POPULATION MONITORING OF DIURNAL RAPTORS AT GRAND CANYON NATIONAL PARK

PROJECT I14005

HawkWatch International, Inc.

Salt Lake City, Utah

April 2015

Heritage Fund

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

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

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 Yaki Point; a companion report will highlight results from Lipan Point.

The Yaki 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). 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 Grand Canyon ecosystem in general.

DISCLAIMER

The findings, opinions, and recommendations in this report are those of the investigators who have received partial or full funding from the Arizona Game and Fish Department Heritage Fund. The findings, opinions, and recommendations do not necessarily reflect those of the Arizona Game and Fish Commission or the Department, or necessarily represent official Department policy or management practice. For further information, please contact the Arizona Game and Fish Department.

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 atYaki 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

Yaki Point HawkWatch's standard season runs 27 August – 5 November; in 2014 observers were able to count on all 71 possible days during this period for a total of 605.65 hours—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 ≤ 4 hours). Weather varies throughout every season, in 2014 based on hourly recording of conditions during observation it was clear 51% of the time, hazy 13% of the time, and rainy 4% of the time.

FLIGHT SUMMARY

2014 Overall Flight

A total of 5045 migrant raptors of 15 species were counted in 2014, making this an average year for migrating raptors at the Yaki Point HawkWatch (Table 1). Highlight this season included record high counts for both Broad-winged Hawks (28) and Ferruginous Hawks (12), and the second highest Osprey count on record (record was last year).

The flight consisted of 59.7% accipiters, 27.5% buteos, 10.2% falcons, 1.1% Ospreys, 0.6% harriers, 0.3% eagles, and 0.4% 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 (36% of the total), followed by Red-tailed Hawks (25%), Cooper's Hawks (17%), then American Kestrels (9%). The remainder of species comprised 1%, or less (Table 1).

The following sections summarize the 2014 count relative to historic means, and any stastistically significant ($p < 0.05$) population trends based on first and second order linear 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 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 833 raptors counted per 100 hours of observation at Yaki Point in 2014 is in line with the historic site average and no change over time in the overall flight is indicated by regression anaylsis.

Osprey and Northern Harriers (Fig. 5a):

Counts and passage rates (birds/100hr) of Osprey were above average for the second season in a row; in fact the 2014 count was the second highest season on record (61 in 2013 is the high, Table 1). The long-term trend for this species remains stable (no significant trend). Northern Harrier counts and passage rates were low in 2014 compared to site averages.

Accipiters (Fig. 5b):

The 2014 total count of accipiters was in line with the site average. Sharp-shinned Hawk counts an passage rates were average. Cooper's Hawk counts were average but the effort adjusted passage rate was low. Northern Goshawk counts and passage rates were below historic averages. Analyses of the long-term count data indicate regional populations of Cooper's Hawk and Sharp-shinned Hawk are stable (no significant trend).

Buteoine Hawks (Fig. 5c):

Counts for four of the five buteo species regularly seen at Yaki Point were high compared to historic averages: Red-tailed Hawk, Swainson's Hawk, Broad-winged Hawk, and Ferruginous Hawk (Table 1). Ferruginous and Broad-winged Hawk season count totals were records for the site, 12 and 28, respectively. Analyses of long-term trends indicate that both buteo species with average passage rates > 10 birds/100 hours (Red-Tailed Hawk amd Swainson's Hawk) are stable (no significant trend).

Eagles (Fig.5d):

Only two Golden Eagles and twelve Bald Eagles were counted at Yaki Point in 2014, both significantly below historic 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= -0.2, r^2 =0.34, p=0.024) 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):

Merlin and Peregrine Falcon passage rates were high compared to site averages in 2014, Prairie Falcon rates were average, and American Kestrel passage rates were low. Kestrels counts and passage rates have been well below average since 2005, and regression analysis suggests long-term declines in regional Kestrel populations (slope= -10.3, r^2 = 0.56, 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, Protugal, Republic of South Africa, Singapore, Spain, Sweden, Switzerland, Taiwand, 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 Yaki Point were generously provided by the Grand Canyon Association, Arizona Game and Fish Department—Heritage Fund, 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.

LITERATURE CITED

Bildstein, K. L. 2001. Why migratory birds of prey make great biological indicators. Pages 169–179 *in* K. L. Bildstein and D. Klem (Editors), Hawkwatching in the Americas. Hawk Migration Association of North America, North Wales, Pennsylvania, USA.

Bildstein, K. L. 2006. Migrating raptors of the world: their ecology and conservation. Cornell University Press, Ithaca, New York U.S.A. 320 pp.

Bildstein, K. L., J. P. Smith, E. Ruelas Inzunza, and R. R. Veit (Editors). 2008. The state of North America's birds of prey. Series in Ornithology No. 3. Nuttall Ornithological Club, Cambridge, Massachusetts, and the American Ornithologists' Union, Washington, DC, USA.

Farmer, C. J., and J. P. Smith. 2009. Migration counts indicate widespread declines of American Kestrels (*Falco sparverius*) in North America. Journal of Raptor Research 43(4).

Hoffman, S. W., and J. P. Smith. 2003. Population trends of migratory raptors in western North America, 1977–2001. Condor 105:397–419.

Hoffman, S. W., J. P. Smith, and T. D. Meehan. 2002. Breeding grounds, winter ranges, and migratory routes of raptors in the Mountain West. Journal of Raptor Research 36:97–110.

Kerlinger, P. 1989. Flight strategies of migrating hawks. University of Chicago Press, Chicago, Illinois, USA. 375 pp.

Smallwood, J.A., M.F. Causey, D.H. Mossop, J.R. Klucsarits, B. Robertson, S. Robertson, J. Mason, M.J. Maurer, R.J. Melvin, R.D. Dawson, G.R. Bortolotti, J.W. Parrish, Jr., T.F. Breen, and K. Boyd. 2009. Why are American Kestrel (*Falco sparverius*) populations declining in North America? Evidence from nest-box programs. Journal of Raptor Research 43(4):274-282.

Smith, J. P., C. J. Farmer, S. W. Hoffman, G. S. Kaltenecker, K. Z. Woodruff, and P. Sherrington. 2008a. Trends in autumn counts of migratory raptors in western North America. Pages 217–252 *in* K. L. Bildstein, J. P. Smith, E. Ruelas Inzunza, and R. R. Veit (Editors), State of North America's birds of prey. Series in Ornithology No. 3. Nuttall Ornithological Club, Cambridge, Massachusetts, and American Ornithologists' Union, Washington, DC.

Smith, J. P., C. J. Farmer, S. W. Hoffman, C. A. Lott, L. J. Goodrich, J. Simon, C. Riley, and E. Ruelas Inzunza. 2008b. Trends in autumn counts of migratory raptors around the Gulf of Mexico, 1995–2005. Pages 253–278 *in* K. L. Bildstein, J. P. Smith, E. Ruelas Inzunza, and R. R. Veit (Editors), State of North America's birds of prey. Series in Ornithology No. 3. Nuttall Ornithological Club, Cambridge, Massachusetts, and American Ornithologists' Union, Washington, DC.

Zalles, J. I., and K. L. Bildstein (Editors). 2000. Raptor watch: a global directory of raptor migration sites. BirdLife Conservation Series No. 9. BirdLife International, Cambridge, United Kingdom, and Hawk Mountain Sanctuary Association, Kempton, Pennsylvania, USA.

Table 1. Counts and historic records of fall migrating raptors at the Yaki Point HawkWatch, Grand Canyon, AZ.

		1997-2013				All-time Historic Records	
	Species	**Mean Count ± 95 % CI**	**2014**	**% Change**	**Season**	**Daily**
	Osprey	41 ± 5	58	41	61 (2013)	10 (2x)
	Northern Harrier	41 ± 4	31	-24	56 (1999)	6 (3x)
Accipiters						
	Sharp-shinned Hawk	1655 ± 184	1806	9	2323 (2003)	232 (1999)
	Cooper's Hawk	958 ± 173	862	-10	1673 (2003)	237 (2003)
	Northern Goshawk	7 ± 3	4	-44	18 (2008)	10 (2006)
	Unidentified accipiter	221 ± 87	342	55	688 (2010)	
	TOTAL ACCIPITERS	2840 ± 340	3014	6	4154 (2003)	
Buteos						
	Red-shouldered Hawk	±			1 (1997)	1 (1997)
	Broad-winged Hawk	12 ± 3	28	139	28 (2014)	10 (2004)
	Swainson's Hawk	38 ± 20	59	57	147 (2003)	77 (2003)
	Red-tailed Hawk	981 ± 91	1262	29	1264 (2003)	145 (2010)
	Ferruginous Hawk	6 ± 2	12	98	12 (2014)	4 (2000)
	Rough-legged Hawk	1 ± 0	0	-100	2 (2002)	1 (2002)
	Unidentified buteo	34 ± 14	28	-17	116 (2010)	
	TOTAL BUTEOS	1071 ± 108	1389	30	1473 (2003)	
Eagles						
	Golden Eagle	8 ± 4	2	-73	24 (1997)	3 (5x)
	Bald Eagle	19 ± 5	12	-37	49 (2002)	15 (2002)
	Unknown eagles	1 ± 0	0	-100	3 (2007)	
	TOTAL EAGLES	27 ± 9	14	-48	73 (2002)	
Falcons						
	American Kestrel	705 ± 143	474	-33	1035 (2000)	396 (2000)
	Merlin	11 ± 3	16	41	22 (2001)	4 (2x)
	Prairie Falcon	6 ± 1	7	27	9 (2006)	2 (4x)
	Peregrine Falcon	11 ± 3	18	70	19 (2007)	3 (6x)
	Unidentified falcon	9 ± 5	5	-44	31 (2010)	
	TOTAL FALCONS	742 ± 138	520	-30	1048 (2000)	
	Unidentified Raptor	23 ± 9	19	-17	71 (2002)	
	GRAND TOTAL	4785 ± 508	5045	5	6733 (2003)	715 (2000)

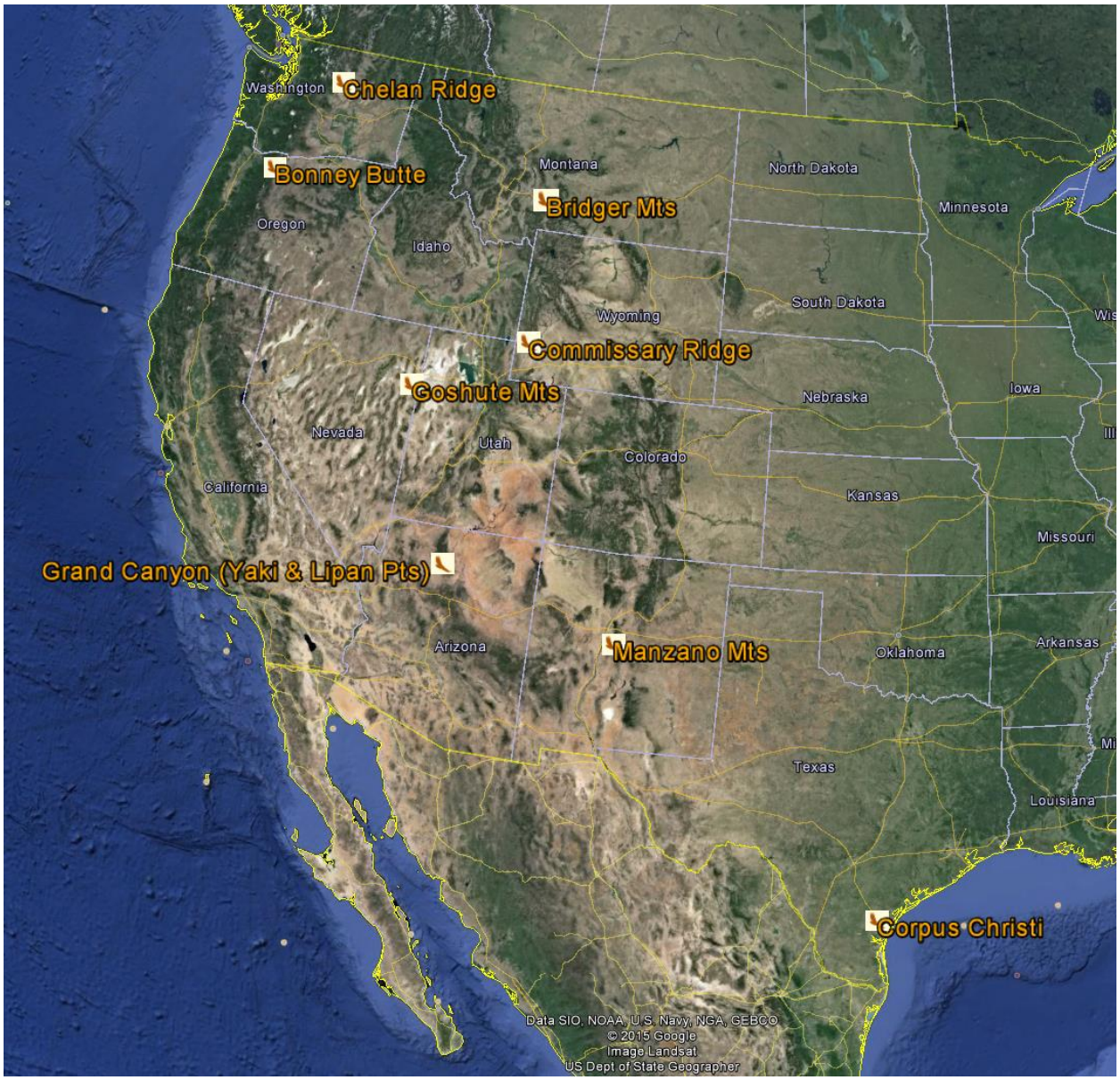

Figure 1. Locations of fall HawkWatch sites operated by HWI and partners.

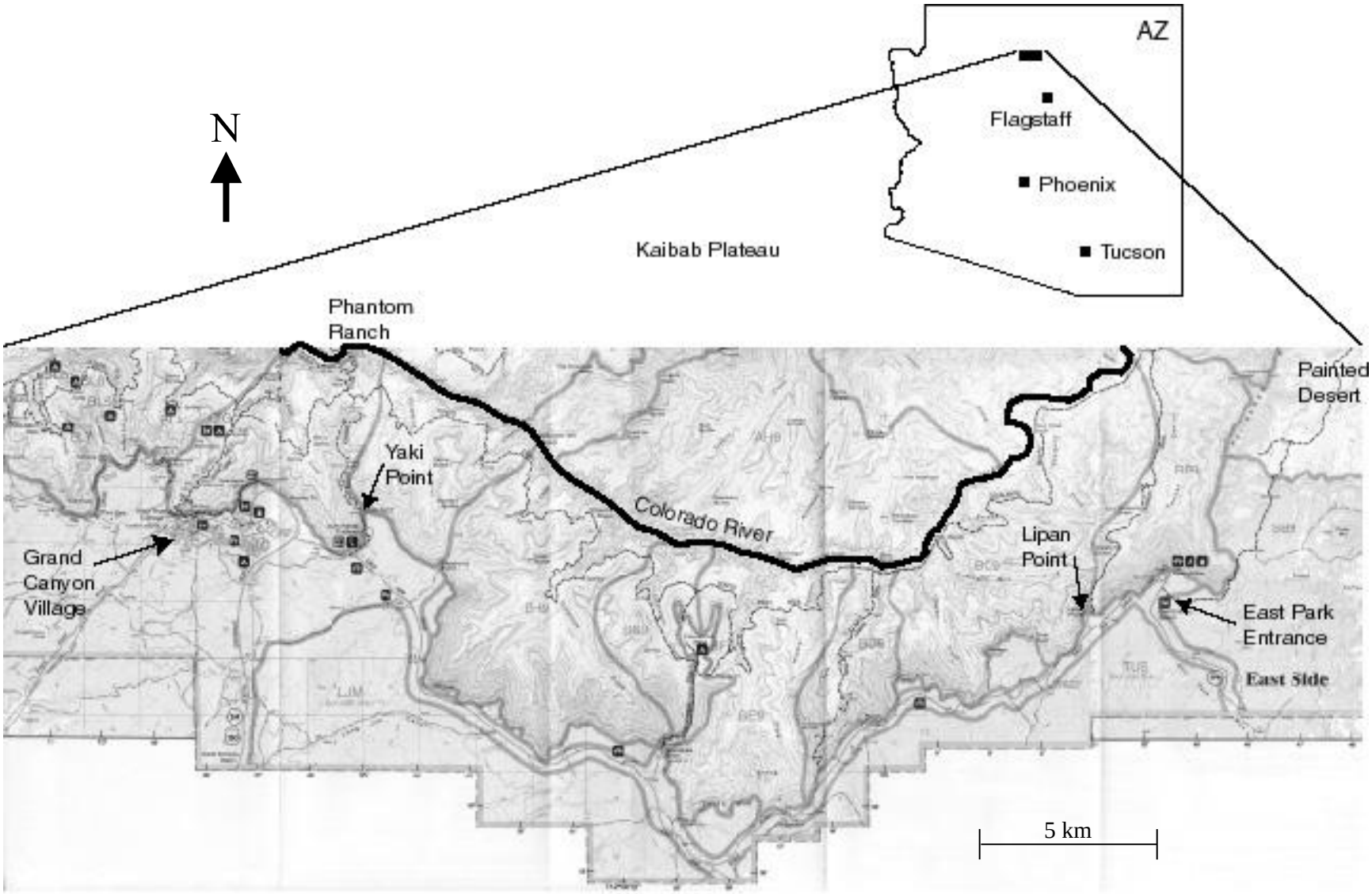

Figure 2. Map showing the Yaki Point and Lipan Point HawkWatches at the Grand Canyon, Arizona.

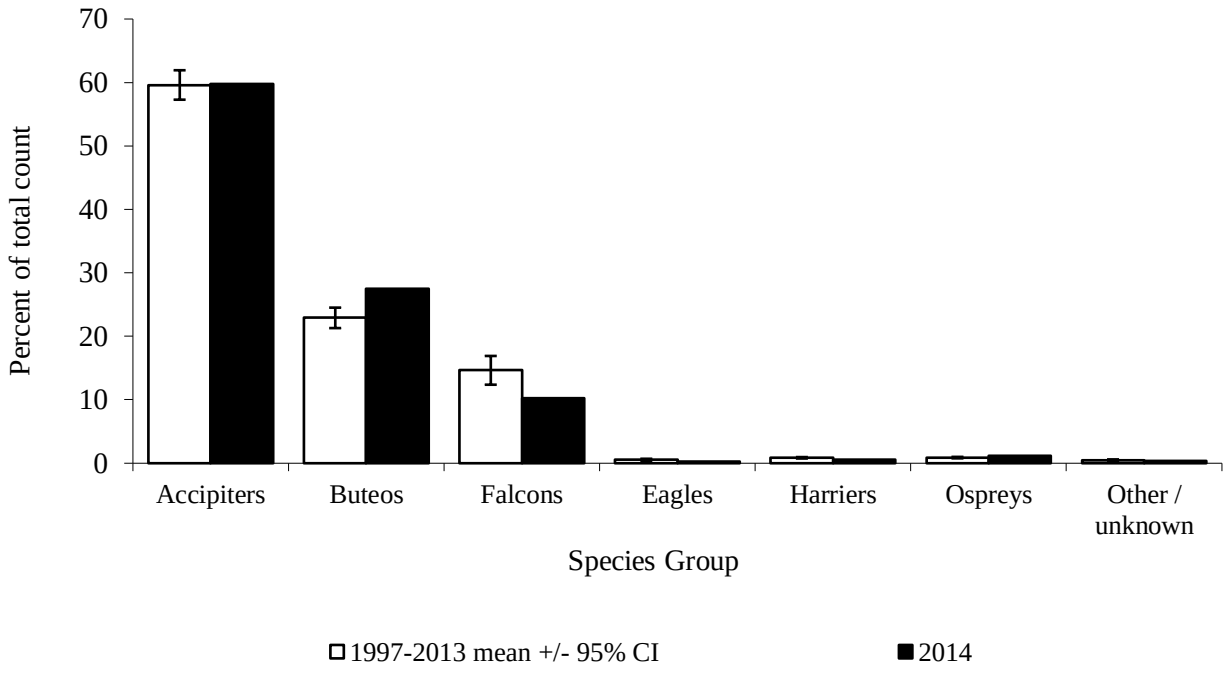

Figure 3. Fall raptor-migration flight composition by major species groups at Yaki Point in the Grand Canyon, AZ: 1997–2013 versus 2014.

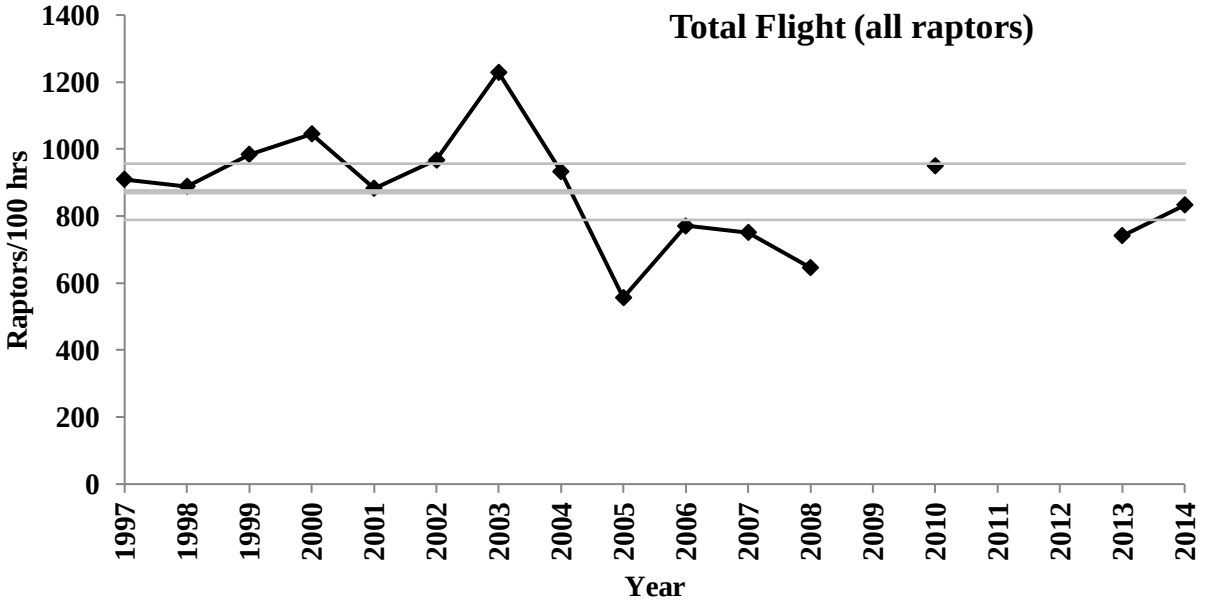

Figure 4. Effort-adjusted fall migration passage rates at Yaki Point forall migrating raptors: 1998-2014. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (1997-2014) at Yaki Point. (count did not occur in 2009,20011, or 2012)

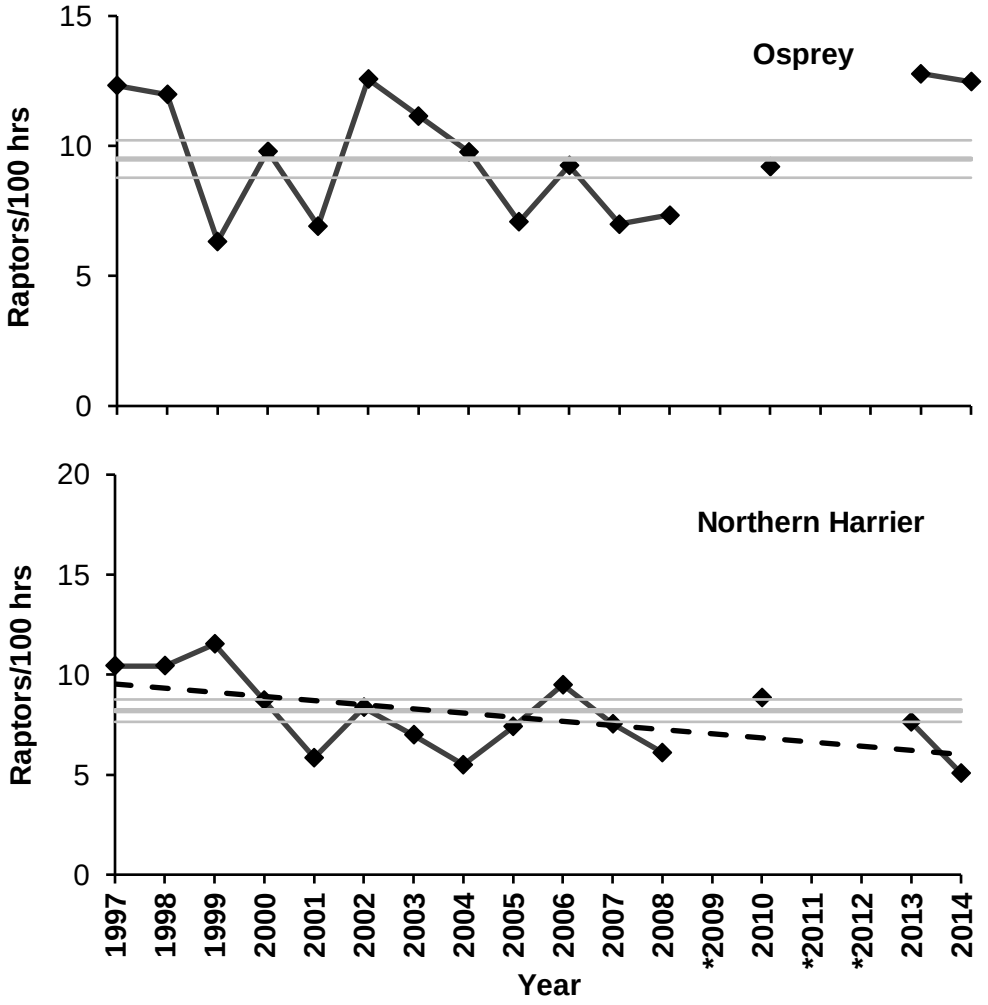

Figure 5a. Fall-migration passage rates for Osprey and Northern Harriers at Yaki Pt. in the Grand Canyon, AZ: 1997–2014. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (1997-2013) at Yaki Pt. Asterisk indicates a year with no counts.

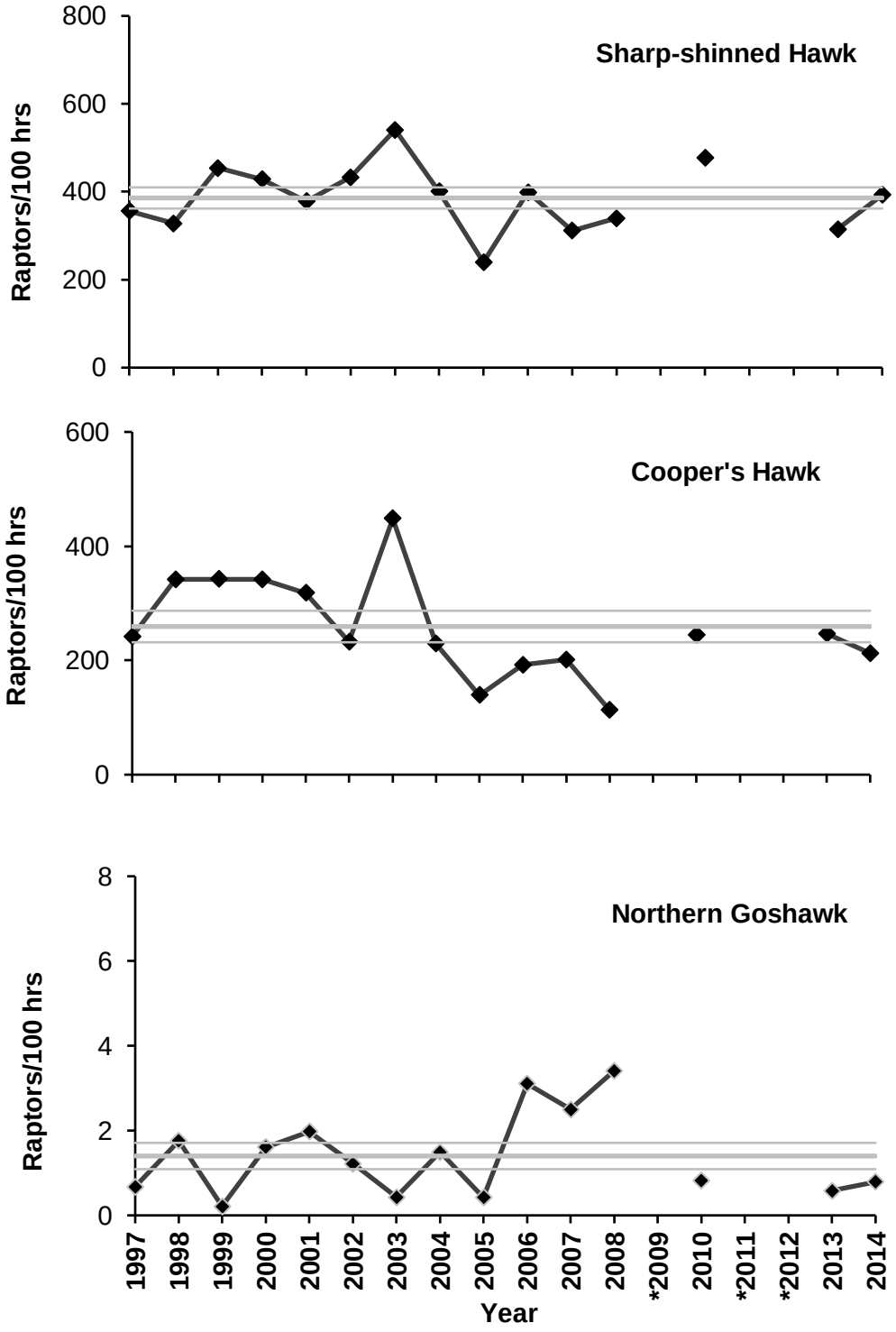

Figure 5b. Fall-migration passage rates for the three North American accipiter species at Yaki Pt. in the Grand Canyon, AZ: 1997–2014. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (1997-2013). Asterisk indicates a year with no counts.

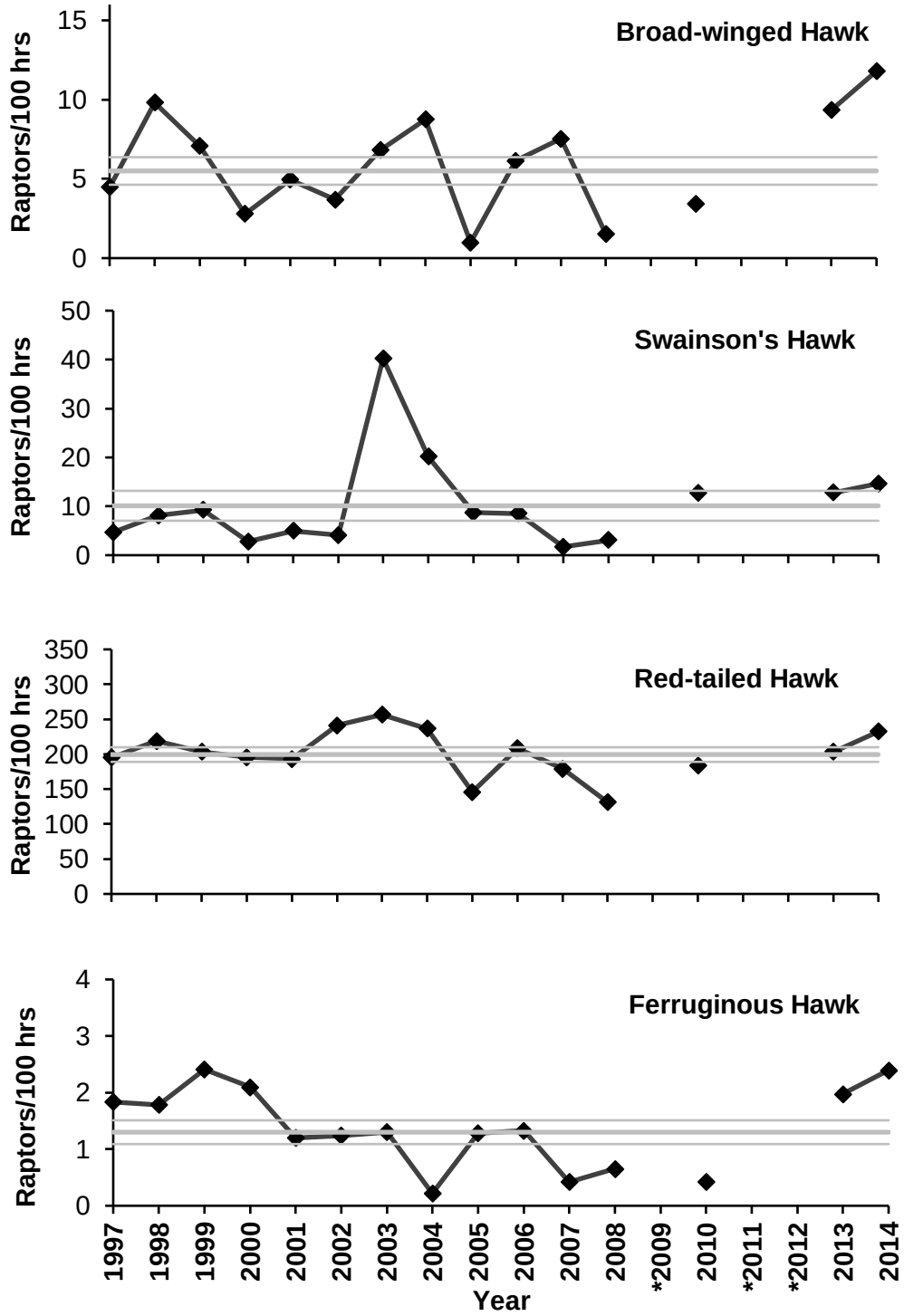

Figure 5c. Fall-migration buteo passage rates at Yaki Pt. in the Grand Canyon, AZ: 1997–2014. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (1997-2013). Asterisk indicates a year with no counts.

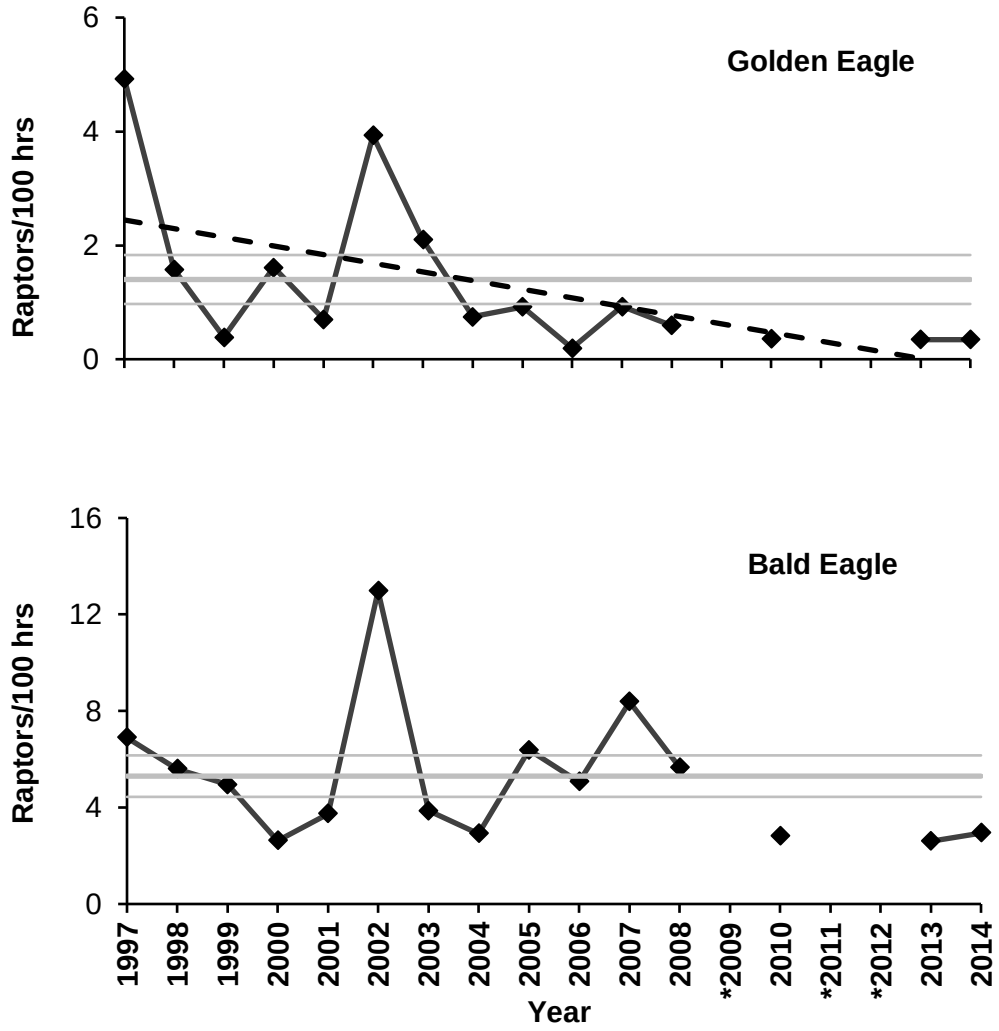

Figure 5d. Eagle fall-migration passage rates at Yaki Pt. in the Grand Canyon, AZ: 1997–2014. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (1997-2013). Asterisk indicates a year with no counts.

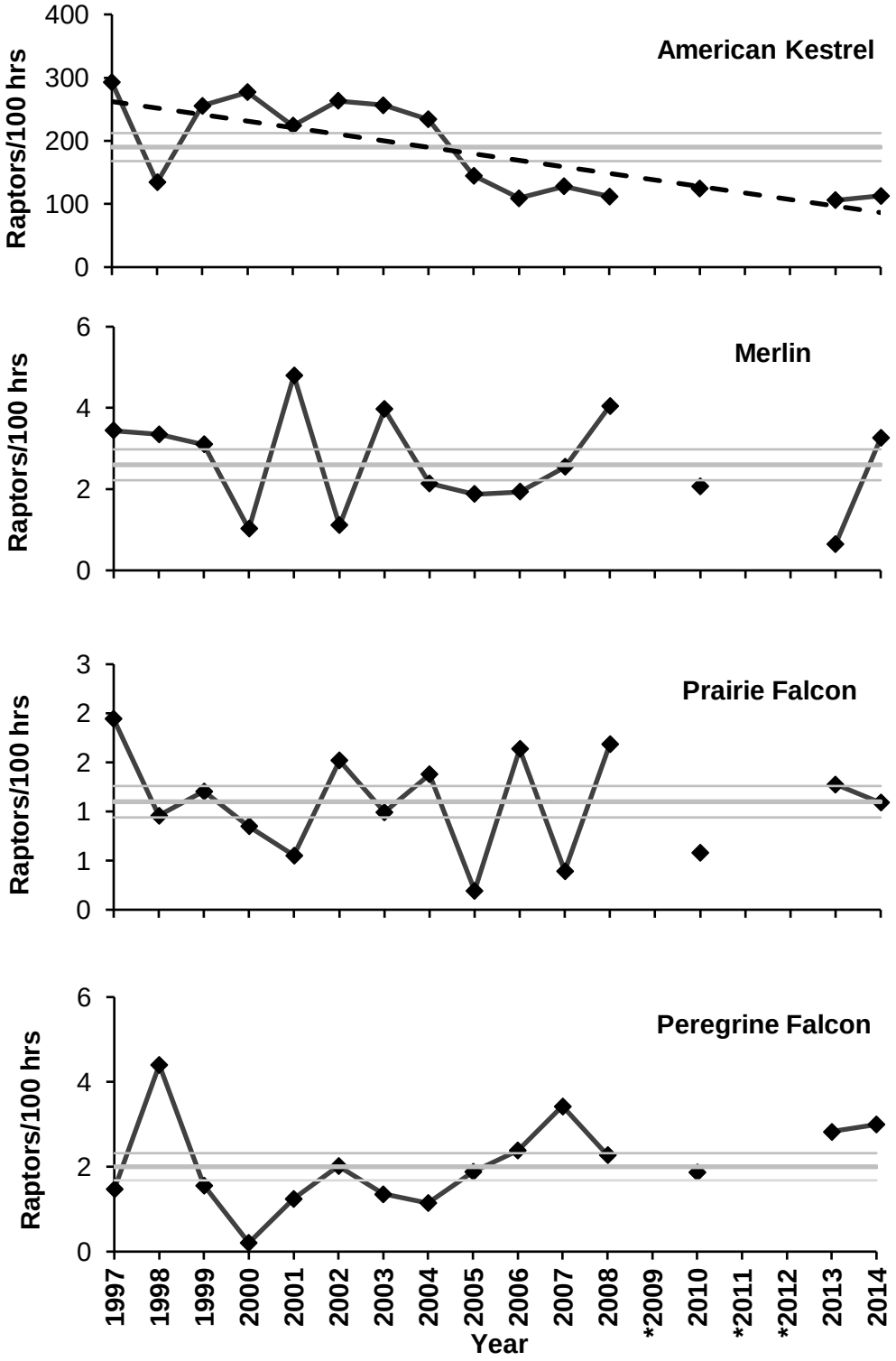

Figure 5e. Falcon fall-migration passage rates at Yaki Pt. in the Grand Canyon, AZ: 1997–2014. Dashed lines indicate significant ($p < 0.05$) population trends based on linear regressions. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (1997-2013). 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 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 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)

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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 small accipiter	*A. striatus* or *cooperii*	SA	U	U	NA
Unknown large accipiter	*A. cooperii* or *gentilis*	LA	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 small falcon	*F. sparverius* or *columbarius*	SF	U	U	NA
Unknown large falcon	*F. mexicanus* or *peregrinus*	LF	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: 1997–2013.

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 accipiter	94	140	109	236	72	239	156	248	127
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 falcon	0	4	2	3	2	8	1	4	6
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

Appendix C. continued

YEAR	2006	2007	2008	2010	2013	2014	MEAN
Start date	27-Aug	27-Aug	1-Sep	27-Aug	27-Aug	27-Aug	26-Aug
End date	4-Nov	5-Nov	5-Nov	5-Nov	5-Nov	5-Nov	4-Nov
Days of observation	70	71	66	71	71	71	69
Hours of observation	533.33	566.76	514.09	572.42	606.33	605.65	547.74
Raptors / 100 hours	771	750	645	951	741.0	833.0	875
SPECIES					RAPTOR COUNTS		
Osprey	37	29	30	42	61	58	41
Northern Harrier	45	38	35	45	42	31	41
Sharp-shinned Hawk	1,627	1,417	1,417	2,065	1,506	1806	1,655
Cooper's Hawk	695	761	417	911	969	862	958
Northern Goshawk	14	12	18	4	3	4	7
Unknown accipiter	136	465	192	688	186	342	221
TOTAL ACCIPITERS	2,472	2,655	2,044	3,668	2,664	3,014	2,840
Red-shouldered Hawk	0	0	0	0	0	0	0
Broad-winged Hawk	12	18	3	8	21	28	12
Swainson's Hawk	30	9	10	51	50	59	38
Red-tailed Hawk	995	903	641	934	1,126	1,262	981
Ferruginous Hawk	6	3	3	2	10	12	6
Rough-legged Hawk	1	0	0	0	1	0	0
Zone-tailed Hawk	0	0	5	0	0	0	1
Unidentified buteo	48	36	34	116	42	28	34
TOTAL BUTEOS	1,092	969	696	1,111	1,250	1,389	1,071
Golden Eagle	1	5	4	2	2	2	8
Bald Eagle	18	30	20	10	12	12	19
Unidentified eagle	0	3	0	1	0	0	1
TOTAL EAGLES	19	38	24	13	14	14	28
American Kestrel	384	475	395	485	424	474	705
Merlin	9	12	18	10	3	16	12
Prairie Falcon	9	2	8	3	7	7	6
Peregrine Falcon	13	19	12	11	16	18	11
Unknown falcon	27	4	25	31	8	5	9
TOTAL FALCONS	442	512	458	540	458	520	742
Unidentified raptor	6	8	31	23	4	19	23
GRAND TOTAL	4,113	4,249	3,318	5,442	4,493	5,045	4,785