

FALL 2013 RAPTOR MIGRATION STUDIES AT YAKI POINT (GRAND CANYON), ARIZONA



HawkWatch International, Inc.
Salt Lake City, Utah



April 2014

**FALL 2013 RAPTOR MIGRATION STUDIES
IN THE GRAND CANYON OF ARIZONA**

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INTRODUCTION

The Grand Canyon Raptor Migration Project in northern Arizona is 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 sites 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 henceforth.

The Yaki Point station was 1 of 8 long-term, annual migration count studies operated or co-sponsored by HWI in North America during 2013. 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). 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. Yaki 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).

Beyond having scientific and conservation value, our migration studies offer unique opportunities for the public to learn about raptors and the natural environment. Providing such opportunities is an important component of the Grand Canyon Raptor Migration Project and HWI's overall mission, and with about five million people visiting the Grand Canyon National Park each year and easy accessibility, Yaki 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. Yaki Point provides a particularly good monitoring location because it lies 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).

Yaki Point is a popular canyon lookout located in Coconino County, Arizona along the south rim of the Grand Canyon. It can be accessed from Hwy 64, about 11.2 km northeast of the south entrance of the park. The observation site elevation is 2,213 m (36° 03' 31.0" N, 112° 05' 01.7" W; Figure 1), and provides superb views of the canyon to the west and north, but thick vegetation obscures the view towards

the east. The predominant vegetation consists of big sagebrush (*Artemisia tridentata*), cliffrose (*Cowania mexicana*), Utah juniper (*Juniperus osteosperma*), and two-needle pinyon (*Pinus edulis*).

METHODS

Two designated observers, occasionally relieved or supplemented by other trained staff and volunteers, conducted standardized daily counts of migrating raptors from a single traditional observation site at Yaki Point in 2013. Sanders Li Ho served as lead observer to start the season, but left at the end of September to take a full-time position as a biologist elsewhere. After this, Amy Zimmerman took over as lead observer. This was Amy's first season and she also served as site interpreter. David Millican and Timothy Alvey also served as observers for the 2013 fall migration count. (For a complete history of observer participation, see Appendix A).

Weather permitting, observations typically began by 0900 H Mountain Standard Time (MST) and ended by 1700 H MST. Data gathering and recording followed standardized protocols used at all HWI migration sites (Hoffman and Smith 2003). The observers routinely recorded 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 MST.
3. Wind speed and direction, air temperature, percent cloud cover, predominant cloud type(s), presence or 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 (high, moderate, low, none) for each hour, recorded on the hour.
7. Daily start and end times for each official observer.

Calculation of “adjusted” (to standardize sampling periods and adjust for incompletely identified birds) passage rates (migrants counted per 100 hours of observation) and analysis of trends updated through 2013 follows Farmer et al. (2007). In comparing 2013 annual statistics against means and 95% confidence intervals for previous seasons, we consider a count value falling outside the 95% confidence interval for historic site means as significantly different from the mean historic count.

2013 RESULTS AND DISCUSSION

Observation effort and weather summary

In 2013 observers were able to count on 71 of 71 possible days between 27 August and 5 November for a total of 606.33 overservation hours—an all time high (historic averages are 69 days and 543.23 observation hours, Appendix C). Only one day was affected by inclement weather (i.e., resulted in reduced observation time to ≤ 4 hours).

Weather varies throughout every season, in 2013 based on hourly recording of conditions during observations it was clear 49% of the time, hazy 47% of the time, and rainy 18% of the time.

FLIGHT SUMMARY

2013 Overall Flight

In 2013 observers counted 4493 migrant raptors of 16 species, which was slightly below (-7%) but not significantly ($\alpha = 0.05$) different than the historic site average of 4,808 birds (Table 1). The flight consisted of 59.3% accipiters, 27.8% buteos, 10.1% falcons, 1.4% Ospreys, 0.9% harriers, 0.3% eagles, and 0.1% unidentified raptors. The proportions of buteos and Ospreys were above average; falcons and eagles were below average; and accipiters and harriers consistent with historic levels (Fig. 2). As per normal, Sharp-shinned Hawks were the most commonly observed species (34% of the total), followed by Red-tailed Hawks (25%), Cooper's Hawks (22%), then American Kestrels (9%). The remainder of species comprised 1%, or less of the fall 2013 flight (Table 1).

The following sections summarize the 2013 count relative to historic means at Yaki Point, and any statistically significant ($p < 0.05$) or near significant ($p < 0.1$) population trends 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.

Osprey and Northern Harriers (Fig. 3a):

In 2013 the crew counted a record number of Osprey (61 total) passing by Yaki Point (Table 1). The 2013 fall migration count for Northern Harriers was in line with historic averages.

Accipiters (Fig. 3b):

Sharp-shinned Hawk and Northern Goshawk counts were below historic (1997-2010) averages, and 2013 was an average year for Cooper's Hawks. Regional populations for all three of accipiter species at this site over the years are stable based on migration count data (no significant trend).

Buteoine Hawks (Fig. 3c):

The 2013 count of Broad-winged Hawks (21 total, 7.7/100hrs) was well above average, in fact the highest year on record. Ferruginous Hawk counts were also above average, and there was also Rough-legged Hawk sighting, very rare for this site. It was an average year for Red-Tailed Hawks and Swainson's Hawks at Yaki Point. All buteo species with average counts > 10 birds/100 hours (Red-Tailed Hawk and Swainson's Hawk) are stable (no significant trend) over the life of the site.

Eagles (Fig.3d):

In 2013 observers counted two Golden Eagles and twelve Bald Eagles, both significantly below long-term averages (Table 1). While neither eagle species migrates through Yaki Point at high enough levels to confidently assess long-term regional population trends, it should be noted that Golden Eagle counts have

been below the historic site average since 2004, consistent with overall population declines documented throughout western (Farmer et al. 2008) and eastern (Katzner et al. 2012) North America.

Falcons (Fig.3e):

Merlins and American Kestrels counts at Yaki Point were lower than historic averages 2013. The Merlin count was an all time low for Yaki Point (3 total, 0.6 birds/100 hrs observation). American Kestrels continue a long-term decline at Yaki Point ($r^2 = 0.53$, $p = 0.003$), similar to findings at other sites in the west and across its range (Farmer and Smith 2009). Based on findings from Yaki Point and other regional monitoring sites across North America, HWI, along with other North American researchers and Citizen Scientists have partnered to understand these declines locally and at the continental scale under the umbrella of the American Kestrel Partnership (<http://kestrel.peregrinefund.org/>). The 2013 flight saw above average counts for Peregrine Falcons and average numbers of Prairie Falcons.

VISITOR PARTICIPATION AND PUBLIC OUTREACH

A total of 1,104 individuals visited Yaki Point in 2013. Visitors came from 40 US states and 22 foreign countries including: Canada, Mexico, Australia, U.K., Belgium, Czech Republic, Ireland, Italy, Brazil, Germany, France, Sweden, Scotland, South Africa, Austria, China, Switzerland, New Zealand, Spain, Russia, Turkey, and Israel. Participants learn about raptor biology, migration ecology, and what counting and banding efforts can tell us about the status of both regional raptor populations and the health of the landscapes they use. At the Grand Canyon, visitors also learn about the unique features of the Grand Canyon itself which makes it a spectacular place to watch raptors. It is one of the few places where you can stand on one of the Natural Wonders of the World and have a hawk fly right past your head. This past fall Grand Canyon National Park was given the prestigious distinction as a Global Important Bird Area, in part because of HWI's migration monitoring efforts. The 2014 season will see ceremonies at the park to commemorate this designation.

ACKNOWLEDGMENTS

Funding for this year's project was provided by NextEra Energy Resources, the Grand Canyon Association, 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. We especially thank the many park rangers, interpreters, biologists, and law enforcement personnel at the Grand Canyon National Park for constant encouragement and logistical support.

Finally, enormous thanks and appreciation to the members of our 2013 field crew: Amy Zimmerman, David Millican, Timothy Alvey, and Sanders Li Ho. Without your skill, dedication, and willingness to brave the elements over the course of a long field season, these efforts would not be possible.

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Table 1. Fall counts and adjusted passage rates (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) by species for migrating raptors at Grand Canyon, AZ (Yaki Point data only): 1997–2010 versus 2013.

SPECIES	COUNTS			RAPTORS / 100 HOURS		
	1997–2010 ¹	2013	% CHANGE	1997–2010 ¹	2013	% CHANGE
Osprey	40 ± 5.0	61	+54	9.3 ± 0.71	12.8	+38
Northern Harrier	41 ± 4.1	42	+3	8.3 ± 0.60	7.9	-6
Sharp-shinned Hawk	1,667 ± 196.9	1,506	-10	422.3 ± 28.16	337.2	-20
Cooper's Hawk	957 ± 187.0	969	+1	279.3 ± 29.20	261.3	-6
Northern Goshawk	7 ± 2.8	3	-60	1.6 ± 0.35	0.8	-52
Unknown small accipiter	187 ± 108.7	165	-12	–	–	–
Unknown large accipiter	16 ± 16.8	12	-23	–	–	–
Unknown accipiter	83 ± 35.5	9	-89	–	–	–
TOTAL ACCIPITERS	2,854 ± 366.0	2,664	-7	–	–	–
Red-shouldered Hawk	0.1 ± 0.2	0	-100	–	–	–
Broad-winged Hawk	11 ± 3.1	21	+91	4.4 ± 0.76	7.7	+77
Swainson's Hawk	37 ± 21.0	50	+37	10.4 ± 3.46	13.8	+33
Red-tailed Hawk	970 ± 95.2	1126	+16	208.4 ± 11.38	210.8	+1
Ferruginous Hawk	6 ± 1.6	10	+73	1.3 ± 0.23	2.1	+59
Rough-legged Hawk	0 ± 0.4	1	+160	–	–	–
Zone-tailed Hawk	0.6 ± 0.8	0	-100	–	–	–
Unidentified buteo	33 ± 15.4	42	+27	–	–	–
TOTAL BUTEOS	1,057 ± 112.8	1,250	+18	–	–	–
Golden Eagle	8 ± 4.1	2	-75	1.5 ± 0.46	0.3	-77
Bald Eagle	20 ± 5.8	12	-39	5.1 ± 0.81	2.6	-49
Unidentified eagle	0.5 ± 0.5	0	-100	–	–	–
TOTAL EAGLES	29 ± 9.7	14	-51	–	–	–
American Kestrel	727 ± 147.1	424	-42	198.2 ± 22.18	107.2	-46
Merlin	12 ± 2.7	3	-75	2.5 ± 0.32	0.6	-74
Prairie Falcon	5 ± 1.4	7	+30	1.2 ± 0.21	1.4	+11
Peregrine Falcon	10 ± 2.7	16	+58	2.2 ± 0.37	2.9	+35
Unknown small falcon	6 ± 5.5	5	-21	–	–	–
Unknown large falcon	2.7 ± 2.1	1	-63	–	–	–
Unknown falcon	3 ± 0.9	2	-28	–	–	–
TOTAL FALCONS	764 ± 141.2	458	-40	–	–	–
Unidentified Raptor	24 ± 9.4	4	-84	–	–	–
GRAND TOTAL	4,808 ± 546.2	4,493	-7	–	–	–

¹ Mean of annual values ± 95% confidence interval.

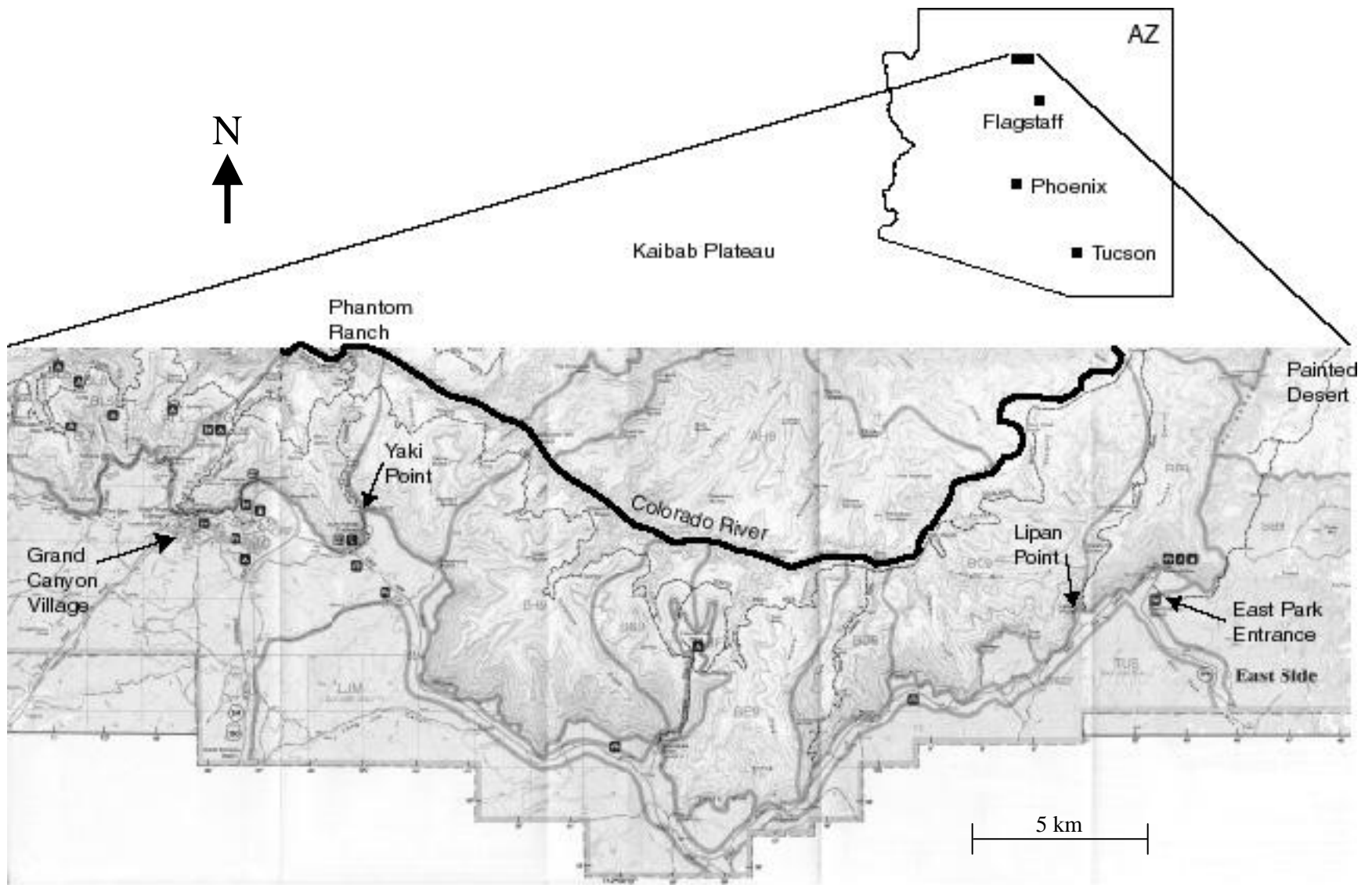


Figure 1. Map showing the Lipan Point and Yaki Point raptor-migration study sites in the Grand Canyon, Arizona.

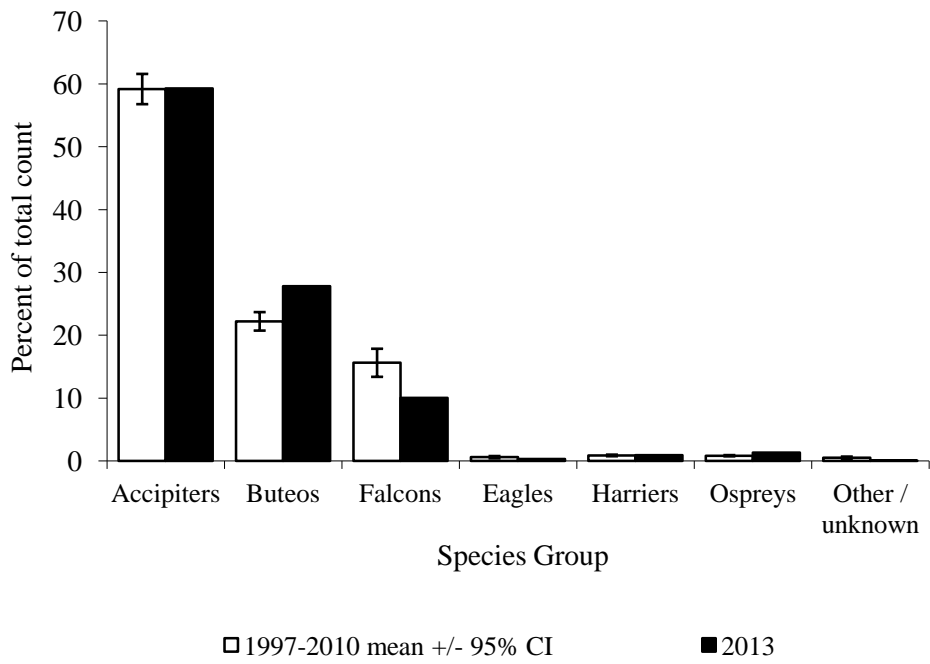


Figure 2. Fall raptor-migration flight composition by major species groups at Yaki Point in the Grand Canyon, AZ: 1997–2010 versus 2013.

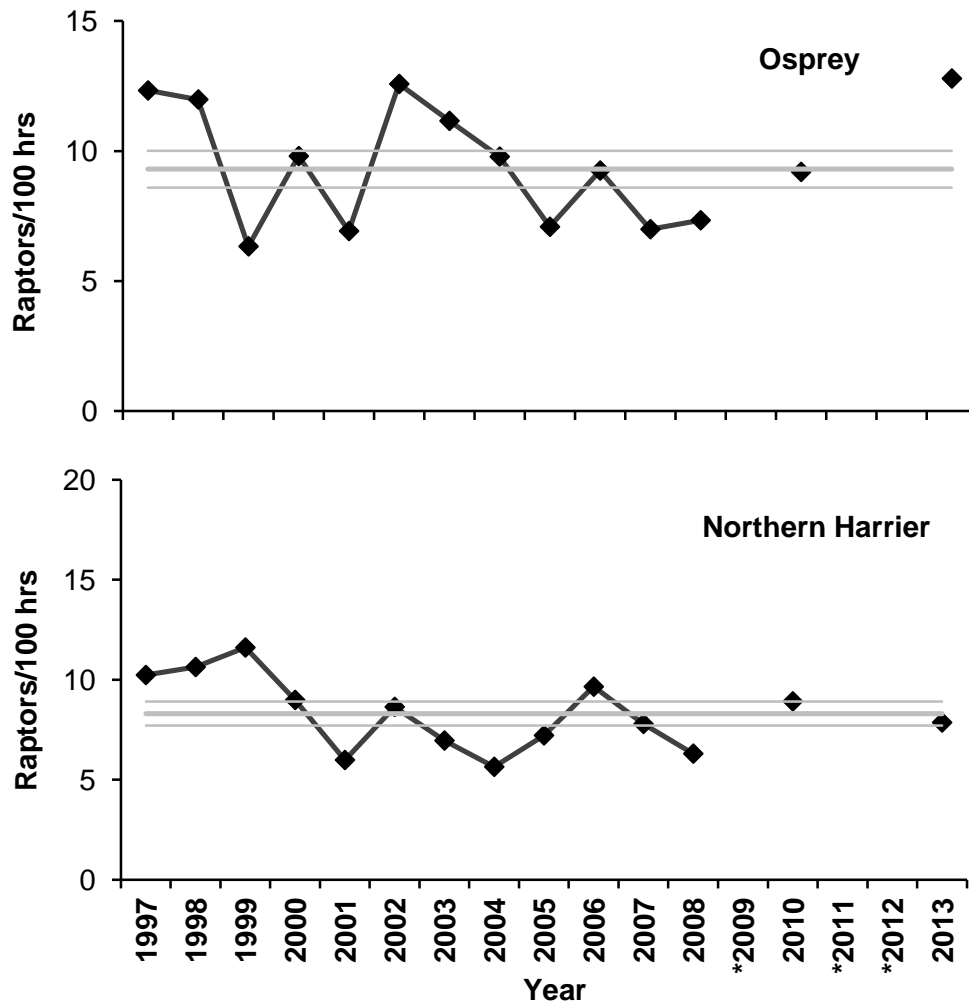


Figure 3a. Adjusted fall-migration passage rates for Osprey and Northern Harriers at Yaki Pt. in the Grand Canyon, AZ: 1997–2013. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (1997-2010) at Yaki Pt. Asterisk indicates a year with no counts.

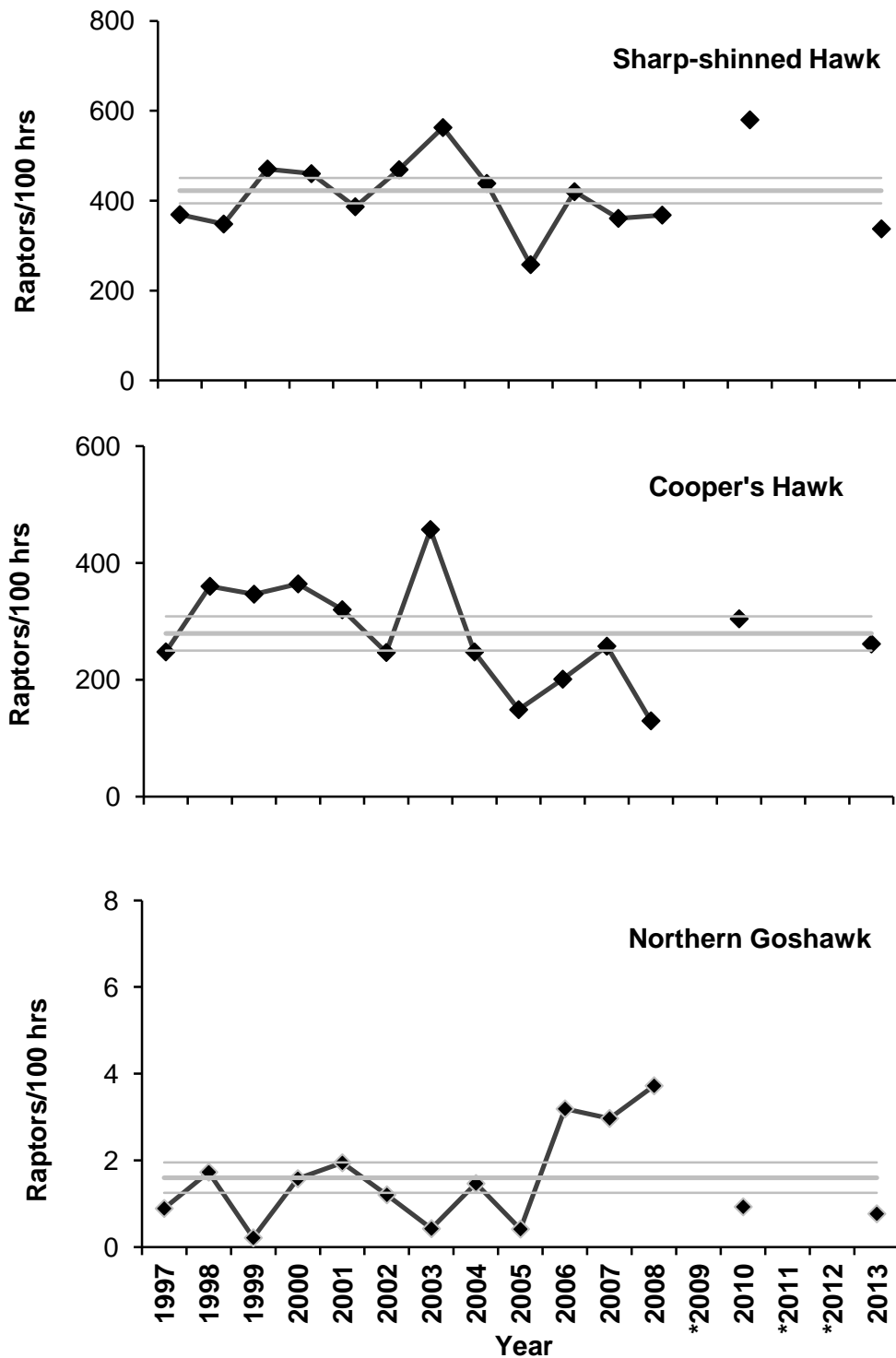


Figure 3b. Adjusted fall-migration passage rates for the three North American accipiter species at Yaki Pt. in the Grand Canyon, AZ: 1997–2013. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (1997-2010). Asterisk indicates a year with no counts.

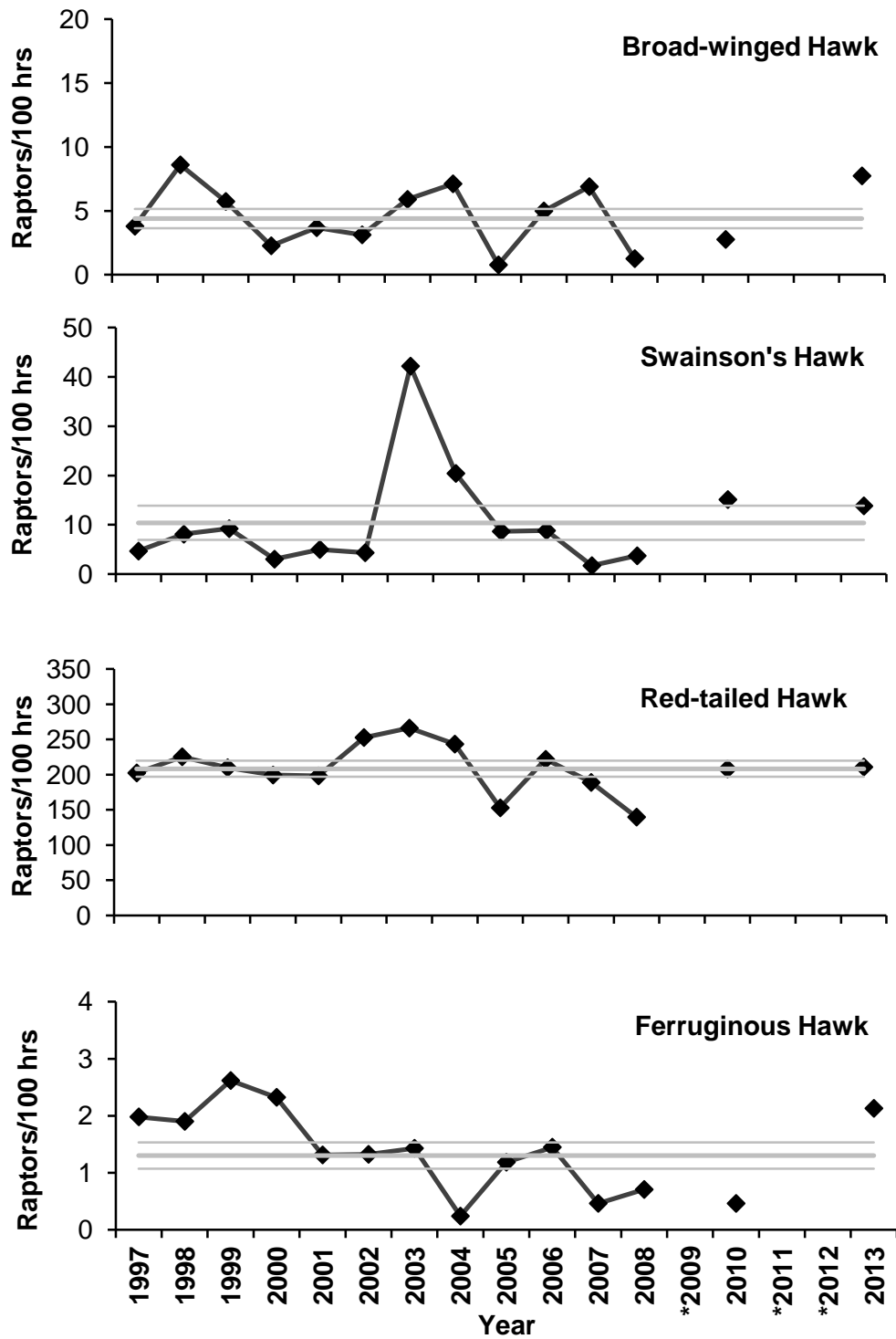


Figure 3c. Adjusted fall-migration buteo passage rates at Yaki Pt. in the Grand Canyon, AZ: 1997–2013. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (1997–2010). Asterisk indicates a year with no counts.

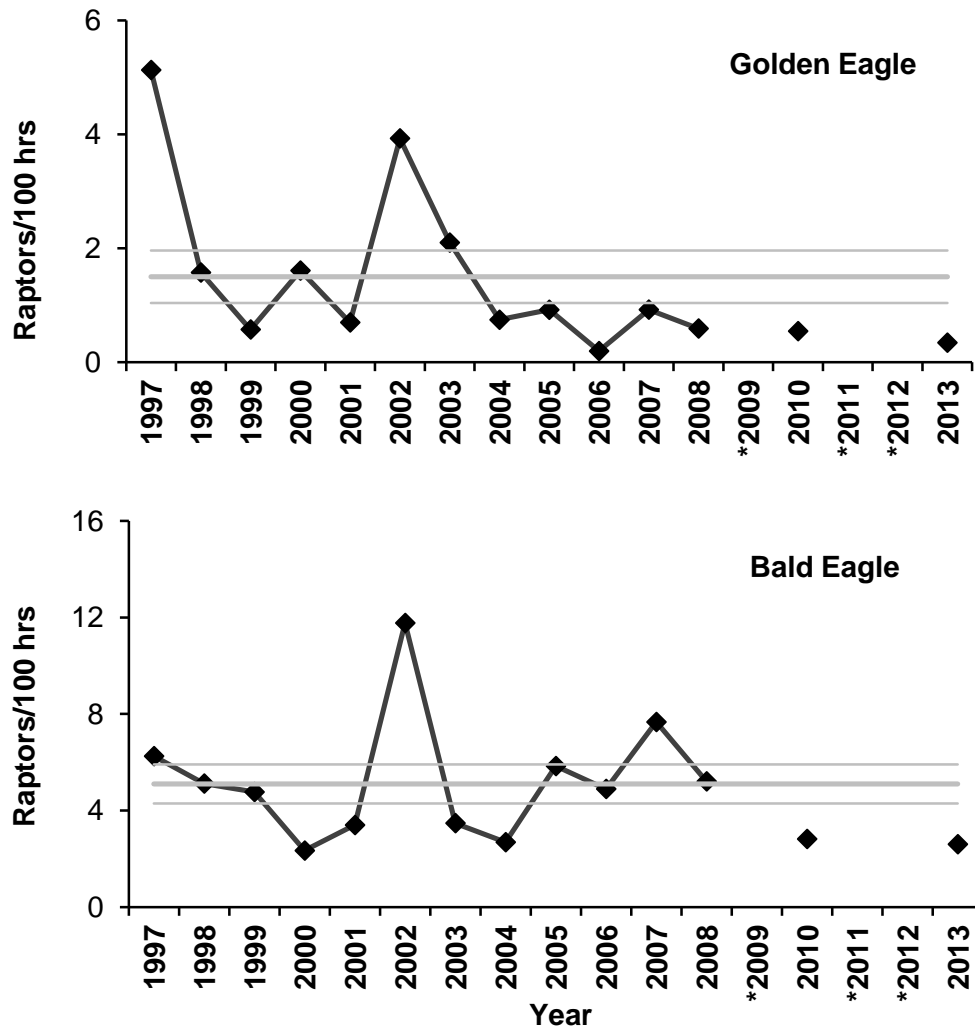


Figure 3d. Adjusted eagle fall-migration passage rates at Yaki Pt. in the Grand Canyon, AZ: 1997–2013. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (1997-2010). Asterisk indicates a year with no counts.

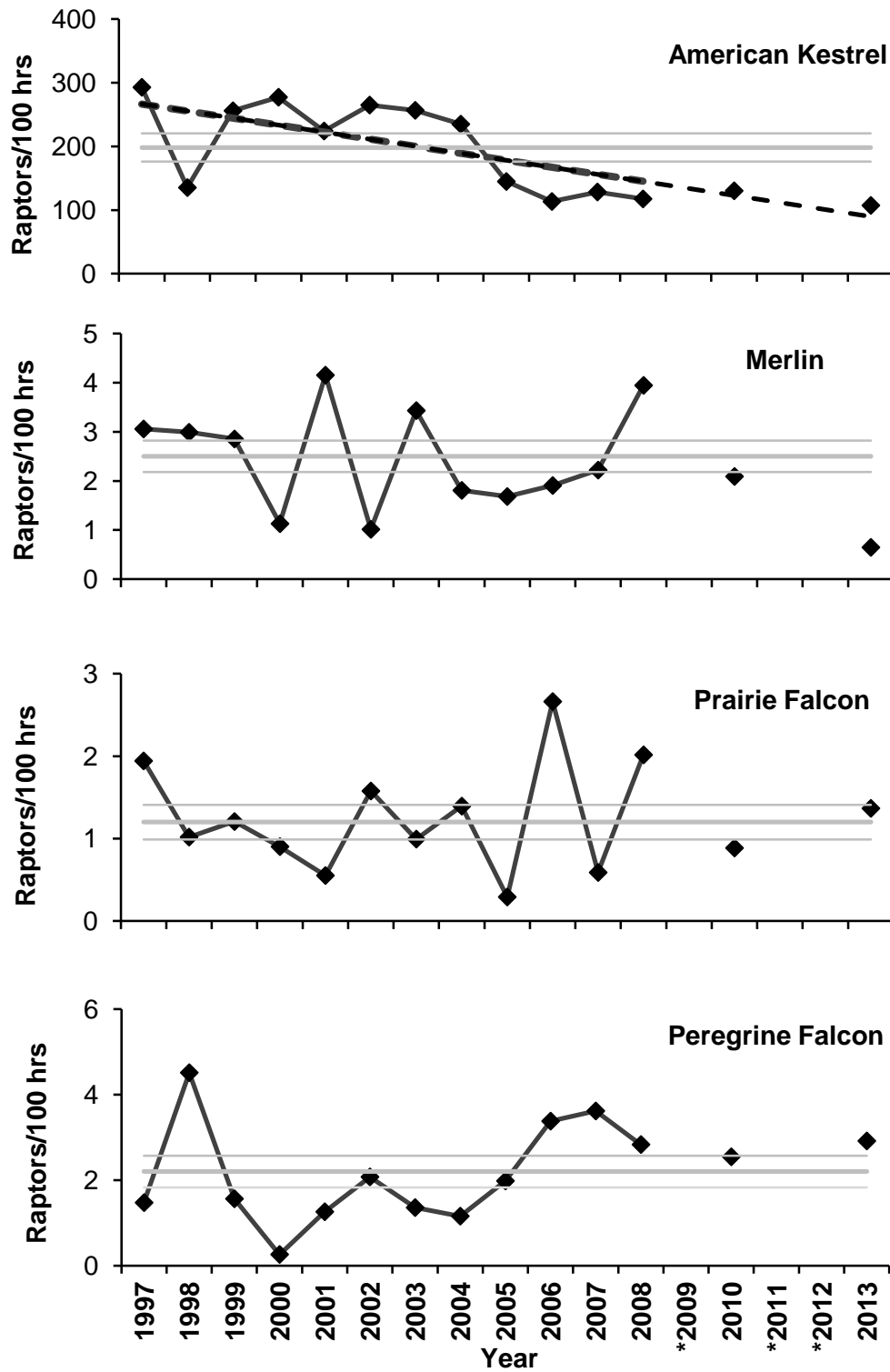


Figure 3e. Adjusted falcon fall-migration passage rates at Yaki Pt. in the Grand Canyon, AZ: 1997–2013. Dashed lines indicate significant ($p < 0.05$) population trends based on linear regressions. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (1997-2010). Asterisk indicates a year with no counts.

Appendix A. History of official observer participation in the Grand Canyon raptor migration studies: 1991–2013.

- 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** Two observers throughout at Yaki Pt. only: Kimberly Cullen (2), Christine Duffy (0), Felipe Guerrero (0)
- 2011** No counts
- 2012** No counts
- 2013** Two observers throughout at Yaki Pt. only: Amy Zimmerman (0), David Millican (+), Timothy Alvey (0), Sanders Li Ho (+)

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 Yaki Point, Grand Canyon, AZ: 1997–2013.

YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005
Start date	27-Aug	28-Aug	27-Aug	27-Aug	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
Days of observation	71	66	71	66	71	71	70	68	70
Hours of observation	504.97	455.41	543.20	513.10	595.59	585.70	547.90	559.40	570.48
Raptors / 100 hours	938	908	998	1054	881	968	1229	932	556
SPECIES	RAPTOR COUNTS								
Osprey	50	43	28	43	34	57	50	42	31
Northern Harrier	50	44	56	41	31	45	35	29	38
Sharp-shinned Hawk	1,474	1,190	1,906	1,772	1,792	1,932	2,323	1,743	1,008
Cooper's Hawk	856	1,109	1,204	1,256	1,293	891	1,673	855	516
Northern Goshawk	4	7	1	9	11	6	2	7	2
Unknown small accipiter ¹	–	–	–	–	72	218	52	122	108
Unknown large accipiter ¹	–	–	–	–	0	3	1	1	4
Unknown accipiter	94	140	109	236	0	18	103	125	15
TOTAL ACCIPITERS	2,428	2,446	3,220	3,273	3,168	3,068	4,154	2,853	1,653
Red-shouldered Hawk	1	0	0	0	0	0	0	0	0
Broad-winged Hawk	9	19	14	6	11	8	14	19	2
Swainson's Hawk	15	25	32	10	19	16	147	80	32
Red-tailed Hawk	899	916	985	892	1,008	1,234	1,264	1,169	765
Ferruginous Hawk	8	7	11	10	6	6	6	1	6
Rough-legged Hawk	0	0	0	1	1	2	0	0	0
Zone-tailed Hawk	0	0	1	0	1	1	0	0	0
Unidentified buteo	20	20	13	8	8	43	42	17	24
TOTAL BUTEOS	952	987	1,056	927	1,054	1,310	1,473	1,286	829
Golden Eagle	24	7	2	11	4	23	11	4	5
Bald Eagle	23	18	17	9	14	49	14	10	22
Unidentified eagle	1	0	1	0	0	1	0	0	0
TOTAL EAGLES	48	25	20	20	18	73	25	14	27
American Kestrel	1,016	423	918	1,035	881	1,011	943	930	555
Merlin	14	12	14	5	22	5	17	9	9
Prairie Falcon	9	4	6	4	3	8	5	7	2
Peregrine Falcon	7	19	8	1	7	11	7	6	11
Unknown small falcon ¹	–	–	–	–	0	3	0	0	1
Unknown large falcon ¹	–	–	–	–	0	1	0	0	2
Unknown falcon	0	4	2	3	2	4	1	4	3
TOTAL FALCONS	1,046	462	948	1,048	915	1,043	973	956	583
Unidentified raptor	20	38	16	10	25	71	23	36	12
GRAND TOTAL	4,594	4,045	5,344	5,362	5,245	5,667	6,733	5,216	3,173

¹ New designations used regularly beginning in 2001 (see Appendix B).

Appendix C. continued

YEAR	2006	2007	2008	2010	2013	MEAN
Start date	27-Aug	27-Aug	1-Sep	27-Aug	27-Aug	26-Aug
End date	4-Nov	5-Nov	5-Nov	5-Nov	5-Nov	4-Nov
Days of observation	70	71	66	71	71	69
Hours of observation	533.33	566.76	514.09	572.42	606.33	543.23
Raptors / 100 hours	771	750	645	951	741.0	885
SPECIES	RAPTOR COUNTS					
Osprey	37	29	30	42	61	40
Northern Harrier	45	38	35	45	42	41
Sharp-shinned Hawk	1,627	1,417	1,417	2,065	1,506	1,667
Cooper's Hawk	695	761	417	911	969	957
Northern Goshawk	14	12	18	4	3	7
Unknown small accipiter ¹	118	298	112	582	165	187
Unknown large accipiter ¹	4	79	29	19	12	16
Unknown accipiter	14	88	51	87	9	83
TOTAL ACCIPITERS	2,472	2,655	2,044	3,668	2,664	2,854
Red-shouldered Hawk	0	0	0	0	0	0
Broad-winged Hawk	12	18	3	8	21	11
Swainson's Hawk	30	9	10	51	50	37
Red-tailed Hawk	995	903	641	934	1,126	970
Ferruginous Hawk	6	3	3	2	10	6
Rough-legged Hawk	1	0	0	0	1	0
Zone-tailed Hawk	0	0	5	0	0	1
Unidentified buteo	48	36	34	116	42	33
TOTAL BUTEOS	1,092	969	696	1,111	1250	1,057
Golden Eagle	1	5	4	2	2	8
Bald Eagle	18	30	20	10	12	20
Unidentified eagle	0	3	0	1	0	1
TOTAL EAGLES	19	38	24	13	14	29
American Kestrel	384	475	395	485	424	727
Merlin	9	12	18	10	3	12
Prairie Falcon	9	2	8	3	7	5
Peregrine Falcon	13	19	12	11	16	10
Unknown small falcon ¹	15	1	16	21	5	5
Unknown large falcon ¹	10	2	4	5	1	3
Unknown falcon	2	1	5	5	2	3
TOTAL FALCONS	442	512	458	540	458	764
Unidentified raptor	6	8	31	23	4	24
GRAND TOTAL	4,113	4,249	3,318	5,442	4,493	4,808

¹ New designations used regularly beginning in 2001 (see Appendix B).