

FALL 2014 RAPTOR MIGRATION REPORT
LIPAN POINT HAWKWATCH - GRAND CANYON, ARIZONA



HawkWatch International, Inc.
Salt Lake City, Utah



April 2015

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INTRODUCTION

The Grand Canyon HawkWatches in northern Arizona are an ongoing, long-term effort to monitor population trends of migratory raptors that use the southern portion of the Intermountain Flyway (Hoffman et al. 2002, Hoffman and Smith 2003, Smith et al. 2008a). HawkWatch International (HWI) first initiated standardized counts at the Grand Canyon at Lipan Point in 1991, and in 1997 added simultaneous standardized monitoring at Yaki Point. These sites were selected based on exploratory counts conducted by Chuck LaRue in 1987 and Christie Van Cleve during the 1989 and 1990 autumn migration seasons. Fall migration counts were conducted annually at both sites through the fall of 2008, but budgetary and logistical issues caused both the Lipan Point and Yaki Point HawkWatches to close after 18 and 12 consecutive seasons, respectively. HWI re-opened Yaki Point in 2010 and 2013, and plans to operate the site annually going forward. In 2014, with support from partners at the Park, the Grand Canyon Association, and the Arizona State Heritage Fund HWI monitored fall migration at both the Yaki Point and Lipan Point HawkWatches. This report highlights the season's results at Lipan Point; a companion report will highlight results from Yaki Point.

The Lipan Point HawkWatch was 1 of 9 long-term, annual migration counts operated or co-sponsored by HWI in North America during 2014. The primary objective of these efforts is to track long-term regional population trends of diurnal raptors in western North America and around the Texas Gulf Coast (Hoffman and Smith 2003; Smith et al. 2001, 2008 a, b). Lipan Point falls within the Southern Rockies/Colorado Plateau and Sierra Madre Occidental bird conservation regions, the Intermountain West Joint Venture, and the Mogollan Rim Partners in Flight region. Raptors can serve as important biological indicators of ecosystem health (Bildstein 2001) and long-term migration counts can be a cost effective and efficient method for monitoring regional status and trends of multiple raptor species (Zalles and Bildstein 2000).

In addition to long-term counting and banding efforts, HWI conducts and supports other studies to further our knowledge about the biology of migrating raptors. Some of these efforts include: telemetry work to identify species' ranges, migratory routes, and connectivity, as well as blood sampling to track changes in raptor health (e.g., Hoffman et al. 2002, Lott and Smith 2006, Goodrich and Smith 2008, DeLong and Hoffman 2004, McBride et al. 2004).

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 an important component of the Lipan Point HawkWatch and HWI's overall mission. With about five million people visiting the Grand Canyon National Park each year and easy accessibility, Lipan Point offers excellent opportunities for public outreach and educating visitors about the conservation needs and biology of raptors and the Grand Canyon ecosystem in general.

STUDY SITE

The migration over the Grand Canyon is unique among HWI's western sites because migrating raptors are not guided to the region by mountain ridges and must rely on thermal lift rather than ridge updrafts to carry them over the broad North Kaibab Plateau toward the canyon. The Painted Desert along the eastern boundary of the park (Figure 1) may serve as a barrier because most raptors tend to avoid sparsely vegetated landscapes, although the region does produce excellent thermal lift. The edge habitat where the forested Kaibab Plateau juxtaposes the desert may provide for a more hospitable migratory pathway southbound as birds migrate towards the canyon. However, because there are no distinct ridges to serve as "leading lines" to provide a stable source of lift to concentrate migrating raptors (Bildstein 2006), migrants probably approach the canyon along a relatively broad front. Similar to Yaki Point, Lipan Point provides for good monitoring because of its location immediately across from a "peninsula" of plateau land that juts out into the canyon from the north rim. This peninsula creates a narrow gap between the

two canyon rims, and raptors concentrate here, a situation similar to locations where raptors seek narrow passages to cross large bodies of water (Kerlinger 1989, Bildstein 2006).

Lipan Point is a popular lookout located approximately 3.2 km southwest from the eastern park entrance on Hwy 64 in Coconino County, Arizona along the south rim of the Grand Canyon at an elevation of 2,243 m (36° 01' 59.2" N, 111° 51' 11.5" W; Figure 2). The observation point is located about 170 m south of the parking lot at the edge of the canyon rim, directly above an Anasazi granary. This location provides nearly a 360° view of the surrounding landscape, with excellent visibility along the canyon to the north, south, and west. The predominant vegetation consists of big sagebrush (*Artemisia tridentata*), cliffrose (*Cowania mexicana*), Utah juniper (*Juniperus osteosperma*), and two-needle pinyon (*Pinus edulis*).

METHODS

Two observers conducted standardized daily counts of migrating raptors from a single observation site at Yaki Point in 2014; occasionally they were relieved or supplemented by other trained staff and volunteers.

Weather permitting; observations usually begin at 0800 H and end between 1600 and 1700 H Pacific Standard Time (PST). Data collection follows standardized protocols used at all HWI migration sites (Hoffman and Smith 2003). 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 some tables and figures).
2. Hour of passage for each migrant; e.g., the 1000–1059 H 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, recorded 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 2014 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. Linear and quadratic regression was used on effort-adjusted annual passage rates (raptors/100hrs) to identify long-term trends in migrating raptors.

2014 RESULTS AND DISCUSSION

Observation effort and weather summary

Lipan Point HawkWatch's standard season runs 27 August – 5 November; in 2014 observers were able to count on 66 of 70 possible days between 28 August and 5 November for a total of 518.08 observation hours— historic averages are 68 days and 523 observation hours (Appendix C). Several days were

missed at the start of the season due to staffing logistics, and counts on two days were shortened because of weather (i.e., resulted in reduced observation time to ≤ 4 hours).

Weather varies throughout every season, in 2014 based on hourly recording of conditions during observation it was clear 50% of the time, hazy 7% of the time, and rainy 1% of the time.

FLIGHT SUMMARY

2014 Overall Flight

A total of 4,856 migrant raptors of 14 species were counted this past season, making this an average year for migration counts at Lipan Point (Table 1). The flight composition was 50.5% accipiters, 36.9% buteos, 9.6% falcons, 0.9% Ospreys, 0.7% harriers, 0.5% eagles, and 0.8% unidentified raptors. The proportions of accipiters and buteos were above average; eagles, harriers, and Ospreys were consistent with historic levels, and falcons were below average (Fig. 3). The most commonly observed species was Red-tailed Hawk (35% of the total), followed by Sharp-shinned Hawk (25%), Cooper's Hawk (12%), then American Kestrel (9%). The remaining species accounted for 1%, or less of the flight (Table 1).

The following sections summarize the 2014 count relative to historic means, and any statistically significant ($p < 0.05$) population trends are based on first and second order regression analysis. HWI only depicts significant trends for species with average historic count rates ≥ 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 rare species are of interest to managers and the general public and could represent the beginning of meaningful long-term changes.

Total Flight (Fig.4):

The 937 raptors counted per 100 hours of observation at Lipan Point in 2014 is in line with the historic site average for the site. Total number of raptors counted per 100 hours of observation at Lipan Point has decreased significantly over time (slope = -45.6, $r^2 = 0.6$, $p < 0.001$).

Osprey and Northern Harriers (Fig. 5a):

Counts and passage rates (birds/100hrs) were below average for both Osprey and Northern Harriers in 2014 compared to long term site averages (Table 1). Northern Harrier regional populations are declining annually based on linear regression of fall passage rates (slope = -0.74, $r^2 = 0.45$, $p = 0.002$).

Accipiters (Fig. 5b):

Sharp-shinned Hawks counts and passage rates were in line with historic averages in 2014 (Table 1); however, the long-term trend in passage rates indicate regional populations declining (slope = -5.708, $r^2 = 0.21$, $p = 0.047$). It was a below average year for both Cooper's Hawk and Northern Goshawk based on counts and passage rates (Table 1). Like Sharp-shinned Hawks, Cooper's Hawk passage rates are declining (slope = -11.5, $r^2 = 0.61$, $p < 0.001$).

Buteoine Hawks (Fig. 5c):

Counts and passage rates were above historic site average for both Swainson's Hawks and Broad-winged Hawks; were average for Red-tailed Hawks; and below average for Ferruginous Hawks (Table 1).

Analyses of Red-tailed Hawk long-term fall migration passage rates suggest that regional populations of Red-tailed Hawks are in decline (slope = -12.2, $r^2 = 0.37$, $p = 0.005$).

Eagles (Fig.5d):

Only 16 Golden Eagles and 7 Bald Eagles were counted at Lipan Point in 2014, both significantly below historic site averages (Table 1). Despite mean passage rates below the 10 per 100 hr threshold, it is worth noting that Golden Eagle passage rates at Lipan Point have been declining annually (slope= -0.33, $r^2 = 0.44$, $p=0.002$) because similar trends have been seen for this species across the HWI network and at other count sites. Similar declines have been documented across North America and targeted research efforts are underway, including some by HWI, to further understand Golden Eagle, ecology, movements and demographics (Farmer et al. 2008, Katzner et al. 2012).

Falcons (Fig.5e):

Counts and passage rates for Merlins and Peregrine Falcons were average in 2014 (Table 1). No Prairie Falcons were counted during fall migration in 2014. American Kestrel counts and passage rates were significantly below average in 2014 and have been so since 2005; and regression analysis suggests long-term declines in regional Kestrel populations (slope= -11.4, $r^2 = 0.76$, $p = 0.001$). Similar declines have been documented at other HWI network sites and at other migration sites across North America. In response to these declines, HWI, along with many other North American researchers and Citizen Scientists are working to understand Kestrel declines both locally and at the continental scale and have partnered under the umbrella of the American Kestrel Partnership (<http://kestrel.peregrinefund.org/>).

VISITOR PARTICIPATION AND PUBLIC OUTREACH

A total of 3,297 individuals signed the visitor log, and spent time with HWI crews at Yaki and Lipan Points to watch hawks together and learn about their migration, natural history, ecology, the Grand Canyon Park, and some of the threats that raptors face. These visitors came from 46 US states, the US Territory of Guam, and 33 foreign countries, including: Australia, Austria, Belgium, Brazil, Canada, China, Colombia, Commonwealth of Dominica, Costa Rica, Czech Republic, Denmark, France, Germany, Holland, India, Ireland, Israel, Italy, Korea, Mexico, Netherlands, New Zealand, Norway, Philippines, Poland, Portugal, Republic of South Africa, Singapore, Spain, Sweden, Switzerland, Taiwan, and the U.K. At Yaki Point, interpreters gave 65 scheduled programs that took place twice daily from 02 September through 05 November, totaling 3,129 participants.

In recognition of Grand Canyon National Park's role in helping to protect critical habitat for birds during breeding season, winter, and migration, as well as providing critical nesting and wintering habitat for globally threatened species such as the California Condor and Mexican Spotted Owl, the entire Grand Canyon National Park was designated a Global Important Bird Area. A ceremony to celebrate this designation took place at Yaki Point on 13 September 2014, in conjunction with Celebrate Wildlife Day. HWI Education and Outreach Director, Nikki Wayment, was there to represent HWI and discussed the long-term raptor migration monitoring efforts at the park, regional population trends of species based on these efforts, and issues affecting raptors in the west. Nikki also delivered a 4-day intensive raptor ID workshop at the Park, with field trips to both the Yaki Point and Lipan Point HawkWatches.

2014 FALL MIGRATION ACROSS HWI'S NETWORK

HawkWatch International and partners operated 9 fall count sites in 2014 (Fig. 1). During the 4,884.4 hours of standardized observation we counted 504,905 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 2014 included (Table 2):

- Below average counts for the fall flight at 4 of 9 sites
 - Both Pacific Northwest sites, Commissary Ridge, and Corpus Christi
- Low or average Golden Eagle counts at all network sites--no increases at any site
- Below historic average American Kestrel counts at 6 of 9 sites
- Low Northern Harrier counts at 8 of 9 network sites
- Above average Peregrine Falcon counts at 6 of 9 sites and average counts at the other 3
- Above average Broad-winged Hawk numbers at 6 western sites and below average Broad-winged numbers at Corpus Christi – does this signify a change in the migration pathways for this species?

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

Funds for this year's migration count and outreach efforts at Lipan Point were generously provided by the Arizona Game and Fish Heritage Grant, and HWI private donors and members. We want to give thanks to the Tusayan Ranger District of the Kaibab National Forest for providing guidance and help with camp logistics for our field crew. Many thanks go to the Grand Canyon National Park rangers, interpreters, biologists, and law enforcement personnel for their encouragement, friendship, and logistical support of this long-term monitoring effort each year.

Finally, enormous thanks and appreciation to the members of our 2014 field crew: Amy Zimmerman, Frank Mayer, Steve Seibel, Jeremy Halka, Anna Butler, and Melissa Murillo. Without your teamwork, skill, dedication, and willingness to brave the elements and crowds over the course of a long field season, these efforts would not be possible.

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Table 1. Counts and historic records of fall migrating raptors at Grand Canyon, AZ (Lipan Point data only): 1991–2008 versus 2014.

Species	1991-2008		2014	% Change	All-time Historic Records	
	Mean Count	± 95 % CI			Season	Daily
Osprey	73	± 12	45	-38	135 (1997)	23 (1997)
Northern Harrier	76	± 15	35	-54	131 (1992)	15 (2x)
Accipiters						
Sharp-shinned Hawk	1408	± 183	1572	12	2472 (1992)	183 (1992)
Cooper's Hawk	975	± 208	599	-39	1715 (1998)	206 (1999)
Northern Goshawk	10	± 5	2	-80	42 (1992)	4 (2x)
Unidentified accipiter	247	± 57	281	14	593 (2007)	
TOTAL ACCIPITERS	2640	± 367	2454	-7	4524 (1992)	
Buteos						
Red-shouldered Hawk	<1	±			1 (2x)	1 (2x)
Broad-winged Hawk	10	± 4	23	123	35 (1998)	19 (1998)
Swainson's Hawk	39	± 12	54	37	108 (2003)	39 (2005)
Red-tailed Hawk	1538	± 286	1687	10	3229 (1992)	269 (1996)
Ferruginous Hawk	6	± 2	2	-66	15 (1992)	2 (8x)
Rough-legged Hawk	<1	±			1 (2002)	1 (2002)
Unidentified buteo	34	± 15	28	-18	127 (2007)	
TOTAL BUTEOS	1627	± 278	1794	10	3291(1992)	
Eagles						
Golden Eagle	24	± 7	16	-32	62 (1992)	18 (1993)
Bald Eagle	18	± 5	7	-62	49 (1993)	12 (1995)
Unknown eagles	2	± 1	0	-100	4 (1999)	
TOTAL EAGLES	43	± 11	23	-46	89 (1993)	
Falcons						
American Kestrel	1030	± 173	440	-57	1631 (1996)	269 (1995)
Merlin	11	± 3	12	10	24 (1997)	5 (1997)
Prairie Falcon	6	± 1	0	-100	12 (2008)	5 (2005)
Peregrine Falcon	9	± 2	11	22	23 (2007)	3 (6x)
Unidentified falcon	9	± 6	4	-54	54 (2008)	
TOTAL FALCONS	1065	± 168	467	-56	1651 (1996)	
Unidentified Raptor	60	± 16	38	-36	124 (1992)	
GRAND TOTAL	5682	± 827	4856	-15	10048 (1992)	762 (1992)

Table 2. Summary of the 2014 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.

	Bonney Butte, OR	Chelan Ridge, WA	Bridger Mtn, MT	Commissary Ridge, WY	Goshute Mts, NV	Yaki Pt, AZ	Lipan Pt, AZ	Manzano Mts, NM	Corpus Christi, TX
	<i>Hours Counted in 2014</i>								
Species	414.5	448.3	392.7	491.3	690	605.6	518.1	505.1	818.8
Black Vulture									228
Turkey Vulture	322	55	8	31	661	*	*	343	57128
Osprey	53	41	6	6	125	58	45	38	211
Northern Harrier	18	75	112	6	145	31	35	42	171
Crested Caracara									1
Common Black Hawk									0
Harris' Hawk									4
Accipiters									
Sharp-shinned Hawk	802	520	422	600	6141	1806	1572	1304	2101
Cooper's Hawk	465	190	203	148	3986	862	599	770	821
Northern Goshawk	53	21	59	4	152	4	2	11	0
Unidentified accipiter	41	64	66	49	42	342	281	51	105
TOTAL ACCIPITERS	1361	795	750	801	10321	3014	2454	2136	3027
Buteos									
Red-shouldered Hawk	2				0				15
Broad-winged Hawk	1	12	22	0	203	28	23	17	370575
Short-tailed Hawk									0
Swainson's Hawk	0	43	2	16	509	59	54	2279	8035
White-tailed Hawk									23
Zone-tailed Hawk									5
Red-tailed Hawk	415	119	239	530	5095	1262	1687	696	159
Ferruginous Hawk	0		8	3	32	12	2	7	6
Rough-legged Hawk	1	5	84	3	19	0		3	0
Unidentified buteo	6	22	37	73	16	28	28	7	22
TOTAL BUTEOS	425	201	392	625	5874	1389	1794	3009	378766
Eagles									
Golden Eagle	59	67	1222	136	230	2	16	103	1
Bald Eagle	38	14	106	108	16	12	7	6	15
Unknown eagles	5	0	11	22	0	0	0	0	0
TOTAL EAGLES	102	81	1339	266	246	14	23	109	16
Falcons									
American Kestrel	10	24	138	64	1730	474	440	200	1016
Merlin	80	42	28	4	110	16	12	37	98
Prairie Falcon	7	8	13	9	43	7	0	17	8
Peregrine Falcon	17	10	23	16	33	18	11	59	237
Aplomado Falcon									0
Unidentified falcon	7	7	7	10	0	5	4	2	8
TOTAL FALCONS	121	91	209	103	1916	520	467	315	1367
Kites									
Hook-billed Kite									0
Swallow-tailed Kite									59
White-tailed Kite									4
Mississippi Kite					1				20032
Unidentified Kites									0
TOTAL KITES									20095
Unidentified Raptor	21	45	63	28	0	19	38	0	157
GRAND TOTAL	2423	1384	2879	1866	19288	5045	4856	5993	461171

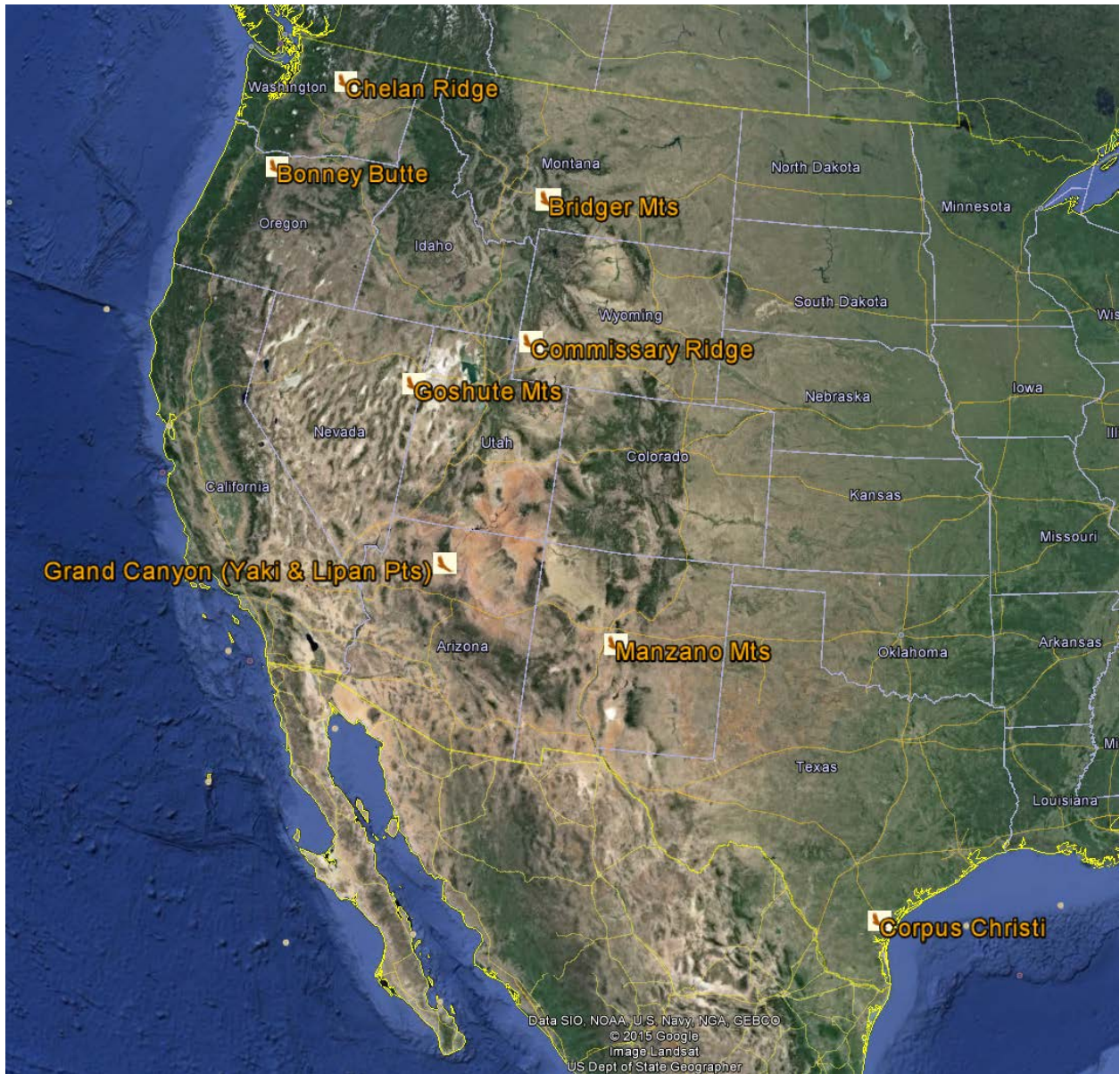


Figure 1. Locations of fall HawkWatch sites operated by HWI and partners.

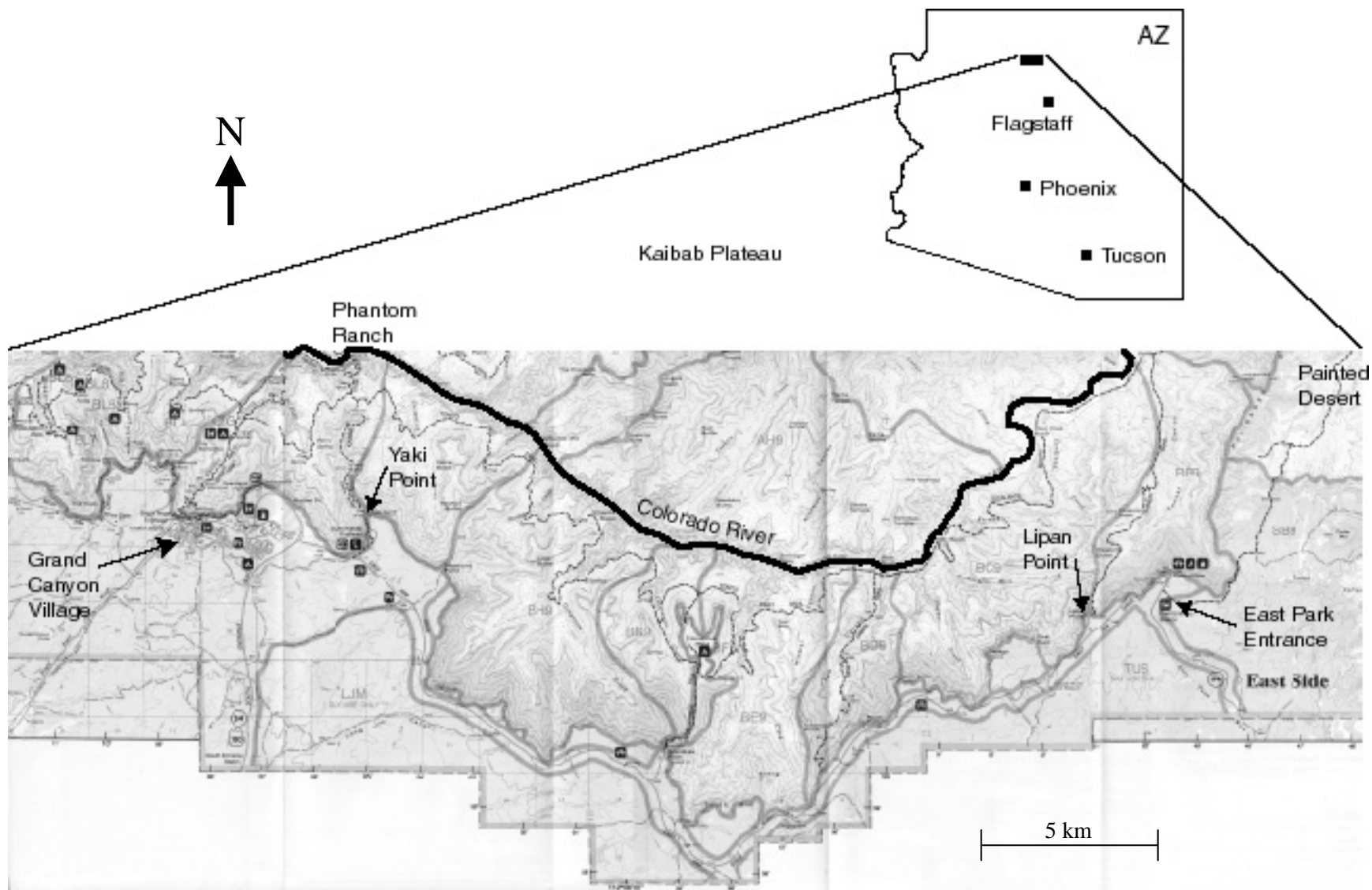


Figure 2. Map showing the Lipan Point and Yaki Point HawkWatches, Grand Canyon, Arizona.

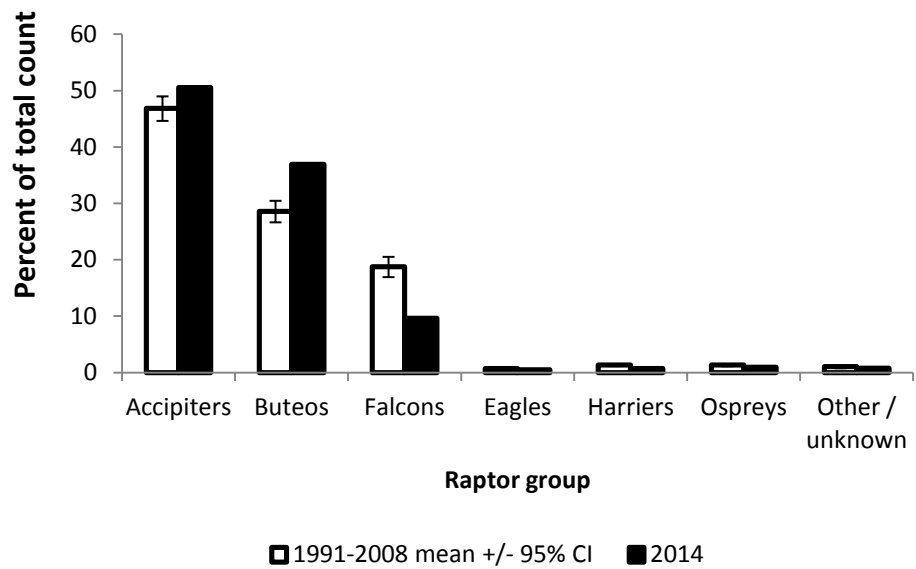


Figure 3. Fall raptor-migration flight composition by major species groups at Lipan Point HawkWatch, Grand Canyon, AZ: 1991–2008 versus 2014.

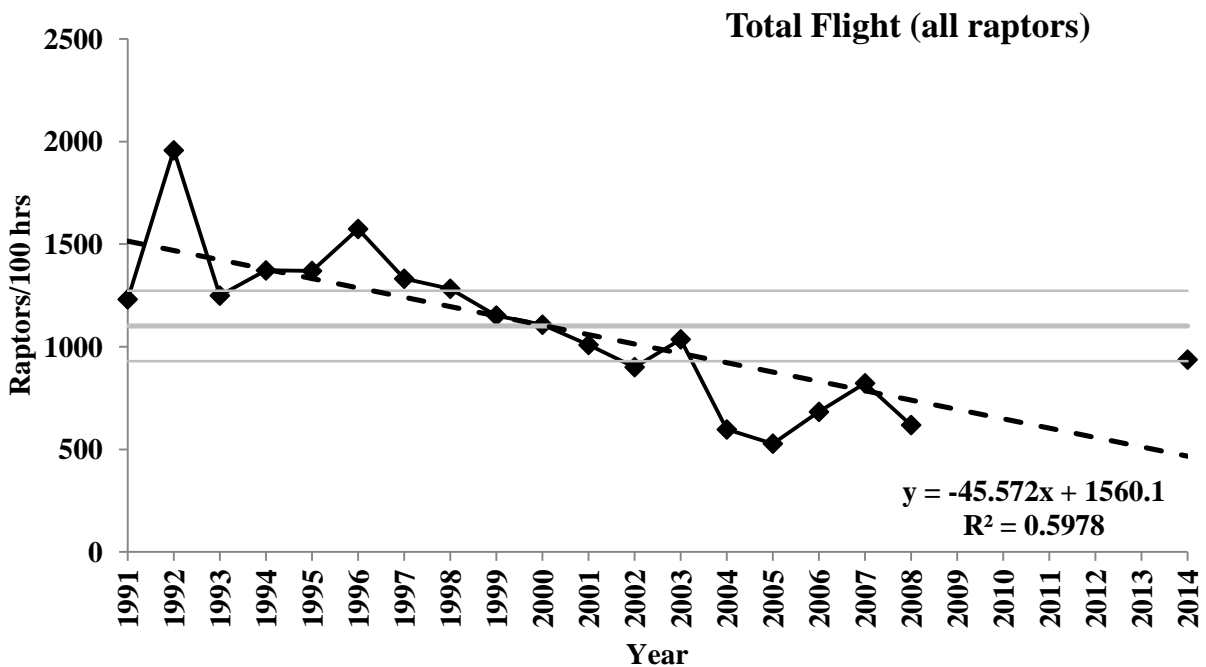


Figure 4. Effort-adjusted fall migration passage rates at Lipan Point for all migrating raptors: 1998-2014. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (1991-2008) at Lipan Point. (count did not occur in 2009-2013)

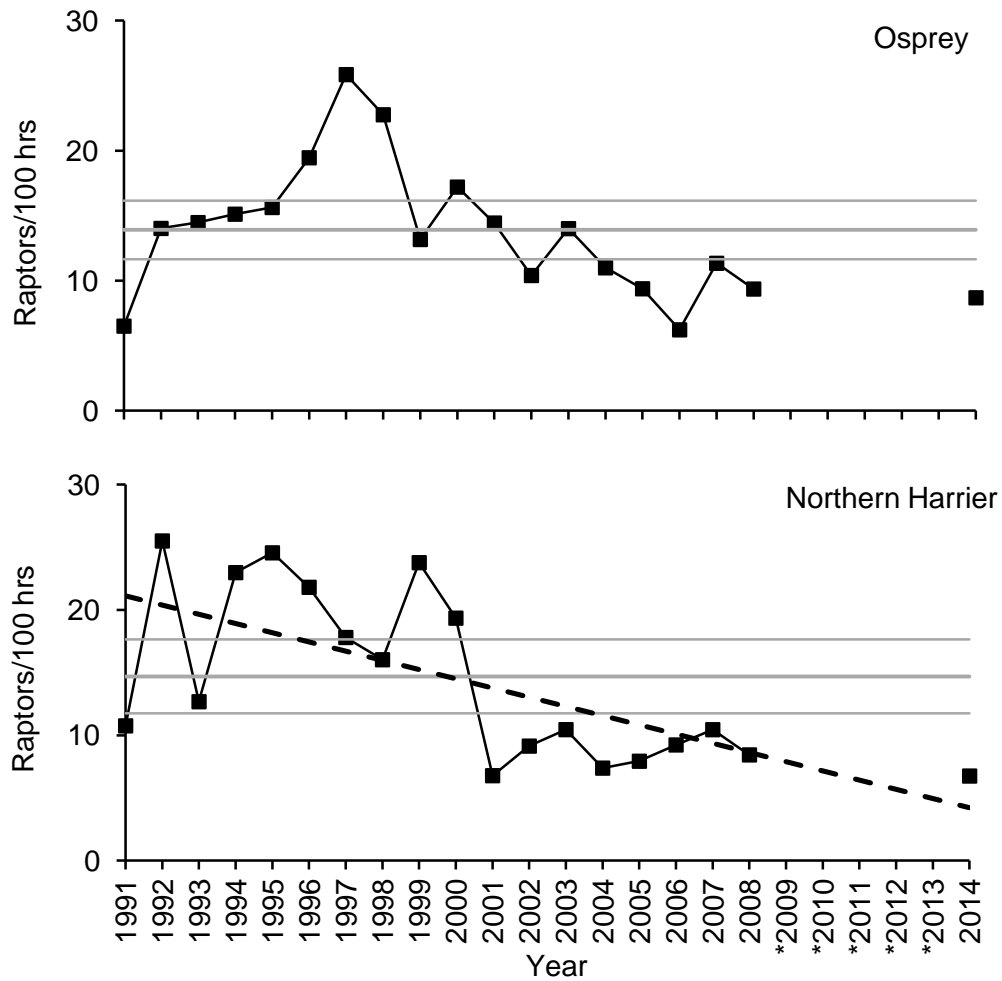


Figure 5a. Fall-migration passage rates for Osprey and Northern Harriers at Lipan Pt. in the Grand Canyon, AZ: 1991–2014. Dashed lines indicate significant ($p < 0.05$) population trends based on linear regressions. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (1991-2008) at Yaki Pt. Asterisk indicates a year with no counts.

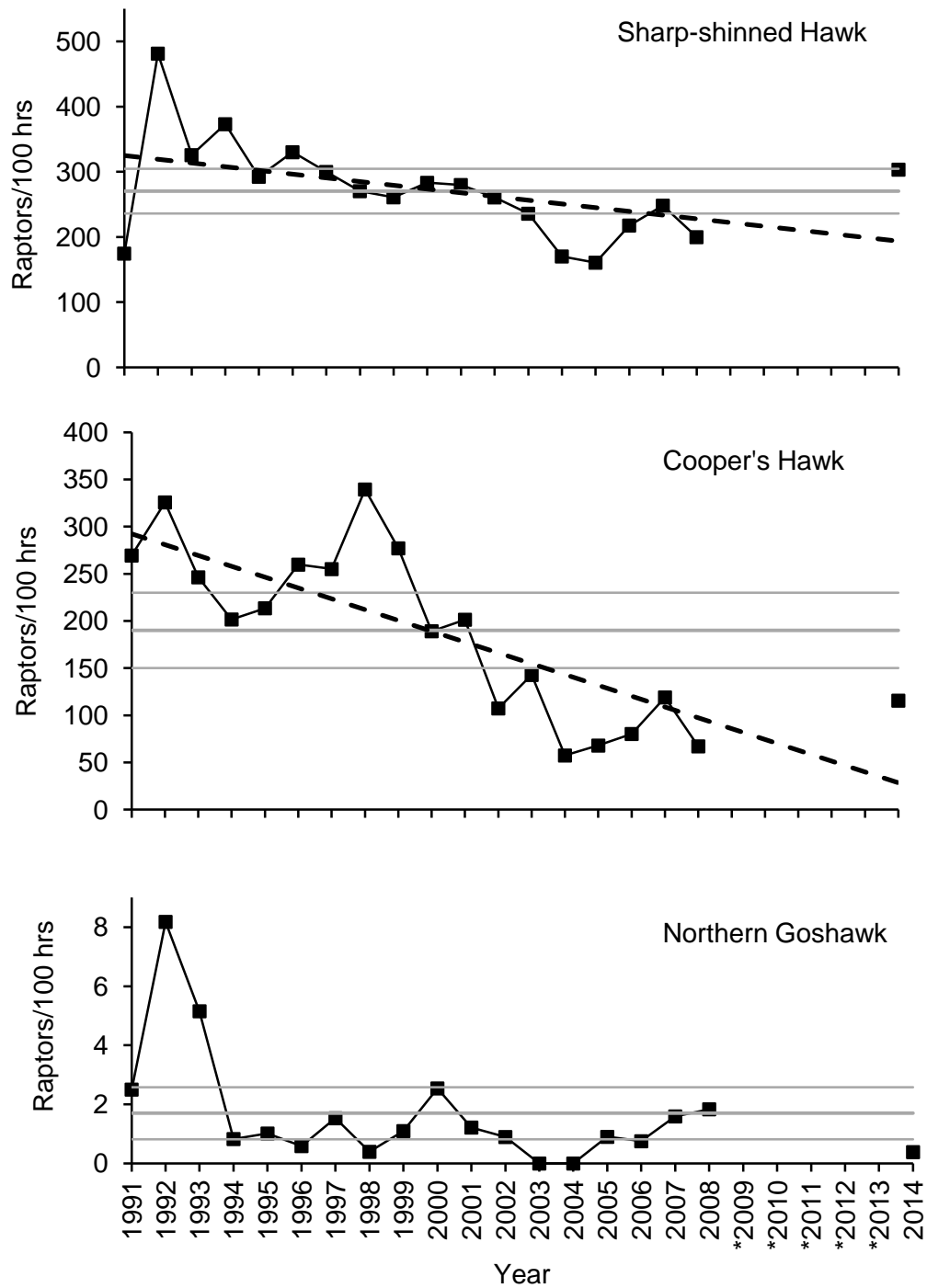


Figure 5b. Fall-migration passage rates for the three North American accipiter species at Lipan Pt. in the Grand Canyon, AZ: 1991–2014. Dashed lines indicate significant ($p < 0.05$) population trends based on linear regressions. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (1991-2008). Asterisk indicates a year with no counts.

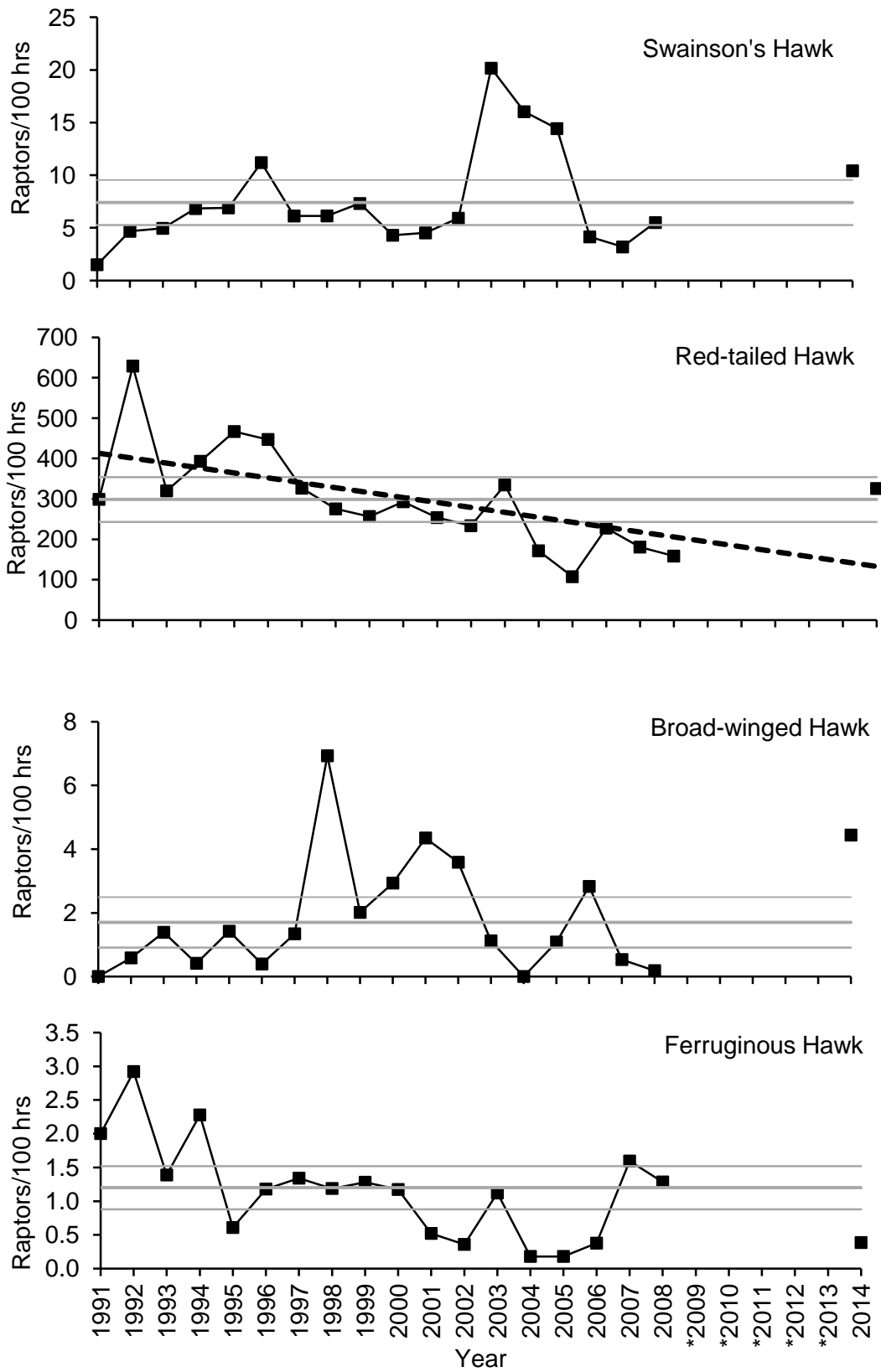


Figure 5c. Fall-migration buteo passage rates at Lipan Pt. in the Grand Canyon, AZ: 1991–2014. Dashed lines indicate significant ($p < 0.05$) population trends based on linear regressions. Solid grey lines represent mean (thick)

and upper and lower 95% confidence intervals (thin) of historic counts (1991-2008). Asterisk indicates a year with no counts.

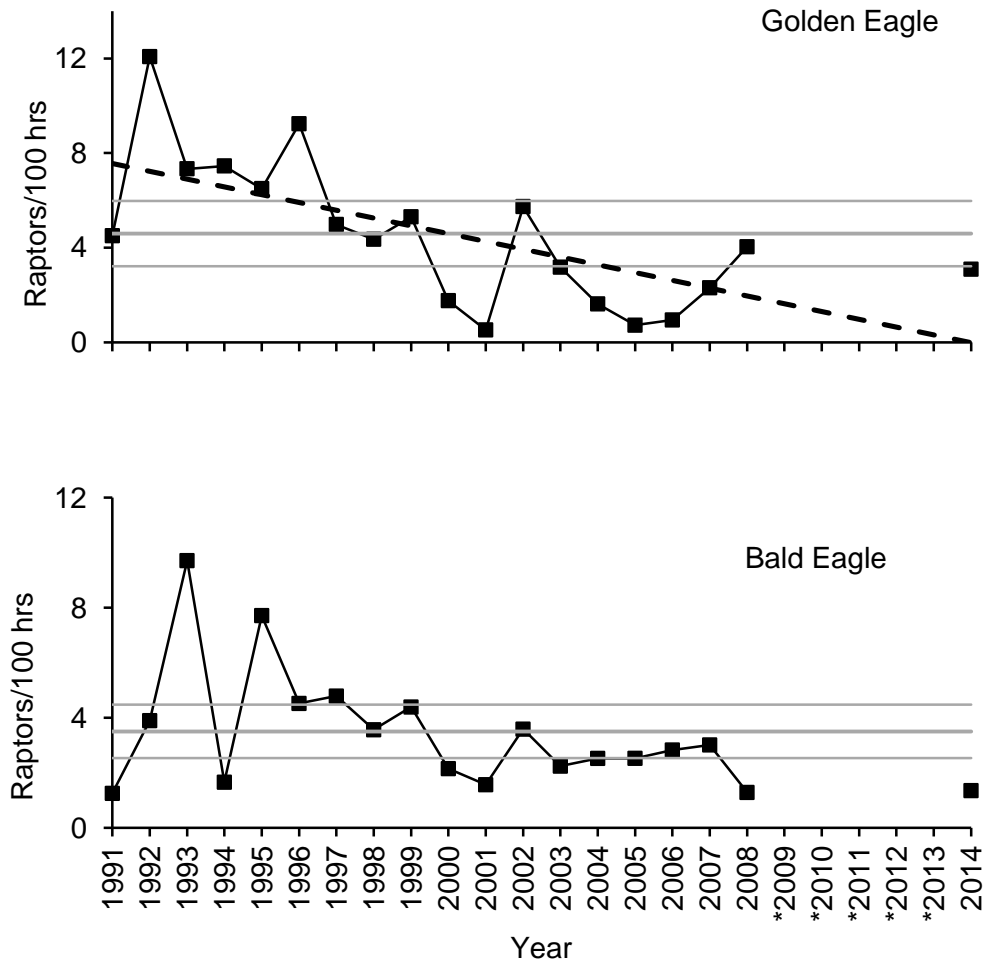


Figure 5d. Eagle fall-migration passage rates at Lipan Pt. in the Grand Canyon, AZ: 1991–2014. Dashed lines indicate significant ($p < 0.05$) population trends based on linear regression. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (1991-2008). Asterisk indicates a year with no counts.

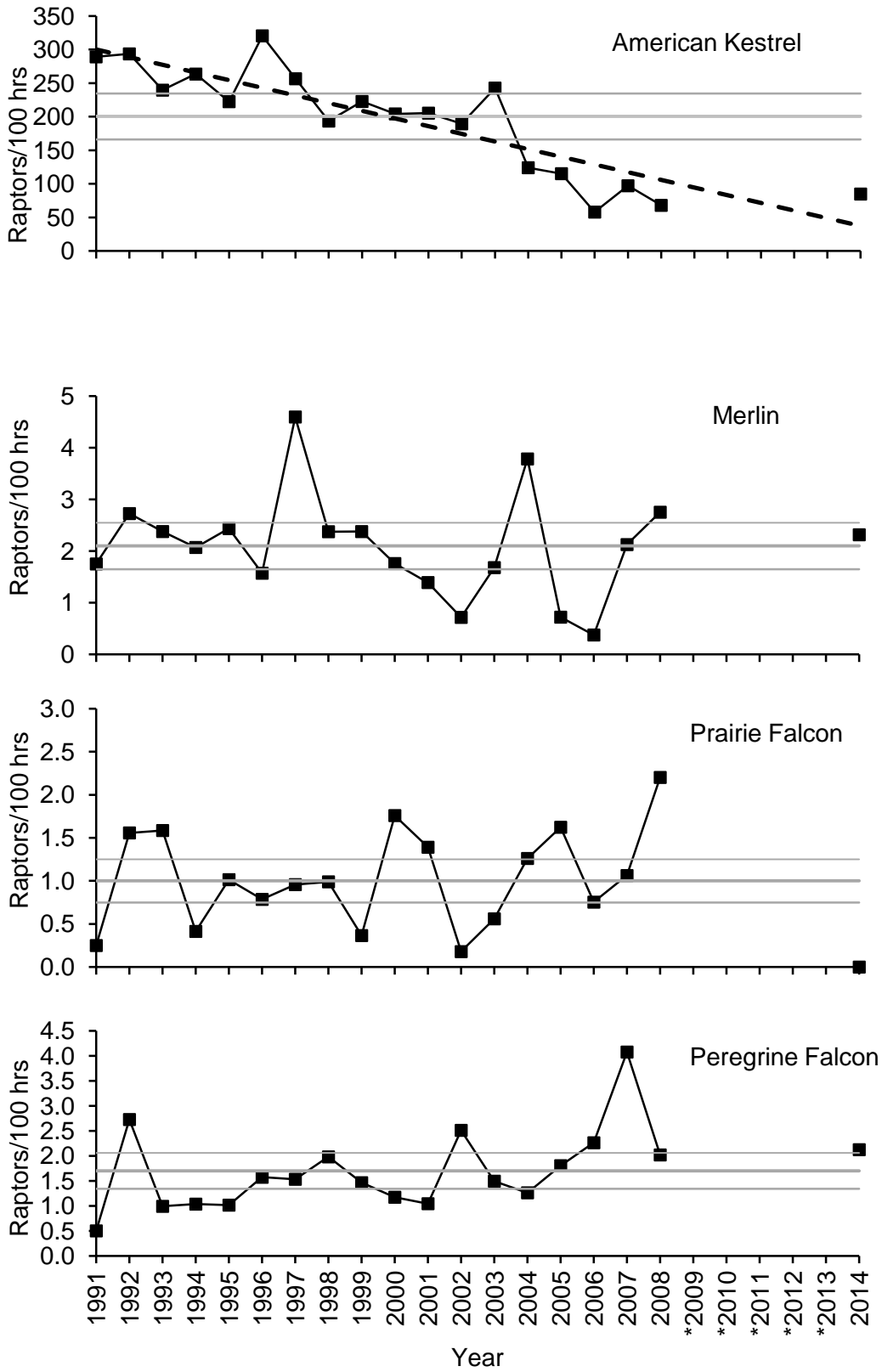


Figure 5e. Falcon effort-adjusted passage rates during fall migration at Lipan Point HawkWatch, Grand Canyon, AZ: 1991–2014. Dashed lines indicate significant ($p < 0.05$) population trends based on linear regression. Solid grey

lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (1991-2008). Asterisk indicates a year with no counts.

Appendix A. History of official observer participation in the Grand Canyon raptor migration studies: 1991–2014.

- 1991** Rotating team with at least two observers throughout at Lipan Pt.: Mark Cantrell (1), Phil West (0), Vickie O'Brien (0), Christie Van Cleve (0), and Don Rosie (0)
- 1992** Rotating team with at least two observers throughout at Lipan Pt.: Mark Cantrell (2), Daniel Perry (3), and Christie Van Cleve (1)
- 1993** Rotating team with at least two observers throughout at Lipan Pt.: Daniel Perry (4), Frank LaSorte (1), and Christie Van Cleve (2)
- 1994** Rotating team with at least two observers throughout at Lipan Pt. and 1–2 observers at Yaki Pt. for limited season: Daniel Perry (5), Justin Silcox (0), Amy Adams (0), Rod Adams (0), and Christie Van Cleve (3)
- 1995** Rotating team with at least two observers throughout at Lipan Pt.: Amy Adams (1), Elliot Swarthout (0), and Christie Van Cleve (4)
- 1996** Rotating team with at least two observers throughout at Lipan Pt.: Amy Adams (2), Elliot Swarthout (1), and Christie Van Cleve (5)
- 1997** Rotating team with at least two observers throughout at Yaki and Lipan Pts.: Sue Thomas (2), Scott Harris (2), Rusty Namitz (1), Annie Touliatos (0), and Christie Van Cleve (6)
- 1998** Rotating team with at least two observers throughout at Yaki and Lipan Pts.: Josh Lipton (4), Jackie Speicher (2), Stacy Prosser (1), Karen McDonald (0), and Christie Van Cleve (7)
- 1999** Rotating team with at least two observers throughout at Lipan Pt. and at least 1 and usually 2 observers throughout at Yaki Pt.: Scott Rush (1), Adam Hutchins (1), Steve Seibel (1), Christie Van Cleve (8), and Kate James (0).
- 2000** Rotating team with at least two observers throughout at Lipan Pt. and Yaki Pt.: Adam Hutchins (2), Steve Seibel (2), Geoff Evans (0), Jody Bartz (0), Christie Van Cleve (9), and Kate James (1).
- 2001** Rotating team with at least two observers throughout at Lipan Pt. and Yaki Pt.: Adam Hutchins (3), Jody Bartz (1), Paula Shannon (1), Tom Magarian (0), and Christie Van Cleve (10).
- 2002** Rotating team with at least two observers throughout at Lipan Pt. and Yaki Pt.: Allison Cebula (2), Corrie Borgman (1), Erin McEldowney (+), Toni Appleby (0), and Christi Van Cleve (11)
- 2003** Rotating team with at least two observers throughout at Lipan Pt. and Yaki Pt.: Jody Bartz (2), Mark Leavens (1), Ken Babcock (2 partial), and Grant Merrill (0).
- 2004** Rotating team with at least two observers throughout at Lipan Pt. and Yaki Pt.: Ken Babcock (2 + 2 partial), Kirsten McDonnell (4), Chadette Pfaff (1), and Scott Olmstead (0).
- 2005** Rotating team with at least two observers throughout at Lipan Pt. and Yaki Pt.: Surya Bahadur Gurung (1+), Brad Alexander (0), Alyson Webber (0), and Sarah Keller (0).
- 2006** Rotating team with at least two observers throughout at Lipan Pt. and Yaki Pt.: Sean Wolfe (1), Sumit Gurung (1+), Thuy-Vy Bui (0), and Geni Gellhaus (+).
- 2007** Rotating team with at least two observers throughout at Lipan Pt. and Yaki Pt.: Jennifer Good (2+), Graeme Davis (1), Tyler Hallman (0), and Jenny Aleman-Zometa (0).
- 2008** Rotating team with at least two observers throughout at Lipan Pt. and Yaki Pt.: Lyndia Hammer (2+), Lainie LaHaye (0), Shannon Longoria (0), Stephanie Newton (0), Kris Schuller (0), Mike Neal (10+).
- 2009** No counts
- 2010** No counts
- 2011** No counts
- 2012** No counts
- 2013** No counts
- 2014** Rotating team with at least two observers throughout at Lipan Pt. and Yaki Pt.: Frank Mayer (5), Amy Zimmerman (1), Frank Mayer (5), Steve Seibel (8+), Jermy Halka (1), Anna Butler (0), Melissa Murillo (0)

¹ Numbers in parentheses indicate previous full seasons of observation experience.

Appendix B. Common and scientific names, species codes, and regularly applied age, sex, and color-morph classifications for all diurnal raptor species observed during fall migration in the Grand Canyon, AZ.

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 small accipiter	<i>A. striatus</i> or <i>cooperii</i>	SA	U	U	NA
Unknown large accipiter	<i>A. cooperii</i> or <i>gentilis</i>	LA	U	U	NA
Unknown accipiter	<i>Accipiter</i> spp.	UA	U	U	NA
Red-shouldered Hawk	<i>Buteo lineatus</i>	RS	A I 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
Zone-tailed Hawk	<i>Buteo albonotus</i>	ZT	A I U	U	NA
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 small falcon	<i>F. sparverius</i> or <i>columbarius</i>	SF	U	U	NA
Unknown large falcon	<i>F. mexicanus</i> or <i>peregrinus</i>	LF	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 fall raptor migration counts by species at Lipan Point, Grand Canyon, AZ: 1991–2014.

YEAR	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Start date	8-Sep	1-Sep	31-Aug	1-Sep	1-Sep	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug
End date	5-Nov	5-Nov	5-Nov	5-Nov	5-Nov	5-Nov	5-Nov	5-Nov	5-Nov	5-Nov
Days of observation	57	65	66	64	65	69	70	68	71	67
Hours of observation	399.66	513.50	504.50	482.92	492.54	508.84	522.19	505.18	546.70	511.54
Raptors / 100 hours	1,231	1,957	1,249	1,372	1,369	1,574	1,331	1,283	1,152	1,107
SPECIES	RAPTOR COUNTS									
Osprey	26	72	73	73	77	99	135	115	72	88
Northern Harrier	43	131	64	111	121	111	93	81	130	99
Sharp-shinned Hawk	698	2,472	1,643	1,802	1,441	1,680	1,566	1,366	1,427	1,449
Cooper's Hawk	1,077	1,673	1,243	974	1,052	1,322	1,332	1,715	1,515	968
Northern Goshawk	10	42	26	4	5	3	8	2	6	13
Unknown accipiter	360	337	199	200	243	423	213	243	185	252
TOTAL ACCIPITERS	2,145	4,524	3,111	2,980	2,741	3,428	3,119	3,326	3,133	2,682
Red-shouldered Hawk	0	1	0	0	0	1	0	0	0	0
Broad-winged Hawk	0	3	7	2	7	2	7	35	11	15
Swainson's Hawk	6	24	25	33	34	57	32	31	40	22
Red-tailed Hawk	1,194	3,229	1,613	1,898	2,299	2,275	1,704	1,390	1,401	1,498
Ferruginous Hawk	8	15	7	11	3	6	7	6	7	6
Rough-legged Hawk	0	0	0	0	0	0	0	0	0	0
Zone-tailed Hawk	0	0	0	0	0	0	1	1	0	0
Unidentified buteo	55	19	2	8	11	16	33	40	17	15
TOTAL BUTEOS	1,263	3,291	1,654	1,952	2,354	2,357	1,784	1,503	1,476	1,556
Golden Eagle	18	62	37	36	32	47	26	22	29	9
Bald Eagle	5	20	49	8	38	23	25	18	24	11
Unidentified eagle	0	0	3	0	0	0	0	1	4	0
TOTAL EAGLES	23	82	89	44	70	70	51	41	57	20
American Kestrel	1,156	1,508	1,209	1,273	1,096	1,631	1,340	978	1,218	1,045
Merlin	7	14	12	10	12	8	24	12	13	9
Prairie Falcon	1	8	8	2	5	4	5	5	2	9
Peregrine Falcon	2	14	5	5	5	8	8	10	8	6
Unknown falcon	0	4	4	1	1	0	6	8	6	5
TOTAL FALCONS	1,166	1,548	1,238	1,291	1,119	1,651	1,383	1,013	1,247	1,074
Unknown raptor	106	124	24	66	48	60	97	96	107	48
GRAND TOTAL	4,920	10,048	6,301	6,625	6,745	8,008	6,952	6,479	6,297	5,664

Appendix C. continued

YEAR	2001	2002	2003	2004	2005	2006	2007	2008	2014	MEAN
Start date	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug	28-Aug	28-Aug
End date	5-Nov	5-Nov	5-Nov	5-Nov	5-Nov	5-Nov	5-Nov	5-Nov	5-Nov	4-Nov
Days of observation	71	69	70	68	70	70	71	71	66	68
Hours of observation	575.08	557.72	535.58	554.98	554.38	530.53	564.42	544.90	518.08	523
Raptors / 100 hours	1,008	901	1036	597	528	683	822	618	937.30	1,101
SPECIES										
Osprey	83	58	75	61	52	33	64	51	45	73
Northern Harrier	39	51	56	41	44	49	59	46	35	76
Sharp-shinned Hawk	1,609	1,455	1,263	945	891	1,155	1,401	1,089	1,572	1,408
Cooper's Hawk	1,158	599	765	319	377	426	672	366	599	975
Northern Goshawk	7	5	0	0	5	4	9	10	2	10
Unknown accipiter	101	245	82	124	134	229	593	286	281	247
TOTAL ACCIPITERS	2,873	2,304	2,110	1,388	1407	1814	2,675	1,751	2,454	2,640
Red-shouldered Hawk	0	0	0	0	0	0	0	0	0	1
Broad-winged Hawk	25	20	6	0	6	15	3	1	23	10
Swainson's Hawk	26	33	108	89	80	22	18	30	54	39
Red-tailed Hawk	1,458	1,302	1,791	951	594	1,207	1,019	862	1,687	1,538
Ferruginous Hawk	3	2	6	1	1	2	9	7	2	6
Rough-legged Hawk	0	1	0	0	0	0	0	0	0	1
Zone-tailed Hawk	0	1	2	0	0	0	0	5	0	2
Unidentified buteo	8	33	20	8	36	93	127	73	28	34
TOTAL BUTEOS	1,520	1,392	1,933	1,049	717	1,339	1,176	978	1,794	1,627
Golden Eagle	3	32	17	9	4	5	13	22	16	24
Bald Eagle	9	20	12	14	14	15	17	7	7	18
Unidentified eagle	0	3	0	0	0	0	1	2	0	2
TOTAL EAGLES	12	55	29	23	18	20	31	31	23	43
American Kestrel	1,180	1,057	1,300	689	639	308	549	371	440	1,030
Merlin	8	4	9	21	4	2	12	15	12	11
Prairie Falcon	8	1	3	7	9	4	6	12	0	6
Peregrine Falcon	6	14	8	7	10	12	23	11	11	9
Unknown falcon	8	4	1	2	6	34	14	54	4	9
TOTAL FALCONS	1,210	1,080	1,321	726	668	360	604	463	467	1,065
Unknown raptor	60	83	23	25	20	7	31	50	38	60
GRAND TOTAL	5,797	5,023	5,547	3,313	2,926	3,622	4,640	3,370	4,856	5,682