and mid-November, dependent on weather and volunteer availability.

Species	12-yr Minimum	12-yr Maximum	12-yr Mean	2020 Total	All-time Total
Turkey Vulture	0	7	3	**1**	33
Osprey	4	19	8	**8**	102
Bald Eagle	25	107	55	**65**	730
Northern Harrier	13	102	45	**38**	581
Sharp-shinned Hawk	687	1,778	1,115	**1,548**	15,053
Cooper's Hawk	215	504	363	**467**	4,855
Northern Goshawk	24	62	37	**36**	480
Unidentified Accipiter	32	93	58	**41**	741
Broad-winged Hawk	2	26	14	**44**	208
Swainson's Hawk	1	3	1	**1**	14
Red-tailed Hawk	136	321	196	**301**	2,676
Ferruginous Hawk	0	1	1	**0**	7
Rough-legged Hawk	1	41	19	**17**	247
Unidentified Buteo	8	22	15	**15**	202
Golden Eagle	212	600	387	**324**	5,009
American Kestrel	35	100	65	**87**	876
Merlin	9	31	20	**39**	280
Peregrine Falcon	3	22	12	**14**	154
Prairie Falcon	1	21	10	**17**	135
Gyrfalcon	0	1	0	**0**	2
Unidentified Falcon	1	14	6	**6**	72
Unidentified Eagle	0	6	2	**2**	22
Unidentified Raptor	8	46	22	**19**	288
TOTAL	1,638	3,411	2,450	**3,088**	32,767
Survey Days	36	52	44	**41**	573
Effort: In hours	226.0	339.0	277.1	**263.6**	3,555
Passage Rate (per hr)	6.3	11.6	9.0	**11.7**	9.2
Total Species	15	17	16	16	18

Species Accounts:

Turkey Vulture. 2020 Total: 1 (<1 per 10 survey hours) 12-yr Average: 3 (<1 per 10hr)

We have now counted just 33 Turkey Vultures (range, 0-7 per year) at the Jewel Basin Hawk Watch site since 2007. A single bird was recorded 11 September this year. Our data set confirms that this species is not as dependent on ridgeline migration corridors as the other species we survey at this northern Rockies location.

Osprey. 2020 Total: 8 (<1 per 10 survey hours) 12-yr Average: 8 (<1 per 10hr)

We have now counted 102 Ospreys (4-19/yr) at the Jewel Basin Hawk Watch site since 2007. We recorded one or two Ospreys on six days between 1 and 16 September. This locally abundant breeder is not prone to migrating on the ridgelines in this region, preferring the more profuse feeding areas of the valley bottom. We occasionally saw local birds traversing the ridge, as in past years. Breeding season surveys at valley nesting areas provide better indices of population health for this easily surveyed species.

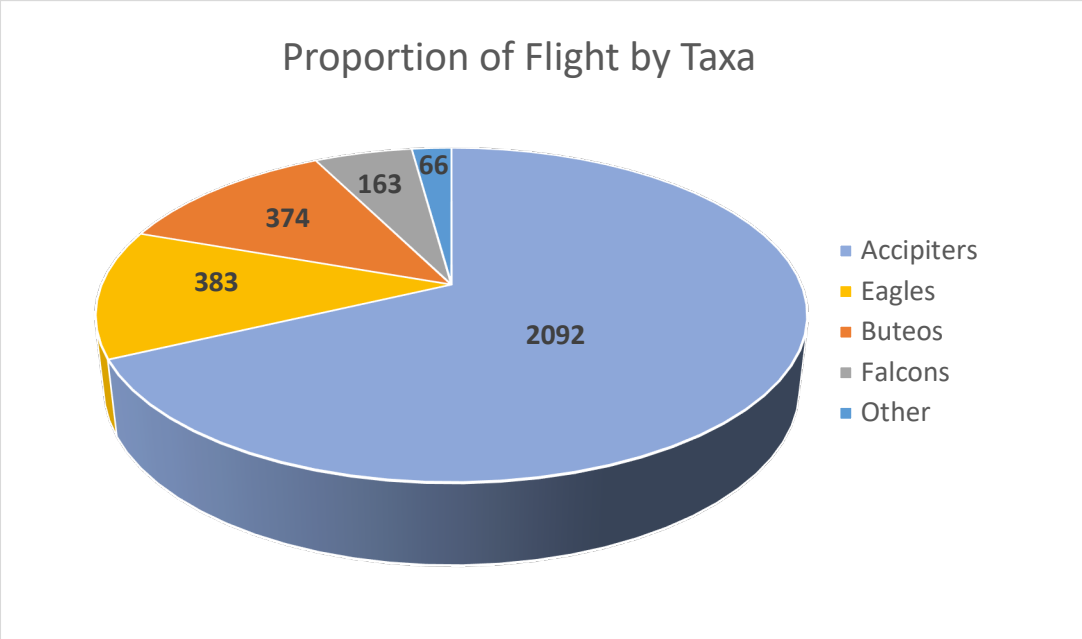

Figure 3. Composition of observed hawk migration at the Jewel Basin Hawk Watch site, fall 2020, by category. Numbers are total counts for the season.

Bald Eagle. 2020 Total: 65 (2.5 per 10 survey hours) 12-yr Average: 55 (2.1 per 10hr)

We have now counted 730 Bald Eagles (25-107/yr) at the Jewel Basin Hawk Watch site since 2007. This year the first was seen 25 August, with a peak count of eight birds on 4 October. As Bald Eagles are generally late migrants; some eagles were likely missed due to lack of survey days after 15 October when weather was still good for migration. Additional local birds were seen in the vicinity of the site throughout the season. We classified all of the Bald Eagles to age class, with immature birds comprising 21% of the flight (30 per 100 adults). (bj Worth photo).

Northern Harrier. 2020 Total: 38 (1.4 per 10 survey hours) 12-yr Average: 45 (1.7 per 10hr)

We have now counted 581 Northern Harriers (13-102/yr) at the Jewel Basin Hawk Watch site since 2007. Harriers were observed from 27 August to 9 October. Harriers are one of the few species for which we can classify not only age, but sex (of adults). The 2020 flight was heavily dominated by immature birds (84%); just one of the five adults recorded was a male.

Sharp-shinned Hawk. 2020 Total: 1,548 (58.7 per 10hr) 12-yr Average: 1,115 (41 per 10hr)

The Sharp-shinned Hawk is far and away the most abundant migrant raptor at the Jewel Basin site, with 15,053 (687-1,778/yr) counted since 2007. We recorded Sharp-shinned Hawks on all but the final survey (15 October), and this species comprised 50% of all raptors counted. Our (all-time) daily high count of 351 Sharp-shinned Hawks fell on 21 September, when we averaged 40 birds per hour of this species alone. We classified 91% of the Sharp-shinned Hawks; the ratio of immatures to adults was 77/100 (Figure 4). The Jewel Basin remains the best site in the northern Rockies for monitoring this species. Abundance data for this species at our site, corrected for unit effort (birds/100hr), has shown no apparent trend, appearing to be nearly cyclic over our 13 full seasons of monitoring (Figure 5). (bj Worth photo)

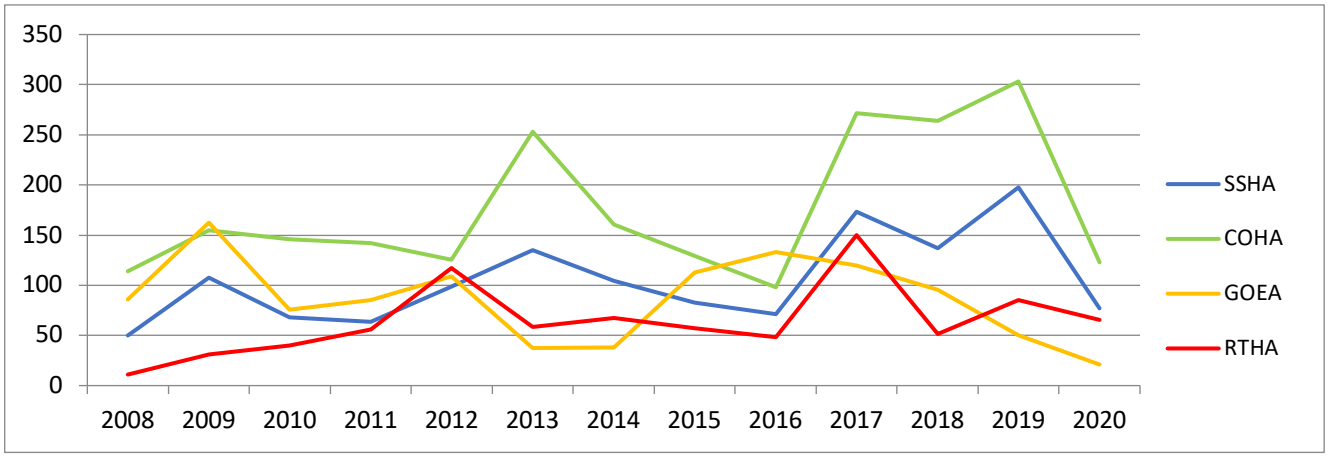

Figure 4. Ratios of immatures per 100/adults counted at the Jewel Basin Hawk Watch, 2008 – 2020, for the four most common species surveyed. SSHA = Sharp-shinned Hawk; COHA = Cooper's Hawk; GOEA = Golden Eagle; RTHA = Red-tailed Hawk

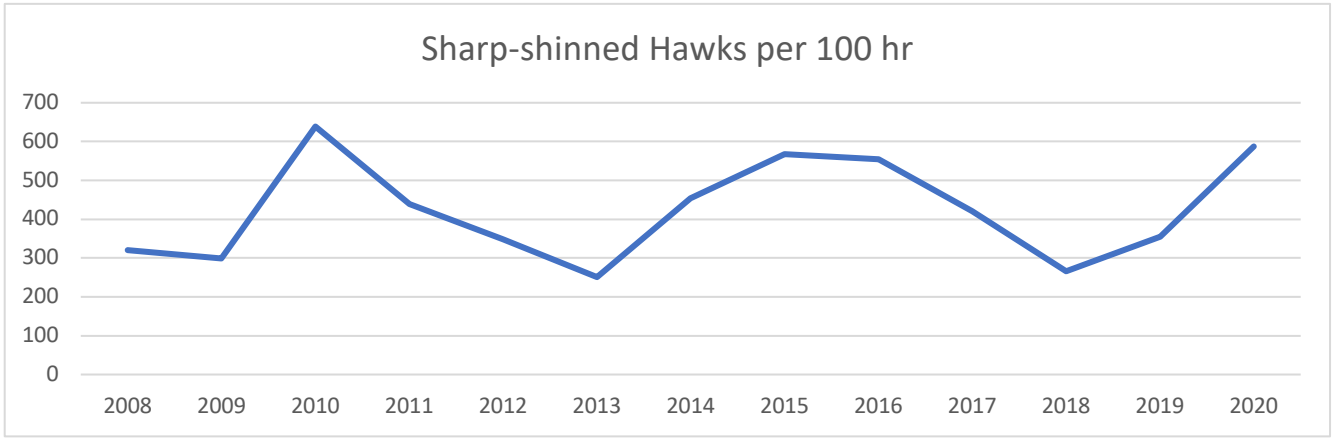

Figure 5. Abundance of Sharp-shinned Hawks reported at the Jewel Basin Hawk Watch site, corrected for effort (birds/10hr), 2008-2020.

Cooper's Hawk. 2020 Total: 467 (17.7 per 10 survey hours) 12-yr Average: 363(13.3/10hr)

We have now counted 4,855 Cooper's Hawks (215-504/yr) at the Jewel Basin Hawk Watch site since 2007. This year we recorded them on all but six of our 41 survey days. Our (all-time) highest daily count was 132 birds on 21 September. We classified 88% of the birds to age this year, with 55% being immature birds for a ratio of 123imm /100 ad. This annual index of Cooper's Hawk reproduction has been consistently higher than that of Sharp-shinned Hawks (Figure 4), averaging 160 immatures:100 adults over the 12 previous years of season-long surveys. Adjusted abundance (birds/100hr) has increased over the past two years (Figure 6) after a low in 2018 but appears to be relatively stable of the 13 years of our surveys. (bj Worth photo)

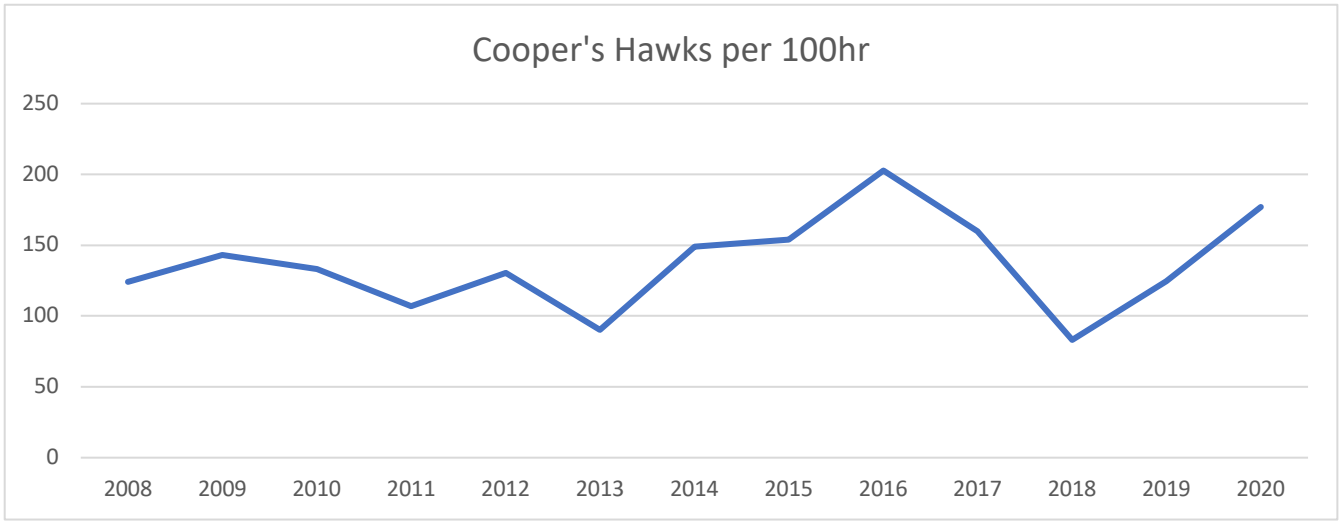

Figure 6. Abundance of Cooper's Hawks reported at the Jewel Basin Hawk Watch site, corrected for effort (birds/10hr), 2008-2020.

Northern Goshawk. 2020 Total: 36 (1.4 per 10 survey hours) 12-yr Average: 37 (1.3/10hr)

We have now counted 480 Northern Goshawks (24-62/yr) at the Jewel Basin Hawk Watch site since 2007. This year the first observation was on 26 August, and the last on 9 October, with a peak count of five on 21 September. Had we been able to continue to survey beyond 15 October, the count of northern goshawks would likely have been higher. The ratio of immature birds to adults (263:100) was below the 12-yr average of 576 immatures/adults, with 72% of the individuals counted this year being immature birds.

Broad-winged Hawk. 2020 Total: 43 (1.6 per 10 survey hours) 12-yr Average: 14 (0.5/10hr)

We have now counted 208 Broad-winged Hawks (2-43/yr) at the Jewel Basin Hawk Watch site since 2007. The migratory status of this small buteo species in the Flathead Valley was poorly known before the initiation of our surveys. It has proven to be a rare but regular migrant at the Jewel Basin site, averaging 14 counted per season (Table 1). This year we counted a record 43 individuals, including a new one-day high count of 21 on 21 September. We recorded the species on 11 days between 10 September and 5 October. The observed age ratio was 77 imm/100 ad. Just one dark morph bird was seen. (bj Worth photo)

Swainson's Hawk. 2020 Total: 1 (<1 per10 survey hours) 12-yr Average: 1 (<1/10hr)

We have now counted just 14 Swainson's Hawks (0-3/yr) at the Jewel Basin Hawk Watch site since 2007. The few individuals of this long-distance migrant that we have recorded have typically been early in the migration season (11 September this year). The Swan Range is clearly not an important migration corridor for this species of the prairies.

Red-tailed Hawk. 2020 Total: 301 (11.4 per 10 survey hours) 12-yr Average: 196 (7.1/10hr)

We have now counted 2,676 Red-tailed Hawks (136-321/yr) at the Jewel Basin Hawk Watch site since 2007, making it our fourth-most abundant species. Until the last two seasons**,** Red-tailed Hawks had shown the most consistent upward trends, in both total birds counted and percentage of immature birds in the flight, of all the species we record at the Jewel Basin site. This year our total count was well above our previous averages (Table 1), even when corrected for unit effort (Figure 7). We saw Red-tailed Hawks throughout the season, on all but two surveys, with an all-time high count of 61 birds on 21 September (more than doubling our previous high count). In spite of our overall high numbers, the flight was dominated by adults; we classified 88% of the individuals to age class, with an observed ratio of 65 immatures to 100 adults. This metric of reproductive success does appear to have a slight upward trend over the 13 years of our surveys, however (Figure 4). (bj Worth photo)

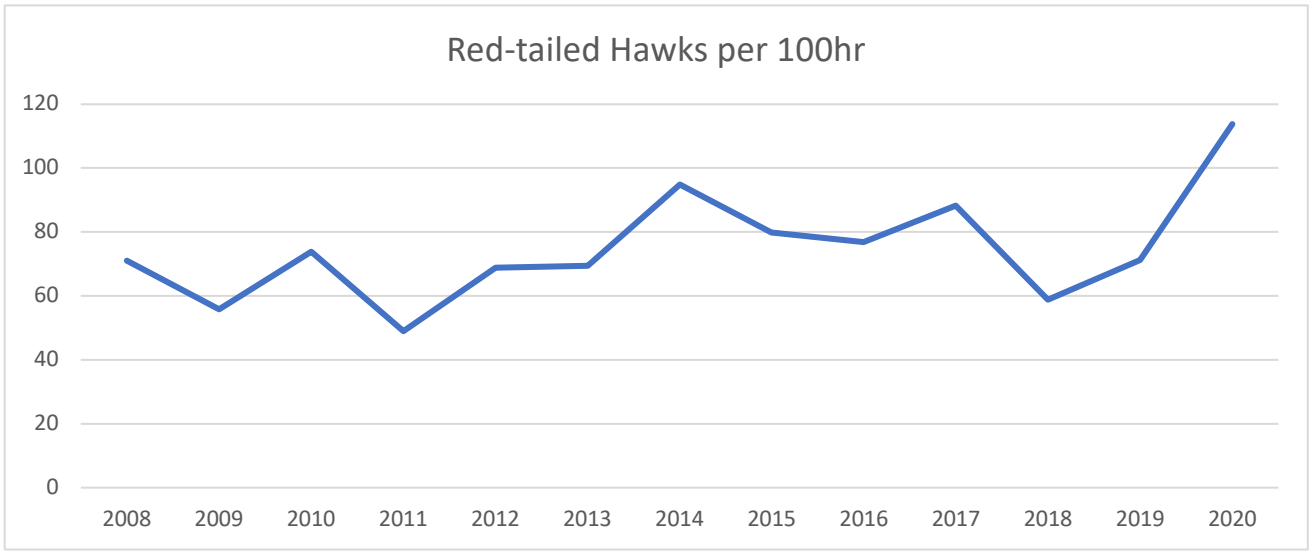

Figure 7. Abundance of Red-tailed Hawks reported at the Jewel Basin Hawk Watch site, corrected for effort (birds/10hr), 2008-2020.

Ferruginous Hawk. 2020 Total: 0 (<1 per 10 survey hours) 12-yr Average: <1 (<1/10hr)

The Ferruginous Hawk is a rare migrant at the Jewel Basin Hawk Watch site, with just seven recorded since 2007 (never more than one in a season).

Rough-legged Hawk. 2020 Total: 17 (0.6 per 10 survey hours) 12-yr Average: 19 (0.7/10hr)

We have now counted 247 Rough-legged Hawks (1-41/yr) at the Jewel Basin Hawk Watch site since 2007. Our 13 years of surveys have shown that this locally abundant wintering species does not seem to rely heavily on ridgeline routes here, even though migration into the area is well underway by late September. Each year many were present in the valley by the end of our survey period, without correspondingly high counts from the hawk watch site. Our seasonal counts have been highly variable, with just one bird seen in 2009, and a high of 41 counted in 2008. This year we recorded Rough-legged Hawks on seven days between 23 September and 10 October, with daily highs of four birds on 2 and 10 October.

Golden Eagle. 2020 Total: 324 (12.3 per 10 survey hours) 12-yr Average: 387 (14.0/10hr)

The Golden Eagle is the second-most abundant migrant raptor species at the Jewel Basin site, with 5,009 (212-600/yr) counted since 2007. A total of 324 Golden Eagles were seen, during 26 of our 41 surveys, with a high count of 49 on 8 October. The bulk of the eagle flight typically occurs in the latter half of our survey season and it is likely we therefore missed a significant segment of the Golden Eagle migration. We assessed the age class of 310 (96%) of the passing birds, with 202 (65%) of those being adults, 60 subadults or non-adult (19%), and 42 immatures (14%). This year's observed age ratio (21 imm/100 ad) marked the fourth straight year where this metric has declined (Figure 4). Adjusted abundance of Golden Eagles counted at our site has also declined since a peak in 2013 (Figure 8). (bj Worth photo)

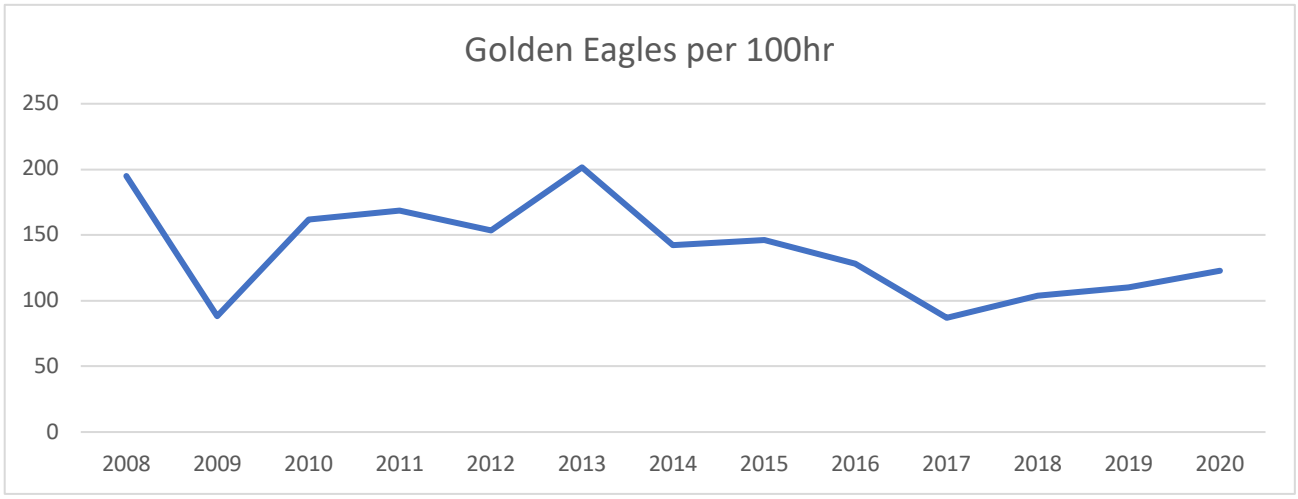

Figure 8. Abundance of Golden Eagles reported at the Jewel Basin Hawk Watch site, corrected for effort (birds/10hr), 2008-2020.

American Kestrel. 2020 Total: 87 (3.3 per 10 survey hours) 12-yr Average: 65 (2.4/10hr)

We have now counted 876 American Kestrels (35-100/yr) at the Jewel Basin Hawk Watch site since 2007. Like the Rough-legged Hawk, this species is prone to migrating in the valley bottoms under certain weather conditions, which may explain the variability in our survey data year to year. We saw kestrels essentially throughout the season, from 25 August through 9 October, with a peak count of 11 birds on 15 September. Among the 74 birds

(85%) classified to sex, the ratio was 1.1 males per female, within the range we have observed (1:1 to 1.6:1) in previous years.

Merlin. 2020 Total: 39 (per 10 survey hours) 12-yr Average: 20 (<1/10hr)

Although we have now counted 280 Merlins (9-39/yr) at the Jewel Basin Hawk Watch site since 2007, they comprise a relatively minor component of the migration at this site (Table 1). We established a new high count for the site this year (39); they were seen from 29 August through 9 October, with a (new high) peak daily count of eight birds on 11 September. We did not collect sex and age data for the majority of these birds, given the difficulty of classifying these birds in flight, and the variability in the three subspecies known to occur at the site. Just one adult male "Prairie" Merlin was recorded. The majority appeared to be "Taiga" Merlins. (bj Worth photo)

Peregrine Falcon. 2020 Total: 14 (<1 per 10 survey hours). 12-yr Average: 12 (<1/10hr)

We have now counted 154 Peregrines (3-22/yr) at the Jewel Basin Hawk Watch site since 2007. This year the first was seen 12 September, and the last was 9 October, with a high count of three on 21 September. Thirteen were classified to age, with 11 adults and two immatures recorded.

Prairie Falcon. 2020 Total: 17 (<1 per 10 survey hours) 12-yr Average: 10 (<1/10hr)

We have now counted 135 Prairie Falcons (1-21/yr) at the Jewel Basin Hawk Watch site since 2007. The first this year was seen 2 September, and the last was 8 October. We counted two Prairie Falcons on each of six different surveys.

Gyrfalcon. 2020 Total: 0 (0 per 10 survey hours) 12-yr Average: <1 (<1/10hr)

Only two Gyralcons have been recorded at the Jewel Basin Hawk Watch site since 2007, each during the first week of November (2012, 2016). We did not observe any Gyrfalcons this migration season. This irregular winter visitor to the western valleys of Montana has been only very rarely encountered at western ridgeline hawk counts.

Classification Data. We continue to be able to classify a high percentage of the passing birds to species, age, and (for some species) sex, because so many of the migrants at the Jewel Basin site fly within 50 meters of the observers. This year we identified 97% of all birds to species, including 98% of all accipiters, 96% of all buteos, 99% of all eagles, and 96 % of all falcons. We recorded age class of 85% of all raptors, and sex of 84% of Northern Harriers and American Kestrels. We do know that the seasonal distribution of our surveys can influence observed age ratios, with immature birds generally flying earlier in the season, and we have generally had more consistent coverage in the first half of the season. This was indeed the case in both 2017, 2019, and again this year due either to weather or lack of coverage later in the season. We therefore generally tended to overestimate the proportion of first year birds in the flight, which is why our age ratios are indices, not estimates. Our 2020 data did indicate potentially that Sharp-shinned, Cooper's, Golden Eagles and Red-tailed all showed a dip in recruitment this breeding season (Figure 4).

Passage Rate. The vast majority of our 2020 survey efforts once again took place between the hours of 1000 and 1700, with daily peak rates between 1100 and 1600. Our season-long passage rate of 11.7 birds/hr was the highest we have recorded. We also established new high daily count (595) and hourly count (161) on 21 September.

Discussion. Data collected over the last 13 years indicate that the Jewel Basin site is one of the best places in the northern Rockies to monitor passing accipiters. It appears that with adequate coverage (and suitable weather), we can expect to consistently record and classify 2,000 – 3,500 birds annually at the site, although poor weather and

access issues can sometimes suppress survey efforts. Accipiters consistently comprise the bulk (51%-72%) of the flight in the Jewel Basin, with 2,092 (68%) counted this year. This combination of an abundance of accipiters, and a diversity of other raptors seen, make the Jewel Basin a valuable addition to the network of monitoring sites in the state and the West.

Our final tally of 3,088 birds was the third highest seasonal total over 13 years of surveys (range, 1638 – 3411), and our highest ever season-long passage rate (11.7/hr), in spite of our earliest ever season closure. We have now counted 32,767 raptors of 18 species since our initial efforts in 2007. This total was boosted substantially by our two highest count days ever, with 595 birds counted 21 September, and another 390 two days later. We set numerous new one-day high counts on the former, including Sharp-shinned Hawks (351), Cooper's Hawks (132), Broad-winged Hawks (21), and Red-tailed Hawks (61). That day also had the distinction of nearly all of our top primary observers being present to record and marvel in the spectacle of a bird a minute all day long. Numerous visitors that day also go to appreciate just how special an event a big migration day at the site can be. It is such moments of engagement with nature that keep our observers engaged and spark interest in the public.

Our season-long passage rates of 6.3 – 11.7 birds/hr (9.2 overall) over the 13 years of surveys to date (Table 1) are comparable to, or surpass historic rates at other hawk migration monitoring sites in Montana. A direct comparison of our data with selected recent survey data from other sites (Casey 2011) showed that our individual species totals are also comparable or exceed those for the other sites, although it appears that migrating Golden Eagles use the Jewel Basin less than other Montana monitoring sites. The long-term monitoring site at the MPG Ranch outside of Missoula, has also been recording far fewer Golden Eagles in than the more traditional monitoring sites in Montana (Bridgers, Rogers Pass, Nora Ridge). But that site has had far more Turkey Vultures, Northern Harriers, Red-tailed Hawks and American Kestrels, and far fewer accipiters than the Jewel Basin site during the fall migration season. Clearly, having a diversity of sites across the state will allow us to gain a broader perspective on the diversity of migrant raptor populations in the region, under a variety of weather influences.

Future Survey Recommendations. Our last four seasons included onsite electronic data entry (via Dunkadoo). We were very pleased with the ease of data entry, availability of data and outreach opportunities that this system provided. Surveys should be continued annually, with target dates of 25 Aug through mid-Nov, weather permitting. We expect continued community support for this project, based on the very favorable response to our results and outreach efforts over the past ten years, particularly with volunteers. Flathead Audubon has assumed primary responsibility of the Jewel Basin Hawk Watch. In contrast to prior few years, Flathead Audubon contracted with only one Hawk Watch technician but coordinated with other skilled volunteers to fill in as primary observers on other days rather than reimburse a number of different contracted technicians. This year we were fortunate to have Josh Covill available to serve as our contract primary observer. Josh has volunteered at the Jewel Basin Hawk Watch for many prior years and is a top-notch primary observer. We hope Josh will return for subsequent seasons. To sustain 35 to 45 surveys/year, we will continue to need sources of funding to ensure the consistent coverage throughout the season.

While season long surveys of eight hours per day from the last week of August through the first or second week of November would maximize coverage, we have found that travel logistics, weather and volunteer availability will invariably impede thorough coverage. Every attempt has (and should) be made to ensure that at least the period 1100-1600 each day with suitable weather is covered, as it typically represents more than 75% of the flight. Likewise, most of the flight occurs between 15 Sep and 15 Oct, and if funds or volunteers ever become limited, this time period should be the focus of survey efforts. Indeed, this year 79% of the raptors were recorded during that period, and a remarkable 32% of all birds were counted during a three-day period between storms, 21-23 September.

Our annual objective for this site has been to run as many daily surveys from 25 Aug through 7 Nov (N=75 days) as weather and observer availability/interest would allow. Beginning in 2011, we made a concerted effort to track the number of days during that period where weather was suitable for counts, and the number (%) of days surveys

were conducted. This year was the third year in the last four where 60% or fewer of the 75-day survey period had weather suitable for surveys, but also the third year in four where we managed to conduct surveys on 90% or more of the days with suitable weather (Table 2). We have further defined our survey opportunity and effort during each annual "survey window", or those dates from the first survey each year until the last (when access is not longer safe). This survey window has varied from a low of 52 days (this year), to a high of 81 days in 2016, when our last survey was l3 November. This year, in spite of our shortest ever survey window, we conducted surveys on 79% of the days during that period, our most comprehensive coverage to date (Table 2). This is a testament to outreach efforts and our growing pool of qualified observers. This year we missed just four days during the survey window (8%) when weather was suitable but no observer was available.

Table 2. Seasonal survey effort, Jewel Basin Hawk Watch, 2011-2020. Percent of days by category by Season (25 Aug – 7 Nov; N=75) and by Survey Window (days between first and last survey each year, inclusive; N=49-81).

Year:	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Suitable Days: Season	77%	73%	71%	77%	67%	64%	57%	79%	49%	60%
Suitable Days: Surveyed	87%	87%	91%	90%	94%	79%	98%	76%	97%	91%
Window Days Surveyed	61%	64%	64%	78%	72%	49%	66%	75%	68%	79%
Window Days Bad Weather	21%	21%	24%	15%	23%	33%	22%	5%	26%	12%
Window Days No Access	9%	9%	7%	7%	5%	17%	2%	20%	2%	8%
Window Days Suitable No Survey	0%	5%	5%	0%	0%	0%	11%	0%	4%	2%
Window Days No Data	8%	0%	0%	0%	0%	0%	0%	0%	0%	0%

As for training future observers, Flathead Audubon continues to offer field trips and one on one training for individuals interested or with experience in raptor observations. We have had 35 people serve as primary observers for at least one survey since this project began, and have a solid base 16 experienced local observers still available, including nine who have served as primary observers 10 or more (11-110) times. We still plan to contract with at least one individual to cover up to 30 survey days/season in future seasons, to ensure that we continue to maximize efforts when weather access allow.

Summary. The U.S. Forest Service is a primary forest steward in the Northern Rockies. Our efforts at this monitoring site indicate that it is an excellent site to monitor the migration and age structure of regional populations of forest-dwelling raptors (e.g. Sharp-shinned Hawk, Cooper's Hawk, Northern Goshawk). Monitoring results from this site complement data collected at other raptor monitoring sites in the state and region, and we are now entering our data directly into the www.hawkcount.org website to make them available to the public and to other researchers, in addition to our annual reports. Because this site allows close study of passing birds, we can track age and (for some species) sex ratios, in addition to overall abundance, indicating the health of populations (and therefore the health of forest ecosystems) over time. The accipiters passing this site are certainly reliant on both public and corporate timberlands; indeed, as they continue south from this site they pass over and through extensive corporate timber and USFS lands. We have observed that a large percentage of the passage birds at this site have full crops, indicating that these birds rely on local habitats to feed before proceeding on migration, though we have not quantified the extent of the phenomenon. Clearly, all the lands along this important migration corridor play a role in its continued value to these birds.

Montana Audubon and the Flathead Audubon Society are committed to environmental education and developing citizen science opportunities. Because of its accessibility, the Jewel Basin Hawk Watch site offers exceptional opportunity to involve the local community and educate and inform them about the ties between sustainable forest management and bird conservation. It may also allow the Flathead National Forest, Montana Audubon and

Flathead Audubon to nurture a volunteer base for other bird monitoring efforts in the region. This was evidenced by the continued overwhelming response by volunteers interested in participating in the 2008-2020 survey efforts. With local publicity, we also have received inquiries from home-schoolers, public school teachers, youth programs, and environmental outreach organizations (e.g. Montana Natural History Center, Glacier Institute, Montana Audubon) about opportunities to get children and adults involved in the surveys as an "outdoor classroom". This is another area of outreach to explore and expand in future years.

Many of the hawk watch sites in North America (including two sites in Montana) supplement their counting efforts with additional efforts to trap, band and release raptors to improve our understanding of migration patterns, distribution, longevity, plumage/molt, and more. We feel that the potential to add a raptor banding component to the Jewel Basin Hawk Watch effort is something that should be considered by partners. There are a number of master banders in Montana that might be available and willing to initiate a pilot effort in 2021 or 2022.

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APPENDIX A. Daily count data, Jewel Basin Hawk Watch, 25 Aug – 15 Oct 2020. Species codes listed below table.

Date	Hours	T	OS	BE	NH	SS	CH	NG	SA	LA	UA	B	SW	RT	FE	RL	UB	GE	AK	ME	PG	PR	GY	UF	UE	UU	TOTAL	Birds/Hr
25-Aug	7.00	0	0	1	0	2	0	1	0	0	0	0	0	6	0	0	0	0	1	0	0	0	0	0	0	0	11	1.6
26-Aug	6.00	0	0	2	0	1	0	1	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	11	1.8
27-Aug	5.50	0	0	2	1	6	3	1	0	0	0	0	0	3	0	0	1	3	0	0	0	0	0	0	1	0	21	3.8
28-Aug	6.00	0	0	0	1	8	3	0	0	0	1	0	0	3	0	0	0	0	3	0	0	0	0	0	0	0	19	3.2
29-Aug	6.50	0	0	1	1	16	3	0	0	0	0	0	0	4	0	0	0	1	0	2	0	0	0	0	0	0	28	4.3
30-Aug	7.00	0	0	1	0	5	4	0	1	0	0	0	0	3	0	0	0	0	0	1	0	0	0	0	0	0	15	2.1
1-Sep	6.60	0	2	0	0	6	2	0	0	0	1	0	0	1	0	0	2	0	0	0	0	0	0	0	0	0	27	4.1
2-Sep	6.50	0	0	2	0	8	6	1	0	0	1	0	0	5	0	0	1	0	0	1	0	2	0	0	0	1	28	4.3
3-Sep	7.80	0	1	0	2	22	14	0	3	0	0	0	0	5	0	0	1	5	4	0	0	0	0	0	0	2	59	7.6
4-Sep	6.00	0	0	0	0	15	4	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	20	3.3
5-Sep	7.00	0	1	0	2	27	8	1	0	0	0	0	0	5	0	0	0	0	5	2	0	0	0	0	0	0	51	7.3
6-Sep	7.50	0	1	0	3	24	11	3	2	0	0	0	0	1	0	0	0	2	10	3		2		1		2	75	10.0
8-Sep	6.00	0	0	0	1	5	3	0	0	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	12	2.0
9-Sep	6.50	0	2	0	0	5	1	0	0	0	0	0	0	2	0	0	1	1	1	0	0	0	0	0	0	0	13	2.0
10-Sep	6.60	0	0	0	2	11	5	2	0	0	0	1	0	8	0	0	0	0	1	0	0	0	0	0	0	0	30	4.5
11-Sep	7.00	1	0	1	2	20	13	2	0	0	0	1	1	1	0	0	0	2	3	8	0	1	0	1	0	0	70	10.0
12-Sep	6.50	0	0	1	1	65	31	2	1	0	2	0	0	1	0	0	3	3	3	1	1	2	0	2	1	0	133	20.5
13-Sep	4.00	0	0	0	0	4	0	0	0	0	0	0	0	1	0	0	0	0	3	1	0	0	0	0	0	0	9	2.3
14-Sep	3.60	0	0	0	0	11	3	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0	0	0	0	0	17	4.7
15-Sep	7.50	0	0	2	0	36	13	1	0	0	0	0	0	**5**	0	0	0	6	11	2	0	0	0	0	0	0	76	10.1
16-Sep	7.50	0	1	0	1	85	8	0	0	0	0	2	0	2	0	0	0	1	2	0	1	0	0	0	0	1	104	13.9
17-Sep	6.50	0	0	0	2	16	16	0	2	0	0	0	0	3	0	0	0	0	1	2	1	0	0	0	0	0	43	6.6
18-Sep	5.00	0	0	0	0	12	7	1	0	1	0	1	0	1	0	0	0	3	0	0	1	0	0	0	0	1	41	8.2
21-Sep	8.70	0	0	3	3	351	13	5	0	0	1	21	0	6	0	0	0	4	6	3	3	1	0	0	0	1	595	68.4
22-Sep	4.20	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0.7
23-Sep	8.00	0	0	2	2	207	84	0	7	0	2	12	0	4	0	1	2	15	6	2	2	1	0	0	0	0	390	48.8
25-Sep	1.80	0	0	0	0	3	8	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	13	7.2
27-Sep	6.70	0	0	2	1	19	2	0	0	0	0	0	0	2	0	0	0	13	0	1	0	0	0	0	0	3	43	6.4
28-Sep	6.30	0	0	2	1	44	4	2	0	1	0	1	0	7	0	0	1	16	2	1	0	1	0	0	0	3	86	13.7
29-Sep	7.00	0	0	1	1	26	12	**1**	0	0	0	1	0	8	0	0	0	6	0	0	0	1	0	0	0	0	57	8.1

APPENDIX A (cont'). Daily count data, Jewel Basin Hawk Watch, 25 Aug – 27 Oct 2017. Species codes listed below table.

Date	Hours	T	OS	BE	NH	SS	CH	NG	SA	LA	UA	BW	SW	RT	FE	RL	UB	GE	AK	ML	PG	PR	GY	UF	UE	U	TOTAL	Birds/H
1-Oct	6.50	0	0	1	2	32	6	1	0	0	1	0	0	1	0	1	1	3	0	1	0	0	0	0	0	3	53	8.2
2-Oct	7.50	0	0	2	2	55	0	1	6	0	0	0	0	0	0	4	0	30	3	0	0	0	0	1	0	0	104	13.9
3-Oct	7.90	0	0	6	2	72	10	2	2	0	0	0	0	10	0	2	0	38	1	2	0	0	0	0	0	0	147	18.6
4-Oct	8.25	0	0	9	1	97	28	1	1	2	0	1	0	12	0	0	1	36	9	1	2	2	0	0	0	1	204	24.7
5-Oct	8.20	0	0	6	0	42	3	**2**	0	0	0	1	0	5	0	1	0	16	6	1	1	0	0	1	0	1	86	10.5
6-Oct	7.70	0	0	4	1	51	4	0	0	0	0	0	0	4	0	0	0	21	1	1	0	0	0	0	0	0	87	11.3
7-Oct	7.50	0	0	2	0	57	12	3	0	0	1	0	0	6	0	2	1	9	1	0	1	2	0	0	0	0	97	12.9
8-Oct	8.50	0	0	6	1	44	2	1	1	0	0	0	0	1	0	1	0	**49**	0	1	0	2	0	0	0	0	109	12.8
9-Oct	8.25	0	0	4	1	20	1	1	0	0	1	0	0	2	0	0	0	24	4	1	1	0	0	0	0	0	60	7.3
10-Oct	4.50	0	0	0	0	16	1	0	0	0	0	0	0	0	0	4	0	10	0	0	0	0	0	0	0	0	31	6.9
15-Oct	4.00	0	0	2	0	0	0	0	0	0	0	0	0	2	0	0	0	6	0	0	0	0	0	0	0	0	10	2.5
Totals	267.6	1	8	65	38	1,548	46	36	26	4	11	**43**	1	30	0	16	15	32	87	**39**	14	17	0	6	2	19	3,088	11.7

Species Code:

TV	Turkey Vulture	SA	Small Accipiter (Unid.)	RL	Rough-legged Hawk	GY	Gyrfalcon
OS	Osprey	LA	Large Accipiter (Unid.)	UB	Unidentified Buteo	UF	Unidentified Falcon
BE	Bald Eagle	UA	Unidentified Accipiter	GE	Golden Eagle	UE	Unidentified Eagle
NH	Northern Harrier	BW	Broad-winged Hawk	AK	American Kestrel	UU	Unidentified Raptor
SS	Sharp-shinned Hawk	SW	Swainson's Hawk	ML	Merlin		
CH	Cooper's Hawk	RT	Red-tailed Hawk	PG	Peregrine Falcon		
NG	Northern Goshawk	FH	Ferruginous Hawk	PR	Prairie Falcon		