FALL 2013 RAPTOR MIGRATION REPORT
HAZEL BAZEMORE COUNTY PARK, CORPUS CHRISTI, TEXAS

HAWK WATCH INTERNATIONAL

Conserving Raptors and Our Shared Environme

Salt Lake City, Utah

July 2014

SUMMARY OF FALL 2013 RAPTOR MIGRATION AT
Hazel Bazemore County Park, Corpus Christi, TX

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INTRODUCTION

The Corpus Christi Raptor Migration Count in southern Texas is an ongoing effort to monitor long-term regional trends in raptor populations using the Gulf Coast migratory flyway (Smith et al. 2001, 2008a). HawkWatch International (HWI), in partnership with Nueces County Parks and Recreation, Texas Parks and Wildlife Department, and local volunteers began standardized annual counts of the fall raptor migration at Hazel Bazemore County Park (HBCP) near Corpus Christi in 1997. Prior to this, local volunteers conducted shortened, peak-season counts at this "Coastal Bend" site each year between 1988 and 1996 following protocols of the Hawk Migration Association of North America (HMANA; see the Dec 1997 issue of Hawk Migration Studies for a summary of those efforts). Since HWI established full-season counts at the site in 1997, we have documented 30 species of raptors migrating through the project area with annual counts ranging between 445,000 to more than 1,000,000 migrants each fall. The spectacular Broad-winged Hawk flight comprises 88–98% of the total count annually. Other species of note seen at HBCP each year include sizeable flights of Mississippi and Swallow-tailed Kites, and an occasional Aplomado Falcon. This report summarizes the 2013fall raptor migration at HBCP, the 16th straight year of fall counting at this site.

The Corpus Christi project was 1 of 8 long-term, annual migration counts conducted 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) by providing western US data for the Raptor Population Index (RPI), a collaborative effort to monitor raptor migration across North America in a standardized way (Hussell and Inzunza 2008, Farmer and Hussell 2008). HBCP falls within the Tamaulipan Brushlands and Gulf Coast bird conservation regions, the Gulf Coast Joint Venture, and the Coastal Prairies 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 population status and trends of multiple raptor species (Zalles and Bildstein 2000).

Beyond having scientific and conservation value, all of HWI's migration studies offer unique opportunities for the public to learn about raptors and the natural environment. Providing such opportunities is another important component of the Corpus Christi Raptor Migration Project and outreach efforts here reach hundreds of people from the Texas Gulf Coast and beyond each season.

STUDY SITE

The nine-county area surrounding Corpus Christi is also known as the Coastal Bend and includes Aransas, Refugio, San Patricio, Nueces, and Kleberg counties along the coast, and Goliad, Bee, Live Oak, and Jim Wells counties to the west. The Gulf Coast in Texas runs from the northeast to the southwest between the Louisiana border and Corpus Christi Bay, and then shifts to a more north–south direction from there into Mexico. Hazel Bazemore County Park (HBCP) is approximately 27 km west of Corpus Christi Bay near the town of Calallen (27º52'3.0"N, 97º38'30.1"W; Figure 1). This geographic location is ideal for monitoring the autumn raptor migration through the region. Past records show that this is a major migration path for Broad-winged Hawks (Rappole and Blacklock 1985).

The HBCP count site sits at an elevation of 28 m above mean sea level, the highest elevation along the coast in a four-county area. The park is located on the southern bank of the Nueces River at a horseshoe bend where the river changes from a southeast to north–northwest flow. Fall 2013 marked the sixth season for the viewing platform centered atop the grassy area that previously served as the central viewshed. The deck can hold up to 150 people, affords a sweeping 180° viewscape, and includes a

backside ramada for shade. Visibility is clear the west, north, and east, but trees and topography at a similar elevation restrict the southern view. The Nueces River bottomlands feature a transitional riparian forest. Characteristic plants include hackberry (*Celtis* spp.), Mexican ash (*Fraxinus berlandieriana*), anacua (*Ehretia anacua*), black persimmon (*Diospyros texana*), chittimwood (*Bumelia lanuginosa*), and cedar elm (*Ulmus crassifolia*). Many species of raptors use this forested area for nocturnal roosting during migration (Rappole and Blacklock 1985). Open farmland predominates to the north and south, open ranchland to the west. Corpus Christi Bay, which is an industrial and urbanized area, lies to the east.

METHODS

STANDARDIZED COUNTS

Weather permitting, two designated observers, relieved or supplemented by other trained staff and volunteers, conduct standardized daily counts of migrating raptors from the observation platform. Observers assign specific roles to other volunteers and visitors taking part in the count to maximize count accuracy and enhance the quality of the count. Counters are responsible for counting large flights of raptors, usually Broad-winged Hawks. Spotters are responsible for scanning the sky for both large flights and single raptors, and notifying the counters of their sightings. Other individuals are responsible for scanning through large flights of Broad-winged Hawks and noting occurrences of other species. Additional volunteer assignments include keeping up with the visitor log, taking weather observations when the primary observer is too busy with counts, and serving as data recorder on busy days.

Weather permitting, observations usually begin by 0800 H and end by 1600 H Central Standard Time (CST). Data gathering and recording 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 A 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). At this location observers generally tally raptors by species and not sex or age class, because the demands of counting during peak flight periods usually precluded paying close attention to details other than species identification.
2. Hour of passage for each migrant; e.g., the 1000–1059 H CST.
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 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 deviating significantly from the mean historic count.

2013 RESULTS AND DISCUSSION

OBSERVATION EFFORT AND WEATHER SUMMARY

During the 2013 season, observers counted on 98 days for a total of 739.75 hours, both values significantly higher than 1997-2012 site averages of 93days and 709.93 hours. No full days were lost due to weather in 2013 and only one day had an abbreviated count (≤4 hours). Weather varies throughout every season, in 2013 based on hourly recording of conditions during observation it was clear 18% of the time, hazy 96% of the time, overcast 46% and rainy 6% of the time.

2013 FLIGHT SUMMARY

Overall Flight:

Crews counted 442,301 raptors of 25 species passing by the Hazel Bazemore County Park migration site during the fall of 2013, a 34% decline below the site long-term average (Table 1); but similar to counts the past 5 years (Appendix E). The 2013 flight consisted of 76 % buteos, 17% vultures, 1% kites and less than 1% of all other groups, owing to the large proportion of Broad-winged hawks (91% on average, but only 76% in 2013) that make up the flight (Fig 2a). Removing Broad-winged Hawks from the flight composition (Fig 2b) resulted in the following species group proportions: Vultures (75%), Kites (14%), Buteos (6%), Accipiters (3%), Falcons (2%), and other species (<1%).

The following sections summarize the 2013 count relative to historic means at the site, and any statistically significant ($p < 0.05$) regional population trends based on first and second order regression analysis. HWI only depicts significant trends for species with a historic average count rate greater than or equal to 10 individuals per 100 hours. The rationale is that trends for counts below this point likely do not contain biologically useful information on regional populations—species with counts this low likely have a very dispersed migration, another primary migration route, or large portions of the population that are resident. We do include count information in the reports, as occurrences of rarer species are of interest to both managers and the general public, and could represent the beginning of meaningful long-term changes.

Vultures and Osprey (Fig. 3a)

The 2013 flight marked the second straight year of below average Black Vulture counts at HBCP (2012 was a record low). In contrast Turkey Vultures were counted in record numbers for the site in 2013, continuing a significant trend of increase ($r^2 = 0.41$, $p = 0.005$). In an average year Turkey Vultures make up 4 % of the flight, in 2013 they comprised 17% of the flight. Osprey counts also were above historic HBCP averages for the third straight fall. Regional Osprey populations are increasing based on HBCP fall counts ($r^2=0.48$, $p = 0.002$).

Northern Harriers and Kites (Fig. 3b):

After above average counts in 2011 and 2012, the 2013 Northern Harrier count was in line with historic counts at HBCP. Overall, Norther Harrier regional populations are increasing ($r^2= 0.28$, $p=0.029$). The 2013 Swallow-tailed Kite flight was below the historic site average, the first below average count for this species in the last 8 years. Trend analysis suggests that Swallow-tailed Kite regional populations have stabilized or may even be declining in recent years after a period of increase from 1997 to 2008 ($r^2= 0.5$, $p=0.007$). It was an average year for Mississippi Kites based on hourly passage rates, but the overall regional population of Mississippi Kites is growing based on trend analysis ($r^2= 0.67$, $p<0.0001$).

Crested Caracara and Accipiters (Fig. 3c):

For the second year in a row, crews at HBCP counted below average numbers of Crested Caracara. It was an average year for both Sharp-shinned and Cooper's Hawks based on hourly passage rates, but the overall trend for regional populations of both species is increasing based on migration counts at HBCP (r^2-0.29, p=0.025 and r^2= 0.41, p= 0.005, respectively).

Buteoine and Near-Buteoine Hawks (Figs. 3d and 3e):

Broad-winged hawks regularly make up the bulk of the fall flight at HBCP (91% on average). In 2013 they comprised 76% of the flight, still a significant proportion but a significant departure from historic levels. This year's flight of Broad-winged Hawks marked the sixth straight year of below average counts at HBCP and regional populations appear to be declining (r^2= 0.4, p= 0.006). It was also a below average year for Red-tailed Hawks, Red-Shouldered Hawks, and Harris's Hawks seen at HBCP in 2013. Swainson's Hawk counts were in-line with the historic average for the species in 2013 after a significantly high count in 2012; over the long term regional populations of Swainson's Hawks appear stable (no significant trend). White-tailed Hawk counts were above average for the second year running.

Falcons (Fig. 3f):

American Kestrels, Merlins, and Peregrine Falcons all passed by HBCP in higher than historic average numbers in 2013. In fact all three species have increasing regional populations based on fall migration counts at HBCP (American Kestrel r^2= 0.57, p=0.0004; Merlin r^2= 0.73, p= 0.00001, and Peregrine Falcon r^2= 0.31, p= 0.017). Interestingly the increasing trend for American Kestrels at this site differ from those found at HWI sites in the western US where the species is declining. Based on findings at those sites and other regional monitoring sites across North America, HWI scientists, along with many other North American researchers and Citizen Scientists have collaborated to understand Kestrel declines locally and at the continental scale under the umbrella of the American Kestrel Partnership (http://kestrel.peregrinefund.org/). HBCP data may indicate that Kestrel populations in the midwest are doing better than elsewhere.

VISITOR PARTICIPATION AND PUBLIC OUTREACH

Nearly 1000 visitors partipated in the spectacle that is the fall raptor migration at HBCP in 2013. As usual, visitation was high during the annual *Celebration of Flight* event in late September, with approximately 350 visitors watching live raptor programs by Sky Kings Falconry and participating in lectures on hawk migration, raptors of the Coastal Bend, and a history of HWI. Other organized groups included students from the Texas State Aquarium Sea Camp, Rockport Elementary, Texas A&M Community College, and Delmar College; four families participating in the Texas Nature Challenge; and birding groups from the Travis Audubon Society and the Rockport Hummerbird Celebration. Many others enjoyed visiting the HBCP throughout the season to learn about raptor migration ecology, and what counting efforts such as these can tell us about regional raptor populations and the health of the landscapes they use.

Most visitors came from Texas, but others hailed from California, Pennsylvania, New Jersey, Georgia, North Carolina, Colorado, Oregon, Ohio, Arkansas, New Mexico, Arizona, Maryland, Connecticutt, Washington, Alaska, Florida, New York, Oklahoma, Virginia, Illinois, and included international guests from New Zealand, Australia, and the United Kingdom.

ACKNOWLEDGEMENTS

Funding and logistical support for the 2013 season and the *Celebration of Flight* event were provided by Swarovski Optik NA, Eagle Optics, the Law Office of John Gilmore, the Audubon Outdoor Club of Corpus Christi, Nueces County Parks and Recreation Department, and HWI private donors and members. Many thanks go to the Nueces County Parks and Recreation Department and their staff at Hazel Bazemore Park for providing such a magnificent place to count hawks. Thanks also to all the dedicated local and visiting volunteers who assisted with counts, on-site coordination, and public outreach. We appreciate the good company and treats you provide, as well as your interest and enthusiasm for raptors, which make it all worthwhile. Local volunteers who contributed mightily during the 2013 season include Joel & Vicki Simon, Bill & Patty Beasley, Bob & Jo Creglow, Jon & Amy Gibson, Clay & Debbie Taylor, Stacy Zarpentine, Peter Collins, Pat Makris, Mary Hager, Peter Wilkinson, Phyllis Hibdon, Mike Clifford, Denise Parks, Linda Alley. Special thanks to Patty Beasley for her continued efforts as webmaster for the Texas Hawkwatches website (http://www.ccbirding.com) and to Carol Kilgore for housing Kevin.

Finally, enormous thanks to all of the members of our 2013 field crew: Dane Ferrell, Kevin Georg, and Celia Benitez Gil; our local site coordinators: Libby Even and Joel Simon; and to Beth Hoekje for education and outreach efforts throughout the Coastal Bend area. Without your skill, dedication, neck-strength, and willingness to brave the bugs and elements over the course of a long and intense season these efforts would not be possible.

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Table 1. Fall counts and passage rates by species for migrating raptors at Hazel Bazemore CountyPark near Corpus Christi, Texas: 1997–2012 means compared to 2013.

	Counts			Raptors/100 hours		
Species	1997–2012[1]	2013	% Change	1997–2012[1]	2013	% Change
Black Vulture	485 ± 169.6	147	-70	68.3 ± 23.81	19.9	-71
Turkey Vulture	28,703 ± 8027.7	78,587	+174	4008.2 ± 1110.51	10623.5	+165
Unidentified vulture	0.6 ± 1.1	0	-100	– – –	–	–
Total vultures	29,189 ± 8040.1	78,734	+170	– – –	–	–
Osprey	202 ± 36.9	281	+39	28.7 ± 5.30	38.0	+33
Northern Harrier	254 ± 83.4	253	-1	35.8 ± 11.73	34.2	-5
Hook-billed Kite	0.1 ± 0.1	0	-100	0.0 – 0.01905	0	–
Swallow-tailed Kite	83 ± 43.9	81	-3	11.2 ± 5.45	10.9	-2
White-tailed Kite	5 ± 1.7	4	-16	0.66374 – 0.22182	0.54072	–
Mississippi Kite	12,727 ± 3979.6	14,960	+18	1762.0 ± 520.99	2022.3	+15
Total kites	12,816 ± 4013.5	15,045	+17	– – –	–	–
Sharp-shinned Hawk	1,431 ± 251.9	1,622	+13	201.6 ± 34.19	219.3	+9
Cooper's Hawk	959 ± 216.6	1,017	+6	134.1 ± 29.75	137.5	+2
Northern Goshawk	0.4 ± 0.4	0	-100	0.05914 – 0.05754	0	–
Unidentified accipiter	256 ± 39.2	138	-46	– – –	–	–
Total accipiters	2,646 ± 418.7	2,777	+5	– – –	–	–
Common Black Hawk	0.1 ± 0.1	0	-100	0.00924 – 0.01811	0	–
Harris's Hawk	15 ± 5.1	9	-38	2.0 ± 0.71	1.2	-40
Red-shouldered Hawk	52 ± 13.6	41	-21	7.3 ± 1.93	5.5	-24
Broad-winged Hawk	579,132 ± 120160.0	336,960	-42	83079.9 ± 19059.19	45550.5	-45
Short-tailed Hawk	0.9 ± 0.6	1	+14	0.11941 – 0.07754	0.13518	–
Swainson's Hawk	7,489 ± 3770.8	6,132	-18	1037.6 ± 484.53	828.9	-20
White-tailed Hawk	19 ± 7.4	29	+52	2.6 ± 0.96	3.9	+50
Zone-tailed Hawk	6 ± 2.8	7	+22	0.8 ± 0.35	0.9	+21
Red-tailed Hawk	166 ± 36.7	61	-63	23.5 ± 5.26	8.2	-65
Ferruginous Hawk	4 ± 1.8	3	-19	0.5 – 0.24674	0.40554	–
Rough-legged Hawk	0.3 ± 0.5	0	-100	– – –	–	–
Unidentified buteo	96 ± 42.9	49	-49	– – –	–	–
Total buteos	586,978 ± 120150.5	343,292	-42	– – –	–	–
Golden Eagle	1.6 ± 0.5	5	+220	0.21915 – 0.06722	0.6759	–
Bald Eagle	4 ± 1.9	6	+39	0.59588 – 0.25685	0.81108	–
Unidentified eagle	0.1 ± 0.2	0	-100	– – –	–	–
Total eagles	6 ± 2.1	11	+83	– – –	–	–
Crested Caracara	10 ± 3.4	4	-61	1.5 ± 0.50	0.5	-63
American Kestrel	731 ± 179.1	1,353	+85	102.8 ± 24.60	182.9	+78
Merlin	55 ± 14.8	78	+42	7.7 ± 1.97	10.5	+38
Prairie Falcon	8 ± 3.6	8	0	1.1 ± 0.51	1.1	-4
Peregrine Falcon	193 ± 37.1	291	+51	27.3 ± 5.12	39.3	+44
Aplomado Falcon	0.8 ± 0.5	0	-100	– – –	–	–
Unknown small falcon	4 ± 2.2	11	+148	– – –	–	–
Unknown large falcon	3 ± 1.6	4	+42	– – –	–	–
Unidentified falcon	24 ± 15.4	4	-84	– – –	–	–
Total falcons	1,020 ± 213.0	1,749	+72	– – –	–	–
Unidentified raptor	712 ± 661.2	155	-78	– – –	–	–
Grand Total	633,833 ± 113502.6	442,301	-30	– – –	–	–

[1] Mean ± 95% confidence interval.

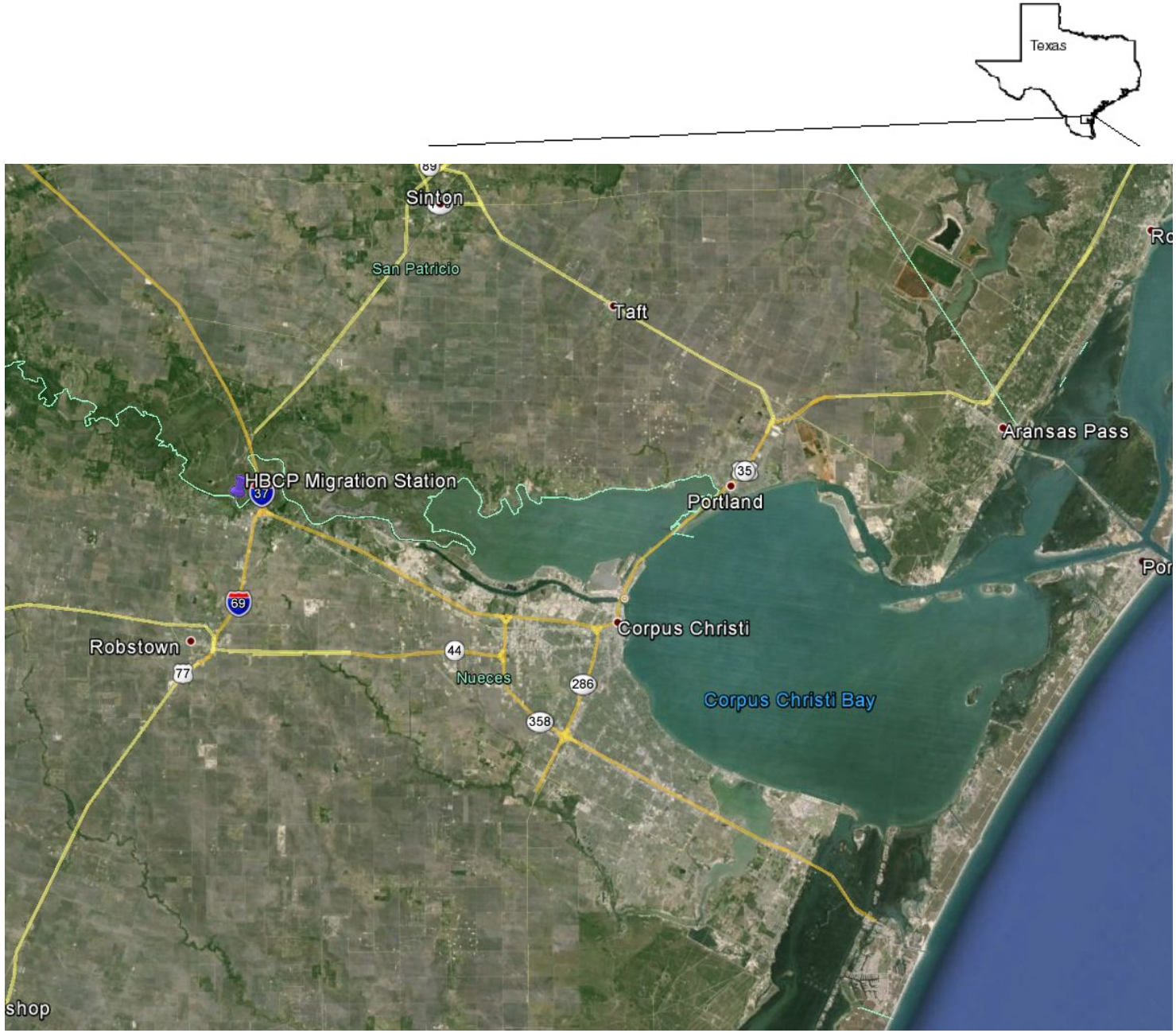

Figure 1. Location of Hazel Bazemore County Park count site near Corpus Christi, Texas.

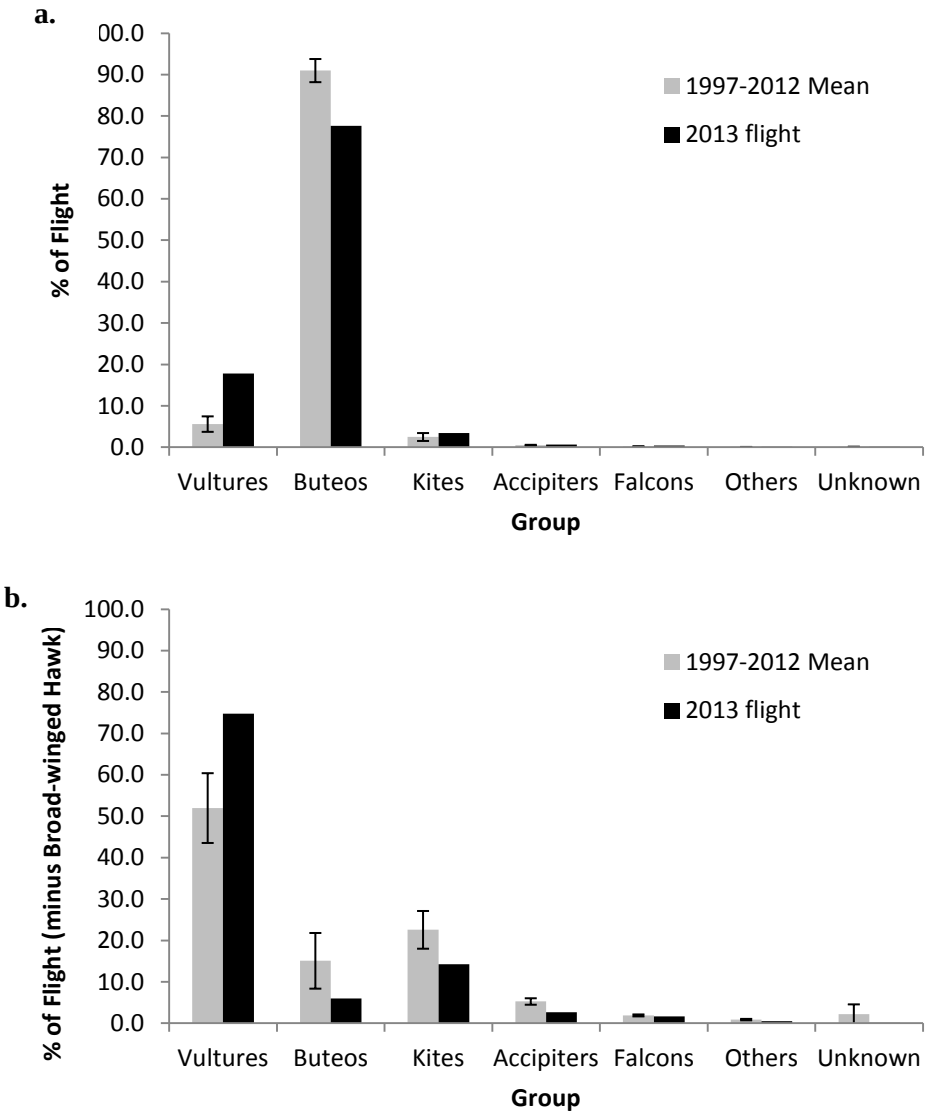

Figure 2. Composition of the fall raptor flight by species group a) with and b) without Broad-winged Hawks at Hazel Bazemore CountyPark near Corpus Christi, Texas: 1997–2012 versus 2013.

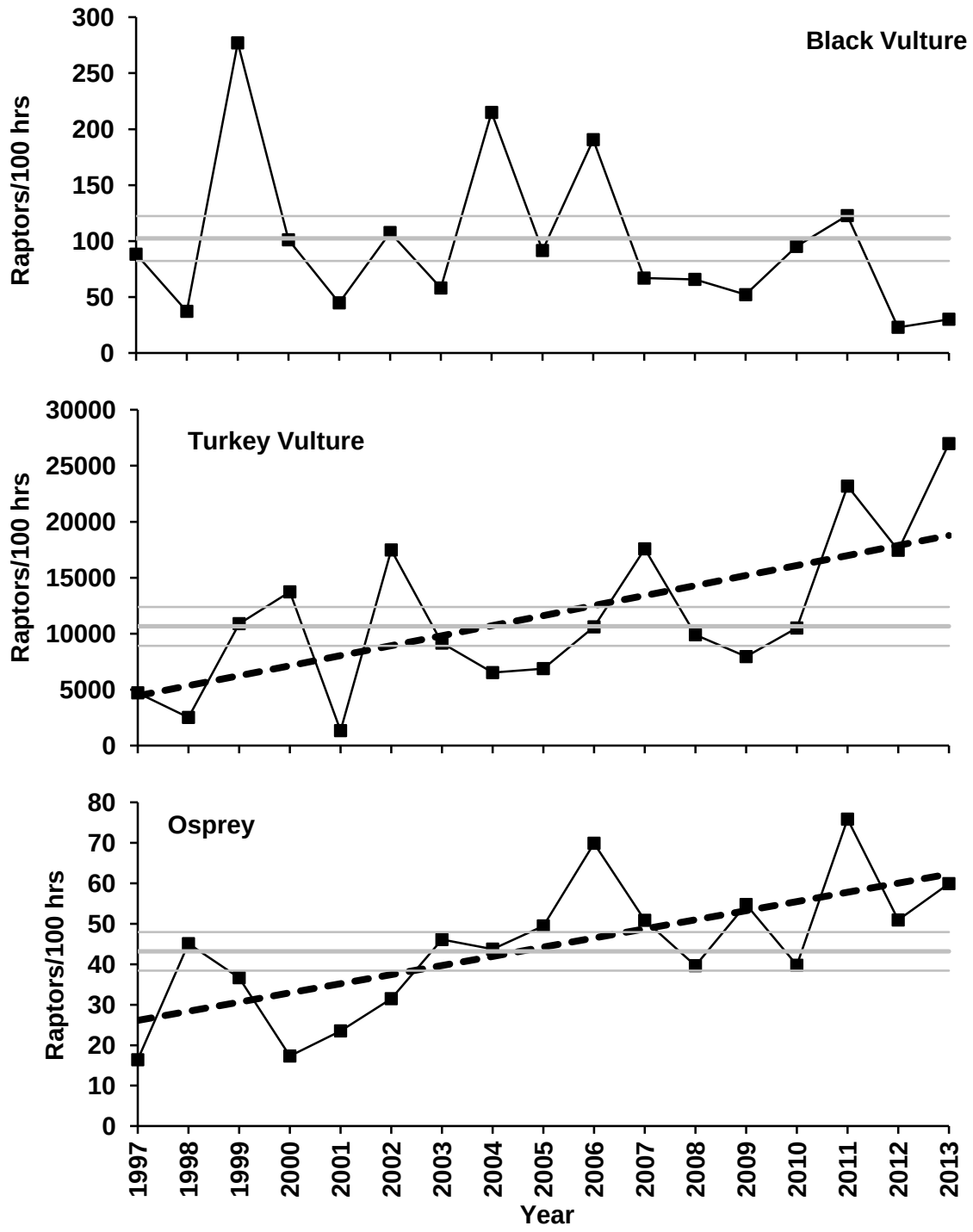

Figure 3a. Adjusted fall-migration passage rates at Hazel BazemoreCounty Park near Corpus Christi, Texas for Black Vultures, Turkey Vultures, and Osprey: 1997–2013. Dashed lines indicate trends for significant ($p < 0.05$) linear regression. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (1997-2012) at HBCP.

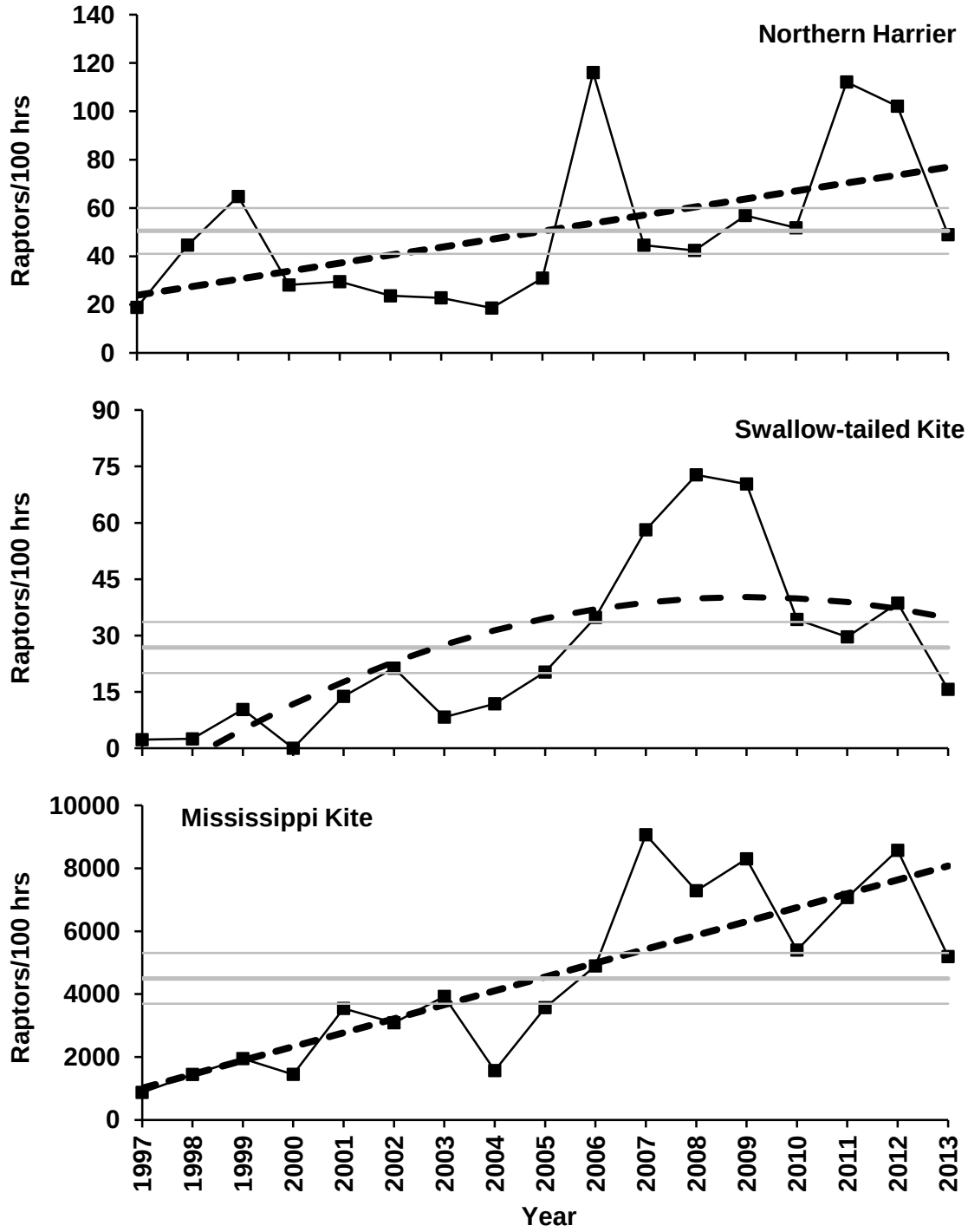

Figure 3b. Adjusted fall-migration passage rates at Hazel Bazemore County Park near Corpus Christi, Texas for Northern Harriers, Swallow-tailed Kites, and Mississippi Kites: 1997–2013. Dashed lines indicate trends for significant ($p < 0.05$) linear or polynomial regression. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (1997-2012) at HBCP.

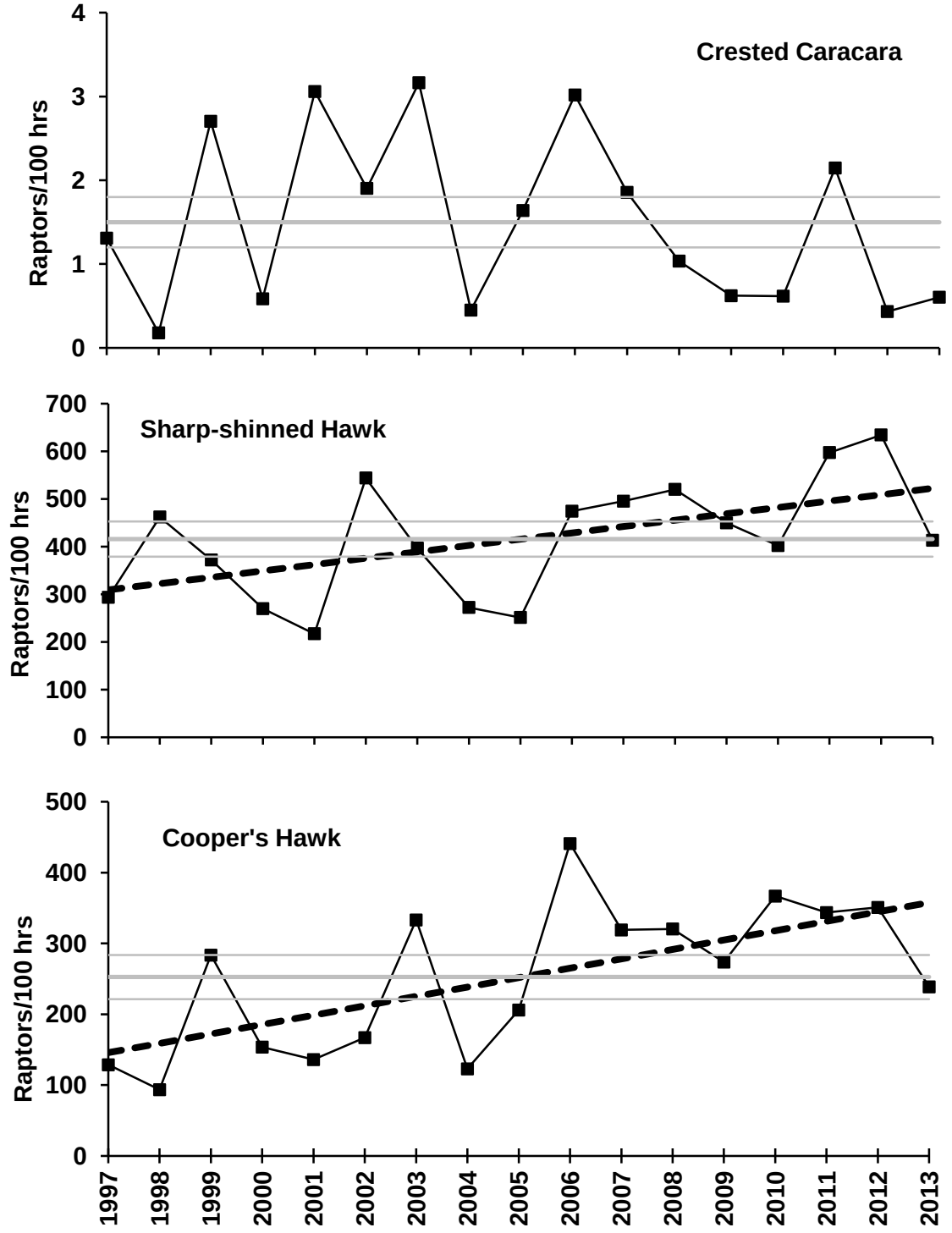

Figure 3c. Adjusted fall-migration passage rates at Hazel Bazemore County Park near Corpus Christi, Texas for Crested Caracara, Sharp-shinned, and Cooper's Hawks: 1997–2013. Dashed lines indicate trends for significant ($p < 0.05$) linear regression. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (1997-2012) at HBCP.

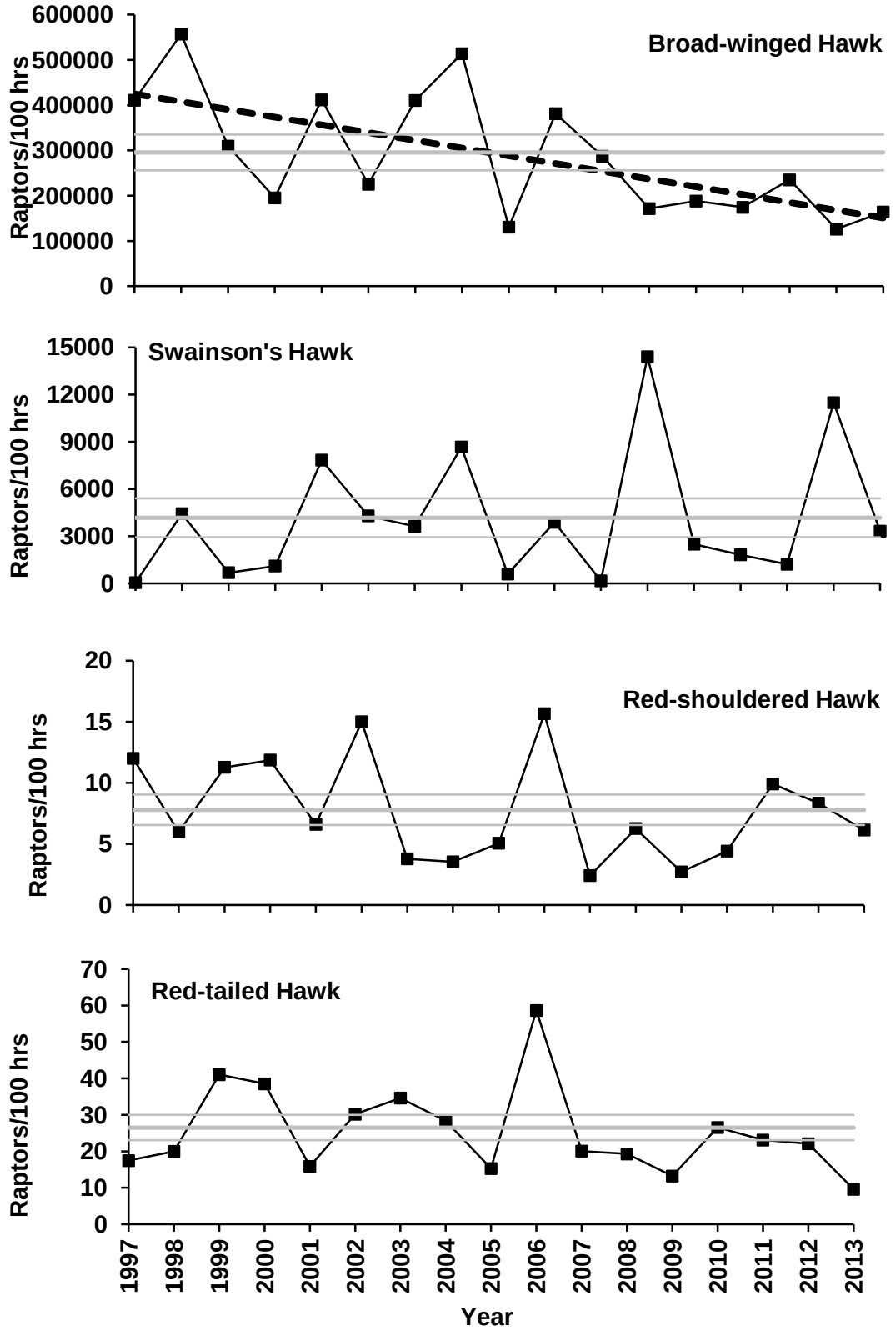

Figure 3d. Adjusted fall-migration passage rates for common buteos at Hazel Bazemore County Park near Corpus Christi,TX: 1997–2013. Dashed lines indicate trends for significant ($p < 0.05$) linear regression. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (1997-2012) at HBCP.

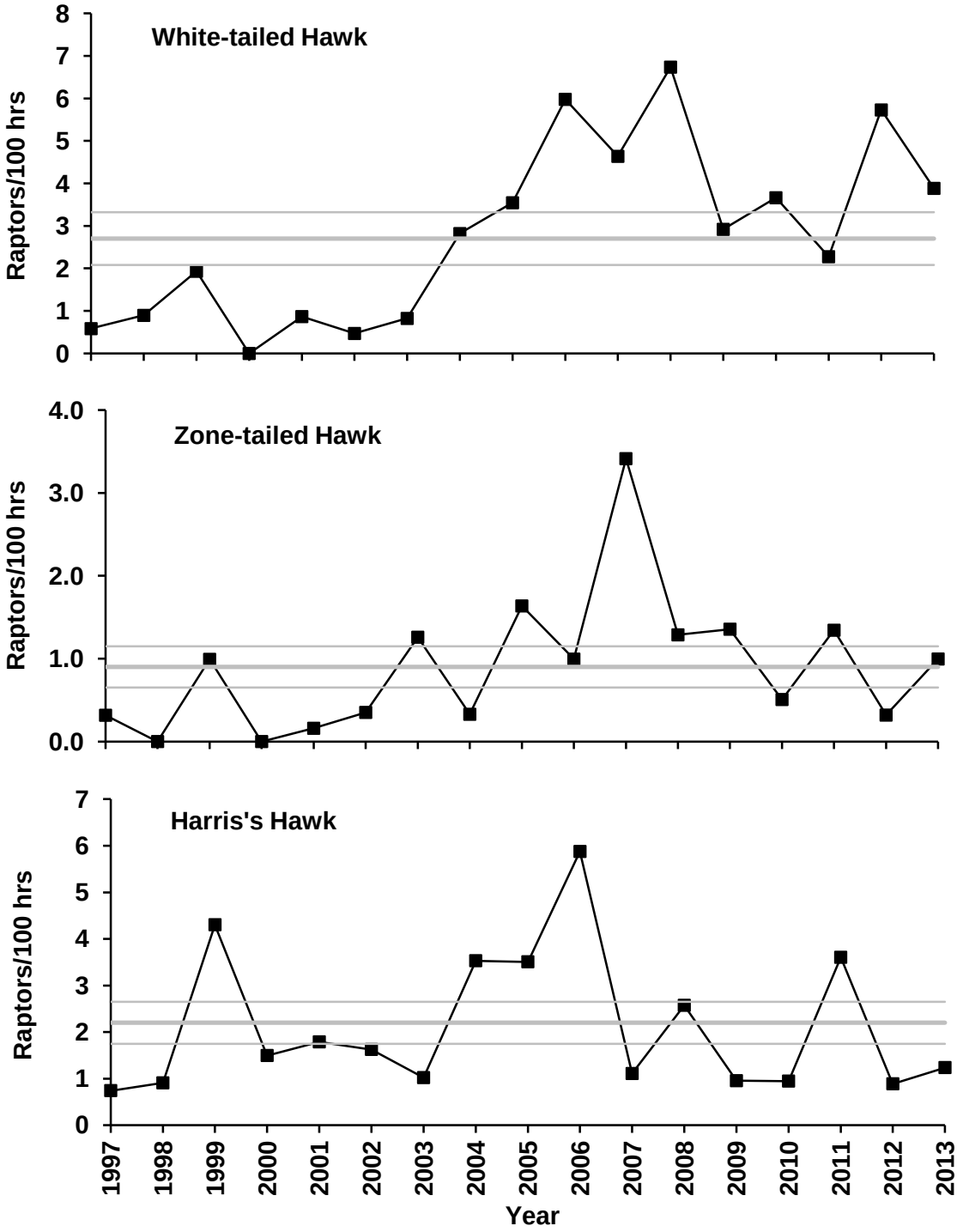

Figure 3e. Adjusted fall-migration passage rates for uncommon buteos and Harris's Hawk at Hazel Bazemore County Park near Corpus Christi, Texas: 1997–2013. Dashed lines indicate trends for significant ($p < 0.05$) linear regression. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (1997-2012) at HBCP.

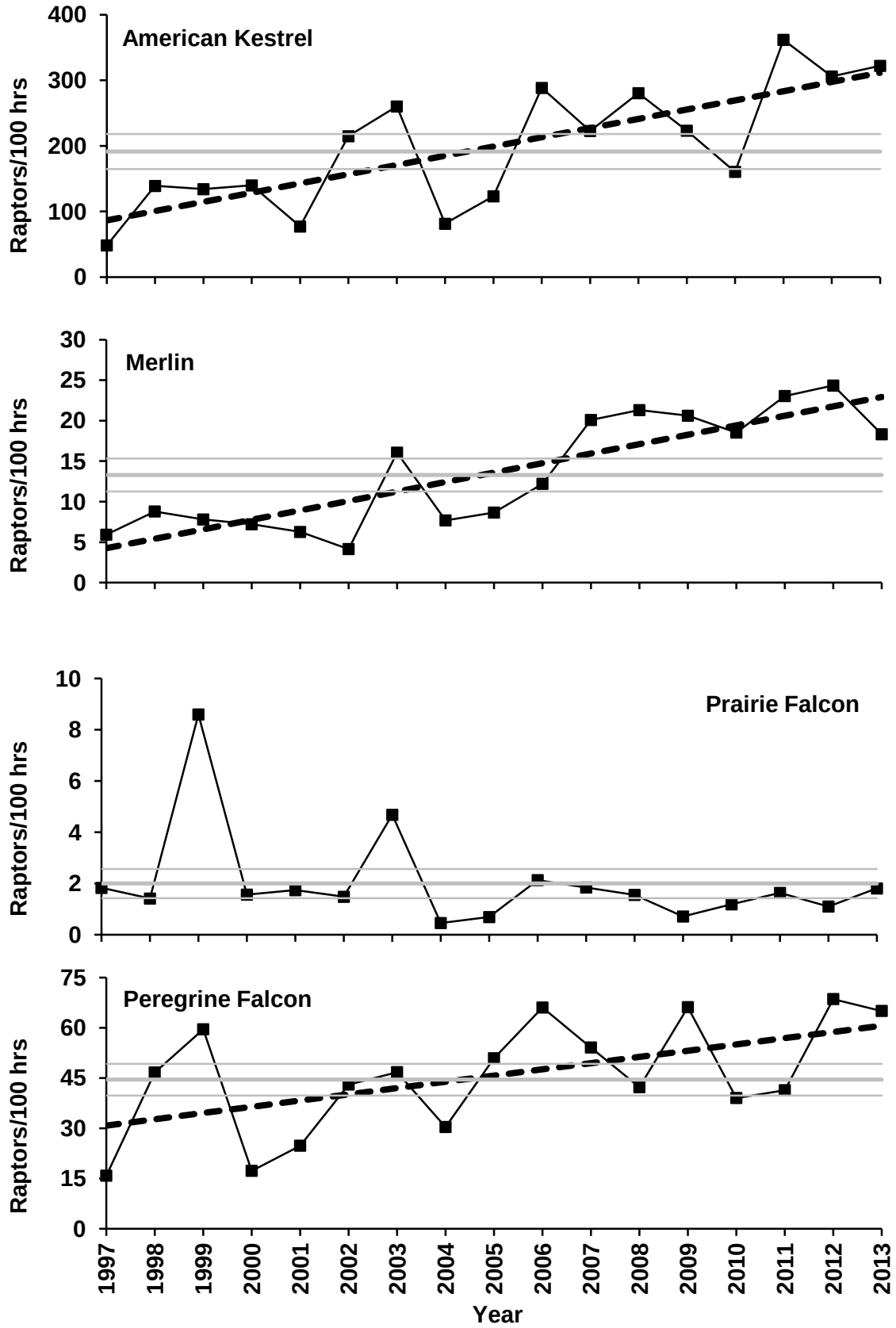

Figure 3f. Adjusted fall-migration falcon passage rates at Hazel Bazemore County Park near Corpus Christi, TX: 1997–2013. Dashed lines indicate trends for significant ($p < 0.05$) linear

regression. Solid grey lines represent mean (thick) and upper and lower 95% confidence intervals (thin) of historic counts (1997-2012) at HBCP.

Appendix A. Common and scientific names, species codes, and regularly applied age, sex, and color-morph classifications.

Common Name	Scientific Name	Species Code	Age[1]	Sex[2]	Color Morph[3]
Black Vulture	*Coragyps atratus*	BV	U	U	NA
Turkey Vulture	*Cathartes aura*	TV	U	U	NA
Unknown vulture	see above	UV	U	U	NA
Osprey	*Pandion haliaetus*	OS	U	U	NA
Northern Harrier	*Circus cyaneus*	NH	A I Br U	M F U	NA
Hook-billed Kite	*Chondrohierax uncinatus*	HK	A I U	AM AF U	D L U
Swallow-tailed Kite	*Elanoides forficatus*	SK	U	U	NA
White-tailed Kite	*Elanus leucurus*	WK	U	U	NA
Mississippi Kite	*Ictinia mississippiensis*	MK	A I U	U	NA
Unknown kite	see above	UK	U	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
Common Black Hawk	*Buteogallus anthracinus*	CB	A I U	U	NA
Harris's Hawk	*Parabuteo unicinctus*	HH	A I 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
Short-tailed Hawk	*Buteo brachyurus*	ST	U	U	D L U
Swainson's Hawk	*Buteo swainsoni*	SW	U	U	D L U
White-tailed Hawk	*Buteo albicaudatus*	WT	A I U	U	NA
Zone-tailed Hawk	*Buteo albonotatus*	ZT	A I U	U	NA
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
Unknown buteo	*Buteo* spp.	UB	U	U	D L U
Golden Eagle	*Aquila chrysaetos*	GE	A S I NA U[4]	U	NA
Bald Eagle	*Haliaeetus leucocephalus*	BE	A S2 S1 I NA U[5]	U	NA
Unknown eagle	*Aquila* or *Haliaeetus spp.*	UE	U	U	NA
Crested Caracara	*Caracara cheriway*	CC	U	U	NA
American Kestrel	*Falco sparverius*	AK	U	M F U	NA
Merlin	*Falco columbarius*	ML	AM Br	M U	NA
Prairie Falcon	*Falco mexicanus*	PR	U	U	NA
Peregrine Falcon	*Falco peregrinus*	PG	A I U	U	NA
Aplomado Falcon	*Falco femoralis*	AF	A I U	U	NA
Unknown falcon	*Falco* spp.	UF	U	U	NA
Unknown raptor	Falconiformes	UU	U	U	NA

[1] A = adult, I = immature (HY), Br = brown (adult female or immature), U = unknown age.

[2] M = male, F = female, U = unknown.

[3] D = dark or rufous, L = light, U – unknown, NA = not applicable.

[4] Golden Eagle age codes: I = immature, first-year bird, bold white wing patch visible below (small patch may be visible above), bold white in the tail, no molt; S = subadult, white wing patch variable or absent, obvious white in the tail, molt or tawny bar on upper wing visible; NA = not adult, unknown age immature/subadult, obvious white in wing or tail, but rest of plumage not adequately observed; A = adult, no obvious white on wing or tail; U = plumage not adequately observed to make an age determination.

[5] Bald Eagle age codes: I = immature, first-year bird, dark breast and tawny belly; S1 = young subadult, Basic I and II plumages, light belly or upside-down white triangle on the 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 tip to tail (may be hard to see in field) and adult with pure white head and tail; U = plumage not adequately observed to make an age determination.

Appendix B. History of official observer participation at the Corpus Christi Raptor Migration Site: 1997–2009.

1997: Two observers throughout: Glenn Swartz (6 partial at this site) and Joel Simon (0), regularly assisted by several other dedicated volunteers.

1998: Two observers throughout: Glenn Swartz (1 plus 6 partial at this site) and Joel Simon (1), regularly assisted by several other dedicated volunteers.

1999: Three observers throughout: Joel Simon (2), Fernando Rincon (1), and Ryan Wagner (0), regularly assisted by several other dedicated volunteers.

2000: Rotating team working two at a time except during peak Broad-winged Hawk flight when all three worked together: Scott Rush (2), Beth Hahn (1), and Jo Creglow (several partial at this site), regularly assisted by several other dedicated volunteers.

2001: Rotating team working two at a time except during the peak Broad-winged Hawk flight when all three worked together: Greg Greene (limited experience in Idaho), Devin Taylor (0), and Karen Johnson (0), regularly assisted by several other dedicated volunteers.

2002: Rotating team working two at a time except during the peak Broad-winged Hawk flight when all three worked together: Joel Simon (3), Vicki Simon (regular volunteer on project since 1997), Kirsten McDonnell (2), Paul Sweet (0), regularly assisted by several other dedicated volunteers.

2003: Rotating team working two at a time except during the peak Broad-winged Hawk flight when all three worked together: Joel Simon (4), Ricardo Perez (0, but relevant experience in PA and El Salvador), Taylor Ellis (0, but relevant experience in FL), regularly assisted by several other dedicated volunteers.

2004: Rotating team working two at a time except during the peak Broad-winged Hawk flight when all three worked together: Joel Simon (5), Dane Ferrell (2), Scott Loss (1), regularly assisted by several other dedicated volunteers.

2005: Rotating team working two at a time except during the peak Broad-winged Hawk flight when all three worked together: Joel Simon (6), Dane Ferrell (4), Brian Bielfelt (1), regularly assisted by several other dedicated volunteers.

2006: Rotating team working two at a time except during the peak Broad-winged Hawk flight when all three worked together: Joel Simon (7), Dane Ferrell (5), Libby Even (1), regularly assisted by several other dedicated volunteers.

2007: Rotating team working two at a time except during the peak Broad-winged Hawk flight when all three worked together: Joel Simon (8), Dane Ferrell (6), Libby Even (2), regularly assisted by several other dedicated volunteers.

2008: Three-person team working two at a time throughout the season, plus two additional full-time counters from mid-September through mid-October: Full-season—Dane Ferrell (7), Leslie Parks (0), Libby Even (3); peak-season—Kevin Georg (2+), Bob Baez (0); regularly assisted by other dedicated, local volunteers, especially Joel Simon (9) and Bob Creglow (10+).

2009: Three-person team working two at a time throughout the season: Libby Even (4), Kevin Georg (3+), Dane Ferrell (8); regularly assisted by other dedicated, local volunteers, especially Bob Creglow (11+).

2010: Three-person team working two at a time throughout the season: Libby Even (5), Kevin Georg (4+), Dane Ferrell (9); regularly assisted by other dedicated, local volunteers, especially Bob Creglow (12+).

2011: Three-person team working two at a time throughout the season: Libby Even (6), Kevin Georg (5+), Dane Ferrell (10); regularly assisted by other dedicated, local volunteers, especially Bob Creglow (13+).

2012: Three-person team working two at a time throughout the season: Celia Benitez Gil (0), Kevin Georg (6+), Dane Ferrell (11); regularly assisted by other dedicated, local volunteers, especially Libby Even (7) and Bob Creglow (14+).

2013: Three-person team working two at a time throughout the season: Celia Benitez Gil (1), Kevin Georg (7+), Dane Ferrell (12); regularly assisted by other dedicated, local volunteers, especially Libby Even (8) and Bob Creglow(15+).

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[1] Numbers in parentheses indicate the number of previous full seasons of experience counting migratory raptors.

Appendix E. Annual observation effort and fall raptor migration counts by species at Hazel Bazemore County Park near Corpus Christi, Texas: 1997–2013.

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Start date	15-Aug	15-Aug	14-Aug	15-Aug	15-Aug	15-Aug	15-Aug	15-Aug	15-Aug	15-Aug	1-Aug	1-Aug	15-Aug
End date	15-Nov	15-Nov	15-Nov	15-Nov	15-Nov	15-Nov	15-Nov	15-Nov	15-Nov	15-Nov	15-Nov	15-Nov	15-Nov
Observation days	89	83	90	91	93	89	86	93	92	93	106	107	92
Observation hours	725.00	585.50	719.75	728.58	723.50	676.50	643.00	701.00	715.75	704.50	798.75	830.42	688.00
SPECIES													
Black Vulture	431	138	1,398	491	222	470	241	1,016	445	893	309	326	245
Turkey Vulture	11,221	5,011	30,027	36,690	4,870	42,536	22,900	17,750	19,090	29,115	46,503	28,530	21,018
Unidentified vulture	0	0	0	0	0	0	0	9	0	0	0	0	0
Total vultures	11,652	5,149	31,425	37,181	5,092	43,006	23,141	18,766	19,535	30,008	46,812	28,856	21,263
Osprey	81	179	181	88	114	146	199	207	241	321	237	197	256
Northern Harrier	93	180	331	153	162	109	100	101	157	614	223	219	282
Hook-billed Kite	0	0	0	0	0	0	1	0	0	0	0	0	0
Swallow-tailed Kite	7	6	31	0	37	57	22	34	56	99	168	349	183
White-tailed Kite	4	6	6	2	2	2	1	2	9	8	1	14	7
Mississippi Kite	2,974	3,584	5,513	4,569	10,155	8,394	9,753	4,441	10,004	14,073	27,285	21,050	23,114
TOTAL KITES	2,985	3,596	5,550	4,571	10,194	8,453	9,776	4,477	10,069	14,180	27,454	21,413	23,304
Sharp-shinned Hawk	936	1,208	1,348	929	698	1,869	1,193	892	880	1,643	1,725	1,927	1,621
Cooper's Hawk	418	260	1,092	555	473	645	1,083	483	815	1,719	1,222	1,308	1,078
Northern Goshawk	0	0	1	0	0	1	0	0	0	2	3	0	0
Unidentified accipiter	308	316	310	379	298	108	344	252	174	290	217	264	149
TOTAL ACCIPITERS	1,662	1,784	2,751	1,863	1,767	2,649	2,620	1,627	1,869	3,654	3,167	3,499	2,848
Common Black Hawk	0	0	0	0	0	1	0	0	0	0	0	0	0
Harris's Hawk	5	5	28	10	14	10	6	23	25	39	7	18	6
Red-shouldered Hawk	79	38	77	81	45	92	26	24	37	101	15	42	17
Broad-winged Hawk	823,602	970,025	640,258	396,774	864,355	464,772	684,815	989,957	263,101	767,730	569,839	370,088	403,192
Short-tailed Hawk	0	0	2	0	0	0	0	1	4	2	1	2	1
Swainson's Hawk	300	6,790	1,246	2,085	14,260	7,912	5,633	14,751	1,347	7,225	412	26,093	4,792
White-tailed Hawk	4	5	13	0	7	4	6	19	25	39	33	50	19
Zone-tailed Hawk	2	0	6	0	1	2	7	2	10	7	22	11	8
Red-tailed Hawk	112	121	282	237	96	182	192	180	103	363	122	126	80
Ferruginous Hawk	1	0	14	1	1	2	1	2	5	8	3	8	3
Rough-legged Hawk	1	0	4	0	0	0	0	0	0	0	0	0	0
Unidentified buteo	18	25	62	215	368	80	71	53	34	79	67	105	154
TOTAL BUTEOS	824,124	977,009	641,992	399,403	879,147	473,057	690,757	1,005,012	264,691	775,593	570,521	396,543	408,272
Golden Eagle	1	0	4	1	1	1	2	1	2	2	1	2	3
Bald Eagle	0	2	4	0	2	1	1	3	4	5	7	10	1
Unidentified eagle	0	0	1	0	0	0	0	0	0	0	0	1	0
TOTAL EAGLES	1	2	9	1	3	2	3	4	6	7	8	13	4
Crested Caracara	9	1	18	4	21	12	21	3	11	20	13	7	4
American Kestrel	189	438	483	509	292	811	860	365	485	1,137	850	1,127	869
Merlin	25	29	34	31	26	18	57	32	36	50	82	96	81
Prairie Falcon	8	5	33	6	7	4	15	2	3	10	7	8	4
Peregrine Falcon	76	163	241	65	114	176	169	144	230	309	247	205	289
Aplomado Falcon	0	0	1	0	0	0	1	0	1	1	4	2	2
Unknown small falcon[1]	-	-	-	-	-	4	5	4	1	2	6	6	14
Unknown large falcon[1]	-	-	-	-	-	5	9	0	0	2	9	4	3
Unidentified falcon	14	39	92	103	41	25	47	11	5	15	2	7	2
TOTAL FALCONS	312	674	884	714	480	1,043	1,163	554	761	1,526	1,207	1,455	1,264
Unidentified raptor	220	4,376	3,874	506	837	98	133	89	35	135	120	211	110
GRAND TOTAL	841,139	992,950	687,015	444,484	897,519	528,540	727,900	1,030,849	297,375	826,058	649,762	452,414	457,607

[1] Designations used consistently for the first time in 2002.

Appendix E (continued). Annual observation effort and fall raptor migration counts by species at Hazel Bazemore County Park near Corpus Christi, Texas: 1997–2013.

	2010	2011	2012	2013	Mean
Start date	15-Aug	15-Aug	15-Aug	10-Aug	12-Aug
End date	15-Nov	15-Nov	15-Nov	15-Nov	14-Nov
Observation days	91	93	93	98	93
Observation hours	689.25	693.25	736.08	739.75	709.93
SPECIES					
Black Vulture	455	572	113	147	485
Turkey Vulture	28,926	62,521	52,543	78,587	28,703
Unidentified vulture	0	0	0	0	1
Total vultures	29,381	63,093	52,656	78,734	29,189
Osprey	182	351	256	281	202
Northern Harrier	257	546	542	253	254
Hook-billed Kite	0	0	0	0	0
Swallow-tailed Kite	85	80	117	81	83
White-tailed Kite	4	4	4	4	5
Mississippi Kite	14,851	19,054	24,825	14,960	12,727
TOTAL KITES	14,940	19,138	24,946	15,045	12,815
Sharp-shinned Hawk	1,389	2,169	2,466	1,622	1,431
Cooper's Hawk	1,328	1,379	1,484	1,017	959
Northern Goshawk	0	0	0	0	0
Unidentified accipiter	333	156	196	138	256
TOTAL ACCIPITERS	3,050	3,704	4,146	2,777	2,646
Common Black Hawk	0	0	0	0	0
Harris's Hawk	6	24	7	9	15
Red-shouldered Hawk	28	63	62	41	52
Broad-winged Hawk	328,730	445,112	283,755	336,960	579,132
Short-tailed Hawk	0	0	1	1	1
Swainson's Hawk	3,565	2,387	21,019	6,132	7,489
White-tailed Hawk	24	17	41	29	19
Zone-tailed Hawk	3	9	2	7	6
Red-tailed Hawk	163	143	148	61	166
Ferruginous Hawk	2	2	6	3	4
Rough-legged Hawk	0	0	0	0	0
Unidentified buteo	84	70	47	49	96
TOTAL BUTEOS	332,605	447,827	305,088	343,292	586,978
Golden Eagle	2	1	1	5	2
Bald Eagle	12	10	7	6	4
Unidentified eagle	0	0	0	0	0
TOTAL EAGLES	14	11	8	11	6
Crested Caracara	4	14	3	4	10
American Kestrel	614	1,381	1,290	1,353	731
Merlin	80	98	104	78	55
Prairie Falcon	4	7	5	8	8
Peregrine Falcon	165	181	317	291	193
Aplomado Falcon	0	1	0	0	1
Unknown small falcon[1]	9	9	11	11	6
Unknown large falcon[1]	7	5	1	4	4
Unidentified falcon	6	2	6	4	24
TOTAL FALCONS	885	1,684	1,734	1,749	1,020
Unidentified raptor	200	201	254	155	712
GRAND TOTAL	381,514	536,555	389,630	442,297	633,822

[1] Designations used consistently for the first time in 2002.