RAPTOR MIGRATION AT GUNSIGHT MOUNTAIN, ALASKA: 2003 – 2015

Report prepared for:

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HAWKWATCH INTERNATIONAL

Conserving Raptors and Our Shared Environment

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Background

Every spring, thousands of migrating raptors pass by Gunsight Mountain in south-central Alaska on their way back to their summer breeding grounds. Gunsight Mountain lies in the Tahneta Pass between the Chugach and Talkeetna Mountain ranges, 120 miles northeast of Anchorage and 70 miles from Palmer along the Glenn Highway. These two mountain ranges act as a natural funnel, channeling migrating raptors through the Tahneta Pass where they can be easily counted by biologists on the ground. Gunsight Mountain has been known as a good location to see migrating spring raptors since the 1970s with sporadic and informal counts being conducted by Bob Dittrich and Ted Swem. Paul and Cecily Fritz voluntarily counted migrating raptors at Gunsight during the 2003 – 2009 spring seasons; however coverage was inconsistent and skewed towards the month of April. No consistent or standardized full-season migration data has ever been collected at Gunsight to accurately assess the population size and trends of raptors seen passing through the site.

There are currently no formal sites monitoring raptor migration in Alaska or northwest Canada. In addition, northern raptor populations are logistically difficult and expensive to study on their breeding grounds. Counting migrating raptors at Gunsight Mountain in south-central Alaska would be a relatively cheap and easy way to assess the population status of several species that breed in Alaska including the: Golden Eagle (*Aquila chrysaetos*), Rough-legged Hawk (*Buteo lagopus*), Northern Harrier (*Circus cyaneus*), Red-tailed (Harlan's) Hawk (*Buteo jamaicensis harlani*), and Sharp-shinned Hawk (*Accipiter striatus*) among a few others.

Methods

Historical Surveys – Paul and Cecily Fritz, and several volunteers conducted periodic spring migration monitoring at Gunsight Mountain from 2003 – 2009, and 2012. Daily and total survey coverage varied across years but was generally best from 2003 – 2009 (Table 2) when an average of 23.6 days and 121.3 hours was surveyed annually. Daily raptor totals for each species were recorded in all years, except 2008 when hourly raptor and weather observations were recorded (hawkcount.org).

Surveys before April 1st were generally conducted at the milepost 121 pullout along the Glenn Highway to view migrating Golden Eagles along the Syncline Mountains to the northwest. Surveys after April 1st were conducted at milepost 120, and then switching to milepost 118.8 as the Golden Eagle flight became minimal along the Syncline Mountains (P. Fritz personal communication). The Syncline Mountains are not visible from the 118.8 pullout, but can be seen from milepost 120 and 121 (Figure 1).

2015 Surveys – HawkWatch International (HWI) conducted 14-days of full-time spring migration monitoring at Gunsight Mountain between April 6th and April 19th, 2015. Surveys were lead by an experienced hawkwatcher (Neil Paprocki) with multiple seasons of hawk counting experience. Additional survey effort was provided by volunteers from the Anchorage Audubon Society and Mat-Su Birders with a wide range of experience.

We conducted surveys following established HWI migration protocols. The lead observer, using 8x42 binoculars, conducted east and west vertical binocular scans, slowly moving ahead against the prevailing flight direction (south) until finishing a scan looking north. Binocular scans were followed immediately by naked-eye scans before conducting another binocular scan. Scans were conducted in both east and west directions moving northwards as weather conditions (namely wind direction) affected the daily flight path of migrants. Binocular and naked-eye scans were also directed overhead, especially on days with light winds, little cloud cover, and lots of sun as migrants tended to be scattered, high, and difficult to see. We also used a 30x spotting scope to view and identify distant raptors when necessary.

Daily counts began between 8:00 and 10:15 AKST and concluded between 17:35 and 19:40 AKST. Total count effort was 127.92 hours (Table 1) with daily effort ranging from 7.67 - 10.33 hours depending on weather and flight conditions. All qualified observer start and end times were recorded throughout the day. Migrant raptors were observed, identified to species (and age/morph when possible) and tallied into 1-hour time intervals (e.g. 10:00 - 11:00 AKST). Local raptors were not counted and were differentiated from migrants when possible based on behavior (e.g. territorial displays, etc.) and unique plumage (e.g. missing feathers).

The following weather, visitor, and flight information was recorded every hour on the half-hour (e.g. 9:30, 10:30, etc.): number of observers, visitor disturbance level, minutes of observation, Hawk Migration Association of North America (HMANA) flight altitude code, horizontal direction of flight, HWI flight distance code, time of weather observation, sky condition (cloud cover, precipitation), cloud cover type, thermal lift rating, average and maximum wind velocity (km/hour), temperature (degrees Celsius), barometric pressure (in HG), and east and west visibility (km).

The vast majority of counting (123.25 of 127.92 hours) was conducted at the milepost 118.8 pullout along the Glenn Highway (Figure 1). The following count efforts (4.67 hours) were made at other viewpoints: 2 hours at the milepost 120 pullout, 1.67 hours at the Alascom Tower, and 1 hour at the milepost 121 pullout. Concurrent with the 127.92 hours of total observation, I received 394 hours of observation support from 58 different volunteer observers (Table 1).

Data Analysis – Total observation hours for each season was the total amount of time spent counting, irrespective of the number of observers (e.g. 127.92 hours in 2015). Yearly indices for each raptor species were computed by dividing the total number of migrants by the total observation hours for the season, and then multiplying by 10 (raptors per 10-hours). I used data from 2003 – 2015 to analyze the overall timing of migration by species by computing average birds per 10-hours over 5-day windows. Using 5-day instead of 1-day averages dampened the effect of day-to-day flight variation. All the daily counts and observation hours within each 5-day window were summed and used to calculate a 5-day "birds per 10-hour" index for each species to create species-specific migration timing bar plots (Figures 3 – 9).

I used 5-day indices and migratory timing to create total yearly passage projections for the seven most common species counted at Gunsight Mountain. I multiplied each 5-day index by 40 hours of total observation (assuming 8 hours per day) and then divided by 10 to calculate a total number of 'birds counted' during the 5-day window. For example, the 5-day Golden Eagle index from March 22 – 26 was 137.5 birds per 10-hours. Therefore the total passage projection from March 22 – 26 was 550.2 birds. All 5-day passage projections were summed to create a yearly passage projection, rounded to the nearest integer. The full migratory passage for several species has not been captured by historic counts (namely Golden Eagles, Northern Harriers, and Sharp-shinned Hawks); therefore several assumptions were made concerning projections for these species. Early Golden Eagle passage, for example, has likely not been well documented. In this case we assumed a normal distribution and used the 5-day indices after the 'peak' from March 27 – 31 and April 1 – 5 as our 5-day indices before the 'peak' from March 12 – 16 and March 17 – 21. Based on personal communication with S. Lewis and T. Booms, we assumed little Golden Eagle migration before March 12. Similar projections were made for Northern Harriers and Sharp-shinned Hawks, however I assumed historic observations missed late passage for these two species.

Results

I observed 1,367 migrating raptors over 14-days and 127.9 observation hours from April 6th to 19th, 2015. The most common raptors observed were (in order of abundance) Red-tailed Hawk (mostly subspecies *harlani*), Rough-legged Hawk, Golden Eagle, Bald Eagle (*Haliaeetus leucocephalus*), Northern Harrier, Northern Goshawk (*Accipiter gentilis*), Sharp-shinned Hawk, Merlin (*Falco columbarius*), and Peregrine Falcon (*Falco peregrinus;* Table 1).

The peak of migration across all species from 2003 – 2015 at Gunsight Mountain occurred between the dates of April 11 – 25 (Figure 2). However, migratory timing varied by species (Figures 3 – 9). Golden Eagles are the earliest spring migrants (Figure 3), followed by Bald Eagles (Figure 4), Northern Goshawks (Figure 5) , Red-tailed Hawks (Figure 6), and Rough-legged

Hawks (Figure 7). Northern Harriers (Figure 8) and Sharp-shinned Hawks (Figure 9) are later migrants at Gunsight. Assuming a normal distribution for migration passage, migratory timing graphs also indicate counts-to-date have missed early Golden Eagle passage and late Northern Harrier and Sharp-shinned Hawk passage. Based on species timing plots from 2003 to 2015, I was present for the peak flight of Red-tailed Hawk, Rough-legged Hawk, Bald Eagle, and Northern Goshawk passage in 2015. Based on these same plots, the April 6 – 19, 2015 surveys missed the bulk of the Golden Eagle (earlier), Northern Harrier (later), and Sharp-shinned Hawk (later) flight.

Annual indices (raptors per 10-hour) varied by species and year from 2003 – 2015. Red-tailed Hawks had the highest index in nearly all years (Table 3). Between years, 2006 indices were higher for nearly all species. I compared the 2015 annual index to the 2003 – 2009 average index for four species whose peak migratory timing roughly coincided with the 2015 observation period (Red-tailed Hawk, Rough-legged Hawk, Bald Eagle, Northern Goshawk; Figure 10). I did not include 2012 annual indices in this comparison because of minimal survey coverage (6 days and 30.5 observation hours; Table 2). I did not compare annual indices for those species whose peak migration timing was not counted in 2015 because of inadequate survey coverage. Qualitatively speaking, Red-tailed Hawk and Bald Eagle indices were higher in 2015 than the historical average, while the Rough-legged Hawk 2015 index was lower than the historical average. The Northern Goshawk annual index in 2015 was similar to the historical average (Figure 10).

Yearly passage projections based on incomplete 2003 – 2015 data also varied by species (Table 4), but must be viewed as highly rough estimates of annual passage (see Conclusions for more on limitations). The most abundant species projected to pass by Gunsight Mountain each spring are, in order of abundance: Golden Eagle, Red-tailed Hawk, Rough-legged Hawk, Northern Harrier, Sharp-shinned Hawk, Bald Eagle, and Northern Goshawk.

Conclusions, Limitations and Recommended Follow-up Work

First it must be said that all of these results are based on incomplete coverage comprising varying survey effort and coverage dates among and within years. None of these results are meant to be definitive, and are merely descriptive in nature. Even with 2-weeks of full-time coverage in 2015, only a fraction of the migratory window for most raptor species was captured. This result by itself highlights the need for a full season of hawk counting at Gunsight Mountain.

Golden Eagles – The average Golden Eagle index at Gunsight Mountain from 2003 – 2015 between the observed bulk passage dates of March 22 to May 5 was calculated as 38.9 Golden

Eagles per 10-hours. In comparison, Golden Eagle indices at HawkWatch International's top two eagle count sites were 41.4 (Bridger Mountains, Montana; autumn) and 6.3 (Sandia Mountains, New Mexico; spring) Golden Eagles per 10-hours. The Gunsight index may likely be a low estimate as the early eagle migration has been missed by observers with no counts conducted before March 22 (see Figure 3). The average passage at our Bridger Mountains, Montana site is 1,350 Golden Eagles, and the projected estimate of passage at Gunsight Mountain is 1,983 Golden Eagles.

It must be emphasized that this is a speculative estimate as there is little information on early eagle passage at Gunsight, and the estimate was derived by making some major assumptions whose validity is unknown. The passage information we do have on Golden Eagles, particularly during peak migration in March, is derived from very few days of observations (*n* = 28 in March over 8 years). Data is also biased towards those days when high numbers of Golden Eagles were counted. Observers tended to stay longer during high-count days, whereas they would observe for fewer hours during low-count days. This may have artificially inflated the peak passage rate (137.5 birds per 10-hours from March 22-26) of Golden Eagles, as well as our yearly passage projection of 1,983 eagles. All of this is to say we still know very little about the actual number of Golden Eagles that migrate past Gunsight Mountain every spring, and a full documentation of the Golden Eagle passage in March and early April at Gunsight Mountain is much needed. With these limitations in mind, Gunsight Mountain has the potential to be a high volume site for Golden Eagles, and is an important spring migratory flyway for individuals returning to Alaska. For these reasons, annual spring migration counts at Gunsight may be a relatively easy and inexpensive way to assess Golden Eagle population trends for those breeding areas accessed through the Tahneta Pass.

Red-tailed & Rough-legged Hawks – Peak passage for the two Buteo species counted at Gunsight Mountain is mid-April, which is when the bulk of migration counts at the site have occurred, giving us a better understanding of Buteo passage than any other group of raptors. The vast majority of Red-tailed Hawks that pass by Gunsight Mountain each spring are of the subspecies *harlani* found breeding in Alaska and northwest Canada. No other migration site in the world counts as many Harlan's Red-tailed Hawks as Gunsight Mountain does, making it an incredibly unique site where our estimates project a yearly passage total of 1,696 birds.

The number of Rough-legged Hawks counted at Gunsight Mountain (projected at 637 per year) would immediately add to our understanding of this understudied species. Rough-legged Hawks are counted in considerable numbers at a few Midwest and Eastern North American migration sites including Hawk Ridge, Minnesota (autumn avg. = 369), Whitefish Point, Michigan (spring avg. = 706), Braddock Bay, New York (spring avg. = 346), and Derby Hill, New

York (spring avg. = 295). However, there are no western North American migration sites we are aware of that count more than 100 Rough-legged Hawks annually. Peak passage has been well documented for both Red-tailed and Rough-legged Hawks, however considerably more counting should occur during the month of May to document later adult and immature passage. A total of 9 days in 9 years have been counted during the month of May at Gunsight Mountain, and even though passage likely declines during this month, a full documentation of the spring passage into May is warranted.

Northern Harriers – The Northern Harrier is another species that is poorly represented at most western North American migration sites, and the projected passage total of 602 harriers at Gunsight Mountain each spring would again add to our understanding of this species in Alaska. Anecdotal accounts from several experienced hawkwatchers at Gunsight suggest the number of Northern Harriers seen on migration has declined in recent years. Furthermore, migration timing graphs suggest the tail end of harrier passage in May has not been fully documented. These two points suggest a more complete understanding of Northern Harrier migration at Gunsight Mountain is needed.

Count Site Recommendations – Through personal experience in 2015, and in talking with numerous experienced Gunsight Mountain observers, I would like to make the following count site recommendations for future work at Gunsight:

1) Counts before April 1st should be conducted at the milepost 121 trailhead pullout. March Golden Eagles generally migrate along the Syncline Mountains to the northwest, and would not be visible from the milepost 118.8 pullout. The milepost 120 pullout can see a portion of the Syncline Mountains, but is 1-mile further east, making viewing more distant and identification more difficult. In order to capture the full Golden Eagle passage, I would recommend a March 15th start date *at the latest*. Without knowing the timing of early eagle passage however, I would recommend an earlier start date of March 7th until the timing of Golden Eagle migration is fully understood.

2) The bulk of counts after April 1st should be conducted at the milepost 120 pullout as this is the best place to view the full passage of all other raptor species flying along the ridge leading up to Gunsight Mountain, and over the valley to the east. Milepost 118.8 is a better site for visitors as the pullout is larger, but milepost 120 is the better observation site, and is recommended as the standard count site after April 1st. Some raptors at milepost 118.8 can be missed if they are flying low along or pass west of the ridge leading up to Gunsight Mountain. Counts in early April may be the most challenging time to 'pick' the appropriate count site however, as Golden Eagle passage can still occur along the Syncline Mountains, but Buteo

passage is also beginning. As previously mentioned, Golden Eagle passage along the Synclines can still be viewed from milepost 120, but is more difficult. If two observers were present in early April, I might recommend putting one at milepost 121 to solely count Golden Eagles over the Synclines and one at milepost 120 to count all other migrants. This might continue for a week or so until Golden Eagle passage along the Synclines slowed or stopped at which point both observers would count from milepost 120 for the remainder of the season.

Acknowledgements

None of this work would have been possible without the intrepid early observations conducted at Gunsight Mountain by Bob Dittrich, Ted Swem, and others. Paul and Cecily Fritz carried the torch of hawkwatching at Gunsight Mountain during the 2000s, and greatly inspired the local bird watching communities in Anchorage and Palmer to become more involved in counting at Gunsight. Their article on "The Hawks of Gunsight Mountain, Alaska" in a 2011 issue of Birding Magazine initially introduced me to the site during the summer of 2014. I am indebted to all of these people for discovering the site, conducting historic migration counts, and for rallying local community support.

Spring migration counts in 2015 would not have been possible without the generous financial support from the U.S. Fish & Wildlife Service and the Anchorage Audubon Society. Two special thanks within these organizations need to be extended to Steve Lewis (USFWS) and White Keys (Anchorage Audubon). White Keys of Anchorage Audubon deserves particular recognition as he helped organizing and coordinate volunteer observers during this 2-week count. A huge thank you must also be extended to all of the 58 volunteer observers who assisting in this count effort. A final thank you must also be extended to all the local birders from the Anchorage Audubon Society and Mat-Su Birders who attended the annual Hawk Watching Weekend at Gunsight on April 18th and 19th. Travis Booms (Alaska Fish & Game) also provided guidance, encouragement, and critical logistical support in the field.

Figure 1. Major observation sites (Mile 118.8, 120, and 121), topographic features, and flight lines for spring migrating raptors at Gunsight Mountain, Alaska. Figure prepared by White Keys, Anchorage Audubon Society.

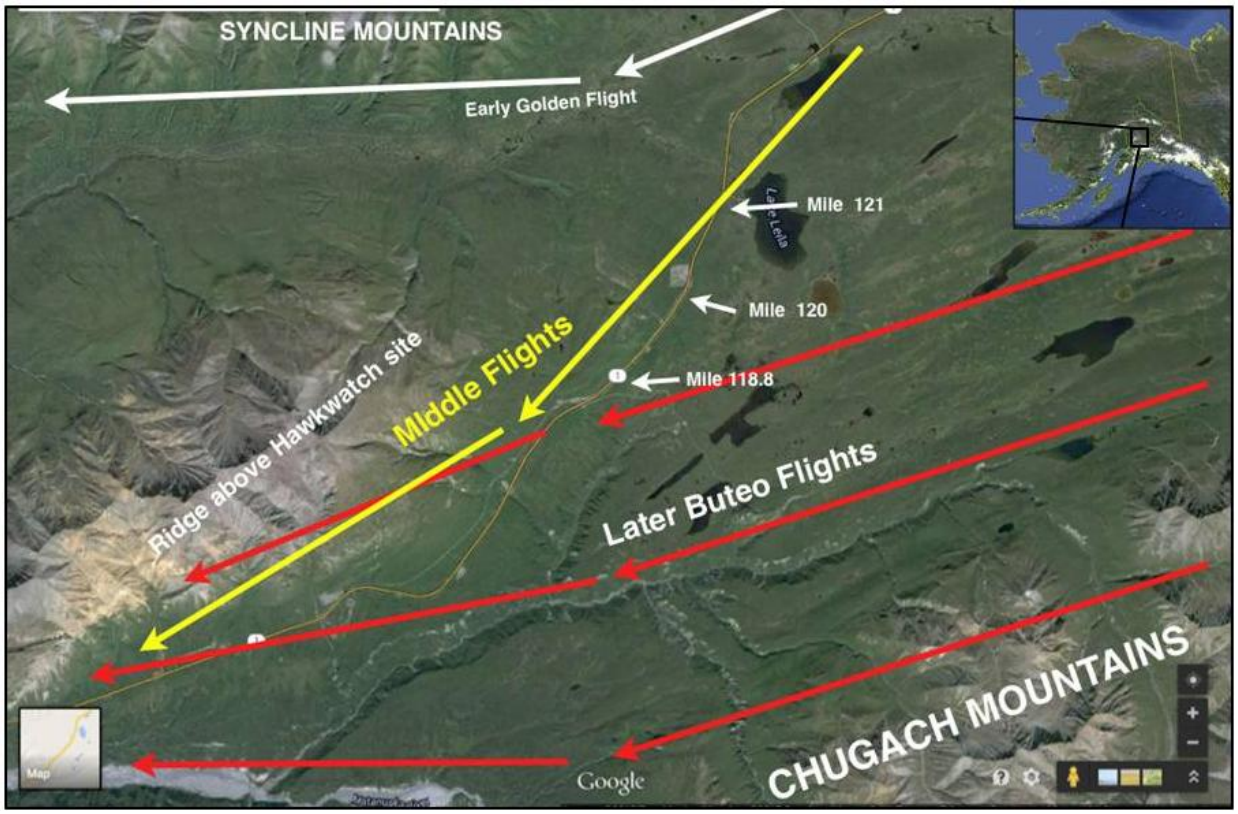

Figure 2. Raptor observations per 10-hours for all species within 5-day windows from March 22 to May 20 for spring migration counts conducted at Gunsight Mountain, Alaska from 2003 – 2015. Bar labels represent the total number of survey days within each 5-day window. The time period surveyed during 2015 is bracketed in red.

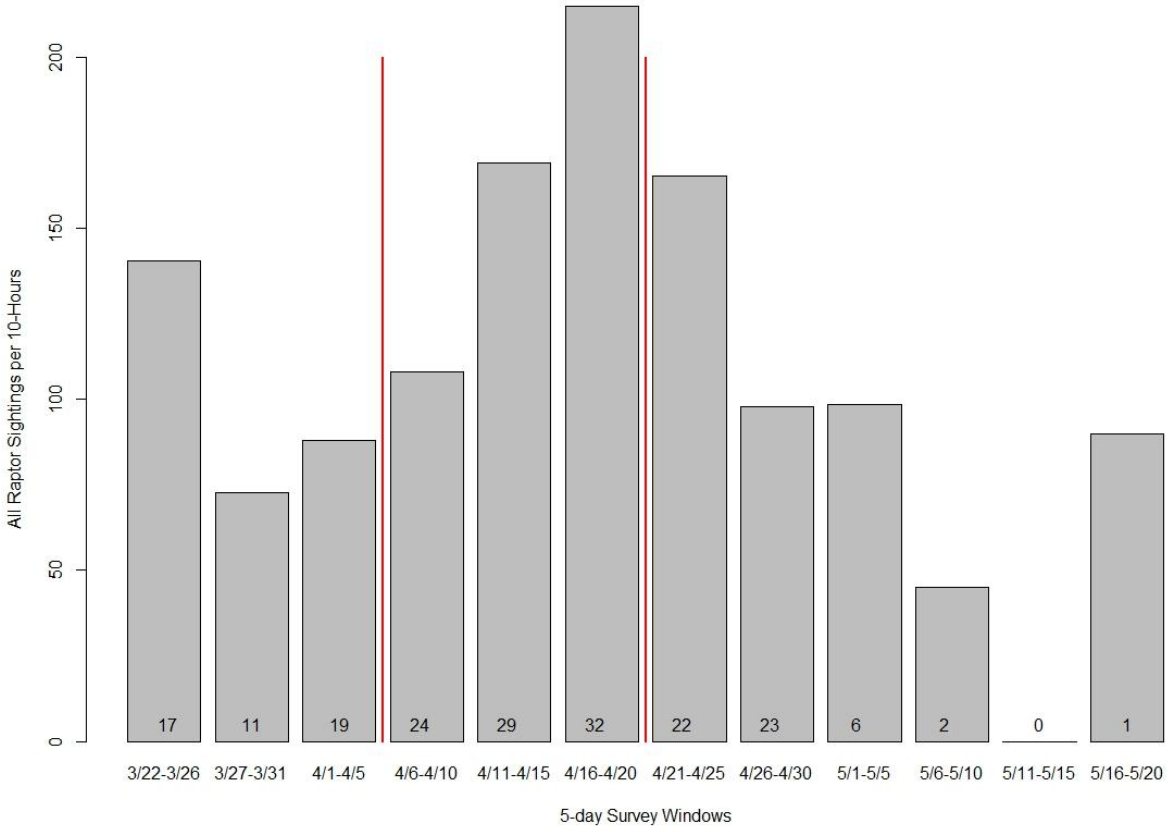

Figure 3. Golden Eagle observations per 10-hours within 5-day windows from March 22 to May 20 for spring migration counts conducted at Gunsight Mountain, Alaska from 2003 – 2015. Bar labels represent the total number of survey days within each 5-day window. The time period surveyed during 2015 is bracketed in red.

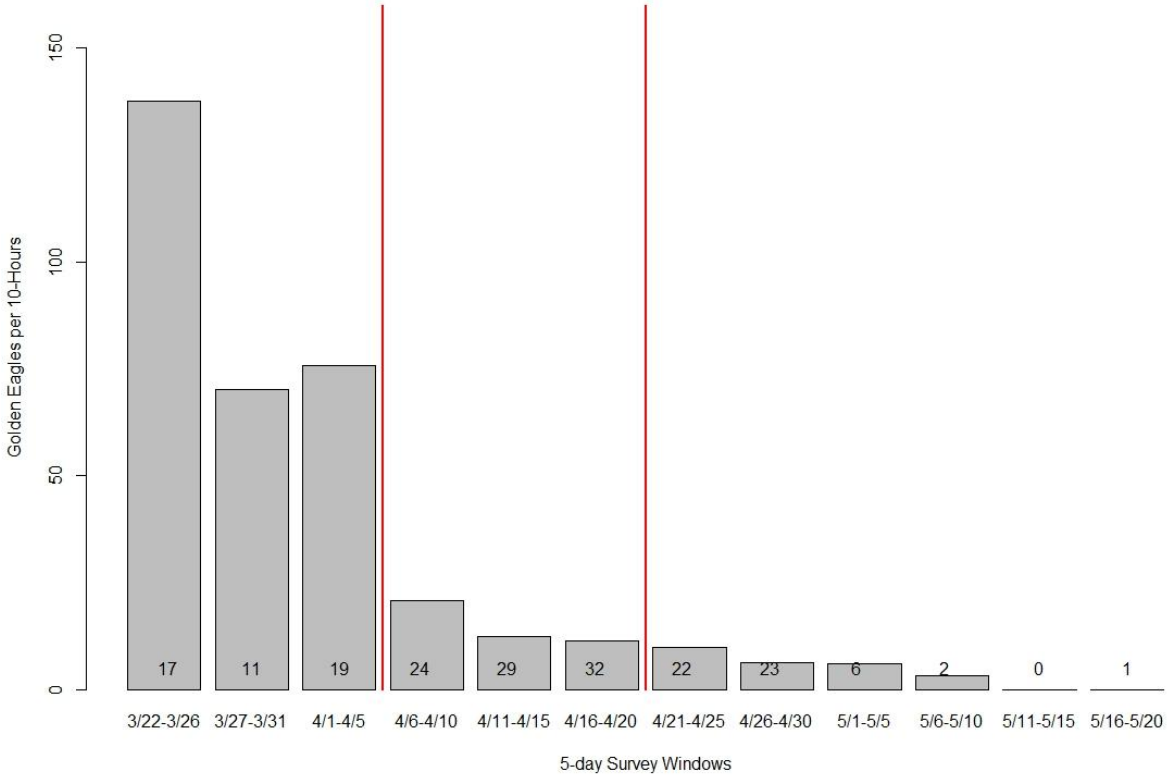

Figure 4. Bald Eagle observations per 10-hours within 5-day windows from March 22 to May 20 for spring migration counts conducted at Gunsight Mountain, Alaska from 2003 – 2015. Bar labels represent the total number of survey days within each 5-day window. The time period surveyed during 2015 is bracketed in red.

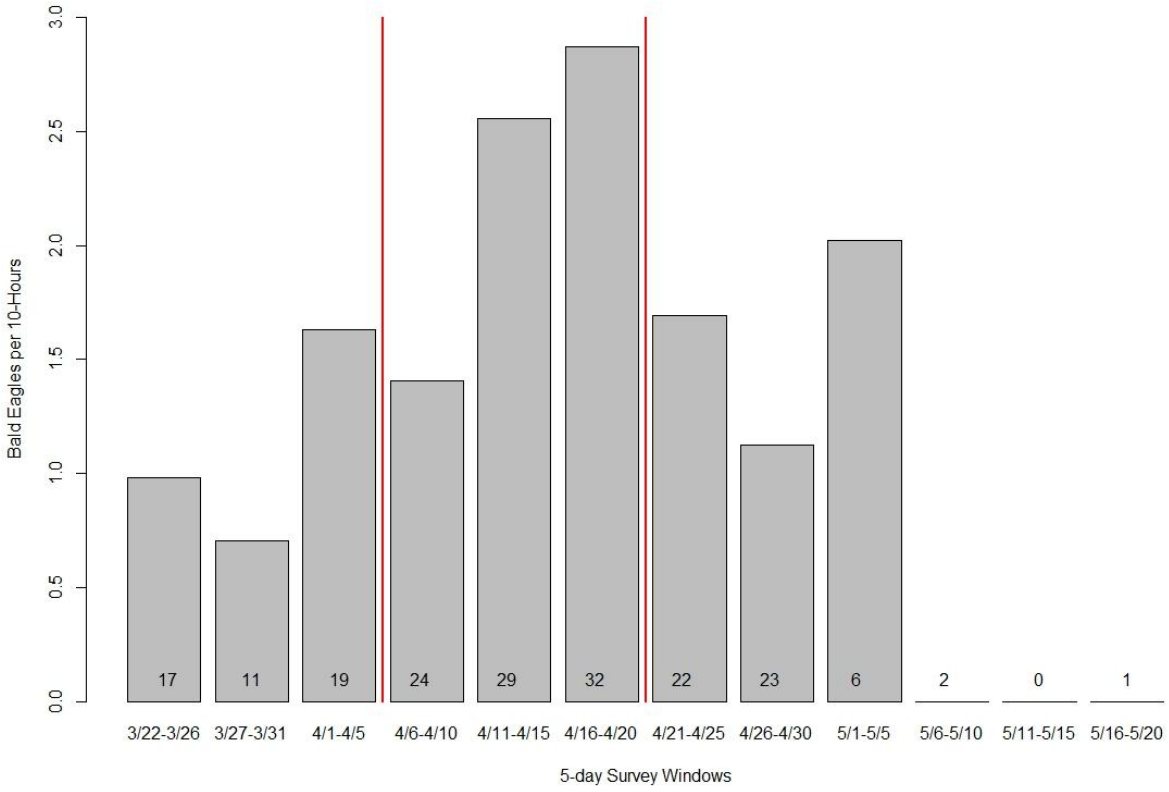

Figure 5. Northern Goshawk observations per 10-hours within 5-day windows from March 22 to May 20 for spring migration counts conducted at Gunsight Mountain, Alaska from 2003 – 2015. Bar labels represent the total number of survey days within each 5-day window. The time period surveyed during 2015 is bracketed in red.

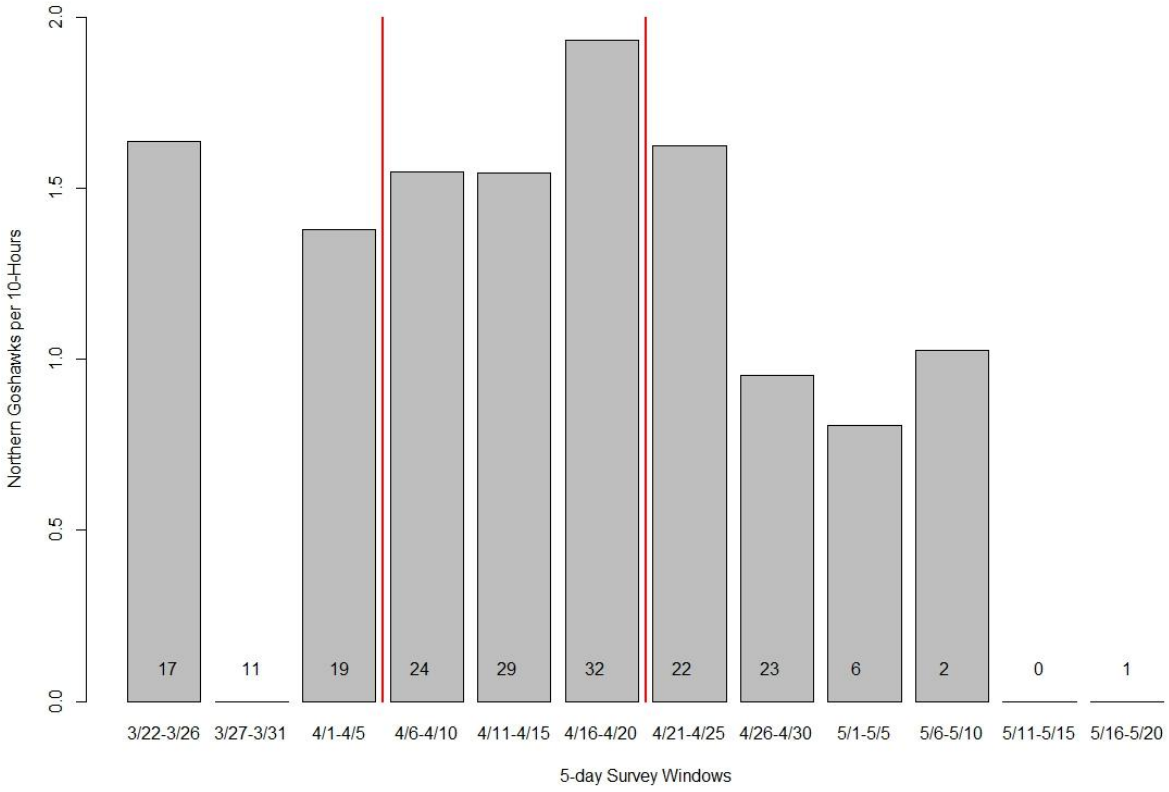

Figure 6. Red-tailed Hawk observations per 10-hours within 5-day windows from March 22 to May 20 for spring migration counts conducted at Gunsight Mountain, Alaska from 2003 – 2015. Bar labels represent the total number of survey days within each 5-day window. The time period surveyed during 2015 is bracketed in red.

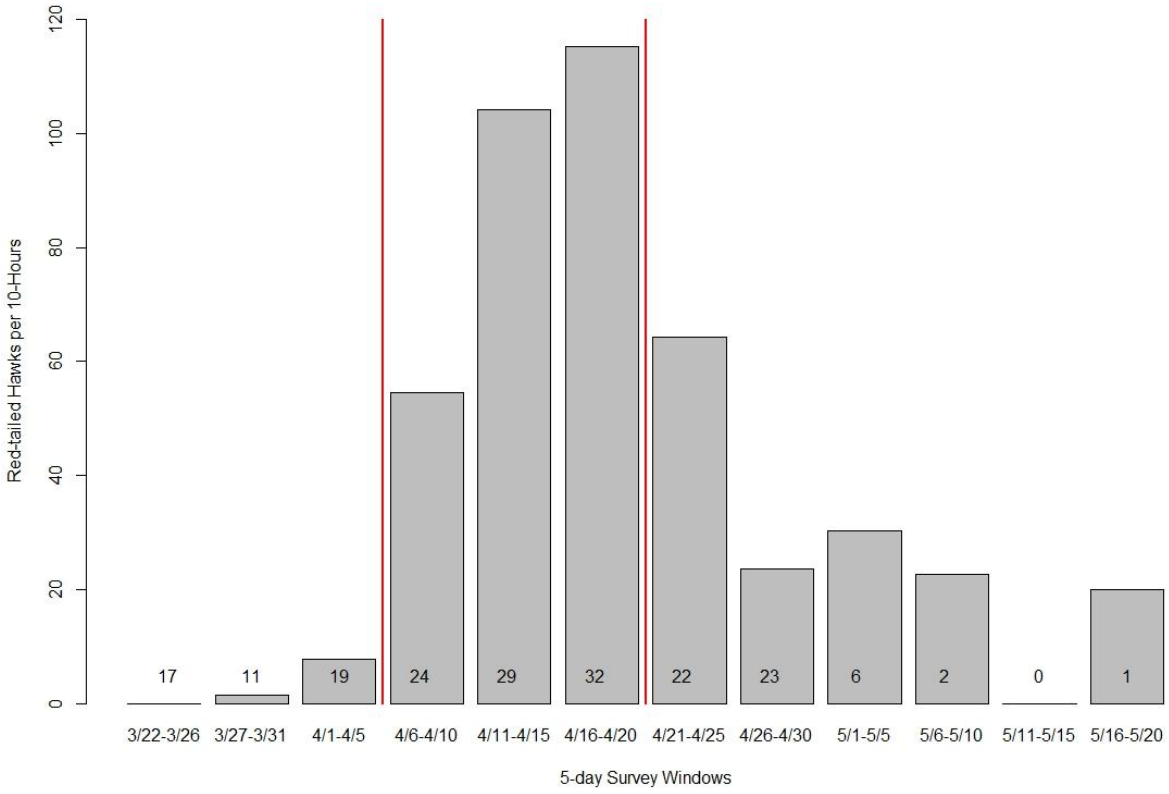

Figure 7. Rough-legged Hawk observations per 10-hours within 5-day windows from March 22 to May 20 for spring migration counts conducted at Gunsight Mountain, Alaska from 2003 – 2015. Bar labels represent the total number of survey days within each 5-day window. The time period surveyed during 2015 is bracketed in red.

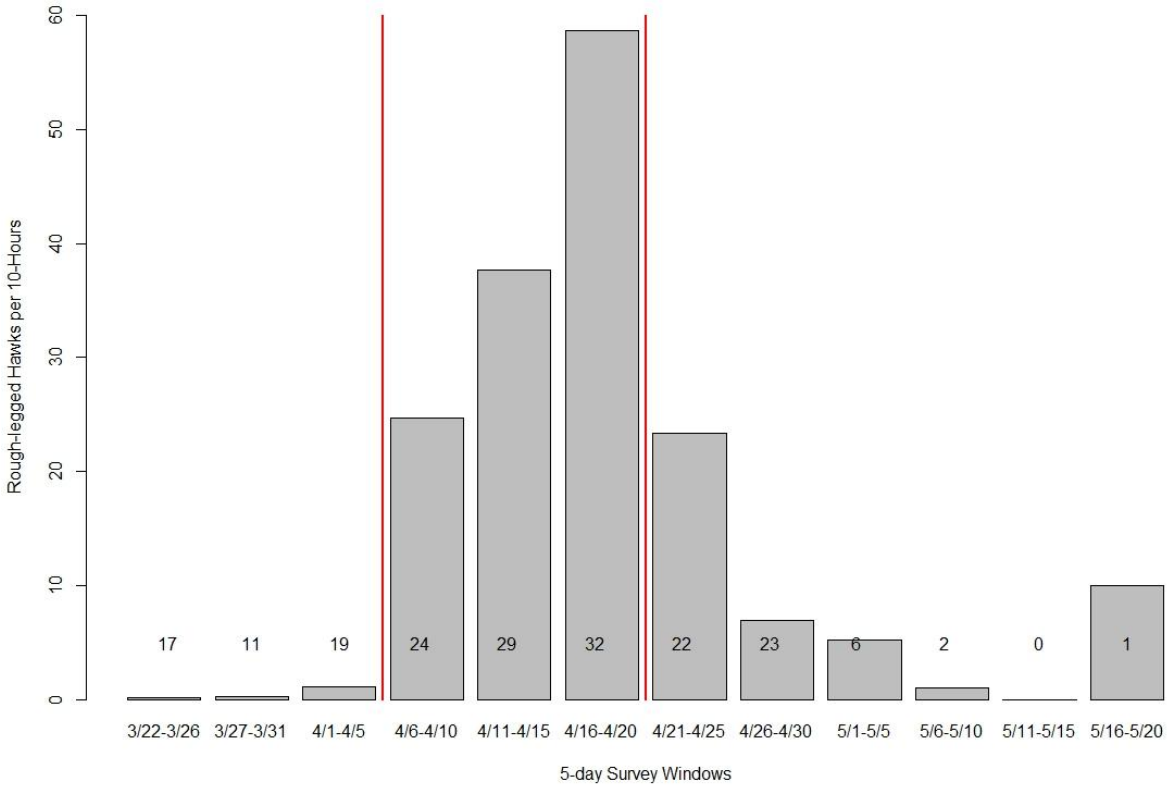

Figure 8. Northern Harrier observations per 10-hours within 5-day windows from March 22 to May 20 for spring migration counts conducted at Gunsight Mountain, Alaska from 2003 – 2015. Bar labels represent the total number of survey days within each 5-day window. The time period surveyed during 2015 is bracketed in red.

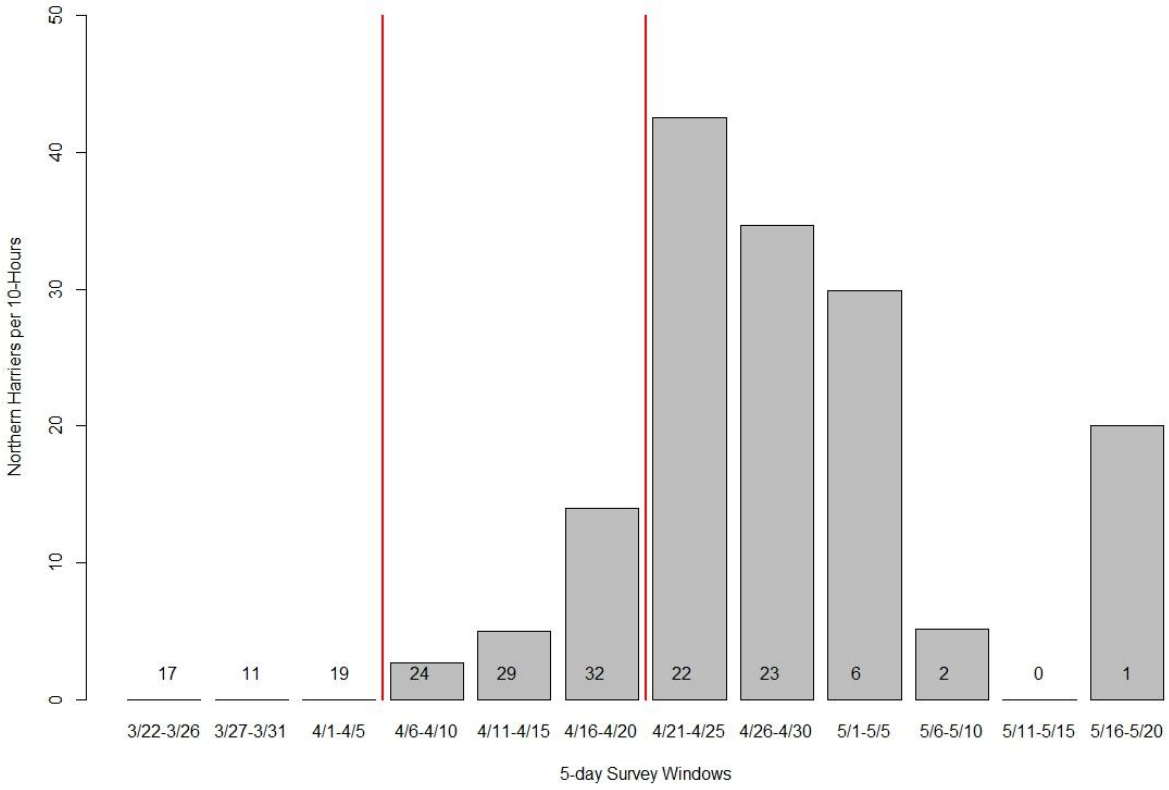

Figure 9. Sharp-shinned Hawk observations per 10-hours within 5-day windows from March 22 to May 20 for spring migration counts conducted at Gunsight Mountain, Alaska from 2003 – 2015. Bar labels represent the total number of survey days within each 5-day window. The time period surveyed during 2015 is bracketed in red.

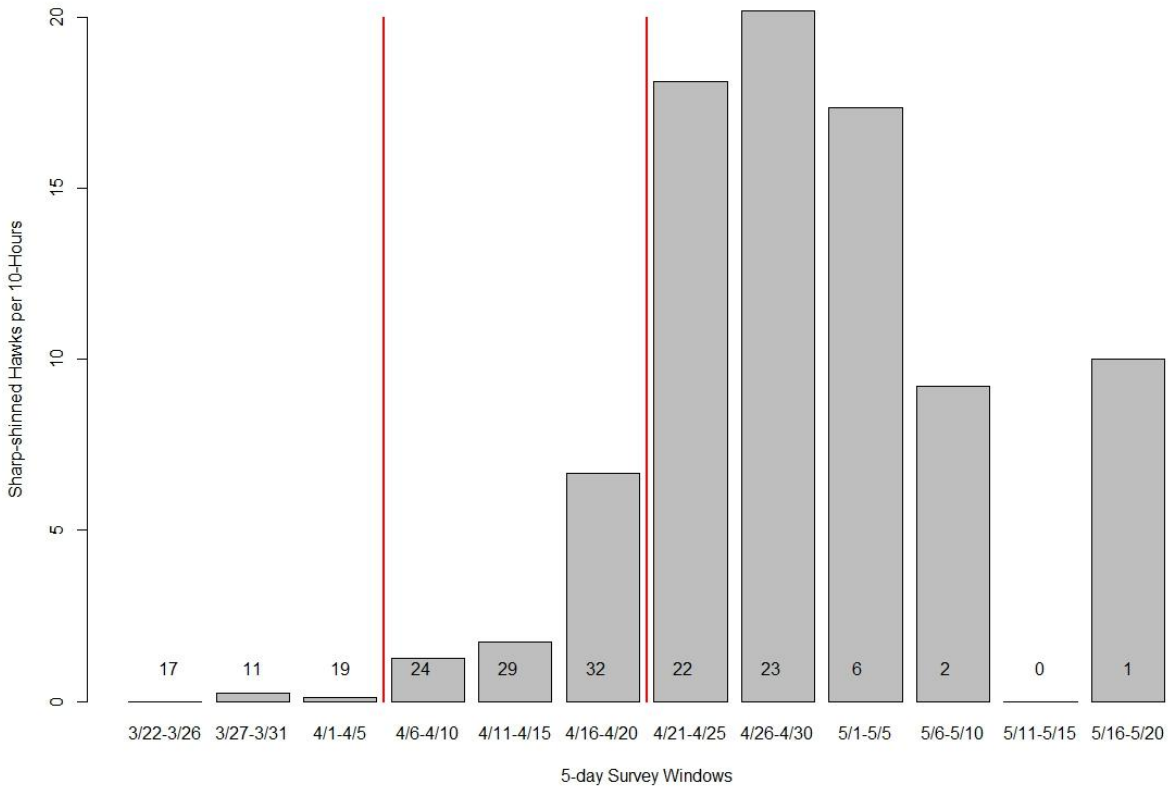

Figure 10. Average annual indices (raptors per 10-hours) with 95% confidence intervals from 2003 – 2009 and 2015 for Red-tailed Hawk, Rough-legged Hawk, Bald Eagle, and Northern Goshawk spring migration counts conducted at Gunsight Mountain, Alaska.

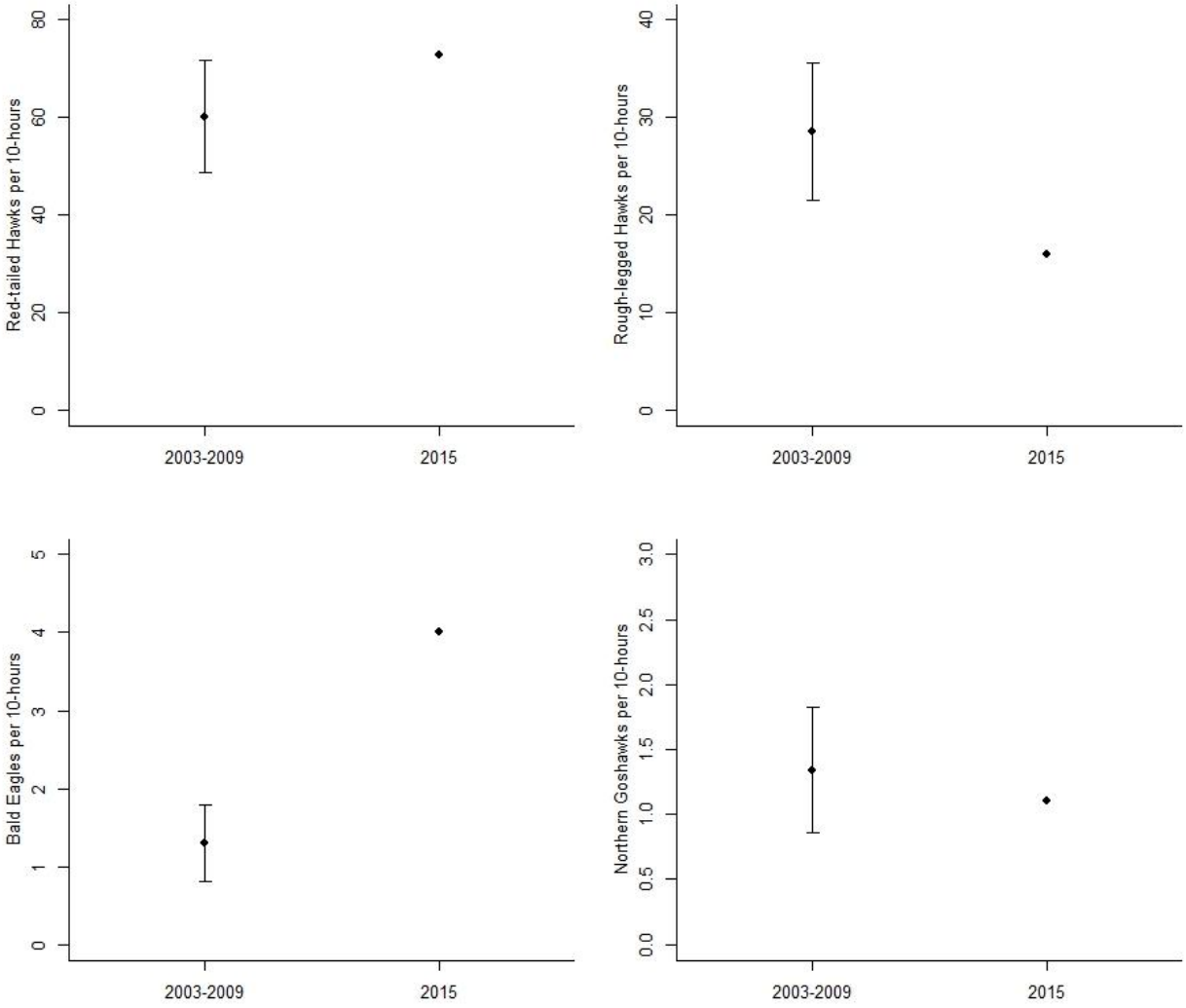

Table 1. Raptor observations, survey effort, and volunteer effort for spring raptor migration counts conducted at Gunsight Mountain, Alaska from April 6 - April 19, 2015.

Species	Total Observations
Red-tailed Hawk	931
Rough-legged Hawk	204
Golden Eagle	88
Bald Eagle	51
Northern Harrier	46
Northern Goshawk	14
Sharp-shinned Hawk	13
Merlin	2
Peregrine Falcon	1
Unknown Buteo	16
Unknown Raptor	1
Total Raptors	1367
Days of Observation	14
Raptors per Day	97.6
Hours of Observation	127.9
Raptors per Hour	10.7
Number of Volunteer Observers	58
Volunteer Observation Hours	394
Volunteer Travel Hours	234
Total Volunteer Hours	628

Table 2. Spring raptor migration counts by species, observation days, and observation hours from Gunsight Mountain, Alaska from 2003 – 2015. RT – Red-tailed Hawk; RL – Rough-legged Hawk; GE – Golden Eagle; BE – Bald Eagle; NH – Northern Harrier; NG – Northern Goshawk; SS – Sharp-shinned Hawk; ML – Merlin; PG – Peregrine Falcon; OS – Osprey; GY – Gyrfalcon; UB – Unknown Buteo; UF – Unknown Falcon; UR – Unknown Raptor; SE – Short-eared Owl; SW – Swainson's Hawk.

Year	Obs. Days	Obs. Hours	RT	RL	GE	BE	NH	NG	SS	ML	PG	OS	GY	UB	UF	UR	SE	SW	Total
2003	23	99.0	461	265	269	14	150	15	63	8	2	0	0	36	1	3	1	0	1291
2004	22	105.0	452	219	127	20	159	5	119	12	3	0	0	0	0	35	0	1	1155
2005	22	96.8	625	357	252	9	293	13	137	20	6	0	0	2	0	2	0	0	1717
2006	17	80.3	666	368	462	10	493	9	227	18	3	7	1	0	0	0	0	1	2267
2007	22	119.0	663	310	395	4	196	22	93	5	2	2	0	16	0	34	0	0	1749
2008	28	137.5	1078	285	421	15	52	17	33	5	1	1	1	11	0	0	0	0	1920
2009	31	211.6	1059	479	492	48	94	43	38	7	4	0	0	0	0	7	0	0	2272
2012	6	30.5	68	11	178	9	2	4	1	0	0	0	0	0	0	0	0	0	273
2015	14	127.9	931	204	88	51	46	14	13	2	1	0	0	16	0	1	0	0	1367

Table 3. Yearly spring raptor migration indices (birds per 10-hours) and observation hours from Gunsight Mountain, Alaska from 2003 – 2015.

Year	Obs. Hours	RT/10-hr	RL/10-hr	GE/10-hr	BE/10-hr	NH/10-hr	NG/10-hr	SS/10-hr	ML/10-hr	PG/10-hr	Total/10-hr
2003	99.0	46.6	26.8	27.2	1.4	15.2	1.5	6.4	0.8	0.2	130.4
2004	105.0	43.0	20.9	12.1	1.9	15.1	0.5	11.3	1.1	0.3	110.0
2005	96.8	64.6	36.9	26.0	0.9	30.3	1.3	14.2	2.1	0.6	177.5
2006	80.3	83.0	45.9	57.6	1.2	61.4	1.1	28.3	2.2	0.4	282.5
2007	119.0	55.7	26.1	33.2	0.3	16.5	1.8	7.8	0.4	0.2	147.0
2008	137.5	78.4	20.7	30.6	1.1	3.8	1.2	2.4	0.4	0.1	139.6
2009	211.6	50.0	22.6	23.3	2.3	4.4	2.0	1.8	0.3	0.2	107.4
2012	30.5	22.3	3.6	58.4	3.0	0.7	1.3	0.3	0.0	0.0	89.5
2015	127.9	72.8	15.9	6.9	4.0	3.6	1.1	1.0	0.2	0.1	106.9

Table 4. The projected yearly passage for seven species at Gunsight Mountain, Alaska based on count data from 2003 – 2015.

Species	Yearly Passage
Golden Eagle	1983
Red-tailed Hawk	1696
Rough-legged Hawk	637
Northern Harrier	602
Sharp-shinned Hawk	302
Bald Eagle	60
Northern Goshawk	46