FALL 2015 RAPTOR MIGRATION REPORT

YAKI POINT HAWKWATCH - GRAND CANYON, ARIZONA

HawkWatch International, Inc.

Salt Lake City, Utah

February 2016

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INTRODUCTION

The Grand Canyon HawkWatch 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 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 2015, with support from partners at the Park, and the Grand Canyon Association, HWI monitored fall migration at Yaki Point for the 16th season.

The Yaki Point HawkWatch was 1 of 8 long-term, annual migration counts operated or co-sponsored by HWI in North America during 2015. 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). 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).

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 Yaki Point HawkWatch and HWI's overall mission. 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 ecosystems of the Grand Canyon National Park in general.

STUDY SITE

The migration over the Grand Canyon is unique among sites in HWI's network 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 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 2015 counts and passage rates against means and 95% confidence intervals for previous seasons, we consider a count value falling outside the 95% confidence interval of the historical 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.

2015 RESULTS AND DISCUSSION

Observation effort and weather summary

Yaki Point HawkWatch's standard season runs 27 August – 5 November; in 2015 observers were able to count on 68 possible days during this period for a total of 568.3 hours—historic averages are 69 days and 543.23 observation hours (Appendix C). Three additional days were affected by inclement weather (i.e., resulted in reduced observation time $\leq$ 4 hours). Weather varies throughout every season, in 2015 based on hourly recording of conditions during observation it was clear 38% of the time, partly cloudy 21% of the time, and mostly cloudy/overcast 41% of the time; with precipitation 12% of the time.

FLIGHT SUMMARY

2015 Overall Flight

A total of 7,290 migrant raptors of 15 species were counted in 2015, making this the all-time record year for migrating raptors counted at the Yaki Point HawkWatch (Table 1). Additionaly highlights this season included record high counts for Broad-winged Hawks (47), Osprey (75) and Red-tailed Hawks (1,723).

The flight consisted of 61.4 % accipiters, 27.2% buteos, 8.7 % falcons, 1% Ospreys, 0.8 % harriers, 0.2% eagles, and 0.7% unidentified raptors. The proportions of buteos and Ospreys were above average; accipiters, eagles, and harriers were consistent with historic levels, and falcons were below average (Fig. 2). Sharp-shinned Hawks were the most commonly observed species (30% of the total), followed by Red-tailed Hawks (24%), Cooper's Hawks (21%), then American Kestrels (8%). The remainder of species comprised 1%, or less (Table 1).

The following sections summarize the 2015 count relative to historic means, and any stastistically significant ($p < 0.05$) population trends based on first and second order linear regression analysis of effort adjusted passage rates. 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 thrshold 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 record 1,283 raptors counted per 100 hours of observation at Yaki Point in 2015 is significantly higher than the historic site average; despite this record year no change over time in the overall flight is indicated by regression anaylsis.

Osprey and Northern Harriers (Fig. 5a):

Osprey count (75) and passage rate (13 birds/100 hr) were the highest ever documented at Yaki Point (Table 1). Northern Harrier count (55) and passage rate (10 birds/100 hr) were above average in 2015 compared to site averages, the first above average count for this species since 2006.

Accipiters (Fig. 5b):

The 2015 Accipiter was significantly above average, in fact it set a new site record (Table1) and was driven by second highest counts ever recorded at the Yaki Point HawkWatch for both Sharp-shinned Hawks (2,909) and Cooper's Hawks (1,538). Northern Goshawk counts and passage rates were significantly low for the fourth straight year of observation. Regression analyses of the long-term passage rates indicate that regional populations of Sharp-shinned Hawk and Cooper's Hawk are stable (no significant trend).

Buteoine Hawks (Fig. 5c):

Record high counts of Broad-winged Hawks (47), Red-tailed Hawks (1,723), and the second biggest flight of Swainson's Hawks (138) led to the largest flight of Buteos ever seen at Yaki Point (Table 1).

Analyses of long-term trends indicate that Red-Tailed Hawk regional populations are stable (no significant trend) based on migration counts.

Eagles (Fig.5d):

Only one Golden Eagle and eleven Bald Eagles were counted at Yaki Point in 2015, both significantly below historical site averages. Despite mean passage rates below the 10 per 100 hr threshold, it is worth noting that Golden Eagle passage rates at Yaki Point have been declining annually (slope= -0.14, r^2 =0.37, F=8.03, p=0.013) 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):

It was an average year for the flights of all falcon species in 2015 (Table 1). An average year for American Kestrels is a positive thing given recent below average counts and passage rates; despite this reversal regression analysis still suggests long-term declines in regional Kestrel populations (slope= -6.0, r^2 = 0.49, F=13.6, p= 0.002). 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 2,950 individuals spent time with HWI crews at Yaki Points to watch hawks together and learn about their migration, natural history, ecology, the Grand Canyon National Park, and some of the threats that raptors face. These visitors came from 38 US states, and 20 foreign countries, including: Australia, Brazil, Canada, Denmark, France, Germany, Holland, India, Israel, Italy, S. Korea, New Zealand, Philippines, Republic of South Africa, Singapore, Sweden, Switzerland, Taiwan, and the U.K.

2015 FALL MIGRATION ACROSS HWI'S NETWORK

HawkWatch International and partners operated 8 fall count sites in 2015(Fig. 1). During the 4,252 hours of standardized observation we counted 700,457 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 2015 included (Table 2):

- Above average or average counts at 6 of 8 sites
    - Exceptions were Chelan Ridge and Manzano Mountain sites which had significantly low counts.
- Below average Golden Eagle counts at 6 of 8 sites—only above average count was at Commissary Ridge, WY
- Below historic average American Kestrel counts at 6 of 9 sites

- Significantly low counts of all accipiter species at both Pacific Northwest sites
- Significantly high Turkey Vulture counts at 5 of 7 sites where counted (record set at 3 sites: Chelan Ridge, Goshute Mountains, and Corpus Christi-where 170,976 were counted!)
- Above average or average Broad-winged Hawk numbers at all sites with record numbers at 3 sites (Chelan Ridge, Goshute Mountains, and Yaki Point).

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

Funding for this year's migration count and outreach efforts at Yaki Point was generously provided by the Grand Canyon Association, and HWI private donors and members. Specteo provided a tablet and software services that allowed us to field test digital data entry in 2015. 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. The Park also generously provided lodging for the field crew this season, making life a little easier after a full day of hawkwatching and interpreting.

Finally, enormous thanks and appreciation to the members of our 2015 field crew: Steve Seibel, Kumara MacLeod, and Emilee Sparks. 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 the Yaki Point HawkWatch, Grand Canyon, AZ.

		1997-2014				All-time Historic Records	
	Species	**Mean Count ± 95 % CI**		**2015**	**% Change**	**Season**	**Daily**
	Osprey	42.3 ± 5.6		75	77	75 (2015)	12 (2015)
	Northern Harrier	40.3 ± 3.8		55	36	56 (1999)	6 (4x)
Accipiters							
	Sharp-shinned Hawk	1665.2 ± 172.1		2209	33	2323 (2003)	232 (1999)
	Cooper's Hawk	951.2 ± 161.6		1538	62	1673 (2003)	237 (2003)
	Northern Goshawk	6.9 ± 2.5		3	-57	18 (2008)	10 (2006)
	Unidentified accipiter	228.7 ± 82.5		728	218	728 (2015)	
	TOTAL ACCIPITERS	2852.0 ± 317.2		4478	57	4478 (2015)	
Buteos							
	Red-shouldered Hawk	0.1 ± 0.1		0		1 (1997)	1 (1997)
	Broad-winged Hawk	12.8 ± 3.7		47	267	47 (2015)	21 (2015)
	Swainson's Hawk	39.0 ± 18.4		138	254	147 (2003)	77 (2003)
	Red-tailed Hawk	999.5 ± 92.2		1723	72	1723 (2015)	145 (2010)
	Ferruginous Hawk	6.5 ± 1.7		8	24	12 (2014)	4 (2000)
	Rough-legged Hawk	0.4 ± 0.3		0	-100	2 (2002)	1 (2002)
	Unidentified buteo	33.3 ± 13.3		68	104	116 (2010)	
	TOTAL BUTEOS	1091.6 ± 109.0		1984	82	1984 (2015)	
Eagles							
	Golden Eagle	7.1 ± 3.7		1	-86	24 (1997)	3 (5x)
	Bald Eagle	18.5 ± 5.2		11	-41	49 (2002)	15 (2002)
	Unknown eagles	1.4 ± 0.5		0	-100	3 (2007)	
	TOTAL EAGLES	26.1 ± 8.1		12	-54	73 (2002)	
Falcons							
	American Kestrel	689.9 ± 136.2		595	-14	1035 (2000)	396 (2000)
	Merlin	11.7 ± 2.7		10	-14	22 (2001)	4 (2x)
	Prairie Falcon	5.6 ± 1.3		6	7	9 (2006)	2 (4x)
	Peregrine Falcon	11.1 ± 2.7		9	-19	19 (2007)	3 (6x)
	Unidentified falcon	8.7 ± 5.1		17	96	31 (2010)	
	TOTAL FALCONS	726.9 ± 131.3		637	-12	1048 (2000)	
	Unidentified Raptor	22.7 ± 8.6		49	116	71 (2002)	
	GRAND TOTAL	4826.3 ± 473.2		7290	51	7290 (2003)	715 (2000)

Table 2. Summary of the 2015 fall flight of migrating raptors across HWI'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 count. *In 2015 HWI monitored migration for 4,252 hrs and counted 700,457 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
	Hours Counted in 2015							
Species	**365.7**	**338.8**	**399.1**	**532.5**	**679.8**	**568.3**	**553.4**	**814.8**
Black Vulture								186
Turkey Vulture	494	*81*	5	90	*1102*		292	*170976*
Osprey	67	28	*22*	39	162	*75*	30	194
Northern Harrier	24	73	141	*64*	239	55	51	169
Crested Caracara								4
Common Black Hawk								0
Harris' Hawk								2
Accipiters								
Sharp-shinned Hawk	964	367	*655*	1321	6769	2209	1420	1914
Cooper's Hawk	226	179	306	526	4418	1538	469	1094
Northern Goshawk	19	15	38	48	100	3	3	0
Unidentified accipiter	44	41	94	71	43	*728*	39	69
TOTAL ACCIPITERS	1253	602	*1093*	1966	11330	*4478*	1931	3077
Buteos								
Red-shouldered Hawk	1	0	0	0	0	0	0	23
Broad-winged Hawk	4	*16*	29	30	*336*	*47*	18	472276
Short-tailed Hawk								2
Swainson's Hawk	1	14	2	202	*2856*	138	388	2941
White-tailed Hawk								43
Zone-tailed Hawk							1	13
Red-tailed Hawk	614	139	*382*	1070	*6988*	*1723*	384	68
Ferruginous Hawk	0	0	6	3	21	8	2	4
Rough-legged Hawk	1	35	*96*	11	11	0	0	0
Unidentified buteo	3	30	29	47	15	68	16	9
TOTAL BUTEOS	624	234	*544*	1363	*10227*	*1984*	809	475379
Eagles								
Golden Eagle	56	60	1134	*359*	170	1	43	2
Bald Eagle	78	*16*	81	169	15	11	1	14
Unknown eagles	1	1	2	9	0	0	1	0
TOTAL EAGLES	135	77	1217	537	185	12	45	16
Falcons								
American Kestrel	8	16	*180*	189	1881	595	267	1171
Merlin	69	34	*36*	19	73	10	37	*117*
Prairie Falcon	4	7	6	11	37	6	5	4
Peregrine Falcon	12	7	21	8	45	9	23	146
Aplomado Falcon								0
Unidentified falcon	7	2	7	11	1	17	3	11
TOTAL FALCONS	100	66	*250*	238	2037	637	335	1449
Kites								
Hook-billed Kite								0
Swallow-tailed Kite								89
White-tailed Kite								5
Mississippi Kite								8506
Unidentified Kites								0
TOTAL KITES								8600
Unidentified Raptor	7	31	9	12	0	49	7	137
GRAND TOTAL	2704	1192	3281	4309	25282	*7290*	3500	660189

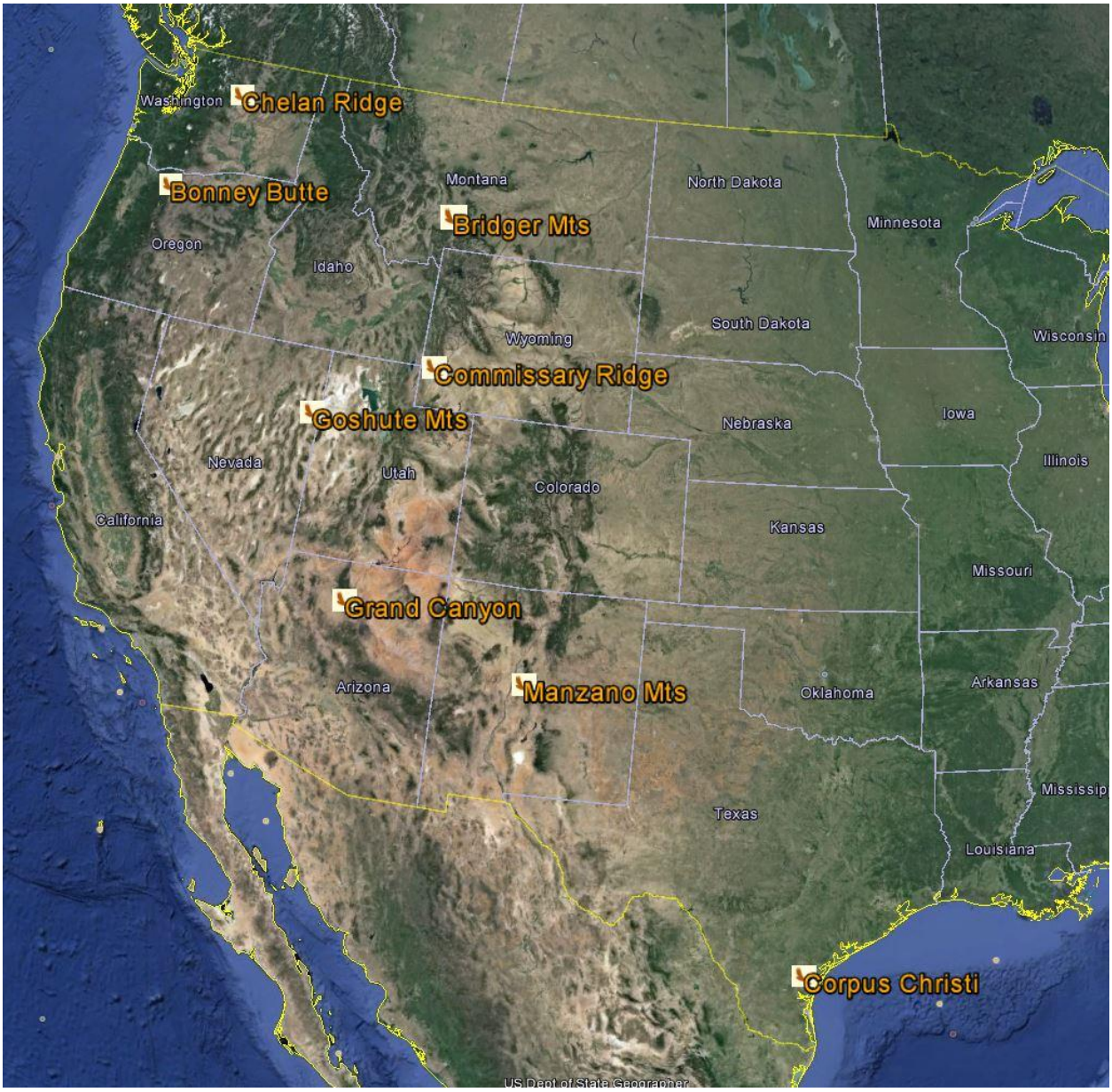

Figure 1. Locations of fall HawkWatch sites operated by HWI and partners.

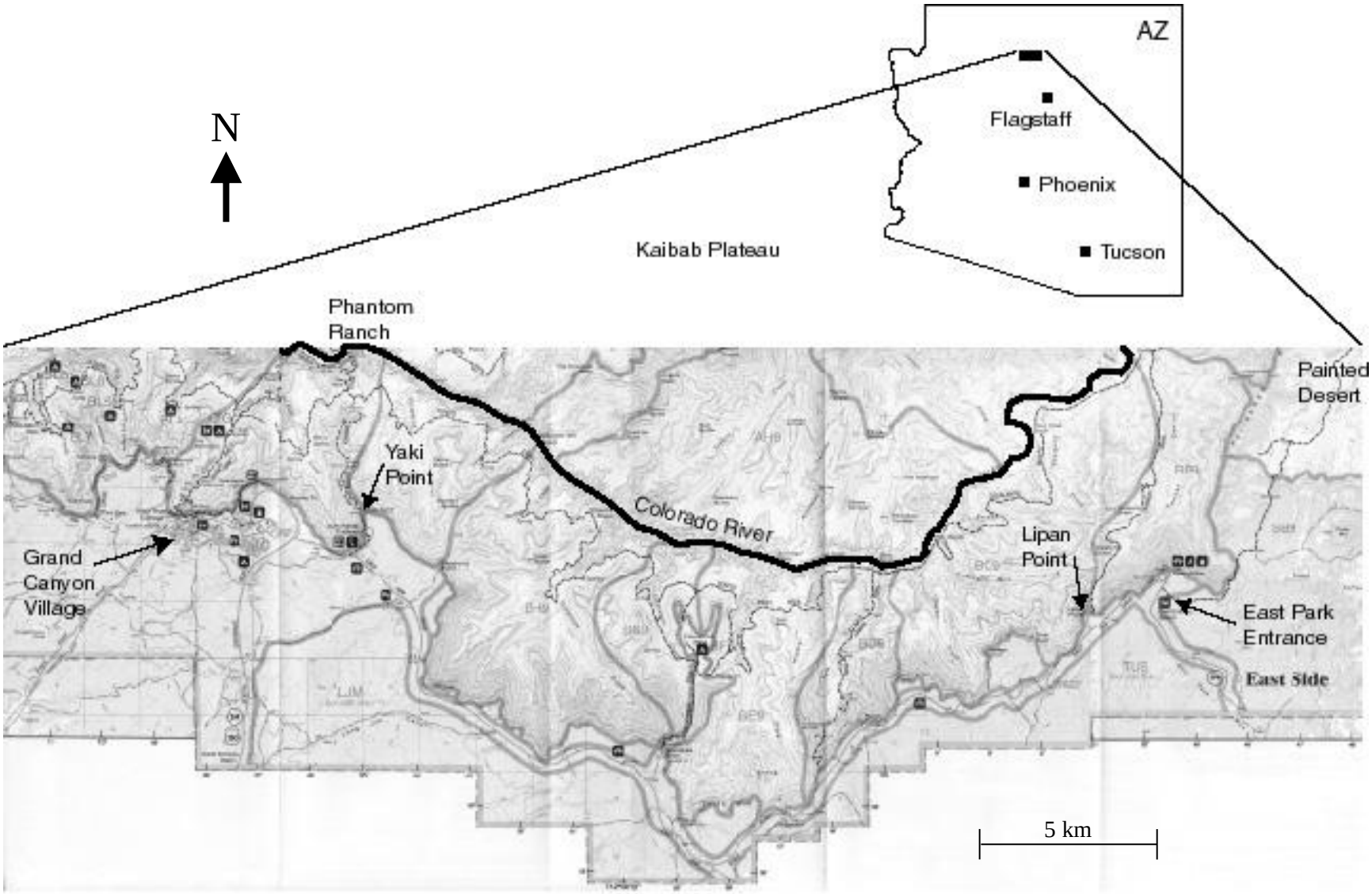

Figure 2. Map showing the Yaki Point and Lipan Point HawkWatches at the Grand Canyon, Arizona.

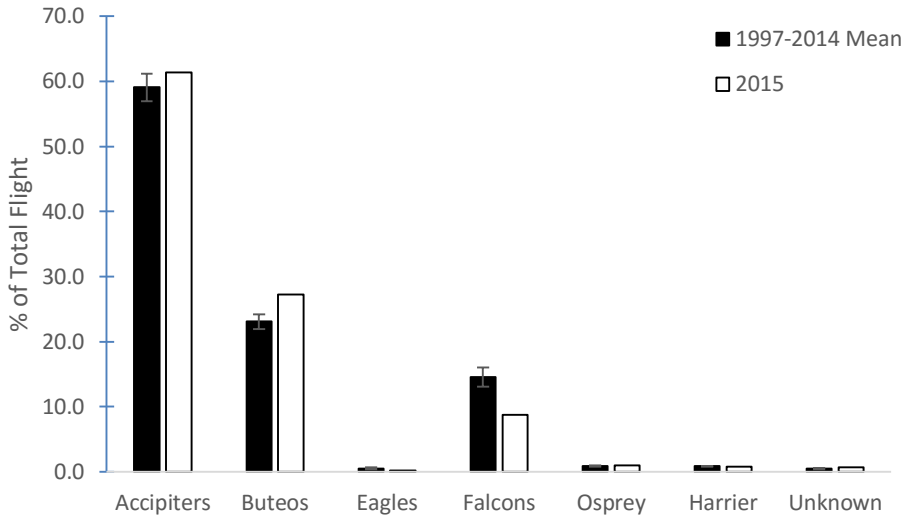

Figure 3. Fall raptor-migration flight composition by major species groups at Yaki Point in the Grand Canyon, AZ: 1997–2014 versus 2015.

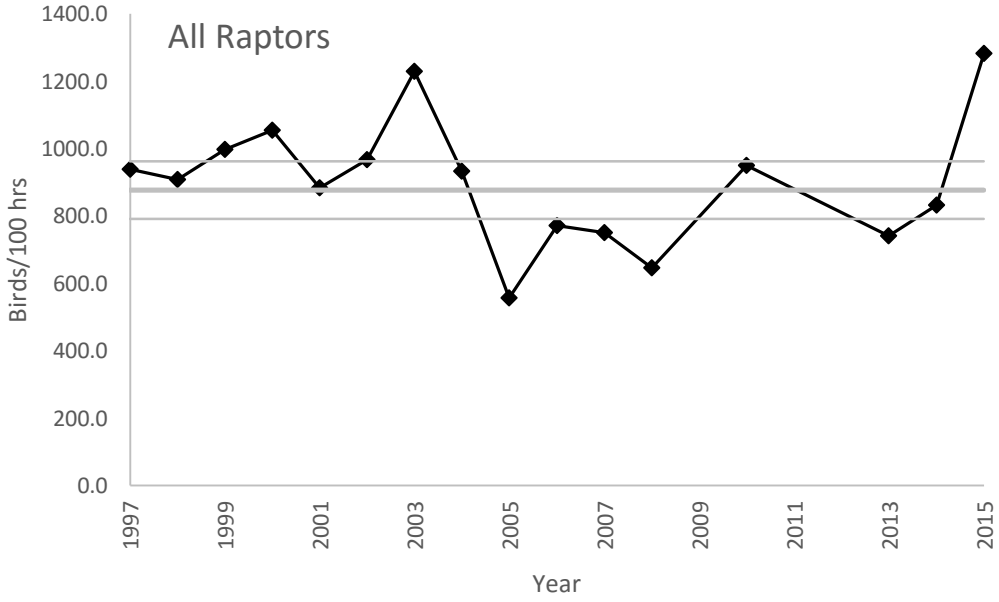

Figure 4. Effort-adjusted fall migration passage rates at Yaki Point forall migrating raptors: 1998-2015. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historical counts (1997-2014) at Yaki Point. (Count did not occur in 2009,20011, or 2012)

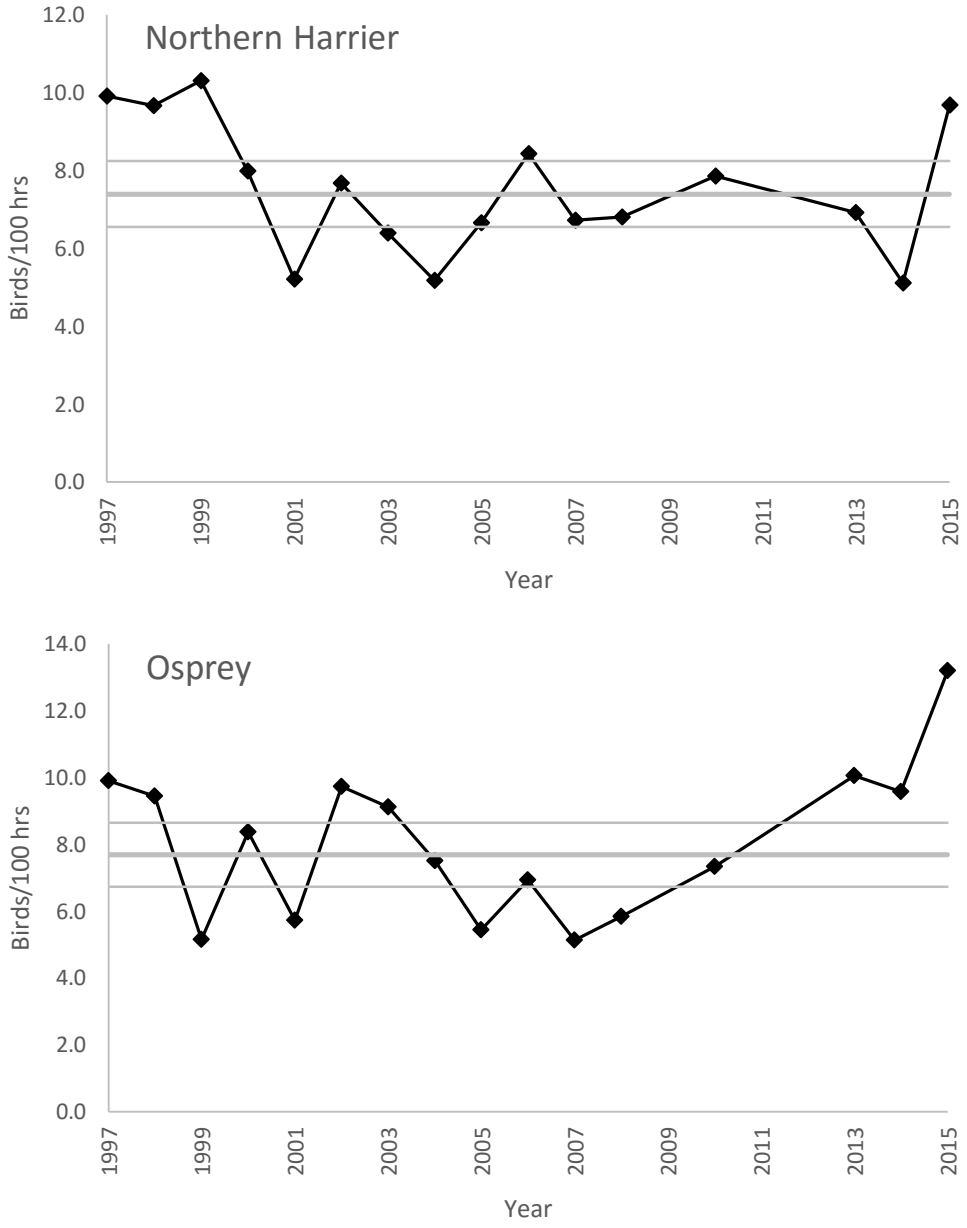

Figure 5a. Fall-migration passage rates for Osprey and Northern Harriers at Yaki Pt. in the Grand Canyon, AZ: 1997–2015. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historical counts (1997-2014) at Yaki Pt. (Count did not occur in 2009, 2011, or 2012)

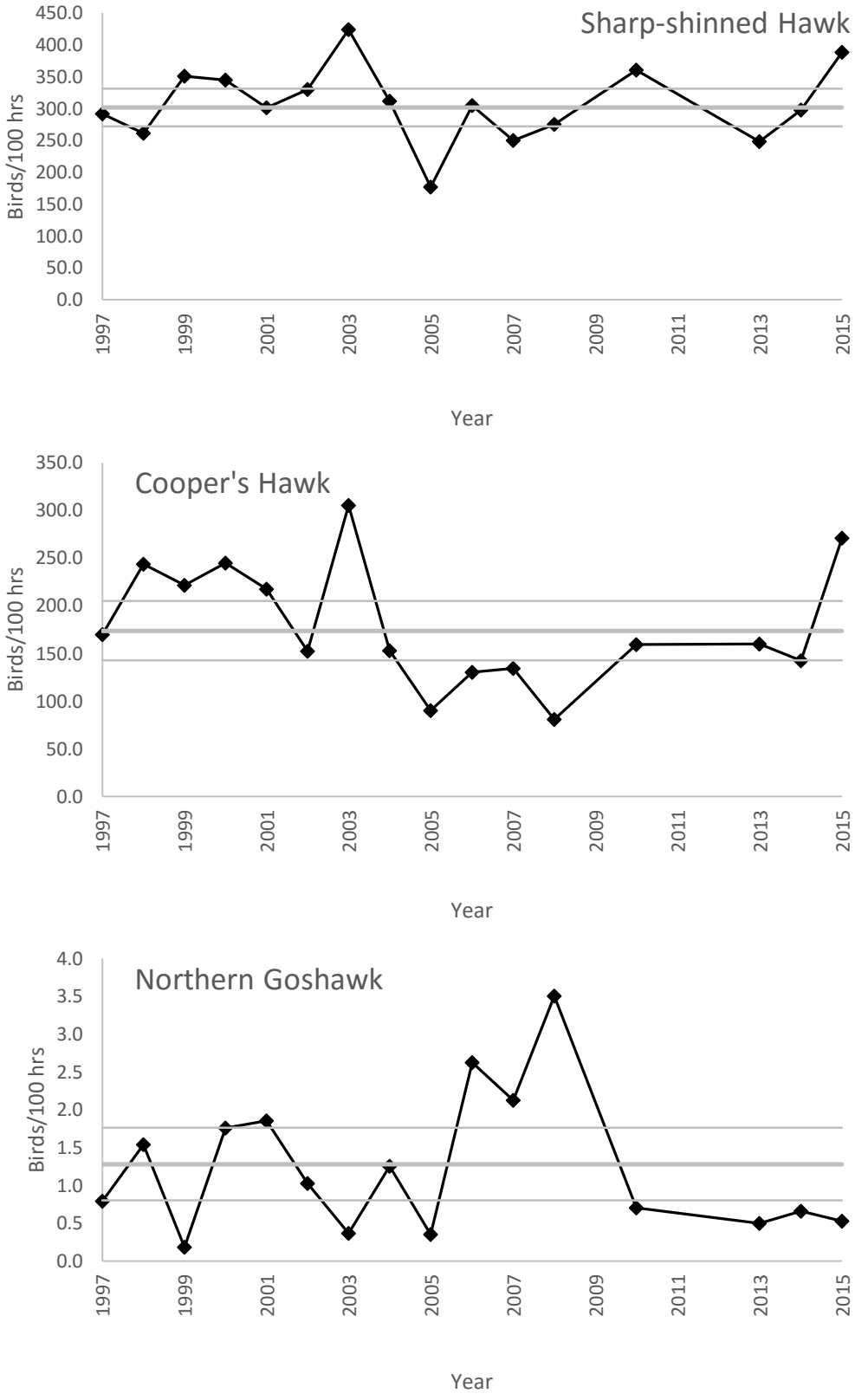

Figure 5b. Fall-migration passage rates for the three North American accipiter species at Yaki Pt. in the Grand Canyon, AZ: 1997–2015. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historical counts (1997-2014). (Count did not occur in 2009, 2011, or 2012)

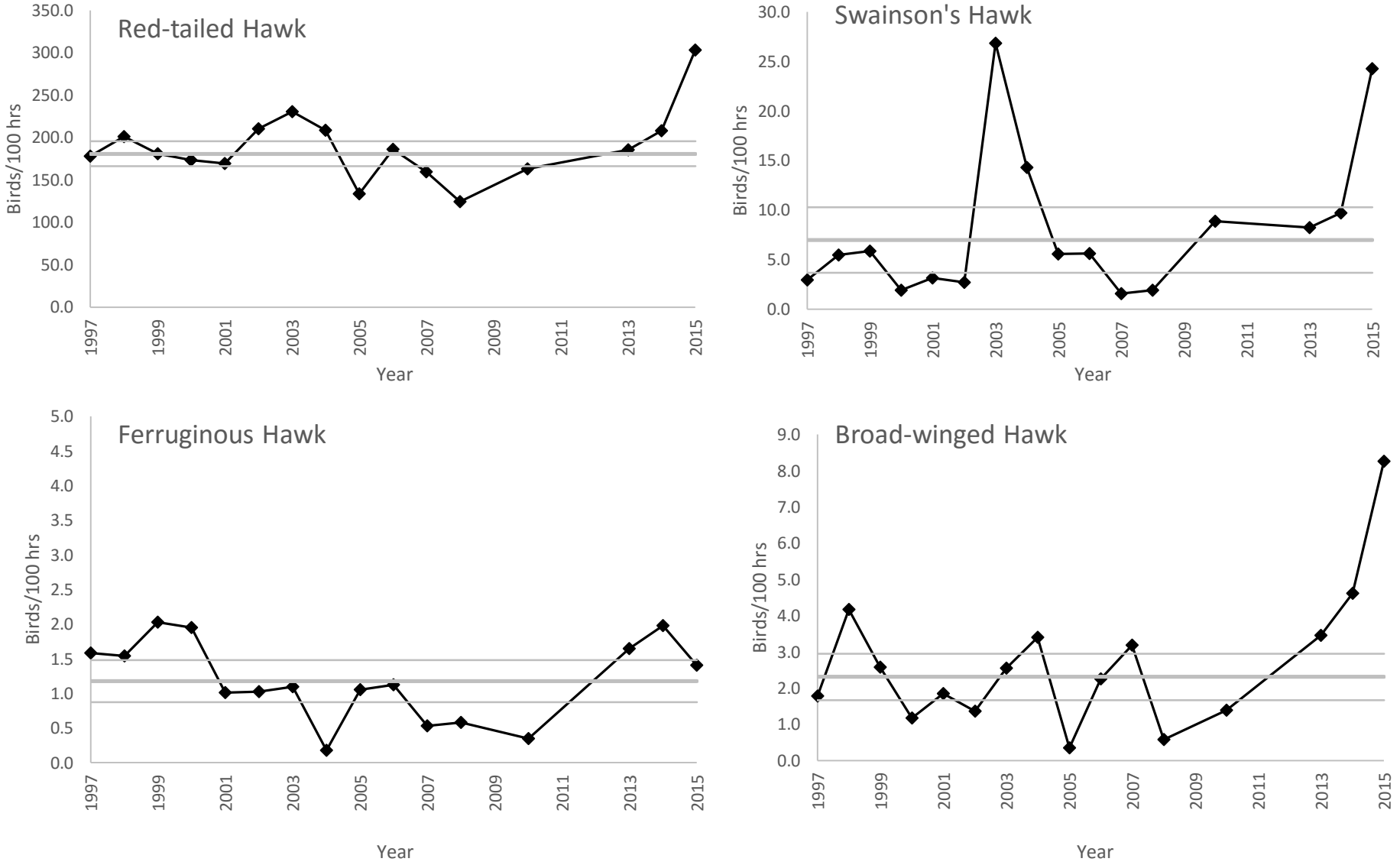

Figure 5c. Fall-migration buteo passage rates at Yaki Pt. in the Grand Canyon, AZ: 1997–2015. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historical counts (1997-2014). (Count did not occur in 2009, 2011, or 2012)

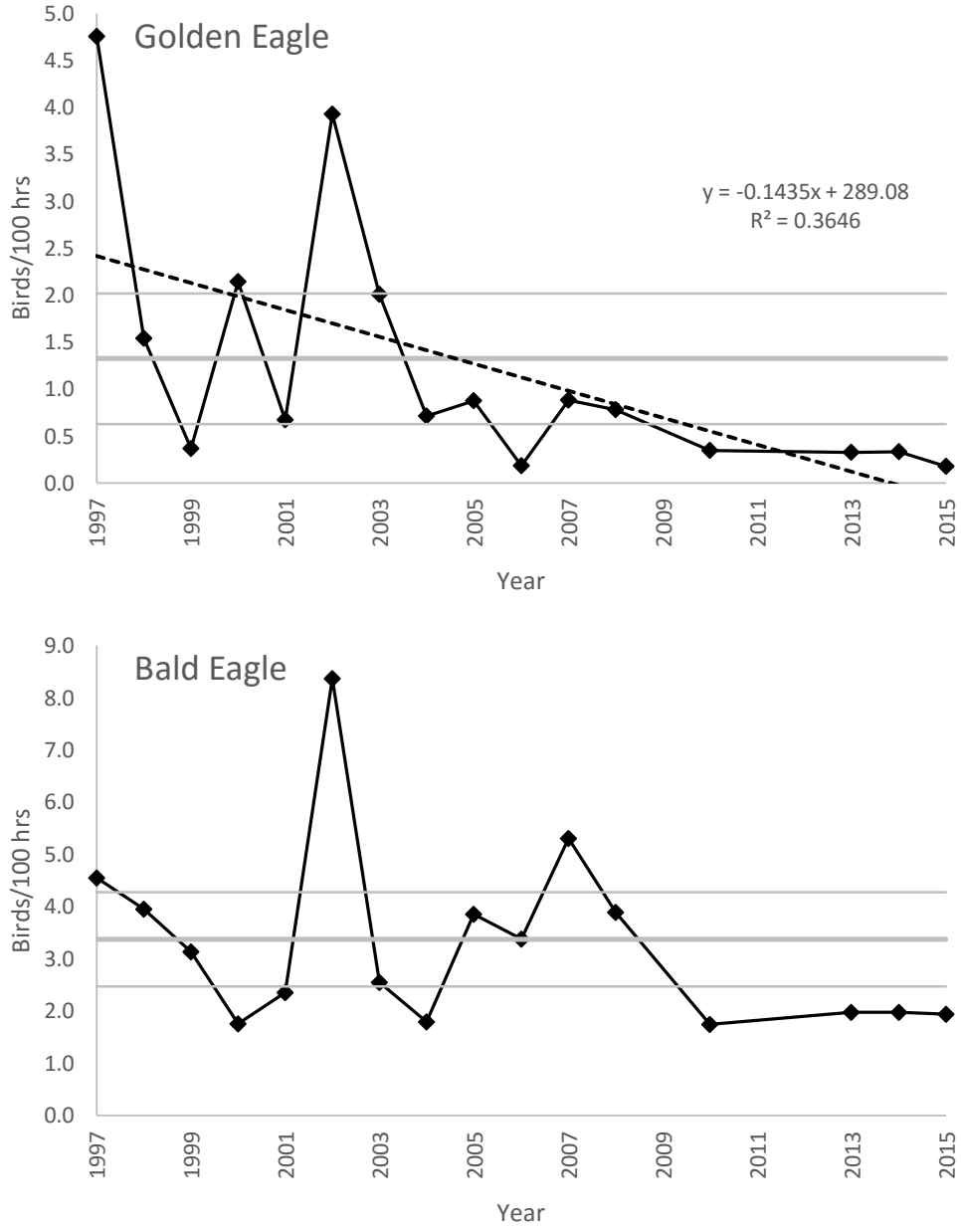

Figure 5d. Eagle fall-migration passage rates at Yaki Pt. in the Grand Canyon, AZ: 1997–2015. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historical counts (1997-2014). (Count did not occur in 2009, 2011, or 2012)

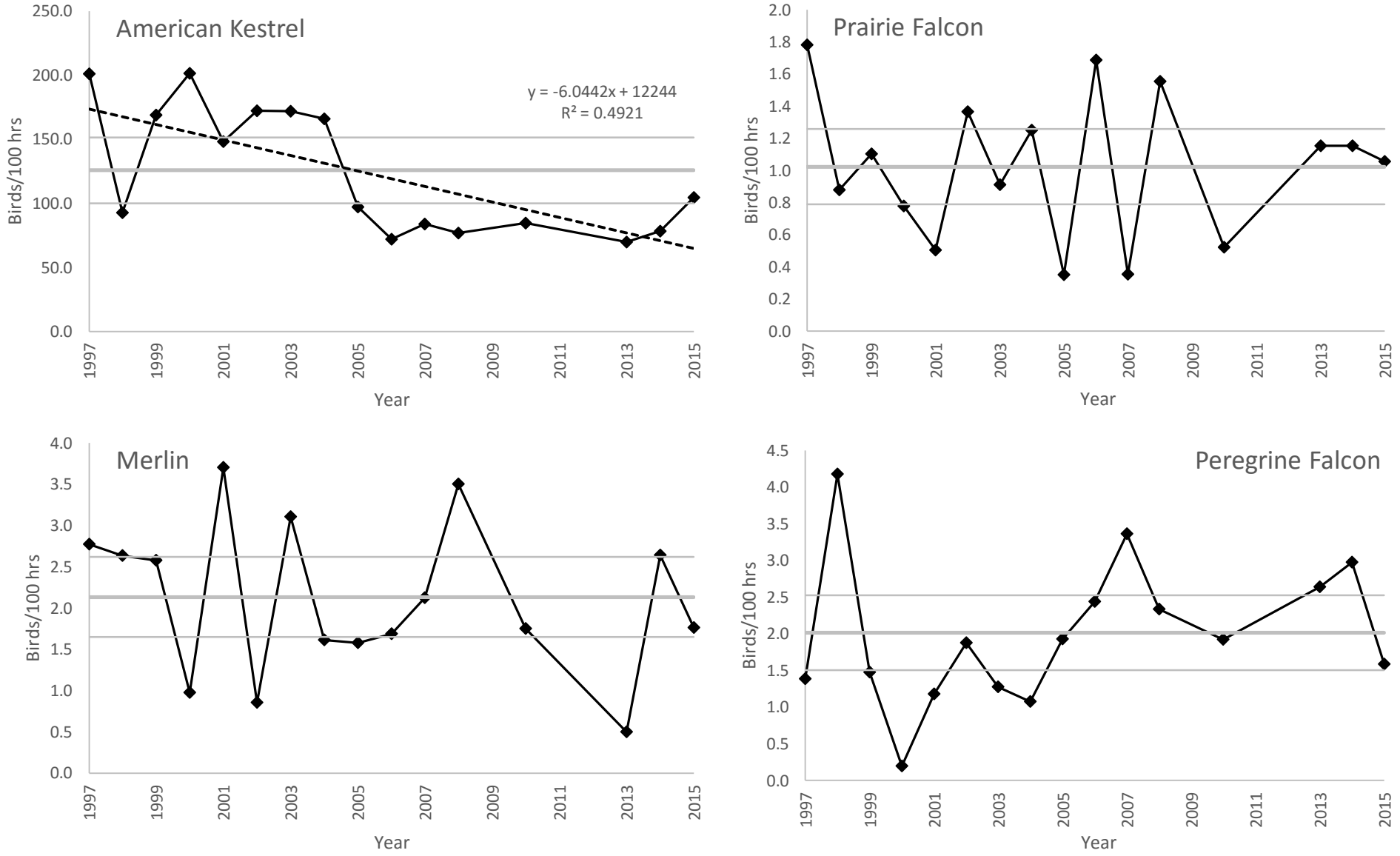

Figure 5e. Falcon fall-migration passage rates at Yaki Pt. in the Grand Canyon, AZ: 1997–2015. Dashed lines indicate significant ($p < 0.05$) population trends based on linear regressions. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (1997-2014). (Count did not occur in 2009, 2011, or 2012)

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 Two observers throughout at Yaki Pt. only: Kimberly Cullen (2), Christine Duffy (0), Felipe Guerrero (0)

2011 - 2012 No counts

2013 Two observers thoughout at Yaki Pt. only: Amy Zimmerman (0), David Millican (+), Timothy Alvey (0), Sanders Li Ho (+)

2014 Two observers thoughout at Yaki Pt. only: Amy Zimmerman (1), Frank Mayer (5), Steve Seibel (8+), Jeremy Halka (1), Anna Butler (0), Melissa Murillo (0)

2015 Two observers throughout: Steve Seibel (9+), Kumara MacLeod (0), and Emilee Sparks (0)

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[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	*Cathartes aura*	TV	U	U	NA
Osprey	*Pandion haliaetus*	OS	U	U	NA
Northern Harrier	*Circus cyaneus*	NH	A I Br U	M F U	NA
Sharp-shinned Hawk	*Accipiter striatus*	SS	A I U	U	NA
Cooper's Hawk	*Accipiter cooperii*	CH	A I U	U	NA
Northern Goshawk	*Accipiter gentilis*	NG	A I U	U	NA
Unknown accipiter	*Accipiter* spp.	UA	U	U	NA
Red-shouldered Hawk	*Buteo lineatus*	RS	A I U	U	NA
Broad-winged Hawk	*Buteo platypterus*	BW	A I U	U	D L U
Swanson's Hawk	*Buteo swainsoni*	SW	U	U	D L U
Red-tailed Hawk	*Buteo jamaicensis*	RT	A I U	U	D L U
Ferruginous Hawk	*Buteo regalis*	FH	A I U	U	D L U
Rough-legged Hawk	*Buteo lagopus*	RL	U	U	D L U
Zone-tailed Hawk	*Buteo albonotus*	ZT	A I U	U	NA
Unknown buteo	*Buteo* spp.	UB	U	U	D L U
Golden Eagle	*Aquila chrysaetos*	GE	I, S, NA, A, U[4]	U	NA
Bald Eagle	*Haliaeetus leucocephalus*	BE	I, S1, S2, NA, A, U[5]	U	NA
Unknown eagle	*Aquila* or *Haliaeetus spp.*	UE	U	U	NA
American Kestrel	*Falco sparverius*	AK	U	M F U	NA
Merlin	*Falco columbarius*	ML	AM Br	AM U	NA
Prairie Falcon	*Falco mexicanus*	PR	U	U	NA
Peregrine Falcon	*Falco peregrinus*	PG	A I U	U	NA
Unknown falcon	*Falco* 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: 1997–2015.

YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2010
Start date	27-Aug	28-Aug	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug	27-Aug	1-Sep	27-Aug
End date	5-Nov	5-Nov	5-Nov	5-Nov	5-Nov	5-Nov	5-Nov	5-Nov	5-Nov	4-Nov	5-Nov	5-Nov	5-Nov
Days of observation	71	66	71	66	71	71	70	68	70	70	71	66	71
Hours of observation	504.97	455.41	543.20	513.10	595.59	585.70	547.90	559.40	570.48	533.33	566.76	514.09	572.42
Raptors / 100 hours	938	908	998	1054	881	968	1229	932	556	771	750	645	951
SPECIES	RAPTOR COUNTS												
Osprey	50	43	28	43	34	57	50	42	31	37	29	30	42
Northern Harrier	50	44	56	41	31	45	35	29	38	45	38	35	45
Sharp-shinned Hawk	1,474	1,190	1,906	1,772	1,792	1,932	2,323	1,743	1,008	1,627	1,417	1,417	2,065
Cooper's Hawk	856	1,109	1,204	1,256	1,293	891	1,673	855	516	695	761	417	911
Northern Goshawk	4	7	1	9	11	6	2	7	2	14	12	18	4
Unknown accipiter	94	140	109	236	72	239	156	248	127	136	465	192	688
TOTAL ACCIPITERS	2,428	2,446	3,220	3,273	3,168	3,068	4,154	2,853	1,653	2,472	2,655	2,044	3,668
Red-shouldered Hawk	1	0	0	0	0	0	0	0	0	0	0	0	0
Broad-winged Hawk	9	19	14	6	11	8	14	19	2	12	18	3	8
Swainson’s Hawk	15	25	32	10	19	16	147	80	32	30	9	10	51
Red-tailed Hawk	899	916	985	892	1,008	1,234	1,264	1,169	765	995	903	641	934
Ferruginous Hawk	8	7	11	10	6	6	6	1	6	6	3	3	2
Rough-legged Hawk	0	0	0	1	1	2	0	0	0	1	0	0	0
Zone-tailed Hawk	0	0	1	0	1	1	0	0	0	0	0	5	0
Unidentified buteo	20	20	13	8	8	43	42	17	24	48	36	34	116
TOTAL BUTEOS	952	987	1,056	927	1,054	1,310	1,473	1,286	829	1,092	969	696	1,111
Golden Eagle	24	7	2	11	4	23	11	4	5	1	5	4	2
Bald Eagle	23	18	17	9	14	49	14	10	22	18	30	20	10
Unidentified eagle	1	0	1	0	0	1	0	0	0	0	3	0	1
TOTAL EAGLES	48	25	20	20	18	73	25	14	27	19	38	24	13
American Kestrel	1,016	423	918	1,035	881	1,011	943	930	555	384	475	395	485
Merlin	14	12	14	5	22	5	17	9	9	9	12	18	10
Prairie Falcon	9	4	6	4	3	8	5	7	2	9	2	8	3
Peregrine Falcon	7	19	8	1	7	11	7	6	11	13	19	12	11
Unknown falcon	0	4	2	3	2	8	1	4	6	27	4	25	31
TOTAL FALCONS	1,046	462	948	1,048	915	1,043	973	956	583	442	512	458	540
Unidentified raptor	20	38	16	10	25	71	23	36	12	6	8	31	23
GRAND TOTAL	4,594	4,045	5,344	5,362	5,245	5,667	6,733	5,216	3,173				

Appendix C. continued

YEAR	2013	2014	2015	MEAN
Start date	27-Aug	27-Aug	27-Aug	27Aug
End date	5-Nov	5-Nov	6-Nov	4-Nov
Days of observation	71	71	68	69
Hours of observation	606.33	605.65	568.3	552.5
Raptors / 100 hours	741.0	833.0	1282.8	902.6
SPECIES				
Osprey	61	58	75	44
Northern Harrier	42	31	55	41
Sharp-shinned Hawk	1,506	1806	2209	1,699
Cooper's Hawk	969	862	1538	988
Northern Goshawk	3	4	3	7
Unknown accipiter	186	342	728	260
TOTAL ACCIPITERS	2,664	3,014	4478	2,954
Red-shouldered Hawk	0	0	0	0
Broad-winged Hawk	21	28	47	15
Swainson’s Hawk	50	59	138	45
Red-tailed Hawk	1,126	1,262	1723	1045
Ferruginous Hawk	10	12	8	7
Rough-legged Hawk	1	0	0	0
Zone-tailed Hawk	0	0		1
Unidentified buteo	42	28	68	36
TOTAL BUTEOS	1,250	1,389	1984	1,147
Golden Eagle	2	2	1	7
Bald Eagle	12	12	11	18
Unidentified eagle	0	0	0	1
TOTAL EAGLES	14	14	12	25
American Kestrel	424	474	595	684
Merlin	3	16	10	12
Prairie Falcon	7	7	6	6
Peregrine Falcon	16	18	9	11
Unknown falcon	8	5	17	9
TOTAL FALCONS	458	520	637	721
Unidentified raptor	4	19	49	24
GRAND TOTAL	4,493	5,045	7290	4,980