

FALL 2016 RAPTOR MIGRATION ANNUAL REPORT: COMMISSARY RIDGE HAWKWATCH, SW WYOMING



**HawkWatch International, Inc.
Salt Lake City, Utah**



August 2017

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INTRODUCTION

The Commissary Ridge HawkWatch in southwest Wyoming is an ongoing effort to monitor long-term regional population trends of diurnal raptors that migrate along the Rocky Mountain Flyway (Hoffman et al. 2002). HawkWatch International (HWI) initiated standardized counts at Commissary Ridge, the first long-term raptor migration site Wyoming in 2002. To date HWI observers have recorded 17 species of migratory raptors at the site, with counts typically ranging between 3,000 and 4,300 migrants per season. The 2016 season marks the 15th consecutive season of counting at Commissary Ridge.

The Commissary Ridge HawkWatch was 1 of 8 long-term, annual raptor migration counts conducted or co-sponsored by HWI in North America during 2016 (Fig. 1). The primary objective of these efforts is to track long-term population trends of diurnal raptors in western North America and around the Texas Gulf Coast region (Hoffman et al. 2002, Hoffman and Smith 2003, Smith et al. 2008a, b). Raptors can serve as important biological indicators of ecosystem health (Bildstein 2001) and long-term migration counts can be a very cost effective and efficient method for monitoring the regional status and trends of multiple raptor species (Zalles and Bildstein 2000, Bildstein et al. 2008).

Beyond having scientific and conservation value, each site in HWI's migration network offers unique opportunities for the public to learn about raptors and the natural environment. Providing such opportunities is another important component of the Commissary Ridge HawkWatch and outreach efforts here reach people from western Wyoming, eastern Utah, northwestern Colorado, and beyond each season.

STUDY SITE

The study site is located atop the southern end of Commissary Ridge on the southwestern tip of South Fork Mountain about 37 km north of Kemmerer, Wyoming, on land managed by the Bureau of Land Management, Kemmerer Field Office (Fig. 2). The site is accessed from Hwy 233 just northeast of Lake Viva Naughton, and is located on the western edge of a broad ridgetop overlooking the Ham's Fork River Valley and Lake Viva Naughton to the west (42°01'29"N 110°35'22"W; T24 R116 S28 SESW; elevation ~2,700 m). The location provides an unobstructed 360° view of the surrounding landscape. The ridgetop and immediate landscape consists of rocky substrates and low growing desert shrubs and grasses, with scattered stands of mixed-conifer and aspen in sheltered pockets and ravines.

METHODS

STANDARDIZED COUNT

Weather permitting; two designated observers conduct standardized daily counts of migrating raptors from late August through late October. Observations typically begin between 0800–0900 hrs and end near 1700 hrs Mountain Standard Time (MST).

Data collection follows standardized protocols used at all HWI migration sites (Hoffman and Smith 2003). The observers routinely record the following data:

1. Species, age, sex, and color morph of each migrant raptor, whenever possible and applicable (Appendix B lists common and scientific names for all species, information about the applicability of age, sex, and color morph distinctions, and two-letter codes used to identify species in tables and figures).
2. Hour of passage for each migrant; e.g., the 1000–1059 hrs PST.
3. Wind speed and direction, air temperature, percent cloud cover, predominant cloud type(s), presence of precipitation, visibility, and an assessment of thermal-lift conditions for each hour of observation on the half hour.
4. Predominant direction, altitude, and distance from the lookout of the flight during each hour.

5. Total minutes observed and the mean number of observers present during each hour (included designated observers plus volunteers/visitors who actively contributed to the count [active scanning, pointing out birds, recording data, etc.] for more than 10 minutes in a given hour), recorded on the hour.
6. A subjective visitor-disturbance rating for each hour, recorded on the hour.
7. Daily start and end times for each official observer.

In comparing 2016 counts against means and 95% confidence intervals for previous seasons, we consider a count value falling outside the 95% confidence interval of the historic site means as significantly different. We used linear and quadratic regression on effort-adjusted annual passage rates (raptors/100hrs) to identify long-term trends in migrating raptors.

2016 RESULTS AND DISCUSSION

OBSERVATION EFFORT AND WEATHER SUMMARY

The Commissary Ridge HawkWatch standard season runs 27 August—5 November; in 2016 observers counted during 67 of the 71 possible days during this period for a total of 573.8 hours (Appendix C), weather led to shortened counts (<4hrs) on six days. The number of count days this season was 3 days above the long-term average (2002-2014) and total observation hours were nearly 50 above the long-term average (Appendix C). Weather varies throughout every season, in 2016 based on hourly recording of conditions during observation it was clear 42% of the time; partly cloudy 26 % of the time; mostly cloudy 17% of the time; overcast 20% of the time; and raining or snowing 3% of the time.

2016 FLIGHT SUMMARY

Overall Flight:

The crew counted 4,580 migrating raptors representing 17 species in 2016, a significant ($\alpha = 0.05$) 28% increase compared to the site long-term average (Table 1). Notable to this year's flight were a site record count for Golden Eagles (476), surpassing the site record of 350 set in 2015; and the second highest counts of both Merlins (31) and Northern Harriers (52).

The flight consisted of 47% accipiters, 30% buteos, 16% eagles, 5% falcons, 1% vultures, 1% Northern Harriers, and less than 1 % Ospreys. The relative proportions of accipiters, eagles, and harriers were above average compared to historic counts; while buteos, falcons, vultures, and ospreys made up less of the flight than they typically do (Fig. 3). Sharp-shinned Hawks were the most abundant species (32% of the total), followed by Red-tailed Hawks (26%), Cooper's Hawks (12%), Golden Eagles (10%), Bald Eagles (5%), American Kestrels (4%), Swainson's Hawks (2%), and Turkey Vultures (1%). The remaining species each accounted for 1% or less of the total count (Table 1).

The following sections summarize the 2016 count relative to historic means at the site, and any statistically significant ($p < 0.05$) population trends, based on analyses of linear and/or quadratic regression. HWI reports significant trends for species with a historic average count rate greater than or equal to 10 individuals per 100 hours. The rationale is that trends for counts below this threshold likely do not contain biologically useful information on regional populations—species with counts this low likely have a very dispersed migration, migrate along a different primary route, or large portions of the population that are resident. We do include count information in the reports, as occurrences of rarer species are of interest to both managers and the public, and could represent the beginning of meaningful long-term changes.

Total Flight (Fig.4):

The 798 raptors counted per 100 hours of observation at the Commissary Ridge HawkWatch in 2016 was near the historic average of 752 raptors/100 hrs (Appendix C). Regression analysis suggests that the total flight of raptors at Commissary Ridge has been stable since counts started (no trend indicated, $r^2 = 0.09$, $F = 1.4$, $p = 0.25$).

Vultures, Osprey, and Harriers (Fig. 5a):

Seasonal counts and effort-adjusted passage rates for Turkey Vultures and Ospreys were below average while Northern Harrier count and passage rate were above average for the second straight season (52) (Table 1). All three species are stable based on regression analysis of passage rates (no significant trend).

Accipiters (Fig. 5b):

Total counts were high for Sharp-shinned Hawks and Cooper's Hawks, and average for Northern Goshawks (Table 1). Passage rates were average for both Cooper's Hawks and Northern Goshawks and above average for Sharp-shinned Hawks. Long-term regional population trends for these species based on migration counts are stable (no significant trend based on regression analysis).

Buteoine Hawks (Fig. 5c):

The crew documented total counts and passage rates for Swainson's Hawks, Rough-legged Hawks, Broad-winged Hawks, and Ferruginous Hawks similar to site historic averages (Appendix C). The Red-tailed Hawk count (1183) was above average but the 2016 passage rate (206 birds/100hr) did not differ from the site average of 197 birds/100hr. Regional populations of all buteo species remain stable (no significant trend based on regression analyses).

Eagles (Fig.5d):

The 2016 Golden Eagle count set a new record (476) for the second straight season--worth noting because 2014 tied the record for the lowest count at Commissary Ridge (Table 1). The passage rate for Golden Eagles was also above the historical average. The passage rate for Bald Eagles was consistent with the historic average while the count was above average. Analyses of long-term passage rates indicate that regional populations of both eagle species remain stable (no significant trend based on regression analysis).

Falcons (Fig. 5e):

Prairie Falcon count and passage rate were below average in 2016, while those for Peregrine Falcons were similar to site average. The 31 Merlins (5.4 birds/100hr) counted by the crew in 2016 exceed site averages. The American Kestrel count was consistent with historic averages, but the passage rate in 2016 was low. Regional populations of Kestrels are declining based on fall migration passage rates (slope = -4.2, $r^2 = 0.66$, $p < 0.001$). We see similar declines for Kestrels across the HWI network and at other count sites. In response, HWI, along with many other North American researchers and Citizen Scientists are working to understand American Kestrel declines both locally (www.hawkwatch.org/our-work/kestrels) and at the continental scale and have partnered under the umbrellas of the American Kestrel Partnership (<http://kestrel.peregrinefund.org/>), and the Full Cycle Phenology study (<http://fullcyclephenology.com>).

Site Visitation and Public Outreach

Commissary Ridge is a remote migration site located in rural Wyoming. In 2016, 20 people from Wyoming and Utah visited the site. The crew also continued to make good local acquaintances by visiting

with hunters, ranchers, herdsman, and other locals from nearby Kemmerer, WY. Last, the HWI staff from Salt Lake visited the site for a day of counting.

2016 FALL MIGRATION ACROSS HWI'S NETWORK

HawkWatch International and partners operated 8 fall count sites in 2016 (Fig. 1). During the 4,341 hours of standardized observation, we counted 714,248 migrating birds of prey. The power and utility of HWI's network of fall count sites, and long-term monitoring in general, lies in that it allows identification of patterns in regional raptor populations, both over time at a single site and also network-wide. Declines in counts or passage rates for a species or group of species at the regional level can highlight the need for more focused research or management attention at local scales, while increases may indicate the success of management and conservation efforts. While each site in HWI's network varied in terms of individual species or group counts, notable network-wide patterns in 2016 included (Table 4):

- Below average Kestrel numbers at 5 of 8 sites (no sites w/ above average counts).
- Below average counts for Prairie Falcons and Osprey at 5 of 8 sites and 4 of 8 sites, respectively.
- Above average Merlin counts at 5 of 8 sites, only exception was Manzanos with a count below average (this site had second lowest overall (all raptors) count in 32-yr history)
- Above average counts at Bridger, Commissary, and Grand Canyon for second year in a row overall and for most species.
- Below average counts for Red-tailed Hawks at 4 of 8 sites, including a record low at Corpus Christi; above average counts at 3 sites.
- Record highs for:
 - Golden Eagles at Commissary (only network site w above average Golden Eagle count)
 - All falcons except Kestrels and Northern Harriers at the Grand Canyon
 - Bald Eagles at Chelan Ridge
 - Mississippi Kites at Corpus Christi (shattered previous record of 27,285)
 -

HWI partners with Hawk Mountain Sanctuary, the Hawk Migration Association of North America (HMANA), and Bird Studies Canada (BSC) to provide western US data for the Raptor Population Index (RPI), a collaborative standardized effort to monitor raptor migration across North America.

ACKNOWLEDGMENTS

We'd like to thanks the Bureau of Land Management – Kemmerer Field Office for providing their encouragement and essential logistical support for our crew. We also want to thank the Kemmerer Recreation Center for also providing our staff local encouragement, camaraderie, and sometimes logistical support as well. Finally, many thanks to our fearless field crew: Will Britton, Frank Simeone, and Dan Green —without all of your dedication, good spirits, grit, and willingness to brave the Wyoming wind and other elements this season would not have been possible.

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Table 1. Counts and historic records of fall migrating raptors at the Commissary Ridge HawkWatch, in sw Wyoming.

	Species	2002-2015				All-time Historic Records			
		Mean Count ± 95 % CI		2016	% Change	Season	Daily		
Accipiters	Turkey Vulture	93.6	± 25.8	59	-37	185	2007	44	2013
	Osprey	32.6	± 8.2	22	-32	59	2004	16	2003
	Northern Harrier	29.4	± 7.9	52	77	64	2015	6	2015
	Sharp-shinned Hawk	952.4	± 211.6	1487	56	1687	2005	167	2008
	Cooper’s Hawk	409.9	± 73.7	536	31	669	2010	100	2008
	Northern Goshawk	33.9	± 12.1	45	33	89	2007	7	2007
	Unidentified accipiter	117.5	± 40.1	66	-44	296	2010		
	TOTAL ACCIPITERS	1513.8	± 293.9	2134	41	2425	2010		
Buteos									
	Broad-winged Hawk	17.8	± 8.0	25	41	58	2010	18	2010
	Swainson’s Hawk	176.1	± 163.0	96	-45	1211	2010	877	2010
	Red-tailed Hawk	935.4	± 154.7	1183	26	1459	2007	300	2008
	Ferruginous Hawk	6.8	± 1.9	8	18	15	2004	4	2009
	Rough-legged Hawk	12.4	± 5.5	11	-11	34	2008	8	2008
	Unidentified buteo	55.9	± 16.4	37	-34	144	2008		
	TOTAL BUTEOS	1204.4	± 241.0	1360	13	2246	2010		
Eagles									
	Golden Eagle	253.2	± 45.2	476	88	476	2016	29	2007
	Bald Eagle	150.2	± 40.4	230	53	299	2007	37	2007
	Unknown eagles	14.3	± 6.2	11	-23	39	2012		
	TOTAL EAGLES	417.7	± 84.4	717	72	717	2016		
Falcons									
	American Kestrel	210.4	± 51.7	167	-21	403	2010	167	2003
	Merlin	16.5	± 5.2	31	88	32	2012	5	2007
	Prairie Falcon	10.5	± 2.7	5	-52	21	2007	5	2013
	Peregrine Falcon	11.6	± 2.9	13	12	20	2010	5	2014
	Unidentified falcon	8.4	± 2.6	2	-76	16	2007		
	TOTAL FALCONS	257.5	± 53.1	218	-15	458	2004		
	Unidentified Raptor	39.5	± 15.7	18	-54	102	2004		
GRAND TOTAL		3588.4	± 599.6	4580	28	5602	2010		

Table 2. Summary of the 2016 fall flight of migrating raptors across HWT's monitoring network. Values are counts ; green indicates a count significantly higher (outside the 95% confidence interval) than the historic site average, red indicates a count significantly lower than average, and black indicates a count that does not differ from the site average. Asterisks denote a record high or low count. In 2016 HWT monitored fall migration for 4,451.7 hrs and counted 713,979 birds.

	Bonney Butte, OR	Chelan Ridge, WA	Bridger Mtn, MT	Commissary Ridge, WY	Goshute Mts, NV	Yaki Pt, AZ	Manzano Mts, NM	Corpus Christi, TX
	<i>Hours Counted in 2016</i>							
Species	366	421	381.8	*573.8*	698.5	600.8	553.5	856.3
Black Vulture								140
Turkey Vulture	596	63	14	59	370		214	45293
Osprey	66	*16*	13	22	54	70	22	187
Northern Harrier	12	82	44	52	211	*68*	30	158
Crested Caracara								5
Common Black Hawk								0
Harris' Hawk								5
Accipiters								
Sharp-shinned Hawk	1146	490	616	1487	3204	1667	892	2159
Cooper's Hawk	362	196	198	536	1960	1255	466	824
Northern Goshawk	24	13	62	45	27	10	9	0
Unidentified accipiter	43	74	60	66	656	377	94	64
TOTAL ACCIPITERS	1575	773	936	2134	5847	3309	1461	3047
Buteos								
Red-shouldered Hawk	0	0		0	*3*	0	0	15
Broad-winged Hawk	4	8	31	25	91	37	8	594222
Short-tailed Hawk								0
Swainson's Hawk	0	6	4	96	180	59	149	2255
White-tailed Hawk								22
Zone-tailed Hawk							3	7
Red-tailed Hawk	344	151	212	1183	3128	1510	421	*44*
Ferruginous Hawk	0	0	3	8	9	10	5	2
Rough-legged Hawk	3	28	77	11	20	0	0	0
Unidentified buteo	25	35	16	37	102	60	22	24
TOTAL BUTEOS	376	228	343	1360	3533	1676	608	596591
Eagles								
Golden Eagle	66	87	1434	*476*	139	4	95	0
Bald Eagle	83	*18*	78	230	10	8	2	9
Unknown eagles	*11*	0	1	11	5	1	0	0
TOTAL EAGLES	160	105	1513	*717*	154	13	97	9
Falcons								
American Kestrel	9	26	88	167	893	496	237	810
Merlin	108	34	33	31	42	*22*	17	83
Prairie Falcon	2	6	14	5	11	*11*	13	7
Peregrine Falcon	17	9	30	13	26	*19*	35	224
Aplomado Falcon								0
Unidentified falcon	4	2	4	2	*43*	*33*	9	10
TOTAL FALCONS	140	77	169	218	1015	581	311	1134
Kites								
Hook-billed Kite								0
Swallow-tailed Kite								152
White-tailed Kite								13
Mississippi Kite								*35219*
Unidentified Kites								0
TOTAL KITES								*35384*
Unidentified Raptor	2	30	34	18	185	*71*	6	172
GRAND TOTAL	2927	1374	3066	4580	11369	5788	2749	682126



Figure 1. Locations of fall HawkWatch sites operated by HWI and partners (symbols with borders represent sites that also banded in 2016).



Figure 2. Location of Commissary Ridge HawkWatch in southwestern Wyoming relative to Kemmerer, WY and other nearby towns.

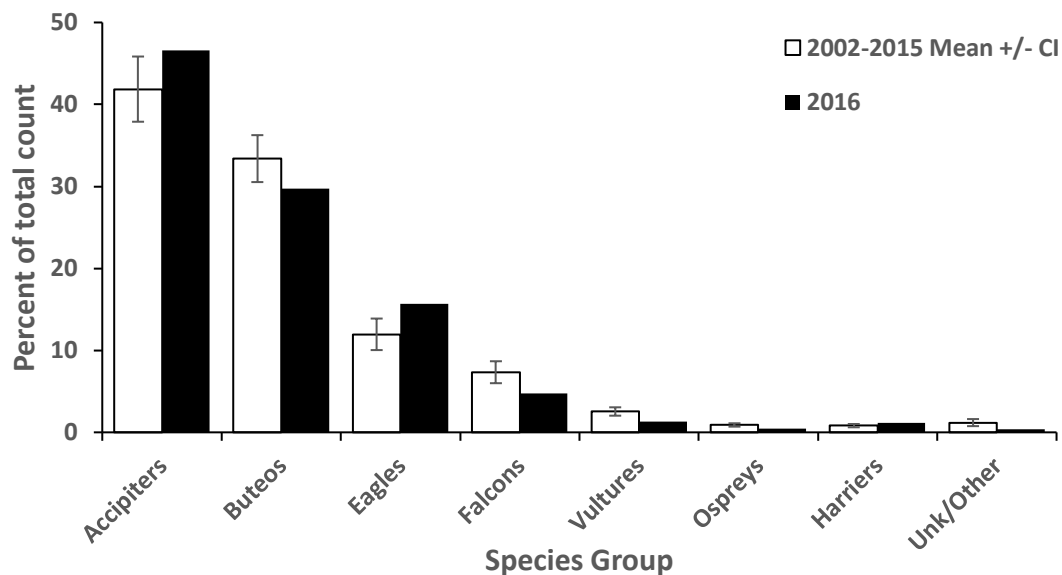


Figure 3. Composition of the fall flight by major raptor species groups of at the Commissary Ridge HawkWatch in SW Wyoming: 2002–2015 average compared to 2016.

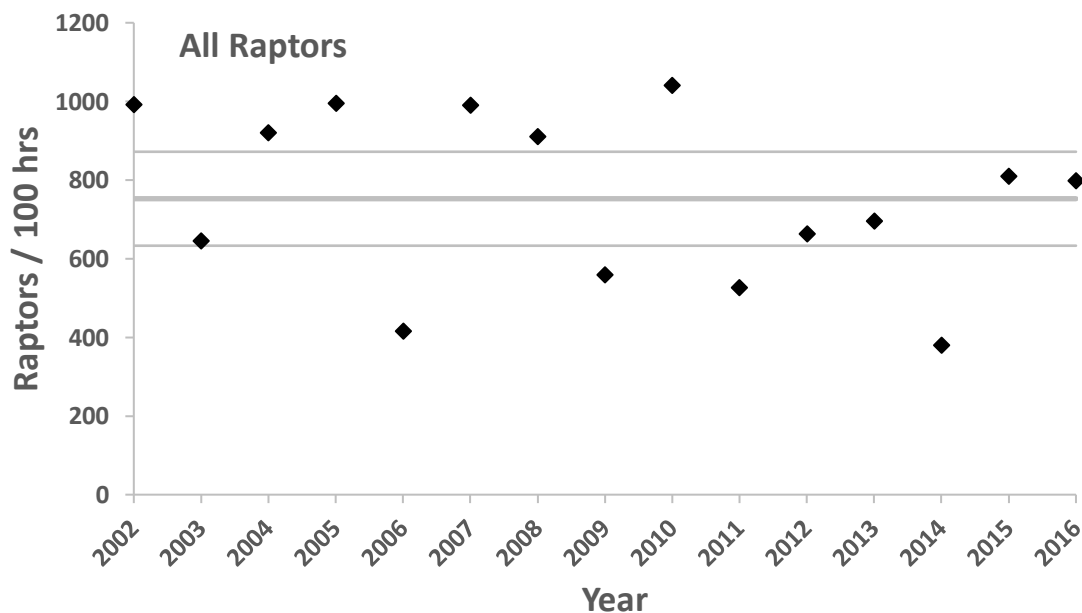


Figure 4. Fall migration passage rates at the Commissary Ridge HawkWatch in SW Wyoming for all migrating raptors: 2002-2016. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (1985-2015) at Commissary Ridge.

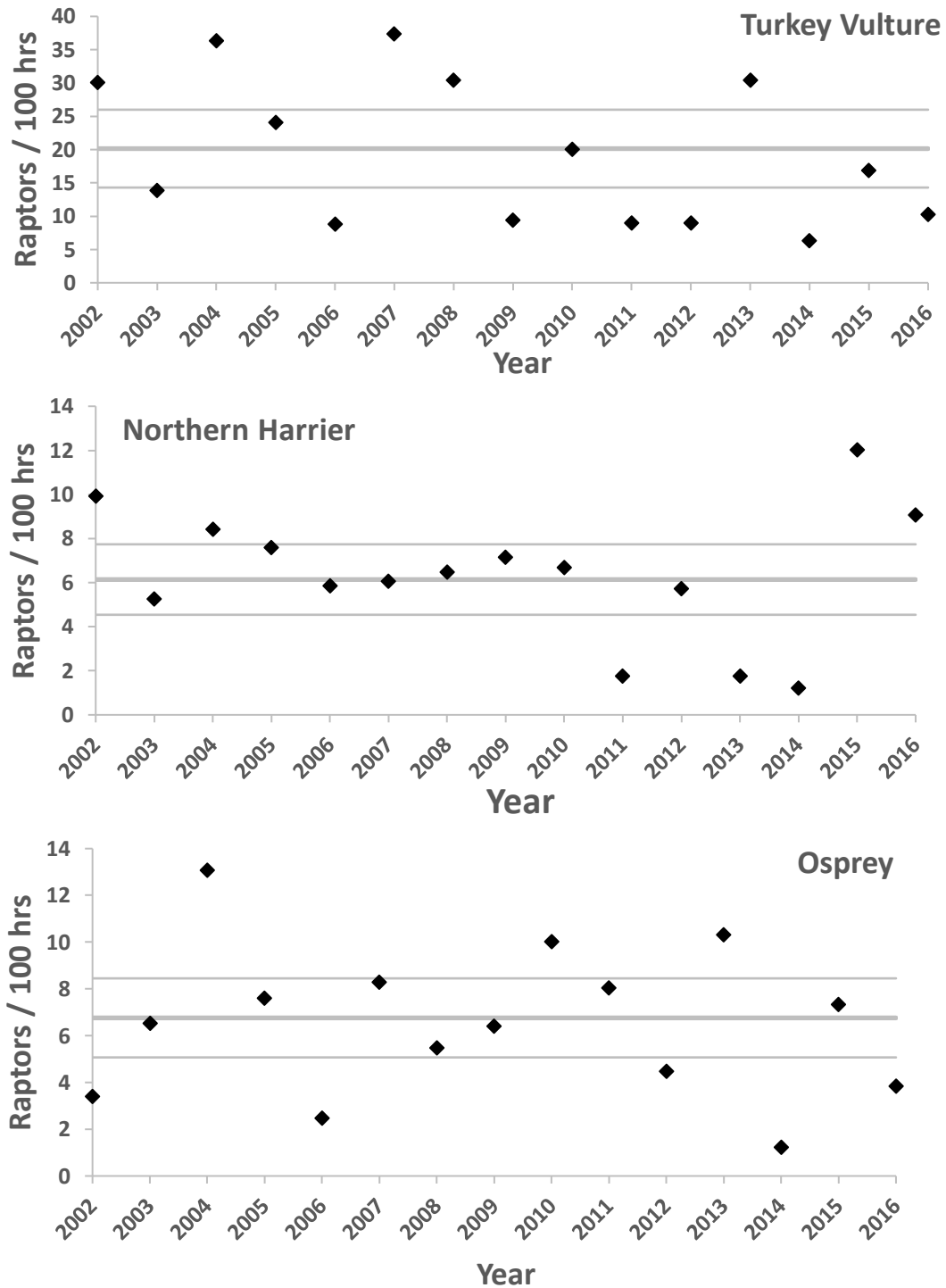


Figure 5a. Fall-migration passage rates a at the Commissary Ridge HawkWatch in SW Wyoming for Turkey Vultures, Ospreys, and Northern Harriers: 2002–2016. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (2002–2015) at Commissary Ridge.

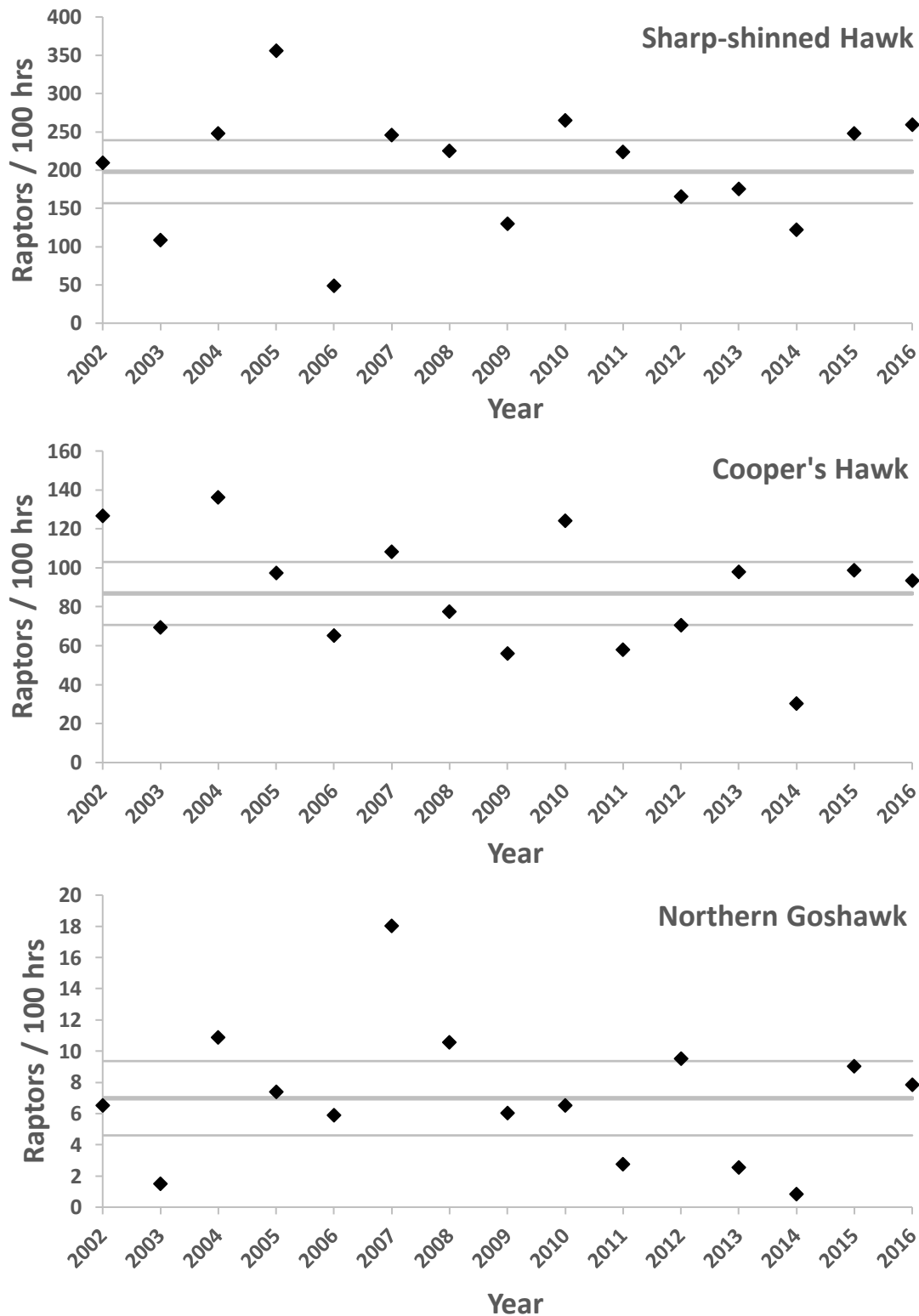


Figure 5b. Fall-migration passage rates at the Commissary Ridge HawkWatch in SW Wyoming for the three North American accipiter species: 2002–2016. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (2002–2015).

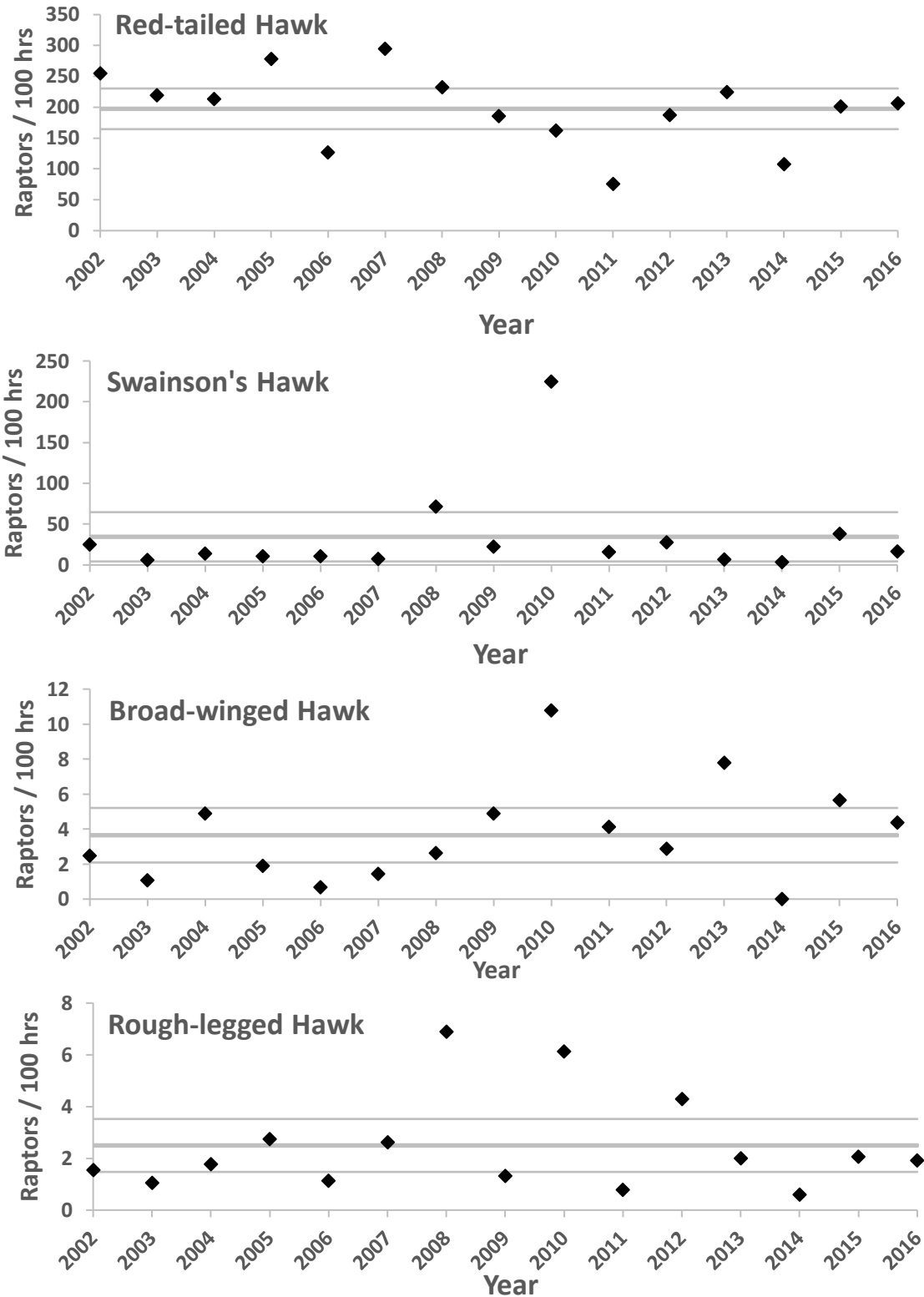


Figure 5c. Fall-migration buteo passage rates at the Commissary Ridge HawkWatch in SW Wyoming: 2002–2016. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (2002-2015).

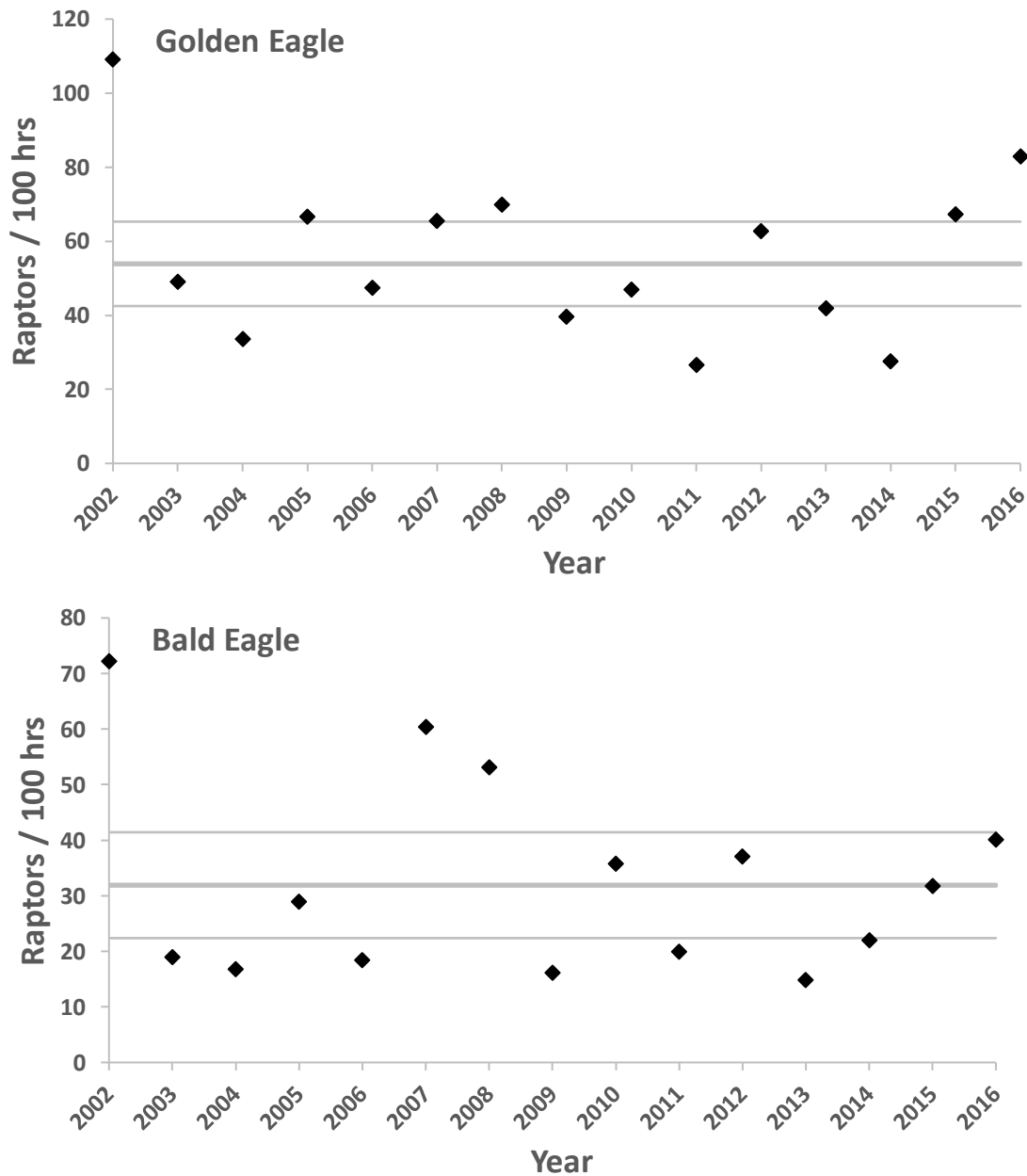


Figure 5d. Eagle passage rates for the fall migration at the Commissary Ridge HawkWatch in SW Wyoming: 2002–2016. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (2002-2015).

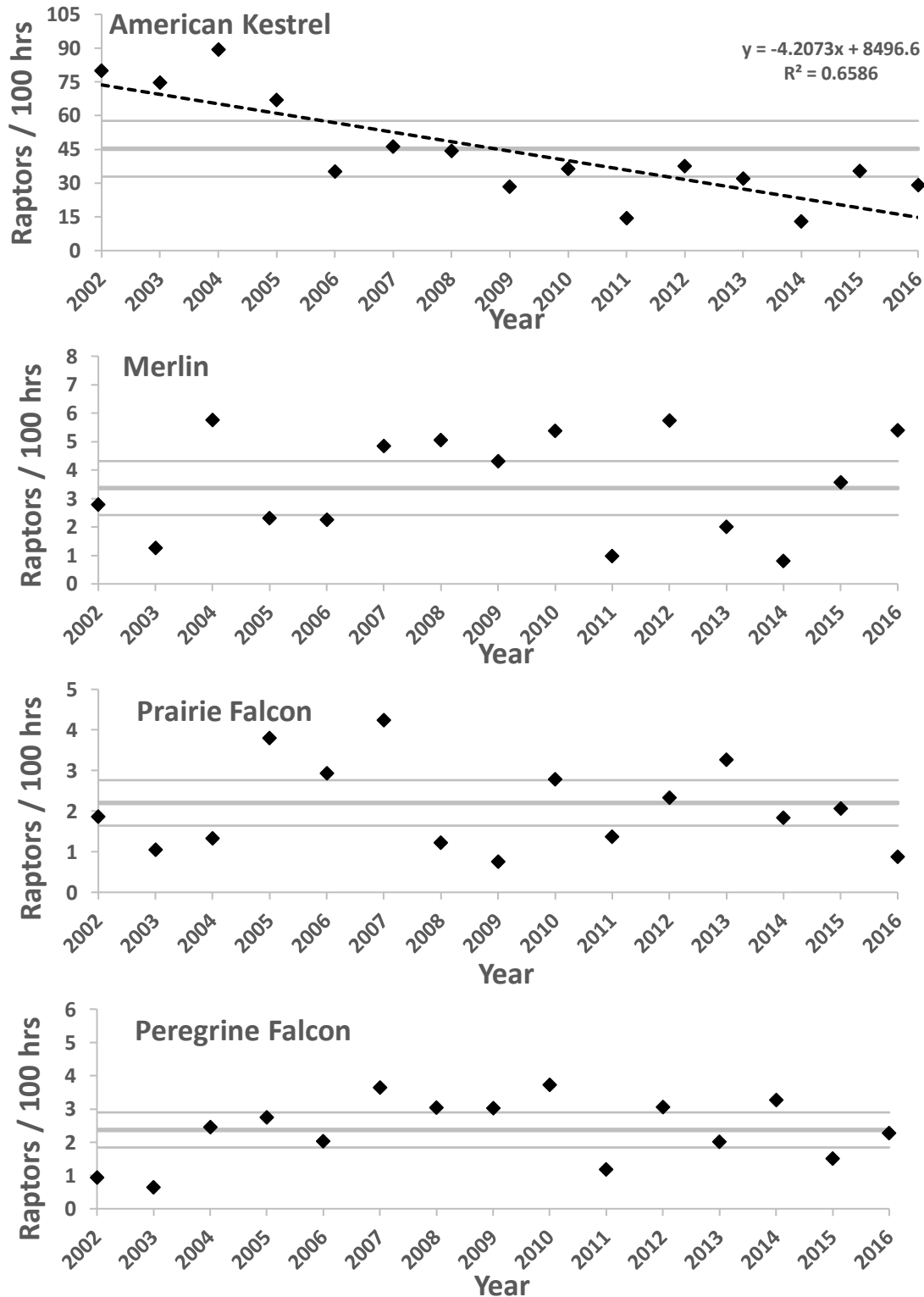


Figure 5e. Fall-migration falcon passage rates at the Commissary Ridge HawkWatch in SW Wyoming: 2002–2016. Dashed lines indicate significant ($p < 0.05$) population trends based on linear or quadratic regressions. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (2002–2015).

Appendix A. History of official observer participation at the Commissary HawkWatch in southwestern Wyoming:

2000: Exploratory count, single observer throughout, rotating observers: Mike Neal (3)¹ and Margarite Lomow (0).

2001: Exploratory count, single observer throughout: Mike Neal (4)

2002: Single observer throughout, two observers for peak: Mike Neal (5), Nick Meyer (1), assisted by other trained crew members and staff.

2003: Two observers throughout: Chadette Pfaff (+), Don Higgins (0), Jason Farrell (0), assisted by Mike Neal (6).

2004: Two observers throughout: Mark Vukovich (1), Jennifer Nagy (0), assisted by other trained crew members and staff.

2005: Two observers throughout: Rob Spaul (1), Mary Ann Donovan (0), assisted by other trained crew members and staff.

2006: Two observers throughout: David Jansen (0), Tiara Westcott (0), assisted by other trained crew members and staff.

2007: Two observers throughout: Tiffany Russell (0), Patty Brundage (0), assisted by other trained crew members and staff.

2008: Two observers throughout: Sue Bruner (4), Sedona Maniak (0), Chase Cammarota (0); assisted by other trained crew members and staff.

2009: Two observers throughout: Andrew Eberly (1), Julia Fromfeld (0), Andrew Grant (+).

2010: Two observers throughout: Robert Baez (1), John Cannon (0), Ben Zyla (0).

2011: Two observers throughout: Lainie LaHaye (1), Mary Raikes (0), Emily Underwood (0).

2012: Two observers throughout: Russell Seeley (2), Rya Rubenthaler (0), Donna Wilhelm (0).

2013: Two observers throughout: Cherin Spencer-Bower (1), Meghan McPherson (0), Bradley Wilkinson (0), and Dan D. Tempest (+).

2014: Two observers throughout: Erik Corredor (0), Philip Kavouriaris (0), and Keelan Dann (0).

2015: Two observers throughout: Thomas Cooney (0), Caleb Hansen (0), and Ben Sweet (0).

2016: Two observers throughout: Will Britton (0), Frank Simeone (0), and Dan Green (0).

¹ Numbers in parentheses indicate the number of seasons of previous experience conducting season-long migratory raptor counts.

Appendix B. Common and scientific names, species codes, and regularly applied age, sex, and color-morph classifications for all raptors observed on migration at Commissary Ridge, Wyoming.

COMMON NAME	SCIENTIFIC NAME	SPECIES CODE	AGE ¹	SEX ²	COLOR MORPH ³
Turkey Vulture	<i>Cathartes aura</i>	TV	U	U	NA
Osprey	<i>Pandion haliaetus</i>	OS	U	U	NA
Northern Harrier	<i>Circus cyaneus</i>	NH	A I Br U	M F U	NA
Sharp-shinned Hawk	<i>Accipiter striatus</i>	SS	A I U	U	NA
Cooper's Hawk	<i>Accipiter cooperii</i>	CH	A I U	U	NA
Northern Goshawk	<i>Accipiter gentilis</i>	NG	A I U	U	NA
Unknown accipiter	<i>Accipiter</i> spp.	UA	U	U	NA
Broad-winged Hawk	<i>Buteo platypterus</i>	BW	A I U	U	D L U
Swanson's Hawk	<i>Buteo swainsoni</i>	SW	U	U	D L U
Red-tailed Hawk	<i>Buteo jamaicensis</i>	RT	A I U	U	D L U
Ferruginous Hawk	<i>Buteo regalis</i>	FH	A I U	U	D L U
Rough-legged Hawk	<i>Buteo lagopus</i>	RL	U	U	D L U
Unknown buteo	<i>Buteo</i> spp.	UB	U	U	D L U
Golden Eagle	<i>Aquila chrysaetos</i>	GE	I, S, NA, A, U ⁴	U	NA
Bald Eagle	<i>Haliaeetus leucocephalus</i>	BE	I, S1, S2, NA, A, U ⁵	U	NA
Unknown eagle	<i>Aquila</i> or <i>Haliaeetus</i> spp.	UE	U	U	NA
American Kestrel	<i>Falco sparverius</i>	AK	U	M F U	NA
Merlin	<i>Falco columbarius</i>	ML	AM Br	AM U	NA
Prairie Falcon	<i>Falco mexicanus</i>	PR	U	U	NA
Peregrine Falcon	<i>Falco peregrinus</i>	PG	A I U	U	NA
Unknown falcon	<i>Falco</i> spp.	UF	U	U	NA
Unknown raptor	Falconiformes	UU	U	U	NA

¹ Age codes: A = adult, I = immature (HY), Br = brown (adult female or immature), U = unknown age.

² Sex codes: M = male, F = female, U = unknown.

³ Color morph codes: D = dark or rufous, L = light, U – unknown, NA = not applicable.

⁴ Golden Eagle age codes: I = Immature: juvenile or first-year bird, bold white wing patch visible below, bold white in tail, no molt; S = Subadult: white wing patch variable or absent, obvious white in tail and molt or tawny bar visible on upper wing; NA = Not adult: unknown age immature/subadult; A = Adult: no white in wings or tail; U = Unknown.

⁵ Bald Eagle age codes: I = Immature: juvenile or first-year bird, dark breast and tawny belly; S1 = young Subadult: Basic I and II plumages, light belly, upside-down triangle on back; S2 = older Subadult: Basic III plumage, head mostly white with osprey-like dark eye line and dark band on tail; NA = Not adult: unknown age immature/subadult; A = Adult: includes near adult with dark flecks in head and dark tail tip, and adult with white head and tail; U = Unknown.

Appendix C. Annual observation effort and raptor counts by species during fall migration at Commissary Ridge, Wyoming: 2002–2016.

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Start date	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug
End date	29-Oct	29-Oct	3-Nov	31-Oct	31-Oct	5-Nov	5-Nov	5-Nov	5-Nov	31-Oct	5-Nov	28-Oct	4-Nov
Observation days	45	63	65	64	56	66	66	64	65	61	68	57	66
Observation hours	322.67	474.85	452.67	478.83	443.58	494.56	493.33	531.82	538.58	510.25	557.83	398.58	491.33
Raptors/100 hrs	991	644	917	985	415	990	911	559	1040	526	662	693	380
SPECIES	RAPTOR COUNTS												
Turkey Vulture	97	66	164	114	39	185	150	50	108	46	50	121	31
Osprey	11	31	59	36	11	41	27	34	54	41	25	41	6
Northern Harrier	32	25	38	36	26	30	32	38	36	9	32	7	6
Sharp-shinned Hawk	675	516	1,118	1,687	217	1,214	1,109	690	1425	1,140	924	698	600
Cooper's Hawk	409	329	614	462	289	535	382	298	669	296	393	389	148
Northern Goshawk	21	7	49	35	26	89	52	32	35	14	53	10	4
Unknown accipiter	100	146	178	68	51	180	82	124	296	214	50	36	49
TOTAL ACCIPITERS	1,205	998	1,959	2,252	583	2,018	1,625	1,144	2,425	1,664	1,420	1,133	801
Broad-winged Hawk	8	5	22	9	3	7	13	26	58	21	16	31	0
Swainson's Hawk	82	28	62	52	47	36	352	119	1,211	80	153	26	16
Red-tailed Hawk	823	1,042	961	1,319	563	1,459	1,148	987	872	386	1,043	892	530
Ferruginous Hawk	6	3	15	8	7	3	7	9	11	5	11	4	3
Rough-legged Hawk	5	5	8	13	5	13	34	7	33	4	24	8	3
Unidentified buteo	17	87	63	42	35	63	144	43	61	44	31	34	73
TOTAL BUTEOS	941	1,170	1,131	1,443	660	1,581	1,698	1,191	2,246	540	1,278	995	625
Golden Eagle	352	233	152	316	211	324	345	211	253	136	350	167	136
Bald Eagle	233	90	76	137	82	299	262	86	193	102	207	59	108
Unidentified eagle	10	7	10	2	6	25	34	0	16	16	39	4	22
TOTAL EAGLES	595	330	238	455	299	648	641	297	462	254	596	230	266
American Kestrel	258	355	403	317	156	229	219	151	196	73	209	127	64
Merlin	9	6	26	11	10	24	25	23	29	5	32	8	4
Prairie Falcon	6	5	6	18	13	21	6	4	15	7	13	13	9
Peregrine Falcon	3	3	11	13	9	18	15	16	20	6	17	8	16
Unknown falcon	2	3	12	4	16	16	15	3	4	7	8	7	10
TOTAL FALCONS	278	372	458	363	204	308	280	197	264	98	279	163	103
Unidentified raptor	38	68	102	19	19	83	39	20	7	32	13	72	28
ALL SPECIES	3,197	3,060	4,149	4,718	1,841	4,894	4,492	2,971	5,602	2,684	3,693	2,762	1,866

Appendix C. (Cont.)

	2015	2016	Mean
Start date	27-Aug	27-Aug	27-Aug
End date	1-Nov	5-Nov	1-Nov
Observation days	63	67	62.4
Observation hours	532.5	573.8	486.3
Raptors/100 hrs	809	798	754.7
Species			
Turkey Vulture	90	59	91.3
Osprey	39	22	31.9
Northern Harrier	64	52	30.9
Sharp-shinned Hawk	1,321	1,487	988.1
Cooper's Hawk	526	536	418.3
Northern Goshawk	48	45	34.7
Unknown accipiter	71	66	114.1
Total accipiters	1,966	2,134	1555.1
Broad-winged Hawk	30	25	18.3
Swainson's Hawk	202	95	170.7
Red-tailed Hawk	1,070	1,183	951.9
Ferruginous Hawk	3	8	6.9
Rough-legged Hawk	11	11	12.3
Unidentified buteo	47	37	54.7
Total buteos	1,363	1,360	1214.8
Golden Eagle	359	476	268.1
Bald Eagle	169	230	155.5
Unidentified eagle	9	11	14.1
Total eagles	537	717	437.7
American Kestrel	189	167	207.5
Merlin	19	31	17.5
Prairie Falcon	11	5	10.1
Peregrine Falcon	8	13	11.7
Unknown falcon	11	2	8.0
Total falcons	238	218	254.9
Unidentified raptor	12	18	38.0
All species	4,309	4,580	3654.5