

**FALL 2006 RAPTOR MIGRATION STUDY
NEAR CORPUS CHRISTI, TEXAS**



**HawkWatch International, Inc.
Salt Lake City, Utah**

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INTRODUCTION

The Corpus Christi Raptor Migration Project in southern Texas is an ongoing effort to monitor long-term population trends of raptors using this southern portion of the Gulf Coast migratory flyway (Smith et al. 2001). During fall 2006, HawkWatch International (HWI) conducted the tenth consecutive, full-season migration count at Hazel Bazemore County Park near Corpus Christi. Previously, volunteers conducted 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). The December 1997 issue of the HMANA Journal of Hawk Migration Studies includes a summary of these counts. Since HWI began full-season counts at the site in 1997, 30 species of raptors have been observed migrating through the project area. Previous annual counts have ranged from 444,844 to 1,030,849 migrants, with Broad-winged Hawks (see Appendix A for common and scientific names of all raptor species observed at the site) comprising 88–98% of the total count each year. This report summarizes the count results from the 2006 season.

The Corpus Christi project was 1 of 14 long-term, annual migration counts conducted or sponsored by HWI in North America during 2006. The primary objective of these efforts is to track long-term population trends of diurnal raptors, emphasizing western North America and the Gulf Coast region (Smith and Hoffman 2000, Ruelas Inzunza et al. 2000, Smith et al. 2001, Hoffman and Smith 2003). Raptors feed atop food pyramids, inhabit most ecosystems, occupy large home ranges, and are sensitive to environmental contamination and other human disturbances. For these reasons, they serve as important biological indicators of ecosystem health (Bildstein 2001). Moreover, due to the remoteness and widespread distribution of most raptor populations, migration counts represent one of the most cost-effective and efficient methods for monitoring the regional status and trends of multiple raptor species (Bednarz and Kerlinger 1989, Titus et al. 1989, Dunn and Hussell 1995, Dixon et al. 1998, Zalles and Bildstein 2000, Hoffman and Smith 2003).

STUDY SITE

The nine-county area around Corpus Christi is commonly called the Coastal Bend. This 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 Texas coast runs from the northeast to the southwest between the Louisiana border and Corpus Christi Bay, and then shifts to a north–south direction. Hazel Bazemore Park (HBP) is approximately 27 km west of Corpus Christi Bay near the town of Calallen (27°52'3.0"N, 97°38'30.1"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 HBP monitoring site is situated at an elevation of 28 m above mean sea level, which is the highest elevation along the coast in a four-county area. The park sits on the southern bank of the Nueces River at a horseshoe bend where the river changes from a southeast to north–northwest flow. The watch site offers clear visibility through a 105° arc from the northeast to the west, but the view to the east is restricted by topography at a similar elevation. 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

Three official or designated observers, routinely assisted by several experienced local volunteers, conducted daily counts of migrating raptors from a single traditional observation site at HBP. On-site project coordinator Joel Simon served as one of the official observers, which he has done most years since 1997, and provided supervision and training for the other observers, the education specialist, and local volunteers (see Appendix B for a complete history of official observer participation). Official observer Dane Ferrell had previously conducted five other full-season migration counts for HWI, including four seasons in Texas. This was official observer Libby Even's first full season of official migration counting, but she had gained extensive exposure to migration monitoring on-site as a volunteer in past seasons. Several other experienced local volunteers, as well as full-time site educator Angela Peterson, routinely assisted with the count, as has been the case in most years.

The official observers assigned a specific task to each actively participating individual to maximize accuracy of the counts and ensure quality participation by all interested volunteers. Counters were responsible for counting large flights of raptors, usually Broad-winged Hawks. Spotters were responsible for scanning the sky for both large flights and single raptors, and notifying the counters of their sightings. Other individuals were responsible for scanning through large flights of Broad-winged Hawks and recording occurrences of other species. Other volunteer assignments included keeping up with the visitor log, taking weather observations when the primary observer was too busy with counts, and serving as data recorder on busy days.

Weather permitting, observations typically began by 0800 hrs and ended by 1600 hrs Central Standard Time (CST). The observers routinely recorded 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). The observers generally tallied raptors only by species, because the demands of counting during peak flight periods usually precluded paying close attention to details other than species identification. High flight altitudes also frequently limited the attainable detail. Because of these limitations, we do not focus attention in this report on the age, sex, or color-morph data.
2. Hour of passage for each migrant; e.g., the 1000–1059 hrs 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 follows Hoffman and Smith (2003). In comparing 2006 annual statistics against means and 95% confidence intervals for previous seasons, we equate significance with a 2006 value falling outside the bounds of the confidence interval for the associated mean.

RESULTS AND DISCUSSION

WEATHER

Inclement weather did not preclude any full days of observation in 2006, and observation time was reduced to <4 hours due to inclement weather on only 2 days (see Appendix C for daily weather records). The long-term averages for the site are 3.4 and 2.7 days, respectively. Fair skies predominated on 29% of the active observation days, transitional weather (i.e., skies changed from fair to mostly cloudy/overcast, or vice versa, during the day) on 32% of the active days, and mostly cloudy to overcast skies on 39% of the active days. The long-term averages for the site are 34% fair, 42% transitional, and 25% mostly cloudy to overcast. Scattered rain and thunderstorms occurred on only 5% of the active observation days, which is significantly lower than the 1997–2005 average of 16%. These data indicate that truly stormy weather was scarce in 2006, but overall cloud cover averaged greater than usual. Visibility reducing fog and haze were unusually prevalent, however, mostly occurring in the morning hours (80% of active days vs. 1997–2005 average of 53%). This translated to reduced average visibility: 8 km east and 10 km west versus long-term averages of 10.6 km east and 9.8 km west.

The 2006 season was one of the calmest yet, with light winds (<12 kph) prevailing on 82% of the active observation days, moderate winds (12–28 kph) on 16%, and strong winds (>28 kph) on 2% (averages 70% light, 30% moderate, and 1% strong). The high prevalence of light winds in 2006 counters a previous distinct shift toward more moderate winds from 2001–2004. In terms of wind directions, E–S winds prevailed throughout most or all of 38% of the active observation days, N–E winds on 15%, W–N winds on 8%, and a combination of W–N and NE–SE winds on 8%, with a variety of other combinations applying on the remainder of the active observation days. The basic distribution of prevailing wind directions very closely matched the long-term average pattern for the site; however, the proportions of days where the combination of W–N and NE–SE winds (8%) and SE–SW/variable conditions (6%) applied were noticeably higher than the long-term averages (2% for both).

Daily-average (mean of hourly readings) temperatures averaged 28.6°C (range 13.4–35.6°C), which is slightly below the long-term average of 29.1°C (range 27.5–29.7°C). Daily-average (mean of hourly readings) barometric pressure averaged 29.88 in Hg, ranging from 29.42–30.30, which are all typical values.

In 2006, 34% of the active observation days received a median thermal lift rating of good to excellent, which nearly matches the 1997–2005 average of 36%.

In summary, weather data collected on site by our observers during active observation periods revealed cloudier than average sky conditions but little stormy weather, lighter winds than usual, mild temperatures, and average thermal lift conditions. A high prevalence of fog and especially haze reduced average visibility, however.

OBSERVATION EFFORT

Observations occurred on all 93 days between 15 August and 15 November (see Appendix D for daily count records). The number of observation days and hours (704.50) were 4% and 2% higher, respectively, than the 1997–2005 averages of $90 \pm 95\%$ CI of 2.17 days and 690.95 ± 31.68 hours of observation per season. The 2006 average of 4.2 observers per hour (includes official and guest observers; value is mean of daily values, which are in turn means of hourly values) was significantly higher than the 1997–2005 average of 3.5 ± 0.20 observers/hr, owing to regular participation of many local volunteers.

MIGRATION SUMMARY

The observers tallied 826,058 migrating raptors of 27 species during the 2006 season (Table 1), which stands in stark contrast to last year's record-low count caused by a severe hurricane season. These marked variations in the total count primarily reflect fluctuations in numbers of Broad-winged Hawks, which comprised 93% of the total count in 2006 (88% in 2005). The 2006 Broad-winged Hawk count was only the fifth highest recorded to date, whereas the total count of all other species (58,328) ranked as the second highest to date. Species that comprised 3% or more of the 2006 count with Broad-winged Hawks excluded included Turkey Vulture (54%), Mississippi Kite (18%), and Swainson's Hawk (15%). Buteos, vultures, and kites were the predominant species groups (Figure 2). With Broad-winged Hawks excluded, the proportions of kites, falcons, and others (Northern Harrier and Osprey) were significantly above average in 2006, whereas the proportions of all other species groups fell within the range of normal variability. Highlights of the season included the third Aplomado Falcon recorded at the site, new record high counts for 12 species (321 Ospreys [fourth record year in a row], 614 Northern Harriers, 99 Swallow-tailed Kites, 14,073 Mississippi Kites, 1,719 Cooper's Hawks, 39 Harris Hawks, 101 Red-shouldered Hawks, 39 White-tailed Hawks, 363 Red-tailed Hawks, 5 Bald Eagles, 1,137 American Kestrel, and 309 Peregrine Falcons), and the second highest tally of Ferruginous Hawks (8).

Interannual Count Trends and Regional Comparisons

The 2006 Broad-winged Hawk count was a non-significant 13% higher than the 1997–2005 average, whereas the combined-species count excluding Broad-winged Hawks was a highly significant 50% above average (Table 1). Among 20 species observed in most years, only the Prairie Falcon showed a below average adjusted passage rate in 2006 (though the actual count was slightly above average). Adjusted passage rates were significantly above average for all other species except Broad-winged and Swainson's Hawks (Table 1).

After 10 years of data collection, for the first time we also statistically analyzed adjusted passage rates to discern long-term trends (Figures 3–9). At least marginally significant ($P \leq 0.10$) linear increasing trends were indicated for Ospreys, Swallow-tailed and Mississippi Kites, Cooper's Hawks, Harris's Hawks, and Zone-tailed Hawks. A significant quadratic regression was indicated for White-tailed Hawks, tracking a mostly stable pattern through 2003, but then a sharp increase during the past three years. No significant long-term trends were indicated for any other species; however, at least a recent upward inflection is apparent for American Kestrels, Merlins, and Peregrine Falcons (Figures 8 and 9).

Farther to the northeast at Smith Point, Texas, on Galveston Bay, the Broad-winged Hawk count (49,527) was the third highest on record and 28% above the 1997–2005 average for that site (Smith and Neal 2007). Both Texas sites tallied record high counts of Ospreys, Harris's Hawks, and Bald Eagles in 2006, while Corpus Christi tallied record highs for another 11 species. Comparing trends in passage rates over the course of the two Texas studies (both begun in 1997), both projects show similar long-term increasing patterns for Turkey Vultures, Ospreys, Mississippi and Swallow-tailed Kites, and Peregrine Falcons; both have shown at least recent increasing patterns for White-tailed Hawks; and both have generally shown increasing patterns for Swainson's Hawks (the count at Smith Point was low in 2006, while the count at Corpus Christi rebounded above average). Species that are currently showing noticeably divergent patterns at the two sites include Sharp-shinned and Cooper's Hawks (recent declining trend at Smith Point; overall stable to increasing pattern at Corpus Christi), American Kestrels (slight increasing trend at Corpus Christi; stable pattern at Smith Point), and Crested Caracaras (overall stable pattern at Corpus Christi; strong increasing pattern at Smith Point).

Elsewhere around the Gulf Coast, in the Florida Keys the total southbound count was 21% below average and was the second lowest combined-species total to date (HWI unpublished data). The only species for which counts were above average were the Bald Eagle, Red-shouldered Hawk, Short-tailed Hawk, and Peregrine Falcon. Record low counts were observed for both American Kestrels and Merlins.

Nevertheless, unlike last year, thankfully the crew was spared from experiencing another severe hurricane season. This also undoubtedly contributed to improved counts for most species, after last year's count fell more than 40% below average, presumably in large part due to the effects of three major hurricanes keeping birds from proceeding down into Florida.

In Veracruz, Mexico, along the far southeastern Gulf Coast, our partners at Pronatura Veracruz recorded an overall combined-species count (data from two count sites combined) that was 21% below average and the lowest recorded since 1993 (Pronatura Veracruz unpublished data). Among the four most common species, counts were 13% below average for Broad-winged Hawks, 22% below average for Turkey Vultures, 38% above average for Mississippi Kites, and 38% below average for Swainson's Hawks. Among commonly observed species that are also seen in Texas, only Northern Harriers, Swallow-tailed Kites, Harris's Hawks, Zone-tailed Hawks, and Red-tailed Hawks showed significantly above average counts in 2006 at Veracruz.

Seasonal Timing

The median passage date for Broad-winged Hawks (27 September) was a non-significant 1 day later than average in 2006, and the overall seasonal passage pattern closely matched the long-term average pattern, which was also the case for the overall combined-species flight (Table 3, Figure 10). Twelve other commonly occurring species also showed at least slightly later than average median passage dates in 2006, though the differences were significant only for Cooper's, Harris's, Red-shouldered, Zone-tailed, and Ferruginous Hawks, Crested Caracaras, and Merlins (Table 3). Species that showed significantly early timing in 2006 included Black Vultures, Swallow-tailed, Mississippi and White-tailed Kites, and Prairie Falcons.

RESIDENT AND LOCAL RAPTOR ACTIVITY

A pair of resident White-tailed Hawks occurred in the count area for the tenth consecutive year, with at least one subadult seen in the area mid-season. Family groups of Red-shouldered and Red-tailed Hawks, each including two adults and one juvenile, were present throughout August. At least one adult and one immature female Northern Harrier were positively identified as residents by late-October. A Peregrine Falcon was observed during the first 10 days of the season. Two Cooper's Hawks and at least two Sharp-shinned Hawks took up residence in the area beginning in mid-September. More Sharp-shinned and Cooper's Hawks began to congregate during late October. Two Crested Caracaras were seen regularly in the area during the first three weeks of the count; and one other bird was seen frequenting the area for a short time in mid-October. A resident Osprey was seen regularly throughout the season, especially early on. Variable numbers of local Black and Turkey Vultures were present throughout the season. Estimated numbers of at least transient locals rose to as high as 90 Black and 20 Turkey Vultures throughout the season, as migrant volume increased, but the early season core group consisted of around 10 Black Vultures and 20 Turkey Vultures. The Aplomado Falcon, recorded in the count on 9 November, may have taken up residency and was again observed on 13 November.

This is a typical array of resident activity for the site, except for the absence of resident American Kestrels.

VISITOR PARTICIPATION AND PUBLIC OUTREACH

During the 2006 season, 676 individuals were logged in at the project site, which is about average for the 10 years of the project. HWI and Joel Simon hosted the annual *Celebration of Flight* event at the site to coincide with the peak passage period of Broad-winged Hawks. As usual, Joel arranged for a wonderful series of special activities and presentations at the event, which attracts hundreds of additional visitors to the project site each year. This year's event featured a live raptor program from Last Chance Forever, programs by HWI Field Studies Coordinator, Mike Neal, and bird-walks early each morning. We also

provided a program for the Calallen Middle School by Last Chance Forever that reached 315 children and 30 adults. These numbers are not included in the on-site educator's off-site outreach totals presented below. Those that did visit during the season reflected a broad diversity of geographic origins (14 states besides Texas); and were treated to a variety of rare sightings and informative interactions with our crew. Organized groups that visited the site in 2006 included local grade-school classes, Cathedral of the Palms, Sanders Bird Club, and Master Naturalists.

Besides the extensive on-site education and public outreach that occurred at the project site in 2006, seasonal education specialist Angela Petersen conducted 68 educational programs in area schools. These programs reached 2,093 children and 295 teachers/adults. Joel Simon also presented two programs titled "Raptors of the Coastal Bend" at the Hummer/Bird Festival in Rockport, which were attended by 165 people.

In 2006, 774 hourly assessments of visitor disturbance resulted in no days when the official observers felt that the presence of visitors detracted from their primary focus of tallying the migration. This continued very low level of visitor disturbance experienced by the official observers is apt testimony to the benefits of having a full-time education specialist on the field crew and a large cadre of highly dedicated and knowledgeable local volunteers regularly available to assist with the count and facilitate visitor interactions.

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Table 1. Fall counts and passage rates by species for migrating raptors at Hazel Bazemore Park near Corpus Christi, Texas: 1997–2005 versus 2006.

SPECIES	COUNTS			RAPTORS/100 HOURS		
	1997–2005 ¹	2006	% CHANGE	1997–2005 ¹	2006	% CHANGE
Black Vulture	539 ± 267.7	893	+66	100.5 ± 27.5	168.8	+68
Turkey Vulture	21,122 ± 8706.2	29,115	+38	8,520.5 ± 2,078.9	11,126.1	+31
Unidentified vulture	1.0 ± 2.0	0	-100	–	–	–
TOTAL VULTURES	21,662 ± 8808.5	30,008	+39	–	–	–
Osprey	160 ± 36.4	321	+101	33.5 ± 4.7	67.6	+102
Northern Harrier	154 ± 48.2	614	+299	30.1 ± 5.3	114.9	+281
Hook-billed Kite	0.1 ± 0.2	0	-100	–	–	–
Swallow-tailed Kite	28 ± 13.7	99	+256	10.1 ± 2.9	34.8	+246
White-tailed Kite	4 ± 1.8	8	+112	–	–	–
Mississippi Kite	6,599 ± 1927.0	14,073	+113	2,379.2 ± 430.5	4,895.4	+106
TOTAL KITES	6,630 ± 1936.6	14,180	+114	–	–	–
Sharp-shinned Hawk	1,106 ± 228.9	1,643	+49	343.8 ± 41.3	474.7	+38
Cooper's Hawk	647 ± 191.1	1,719	+166	173.5 ± 29.1	418.7	+141
Northern Goshawk	0.2 ± 0.3	2	+800	–	–	–
Unidentified accipiter	277 ± 56.0	290	+5	–	–	–
TOTAL ACCIPITERS	2,030 ± 322.3	3,654	+80	–	–	–
Common Black Hawk	0.1 ± 0.2	0	-100	–	–	–
Harris' Hawk	14 ± 5.9	39	+179	2.1 ± 0.5	5.8	+175
Red-shouldered Hawk	55 ± 17.3	101	+82	8.4 ± 1.6	15.6	+87
Broad-winged Hawk	677,518 ± 169219.7	767,730	+13	401,117.5 ± 61,418.8	443,783.0	+11
Short-tailed Hawk	0.8 ± 0.9	2	+157	–	–	–
Swainson's Hawk	6,036 ± 3588.0	7,225	+20	2,423.5 ± 829.5	2,703.6	+12
White-tailed Hawk	9 ± 5.3	39	+323	1.4 ± 0.4	5.6	+302
Zone-tailed Hawk	3 ± 2.3	7	+110	0.5 ± 0.2	1.1	+107
Red-tailed Hawk	167 ± 42.2	363	+117	26.0 ± 3.6	55.8	+114
Ferruginous Hawk	3 ± 2.8	8	+167	–	–	–
Rough-legged Hawk	0.6 ± 0.9	0	-100	–	–	–
Unidentified buteo	103 ± 75.4	79	-23	–	–	–
TOTAL BUTEOS	683,910 ± 171265.4	775,593	+13	–	–	–
Golden Eagle	1.4 ± 0.7	2	+38	–	–	–
Bald Eagle	2 ± 1.0	5	+165	–	–	–
Unidentified eagle	0.1 ± 0.2	0	-100	–	–	–
TOTAL EAGLES	3 ± 1.7	7	+103	–	–	–
Crested Caracara	11 ± 5.0	20	+80	1.7 ± 0.4	3.0	+81
American Kestrel	492 ± 144.0	1,137	+131	130.2 ± 23.6	276.7	+113
Merlin	32 ± 7.1	50	+56	7.8 ± 1.2	12.0	+53
Prairie Falcon	9 ± 6.3	10	+8	2.7 ± 1.1	2.1	-23
Peregrine Falcon	153 ± 39.9	309	+102	38.4 ± 6.0	68.3	+78
Aplomado Falcon	0.3 ± 0.3	1	+200	–	–	–
Unknown small falcon	2 ± 1.4	2	+29	–	–	–
Unknown large falcon	2 ± 2.1	2	+29	–	–	–
Unidentified falcon	39 ± 23.4	15	-61	–	–	–
TOTAL FALCONS	729 ± 173.5	1,526	+109	–	–	–
Unidentified raptor	1,130 ± 1124.8	135	-88	–	–	–
GRAND TOTAL	716,419 ± 164882.4	826,058	+15	–	–	–

¹ Mean ± 95% confidence interval.

Table 2. First and last observed, bulk-passage, and median-passage dates by species for migrating raptors at Hazel Bazemore Park near Corpus Christi, Texas in 2006, with a comparison of 2006 and 1997–2005 average median passage dates.

SPECIES	2006				1997–2005	
	FIRST OBSERVED	LAST OBSERVED	BULK PASSAGE DATES ¹	MEDIAN PASSAGE DATE ²	MEDIAN PASSAGE DATE ^{2,3}	
Black Vulture	15-Sep	13-Nov	21-Sep – 4-Nov	19-Oct	29-Oct	± 6.4
Turkey Vulture	26-Aug	15-Nov	19-Oct – 4-Nov	27-Oct	21-Oct	± 3.9
Osprey	26-Aug	11-Nov	14-Sep – 13-Oct	28-Sep	28-Sep	± 2.0
Northern Harrier	29-Aug	13-Nov	19-Sep – 2-Nov	15-Oct	10-Oct	± 6.3
Swallow-tailed Kite	15-Aug	29-Sep	15-Aug – 13-Sep	17-Aug	25-Aug	± 2.6
White-tailed Kite	29-Aug	23-Oct	29-Aug – 23-Oct	29-Sep	05-Oct	± 5.3
Mississippi Kite	15-Aug	20-Oct	20-Aug – 13-Sep	24-Aug	30-Aug	± 4.0
Sharp-shinned Hawk	17-Aug	15-Nov	26-Sep – 23-Oct	12-Oct	08-Oct	± 4.0
Cooper's Hawk	15-Aug	14-Nov	25-Sep – 28-Oct	16-Oct	07-Oct	± 3.7
Northern Goshawk	21-Sep	28-Oct	–	–	–	–
Harris' Hawk	15-Aug	10-Nov	6-Sep – 6-Nov	13-Oct	02-Oct	± 8.4
Red-shouldered Hawk	29-Aug	11-Nov	25-Sep – 2-Nov	19-Oct	02-Oct	± 8.2
Broad-winged Hawk	17-Aug	13-Nov	20-Sep – 30-Sep	27-Sep	26-Sep	± 1.9
Short-tailed Hawk	23-Aug	14-Sep	–	–	–	–
Swainson's Hawk	15-Aug	13-Nov	6-Oct – 19-Oct	6-Oct	10-Oct	± 3.9
White-tailed Hawk	15-Aug	13-Nov	19-Sep – 11-Nov	26-Oct	27-Sep	± 7.6
Zone-tailed Hawk	27-Sep	13-Nov	27-Sep – 13-Nov	10-Oct	25-Sep	± 0.7
Red-tailed Hawk	15-Aug	15-Nov	25-Sep – 10-Nov	27-Oct	19-Oct	± 8.3
Ferruginous Hawk	8-Oct	5-Nov	8-Oct – 5-Nov	24-Oct	06-Oct	± 2.9
Golden Eagle	1-Oct	3-Oct	–	–	–	–
Bald Eagle	20-Sep	23-Oct	20-Sep – 23-Oct	20-Oct	–	–
Crested Caracara	2-Sep	11-Nov	7-Sep – 10-Nov	28-Oct	11-Oct	± 8.8
American Kestrel	25-Aug	11-Nov	14-Sep – 19-Oct	1-Oct	04-Oct	± 3.0
Merlin	30-Aug	2-Nov	24-Sep – 20-Oct	7-Oct	30-Sep	± 3.7
Prairie Falcon	22-Aug	23-Oct	22-Aug – 12-Oct	25-Sep	02-Oct	± 5.7
Peregrine Falcon	15-Aug	12-Nov	20-Sep – 17-Oct	30-Sep	01-Oct	± 1.9
Aplomado Falcon	9-Nov	9-Nov	–	–	–	–
ALL SPECIES	15-Aug	15-Nov	20-Sep – 30-Sep	27-Sep	26-Sep	± 1.9

¹ Dates between which the central 80% of the flight passed the lookout.

² Date by which 50% of the flight had passed the lookout.

³ Mean of annual values ± 95% confidence interval in days; unless otherwise indicated, values are given only for species with annual counts ≥5 birds for ≥3 years.

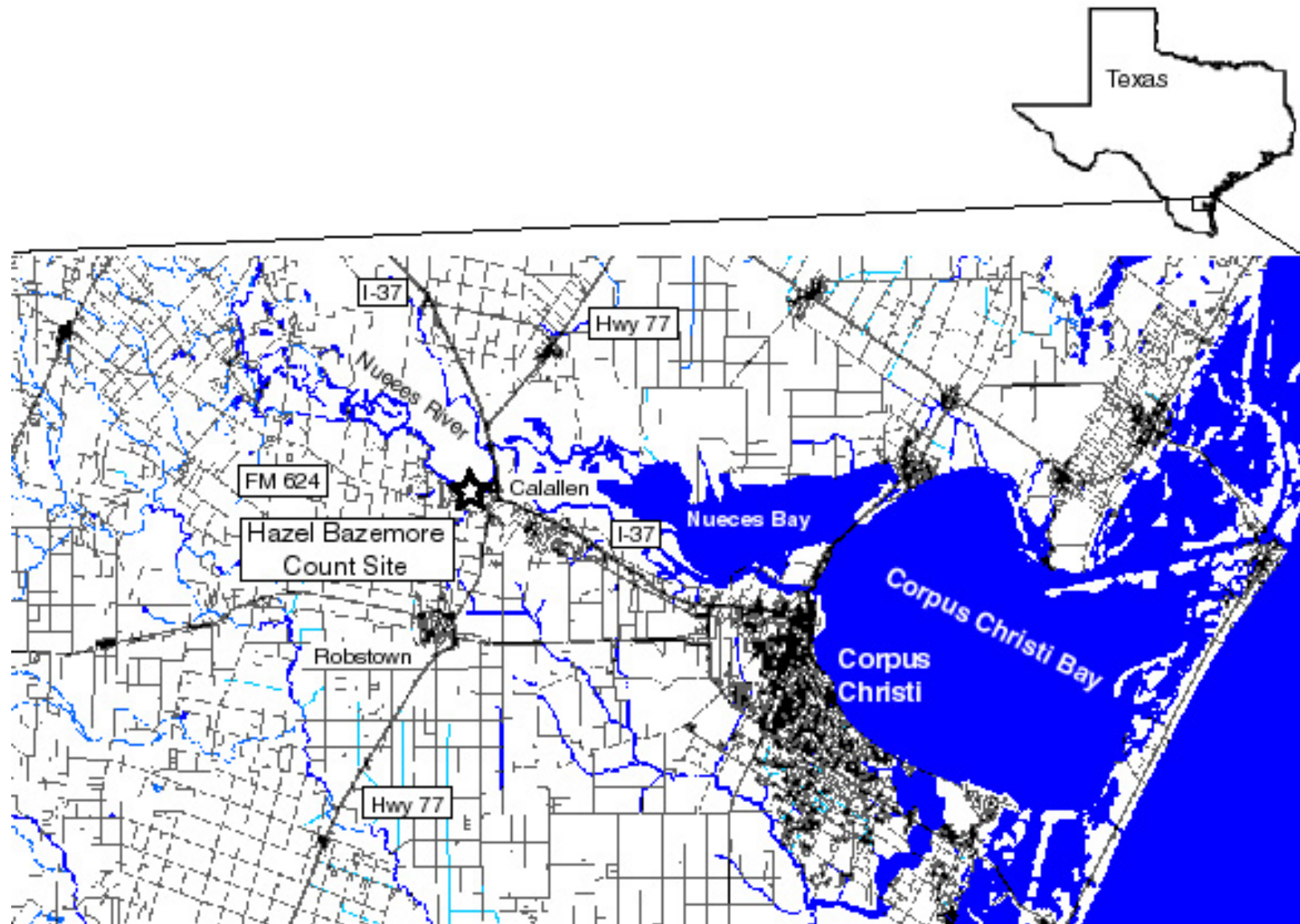


Figure 1. Location of Hazel Bazemore County Park count site near Corpus Christi, Texas.

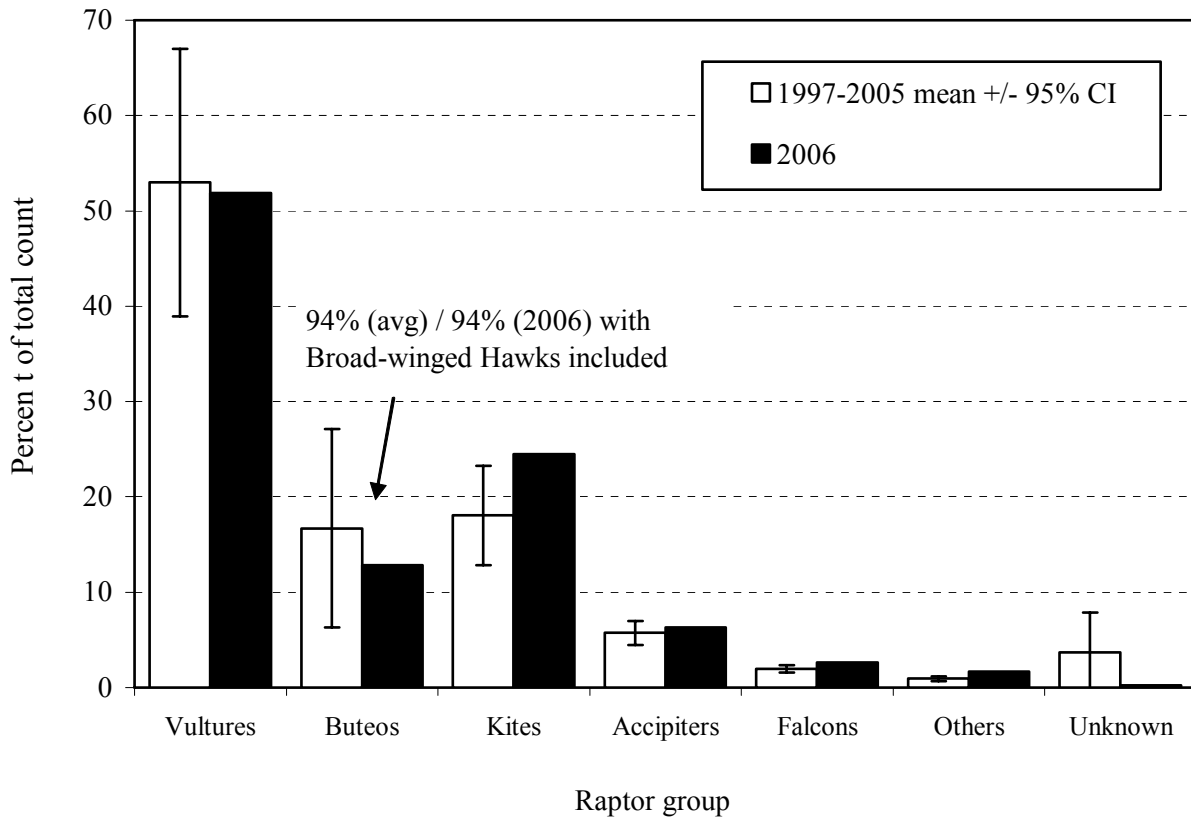


Figure 2. Composition of the fall raptor migration by species groups at Hazel Bazemore Park near Corpus Christi, Texas: 1997–2005 versus 2006.

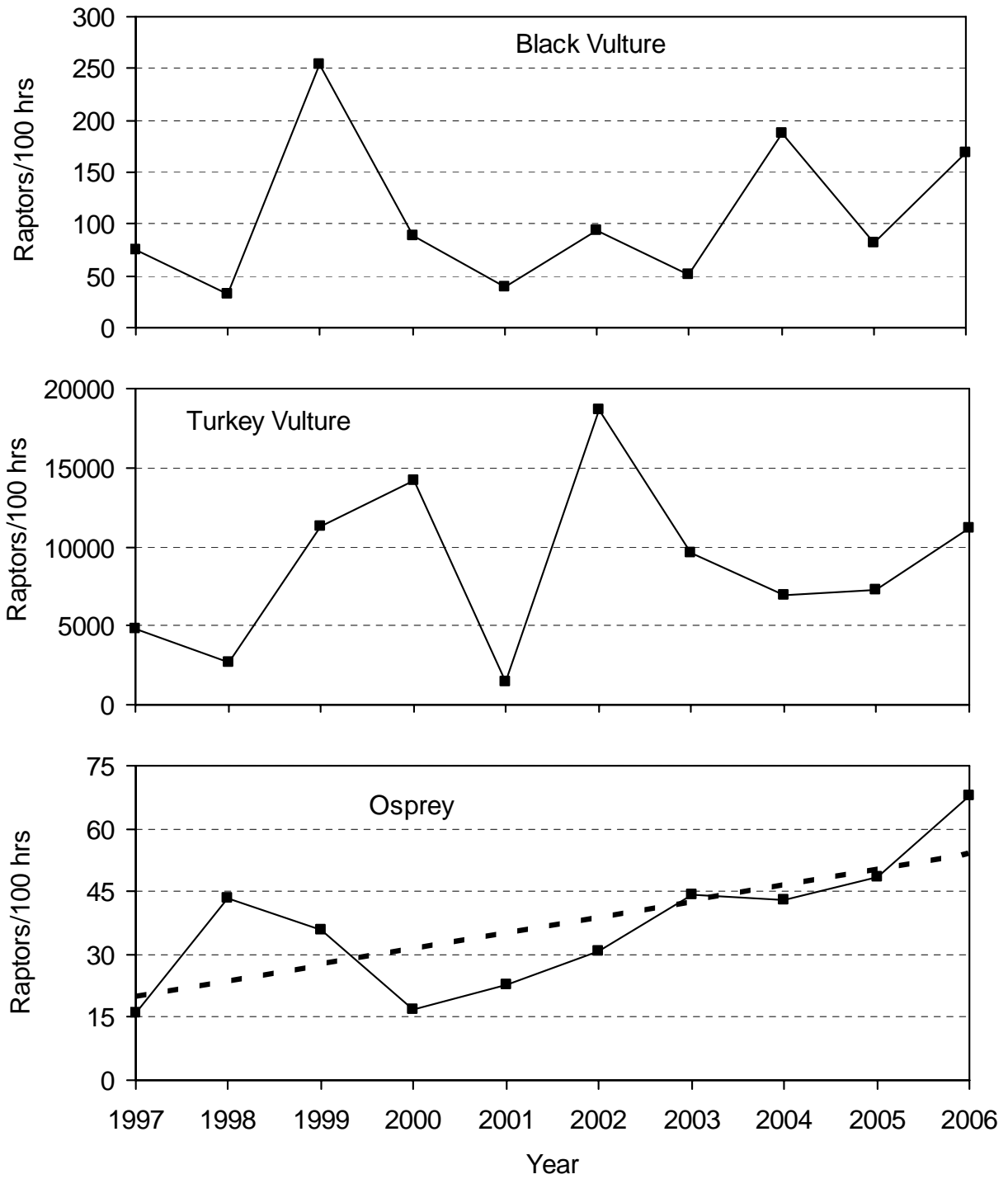


Figure 3. Adjusted fall-migration passage rates at Hazel Bazemore Park near Corpus Christi, Texas for Black Vultures, Turkey Vultures, and Ospreys: 1997–2006. Dashed lines indicate significant ($P \leq 0.10$) linear or quadratic regressions.

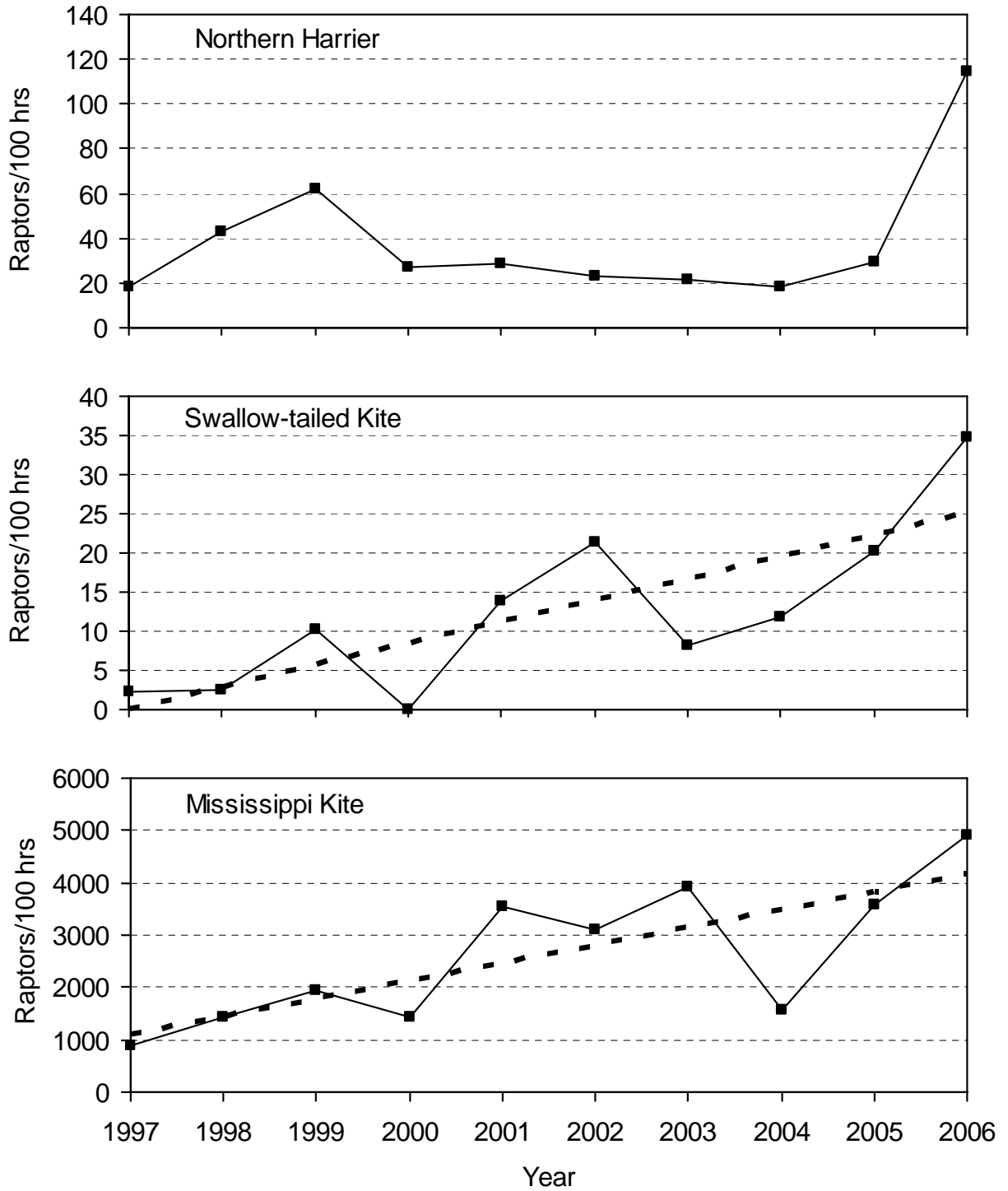


Figure 4. Adjusted fall-migration passage rates at Hazel Bazemore Park near Corpus Christi, Texas for Northern Harriers, Swallow-tailed Kites, and Mississippi Kites: 1997–2006. Dashed lines indicate significant ($P \leq 0.10$) linear or quadratic regressions.

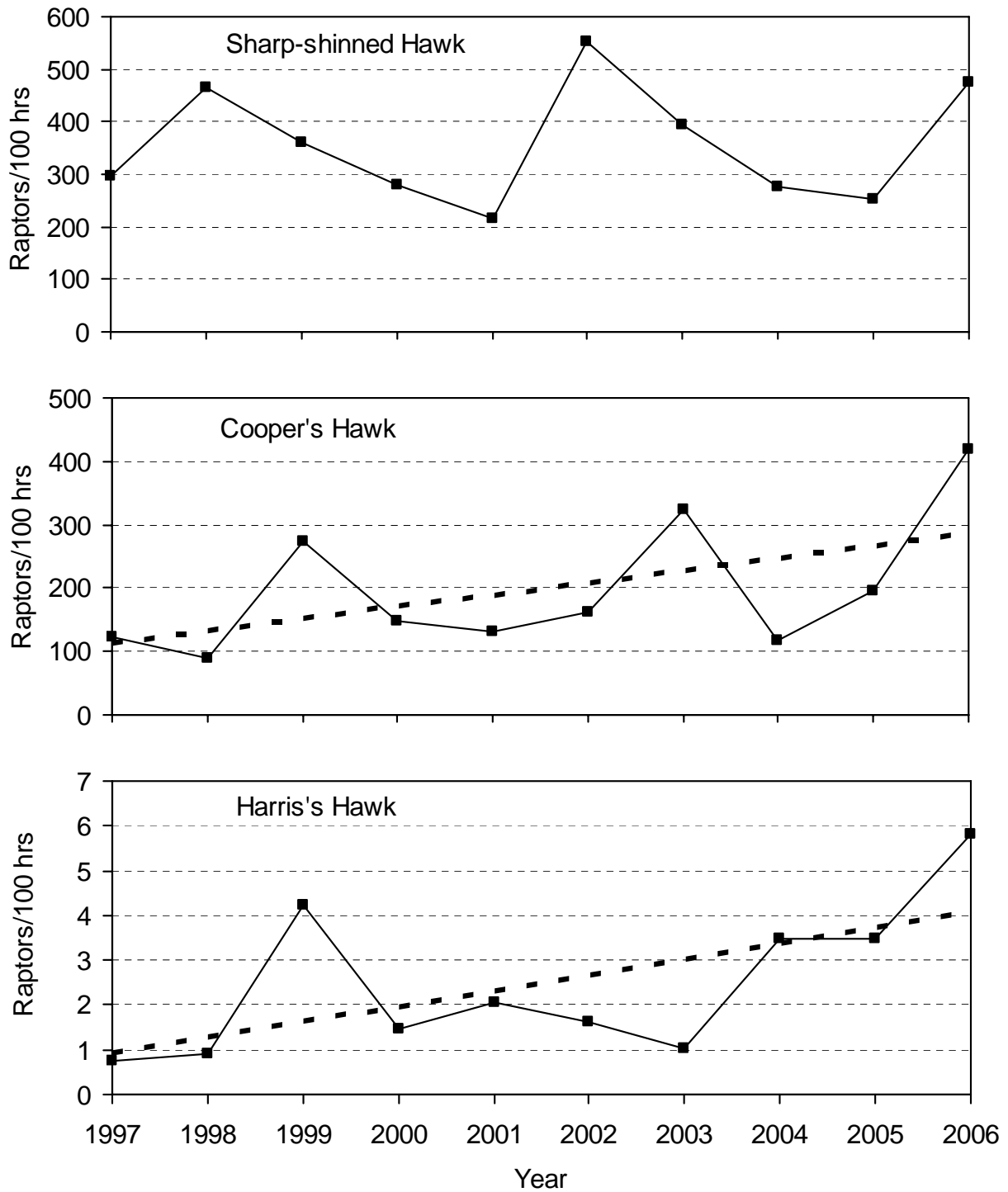


Figure 5. Adjusted fall-migration passage rates at Hazel Bazemore Park near Corpus Christi, Texas for Sharp-shinned, Cooper's, and Harris's Hawks: 1997–2006. Dashed lines indicate significant ($P \leq 0.10$) linear or quadratic regressions.

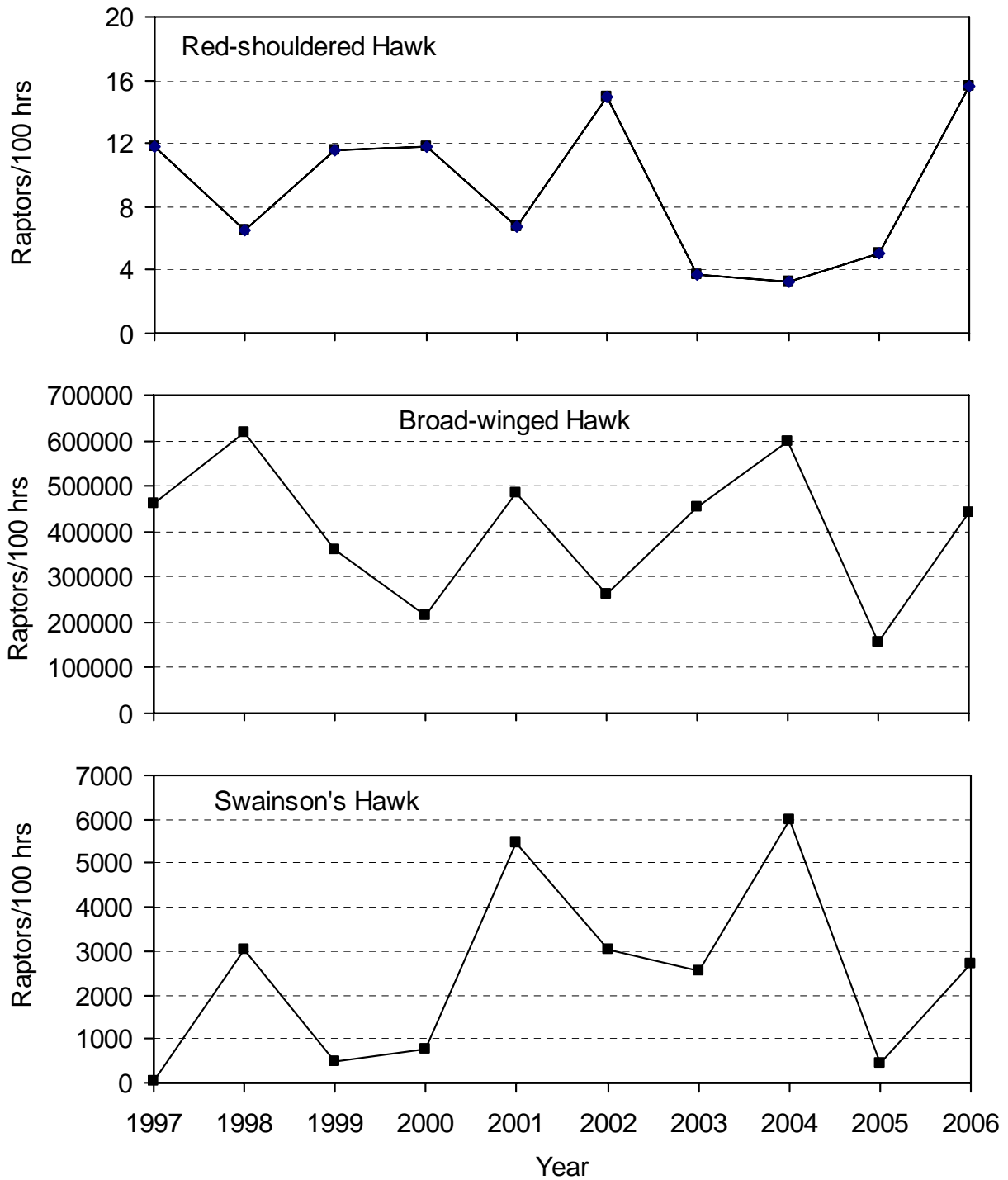


Figure 6. Adjusted fall-migration passage rates at Hazel Bazemore Park near Corpus Christi, Texas for Red-shouldered, Broad-winged, and Swainson's Hawks: 1997–2006. Dashed lines indicate significant ($P \leq 0.10$) linear or quadratic regressions.

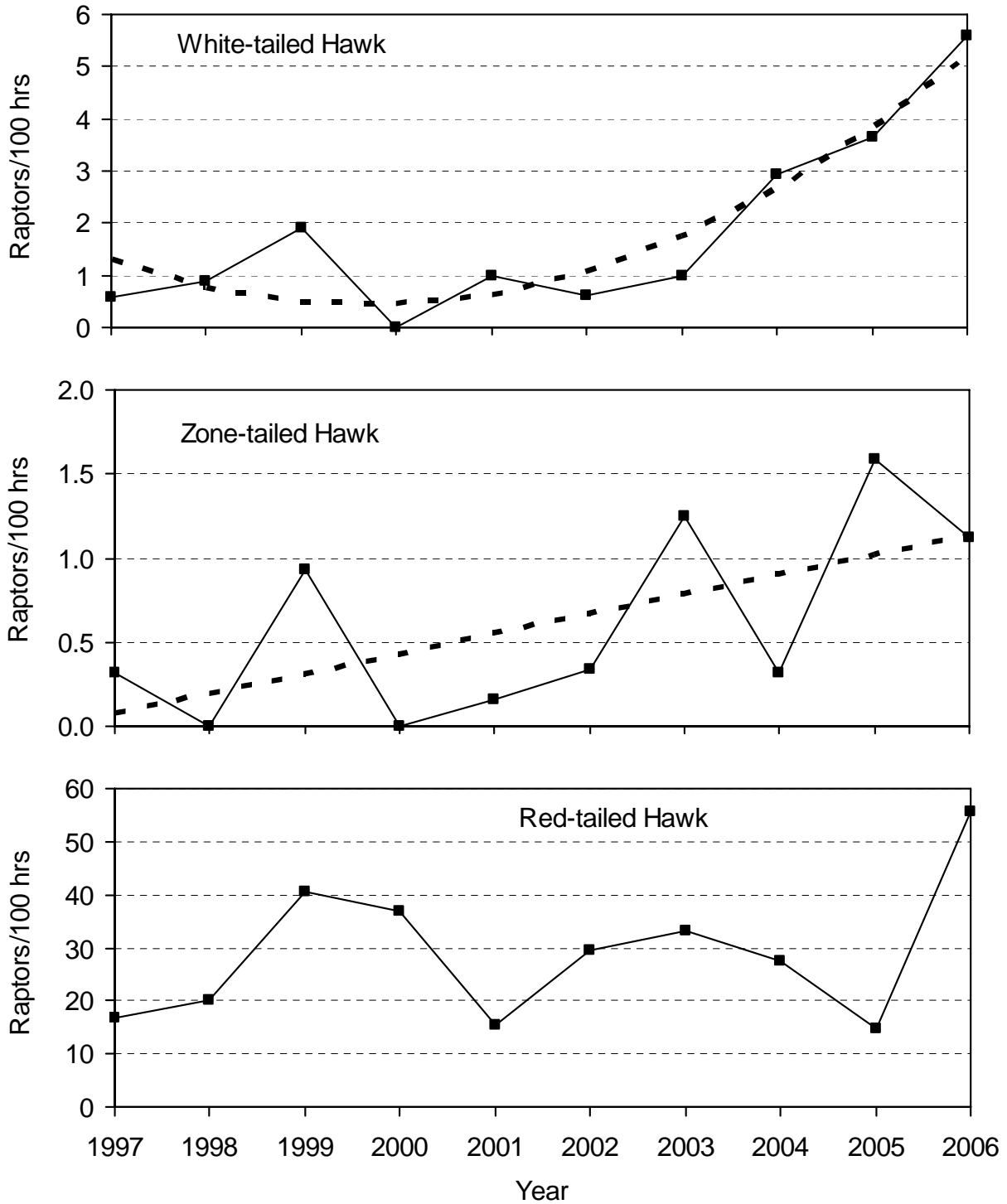


Figure 7. Adjusted fall-migration passage rates at Hazel Bazemore Park near Corpus Christi, Texas for White-tailed, Zone-tailed, and Red-tailed and Hawks: 1997–2006. Dashed lines indicate significant ($P \leq 0.10$) linear or quadratic regressions.

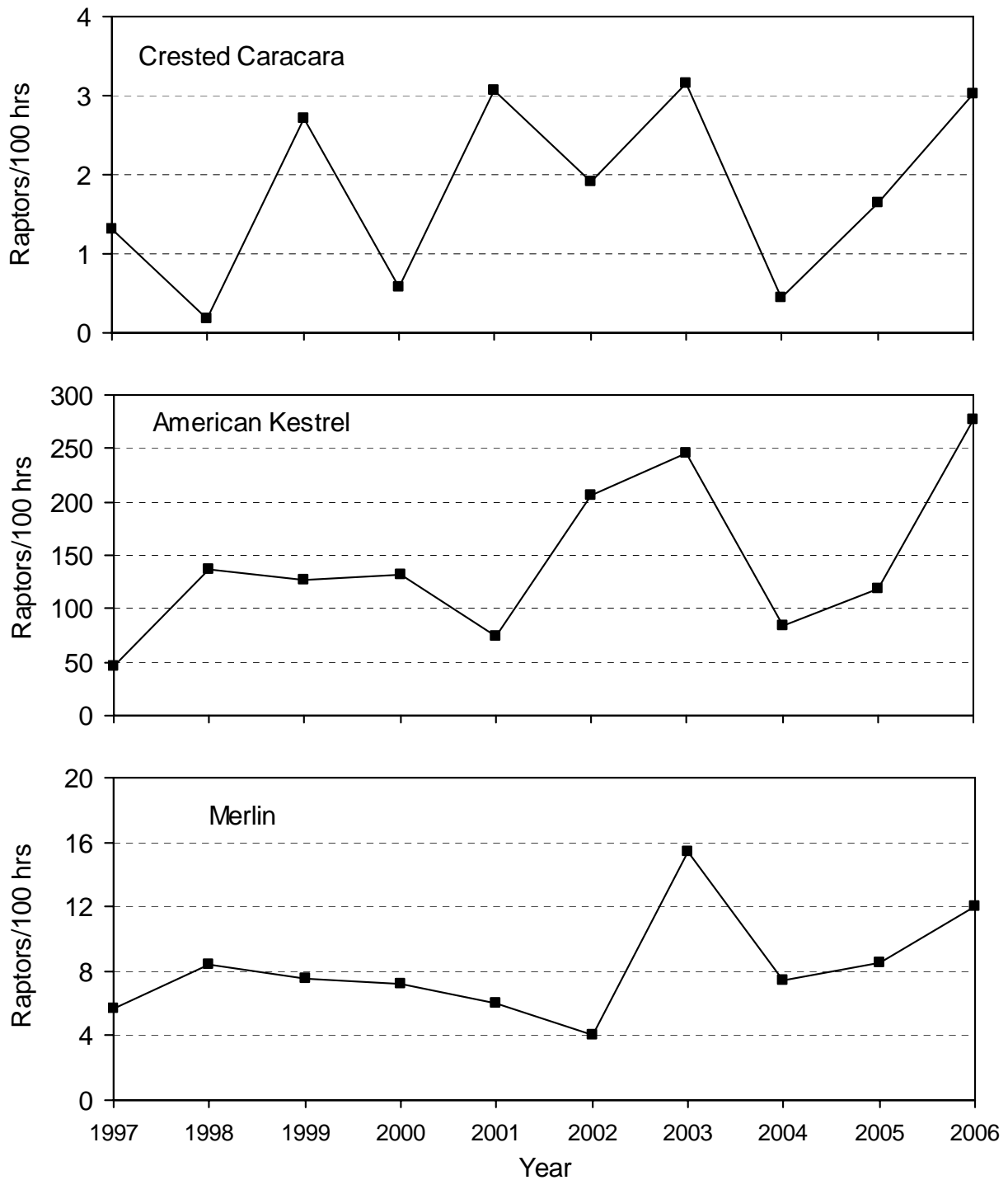


Figure 8. Adjusted fall-migration passage rates at Hazel Bazemore Park near Corpus Christi, Texas for Crested Caracaras, American Kestrels, and Merlins: 1997–2006. Dashed lines indicate significant ($P \leq 0.10$) linear or quadratic regressions.

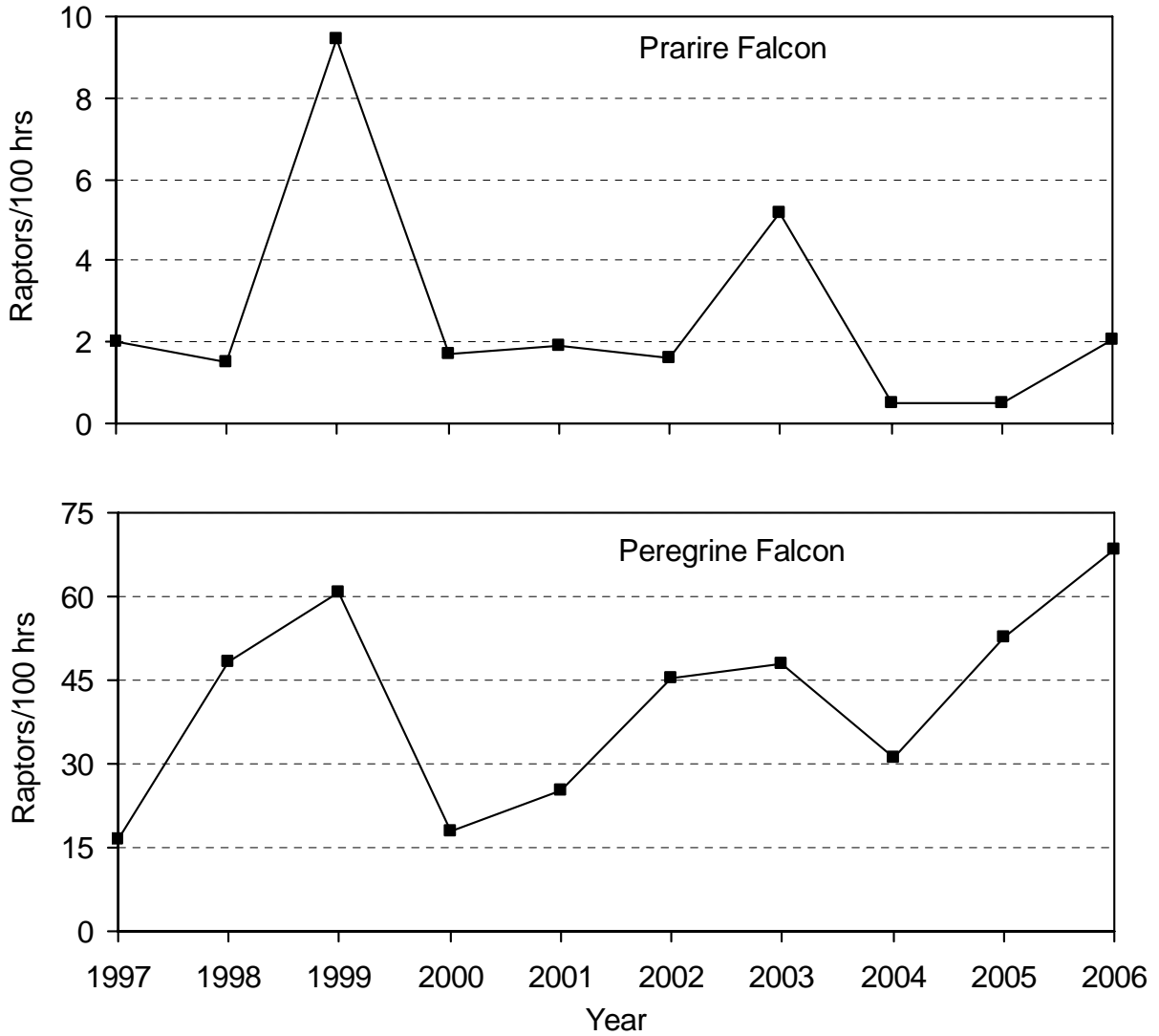


Figure 9. Adjusted fall-migration passage rates at Hazel Bazemore Park near Corpus Christi, Texas for Prairie and Peregrine Falcons: 1997–2006. Dashed lines indicate significant ($P \leq 0.10$) linear or quadratic regressions.

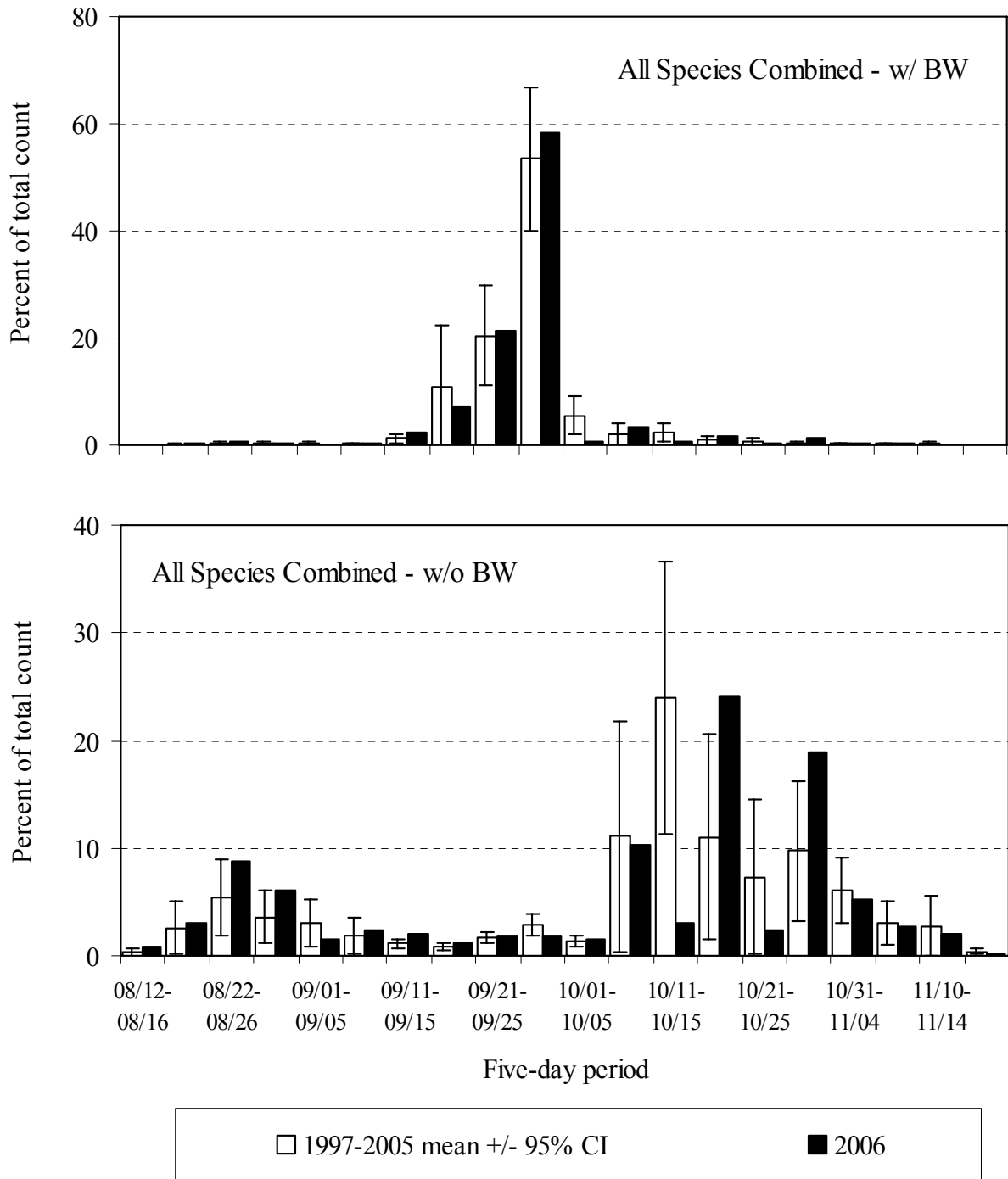


Figure 10. Combined-species flight volume by five-day periods, with and without Broad-wing Hawks, for the fall raptor migration at Hazel Bazemore Park near Corpus Christi, Texas: 1997–2005 versus 2006.

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	<i>Coragyps atratus</i>	BV	U	U	NA
Turkey Vulture	<i>Cathartes aura</i>	TV	U	U	NA
Unknown vulture	see above	UV	U	U	NA
Osprey	<i>Pandion haliaetus</i>	OS	U	U	NA
Northern Harrier	<i>Circus cyaneus</i>	NH	A I Br U	M F U	NA
Hook-billed Kite	<i>Chondrohierax uncinatus</i>	HK	A I U	AM AF U	D L U
Swallow-tailed Kite	<i>Elanoides forficatus</i>	SK	U	U	NA
White-tailed Kite	<i>Elanus leucurus</i>	WK	U	U	NA
Mississippi Kite	<i>Ictinia mississippiensis</i>	MK	A I U	U	NA
Unknown kite	see above	UK	U	U	NA
Sharp-shinned Hawk	<i>Accipiter striatus</i>	SS	A I U	U	NA
Cooper's Hawk	<i>Accipiter cooperii</i>	CH	A I U	U	NA
Northern Goshawk	<i>Accipiter gentilis</i>	NG	A I U	U	NA
Unknown accipiter	<i>Accipiter</i> spp.	UA	U	U	NA
Common Black Hawk	<i>Buteogallus anthracinus</i>	CB	A I U	U	NA
Harris' Hawk	<i>Parabuteo unicinctus</i>	HH	A I U	U	NA
Red-shouldered Hawk	<i>Buteo lineatus</i>	RS	A I U	U	NA
Broad-winged Hawk	<i>Buteo platypterus</i>	BW	A I U	U	D L U
Short-tailed Hawk	<i>Buteo brachyurus</i>	ST	U	U	D L U
Swainson's Hawk	<i>Buteo swainsoni</i>	SW	U	U	D L U
White-tailed Hawk	<i>Buteo albicaudatus</i>	WT	A I U	U	NA
Zone-tailed Hawk	<i>Buteo albonotatus</i>	ZT	A I U	U	NA
Red-tailed Hawk	<i>Buteo jamaicensis</i>	RT	A I U	U	D L U
Ferruginous Hawk	<i>Buteo regalis</i>	FH	A I U	U	D L U
Rough-legged Hawk	<i>Buteo lagopus</i>	RL	U	U	D L U
Unknown buteo	<i>Buteo</i> spp.	UB	U	U	D L U
Golden Eagle	<i>Aquila chrysaetos</i>	GE	A S I NA U ⁴	U	NA
Bald Eagle	<i>Haliaeetus leucocephalus</i>	BE	A S2 S1 I NA U ⁵	U	NA
Unknown eagle	<i>Aquila</i> or <i>Haliaeetus</i> spp.	UE	U	U	NA
Crested Caracara	<i>Caracara cheriway</i>	CC	U	U	NA
American Kestrel	<i>Falco sparverius</i>	AK	U	M F U	NA
Merlin	<i>Falco columbarius</i>	ML	AM Br	M U	NA
Prairie Falcon	<i>Falco mexicanus</i>	PR	U	U	NA
Peregrine Falcon	<i>Falco peregrinus</i>	PG	A I U	U	NA
Aplomado Falcon	<i>Falco femoralis</i>	AF	A I U	U	NA
Unknown falcon	<i>Falco</i> 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 in the Corpus Christi Raptor Migration Project: 1997–2006.

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.

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

Appendix C. Daily observation effort, visitor disturbance ratings, and predominant weather conditions during the fall raptor migration at Hazel Bazemore Park near Corpus Christi, TX: 2006.

DATE	OBS. HOURS	NUMBER OBSRVRS ¹	VISITOR DISTURB ²	SKY CONDITION ³	WIND SPEED (KPH) ¹	WIND DIRECTION	TEMP. (°C) ¹	BARO. PRESS. (IN HG) ¹	MEDIAN THERMAL LIFT ⁴	VISIB. EAST (KM) ¹	VISIB. WEST (KM) ¹	FLIGHT DIST. ⁵	RAPTORS / HOUR
15-Aug	8.00	4.9	0	mc-ovc	3.0	se-s	35.6	29.89	2	8	12	3	42.6
16-Aug	8.00	2.9	0	clr-pc, PM haze	3.3	se-s	34.5	29.90	2	9	17	3	16.6
17-Aug	8.50	3.7	0	clr-pc	4.5	se-s	33.9	29.88	2	13	17	2	46.6
18-Aug	8.50	4.0	0	mc-ovc, AM haze	4.5	var	32.8	29.86	3	9	11	2	64.9
19-Aug	7.25	3.8	0	pc-ovc, AM haze	0.9	ene, nw	32.5	29.85	3	7	9	2	21.2
20-Aug	8.00	4.8	0	clr-mc	2.3	sse-s	33.8	29.87	2	13	16	2	118.8
21-Aug	8.00	3.1	0	clr-mc, AM haze	2.3	ne-e	32.9	29.91	2	9	14	3	30.9
22-Aug	8.00	3.3	0	clr-pc, AM haze	2.3	e	33.6	29.97	2	6	10	2	41.1
23-Aug	8.00	2.9	0	clr-mc, haze	0.7	e, w	33.6	29.91	2	10	15	3	564.0
24-Aug	8.00	3.1	0	pc-mc, AM haze	2.3	ese, ssw	33.0	29.79	3	7	13	3	27.9
25-Aug	8.00	3.7	0	clr-mc	5.7	s	34.0	29.74	2	11	13	3	5.0
26-Aug	8.00	4.1	0	ovc, haze	2.7	s	33.1	29.78	4	3	5	3	6.6
27-Aug	7.75	4.5	0	mc, haze	3.0	sse-s	34.3	29.83	3	1	4	3	2.2
28-Aug	8.00	3.0	0	clr-pc, haze	4.7	se-s	34.9	29.82	3	3	4	2	0.6
29-Aug	8.00	2.4	0	clr-pc, haze	1.3	e, w	33.2	29.86	2	2	7	3	249.8
30-Aug	8.00	4.1	0	clr-mc, haze	2.7	e, nnw	33.7	29.86	2	3	5	2	185.8
31-Aug	8.00	3.9	0	clr-pc, AM haze	2.0	ene, ese	32.5	29.88	3	6	9	3	14.5
01-Sep	8.00	3.4	0	clr-pc, haze	1.0	se-s	33.4	29.87	2	5	7	2	8.1
02-Sep	8.00	3.6	0	clr, haze	2.7	ese, sw	32.3	29.87	3	6	12	3	3.8
03-Sep	8.50	3.8	0	ovc, haze	2.4	e	31.9	29.89	3	2	3	2	45.5
04-Sep	7.50	3.6	0	clr-mc, haze	4.3	ene-e	32.2	29.91	3	3	7	3	12.3
05-Sep	7.50	3.4	0	mc-ovc, haze	3.0	calm, n	30.7	29.96	3	2	3	2	80.9
06-Sep	8.50	3.8	0	mc-ovc, AM haze	3.0	var	30.7	29.94	3	7	11	3	117.5
07-Sep	8.50	3.4	0	clr-pc, AM haze	3.0	wnw	30.3	29.86	2	6	8	2	142.8
08-Sep	7.25	3.9	0	ovc, haze, PM rain	4.7	e	30.7	29.86	3	3	6	3	94.6
09-Sep	5.25	3.1	0	ovc	3.0	nw-n	27.9	29.84	4	12	12	2	70.5
10-Sep	8.00	4.1	0	ovc, AM haze	1.7	e, se	29.2	29.81	4	8	7	2	73.4
11-Sep	4.75	2.7	0	mc-ovc, AM haze	1.7	e, s	31.1	29.86	3	7	12	2	11.6
12-Sep	2.00	2.0	0	ovc, rain	0.6	nne-ne	27.4	29.90	4	3	3	2	25.0
13-Sep	7.75	3.3	0	ovc, fog, PM rain	0.7	e	26.9	29.86	4	6	9	2	612.6
14-Sep	8.50	4.3	0	pc-mc, AM fog	1.5	ne, ese, nw	29.6	29.81	3	8	10	3	1430.1
15-Sep	8.00	4.3	0	pc-mc	2.3	ese, se, s	32.7	29.81	3	14	17	3	248.3
16-Sep	7.50	5.1	0	pc-mc, haze	5.7	sse	32.9	29.80	4	6	12	2	18.7
17-Sep	8.00	3.8	0	ovc, fog/haze	2.3	s	30.6	29.74	4	3	7	2	8.1
18-Sep	7.00	3.9	0	ovc	3.0	sw, nw	27.2	29.79	4	11	13	3	238.7
19-Sep	9.25	5.0	0	clr, haze	3.0	calm	27.9	29.96	1	10	14	3	4482.5
20-Sep	8.00	2.6	0	clr-pc, AM haze	3.0	ese, nnw	28.4	29.91	2	15	15	2	1867.9
21-Sep	8.00	2.8	0	clr-mc	6.3	s	30.3	29.65	4	14	15	2	2652.0
22-Sep	8.00	4.2	0	clr-ovc, AM haze	6.3	s	32.9	29.61	4	3	7	2	12.0
23-Sep	8.00	9.1	0	mc-ovc, haze	4.3	s	32.4	29.71	4	2	6	2	2.6
24-Sep	7.00	9.1	0	ovc	5.3	calm, nnw	24.9	29.95	4	10	11	3	2262.9
25-Sep	10.25	10.8	0	clr	1.8	calm, ne	25.3	30.06	2	15	19	3	13663.1
26-Sep	9.25	11.9	0	clr-pc, AM haze	2.2	calm, ene, n	27.0	30.04	2	13	14	3	13041.6
27-Sep	9.50	11.0	0	pc, haze, AM fog	1.2	s-sw	28.7	29.92	2	11	14	3	17348.1
28-Sep	9.00	10.8	0	pc-mc, AM haze	2.1	se	29.9	29.91	2	11	12	3	10136.1
29-Sep	9.25	10.8	0	mc-ovc, fog/haze	0.6	e	28.9	29.90	3	8	11	3	4092.0
30-Sep	8.00	13.6	0	clr-pc, AM haze	2.7	se-s	30.5	29.91	2	9	10	2	8356.1
01-Oct	8.00	10.3	0	mc-ovc, haze	2.0	se-s	30.8	29.99	3	8	13	3	28.4
02-Oct	7.50	3.0	0	mc-ovc, haze	2.3	se-s	30.8	30.01	3	8	11	2	26.9
03-Oct	8.00	2.4	0	mc-ovc, AM haze	3.7	e, se, s	28.6	30.00	3	4	7	2	128.6
04-Oct	8.00	3.4	0	clr-pc, AM haze	3.7	ne-e	30.3	30.00	3	9	11	3	441.5
05-Oct	7.00	3.5	0	pc-mc, haze, AM fog	3.8	ne-e	29.9	30.04	3	4	4	2	272.6
06-Oct	8.00	3.8	0	clr-mc, AM haze	3.0	ne, e, nw	30.8	30.02	2	4	4	3	2162.3
07-Oct	6.50	3.6	0	ovc, fog/haze	2.6	ne, nnw	28.4	29.99	4	4	6	2	650.9

Appendix C. continued

DATE	OBS. HOURS	NUMBER OBSRVRS ¹	VISITOR DISTURB ²	SKY CONDITION ³	WIND SPEED (KPH) ¹	WIND DIRECTION	TEMP. (°C) ¹	BARO. PRESS.	MEDIAN THERMAL	VISIB. VISIB.		FLIGHT DIST. ⁵	RAPTORS / HOUR
								(IN HG) ¹	LIFT ⁴	EAST (KM) ¹	WEST (KM) ¹		
08-Oct	7.50	3.3	0	clr, haze	3.0	n-ne	27.9	29.96	2	7	8	2	701.1
09-Oct	8.00	3.4	0	ovc, fog/haze	0.7	e	28.7	29.90	4	8	13	2	123.4
10-Oct	6.25	3.6	0	mc-ovc, AM haze/PM rain	3.9	ssw	31.2	29.80	3	6	6	2	160.3
11-Oct	9.00	3.7	0	clr-ovc, AM haze	1.5	ne, e, nnw	27.9	29.79	2	11	15	3	326.8
12-Oct	8.00	4.2	0	mc-ovc	3.0	s	31.2	29.73	2	14	15	3	37.3
13-Oct	6.50	4.2	0	ovc, fog/haze	4.5	ne	22.0	29.85	4	2	2	2	60.2
14-Oct	7.00	4.2	0	ovc, AM haze	2.6	ne-e	25.1	29.85	4	7	10	2	27.3
15-Oct	5.25	3.8	0	pc-ovc	3.0	e, s	27.7	29.50	2	10	13	2	144.8
16-Oct	8.00	2.4	0	clr-ovc, fog/haze	5.7	ssw-sw	30.4	29.42	4	6	10	2	34.8
17-Oct	7.50	3.1	0	pc, haze	2.7	ese, ssw	31.2	29.62	2	9	11	2	243.7
18-Oct	7.50	2.6	0	pc-ovc, fog/haze	1.9	se-s	31.7	29.60	4	7	11	2	17.7
19-Oct	7.75	2.7	0	mc-ovc, haze	15.4	nw	21.0	29.86	4	4	6	2	919.2
20-Oct	8.00	2.4	0	mc-ovc	4.3	nne-ne	20.3	29.86	4	11	12	2	641.6
21-Oct	8.00	4.2	0	clr-ovc, haze	1.7	e, se, sw	28.3	29.73	2	7	12	2	80.0
22-Oct	1.25	3.0	0	ovc, rain	39.0	var	13.4	30.10	4	9	14	2	5.6
23-Oct	8.75	3.7	0	clr	4.2	n-e	19.1	30.17	3	9	14	3	115.7
24-Oct	7.50	3.7	0	ovc, haze	6.4	ne, se	24.5	30.02	4	8	7	2	7.9
25-Oct	6.50	3.1	0	ovc, haze	8.1	se	26.8	29.85	4	3	7	3	4.2
26-Oct	7.50	3.0	0	mc, haze	7.5	sw	30.4	29.76	3	9	12	3	70.8
27-Oct	9.00	3.6	0	pc, dust	15.6	nw	22.6	29.96	4	9	10	2	449.6
28-Oct	8.00	4.3	0	clr, haze	0.0	nw	20.7	30.16	2	12	16	3	658.8
29-Oct	7.50	4.4	0	clr, AM haze	6.0	s	24.6	30.02	3	13	16	2	141.1
30-Oct	7.50	2.4	0	clr-ovc, dust/haze	6.8	se-s	26.6	29.81	4	8	13	2	26.4
31-Oct	7.50	2.7	0	clr-mc	3.0	s	27.7	29.81	2	14	15	3	106.7
01-Nov	7.50	3.4	0	mc-ovc, AM fog	7.5	calm, nne	24.8	29.92	3	8	9	3	84.8
02-Nov	8.50	3.4	0	clr-ovc, haze	6.3	ne	17.8	30.17	4	6	9	2	57.6
03-Nov	7.75	3.7	0	clr-mc	4.5	calm, nne-ne	18.9	30.30	3	14	16	2	85.5
04-Nov	7.50	2.7	0	pc-ovc, haze	4.1	ne, ese	23.8	30.05	4	9	13	2	69.3
05-Nov	7.50	5.0	0	pc-mc, AM haze	3.0	ene, ese	26.8	29.95	3	10	11	2	156.3
06-Nov	6.25	3.4	0	clr, haze	0.9	nw	26.9	29.87	3	7	10	3	22.4
07-Nov	7.50	3.1	0	clr, AM haze	3.0	ne	23.7	29.93	2	10	10	2	24.7
08-Nov	7.00	2.0	0	clr, fog/haze	5.3	sse-ssw	27.3	29.74	2	10	10	2	0.9
09-Nov	7.00	3.0	0	pc-ovc, haze	5.3	s	28.7	29.65	4	6	9	2	11.1
10-Nov	6.50	3.3	0	mc-ovc, haze	6.0	sse-ssw	29.7	29.75	4	2	3	2	18.9
11-Nov	7.50	2.3	0	clr, haze	7.5	calm, nnw-nne	19.6	30.17	4	11	16	3	67.2
12-Nov	7.50	2.8	0	clr-ovc	6.0	ene	20.5	30.00	4	12	13	2	8.5
13-Nov	7.25	2.8	0	ovc, fog/haze	2.6	ne-e	24.7	29.91	4	2	3	2	45.8
14-Nov	6.50	3.1	0	pc-ovc, fog/haze	6.0	sw	26.2	29.65	4	7	11	2	28.3
15-Nov	4.50	5.2	0	clr, dust	30.8	nw	21.8	29.82	4	5	5	2	24.2

¹ Average of hourly records.

² Median hourly visitor-disturbance rating (subjective assessment by observers): 0 = none, 1 = low, 2 = moderate, 3 = high.

³ Predominant sky condition during day: clr = clear (0-15% cloud cover); pc = partly cloudy (16-50% cover); mc = mostly cloudy (51-75% cover); ovc = overcast (76-100% cover); ts = thunderstorms.

⁴ Median hourly rating concerning prevalence of lift-generating thermals, based on subjective assessments of solar intensity, wind speeds, and migrant behavior: 1 = excellent, 2 = good, 3 = fair, 4 = poor.

⁵ Median hourly rating concerning line-of-sight distance of flight from observation site: 1 = close, detection and identification possible with naked eye; 2 = moderate, detection possible with naked eye, but binoculars needed for identification; 3 = far, binoculars needed for both detection and identification; 4 = distant, birds detected and identified only with excellent binoculars or spotting scope and by experienced observers.

Appendix D. Daily fall raptor migration counts by species at Hazel Bazemore Park near Corpus Christi, Texas: 2006.

DATE	OBSERV.				SPECIES ¹																							BIRDS						
	HOURS	BV	TV	OS	NH	SK	WK	MK	SS	CH	UA	HH	RS	BW	ST	SW	WT	ZT	RT	FH	UB	GE	BE	CC	AK	ML	PR	PG	AF	SF	UF	UU	TOTAL	/ HOUR
15-Aug	8.00	0	0	0	0	12	0	309	0	1	1	1	0	0	0	11	1	0	2	0	1	0	0	0	0	0	0	2	0	0	0	0	341	42.6
16-Aug	8.00	0	0	0	0	18	0	103	0	0	0	0	0	0	0	11	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	133	16.6
17-Aug	8.50	0	0	0	0	21	0	70	1	0	0	0	0	291	0	8	0	0	1	0	0	0	0	0	0	0	0	4	0	0	0	0	396	46.6
18-Aug	8.50	0	0	0	0	11	0	507	0	3	1	0	0	22	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	552	64.9
19-Aug	7.25	0	0	0	0	1	0	147	1	0	0	0	0	1	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	154	21.2
20-Aug	8.00	0	0	0	0	5	0	787	0	1	0	0	0	144	0	3	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	8	950	118.8
21-Aug	8.00	0	0	0	0	2	0	199	0	0	0	0	0	34	0	7	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	4	247	30.9
22-Aug	8.00	0	0	0	0	0	0	315	0	0	0	0	0	6	0	5	0	0	0	0	1	0	0	0	0	0	1	1	0	0	0	329	41.1	
23-Aug	8.00	0	0	0	0	1	0	4484	1	0	0	0	0	14	1	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4512	564.0
24-Aug	8.00	0	0	0	0	0	0	214	0	0	0	0	0	5	0	3	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	223	27.9	
25-Aug	8.00	0	0	0	0	0	0	35	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	40	5.0	
26-Aug	8.00	0	33	1	0	0	0	11	0	1	0	1	0	0	0	5	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	53	6.6	
27-Aug	7.75	0	0	1	0	0	0	10	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	2.2	
28-Aug	8.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0.6	
29-Aug	8.00	0	0	0	2	4	1	1917	0	0	0	0	1	55	0	8	0	0	2	0	4	0	0	0	1	0	0	2	0	0	0	1	1998	249.8
30-Aug	8.00	0	0	3	0	3	0	1441	1	1	0	0	0	21	0	6	0	0	3	0	4	0	0	0	2	1	0	0	0	0	0	1486	185.8	
31-Aug	8.00	0	0	3	4	2	0	42	0	0	0	0	0	30	0	23	1	0	0	0	1	0	0	0	8	0	0	1	0	0	0	1	116	14.5
1-Sep	8.00	0	0	1	0	0	0	51	0	0	0	0	0	10	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	65	8.1	
2-Sep	8.00	0	0	0	0	1	0	8	0	1	0	0	0	9	0	6	0	0	1	0	0	0	0	1	2	0	0	1	0	0	0	30	3.8	
3-Sep	8.50	0	0	1	6	1	0	223	0	3	0	0	0	129	0	10	0	0	2	0	0	0	0	0	12	0	0	0	0	0	0	387	45.5	
4-Sep	7.50	0	0	0	0	1	0	24	0	1	0	0	0	54	0	8	0	0	2	0	0	0	0	0	1	0	0	0	0	0	0	1	92	12.3
5-Sep	7.50	0	0	0	0	0	0	492	1	5	0	1	0	95	0	9	0	0	3	0	0	0	0	0	0	0	0	1	0	0	0	607	80.9	
6-Sep	8.50	0	0	3	3	0	0	579	1	0	0	3	0	390	0	13	0	0	0	0	2	0	0	0	3	0	0	2	0	0	0	999	117.5	
7-Sep	8.50	0	0	4	5	0	0	408	0	3	1	0	1	738	0	36	0	0	2	0	1	0	0	1	8	0	1	4	0	0	0	1	1214	142.8
8-Sep	7.25	0	3	1	8	1	0	11	0	0	0	1	0	641	0	13	0	0	0	0	0	0	0	0	4	0	0	0	0	1	1	1	686	94.6
9-Sep	5.25	0	0	0	0	0	0	47	0	2	0	1	2	311	0	3	0	0	0	0	0	0	0	0	3	0	0	1	0	0	0	370	70.5	
10-Sep	8.00	0	1	5	2	1	0	135	0	2	0	0	0	429	0	6	0	0	0	0	0	0	0	0	3	0	0	3	0	0	0	587	73.4	
11-Sep	4.75	0	0	0	2	0	0	37	0	1	0	0	0	10	0	3	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	55	11.6	
12-Sep	2.00	0	0	0	0	3	0	46	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	25.0	
13-Sep	7.75	0	8	6	8	2	0	469	2	7	0	0	0	4159	0	25	0	0	0	0	0	0	0	0	20	0	0	1	0	0	1	40	4748	612.6
14-Sep	8.50	0	0	10	14	0	0	263	3	14	1	0	0	11771	1	17	0	0	2	0	0	0	0	0	55	0	0	2	0	0	1	2	12156	1430.1
15-Sep	8.00	32	1	2	2	0	0	14	0	2	0	0	0	1921	0	4	1	0	0	0	0	0	0	2	2	0	0	0	0	0	0	3	1986	248.3
16-Sep	7.50	0	0	2	0	0	0	41	0	0	0	1	0	95	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	140	18.7	
17-Sep	8.00	15	11	3	0	0	0	0	0	2	0	0	0	30	0	0	0	0	0	0	1	0	0	0	2	1	0	0	0	0	0	65	8.1	
18-Sep	7.00	1	7	1	2	1	0	137	4	5	0	0	1	1506	0	1	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	1671	238.7	
19-Sep	9.25	0	2	15	8	5	0	204	6	31	4	2	1	41106	0	34	1	0	4	0	0	0	0	0	33	0	0	2	0	0	0	5	41463	4482.5
20-Sep	8.00	12	1	3	19	0	0	8	2	5	4	0	0	14864	0	2	0	0	2	0	0	0	1	0	14	0	0	3	0	0	0	3	14943	1867.9

Appendix D. continued

DATE	OBSERV.			SPECIES ¹																								BIRDS						
	HOURS	BV	TV	OS	NH	SK	WK	MK	SS	CH	UA	HH	RS	BW	ST	SW	WT	ZT	RT	FH	UB	GE	BE	CC	AK	ML	PR	PG	AF	SF	UF	UU	TOTAL	/HOUR
21-Sep	8.00	62	34	4	1	0	0	123	0	0	0	0	0	20974	0	10	0	0	0	0	1	0	0	0	3	0	1	2	0	0	0	0	21216	2652.0
22-Sep	8.00	0	0	3	0	0	0	0	0	0	0	0	0	81	0	4	1	0	0	0	1	0	0	0	0	0	0	5	0	0	0	96	12.0	
23-Sep	8.00	0	0	0	0	0	0	1	0	0	0	0	0	9	0	1	0	0	0	0	0	0	0	3	0	0	6	0	0	0	21	2.6		
24-Sep	7.00	38	1	24	12	0	2	24	45	16	9	0	0	15514	0	5	0	0	0	0	1	0	0	0	128	2	0	17	0	0	0	2	15840	2262.9
25-Sep	10.25	0	26	18	26	2	0	89	78	86	20	0	8	139563	0	50	0	0	12	0	0	0	0	52	0	3	10	0	0	1	3	140047	13663.1	
26-Sep	9.25	20	22	12	10	0	0	17	36	46	7	1	14	120388	0	7	0	0	7	0	1	0	0	0	32	2	1	4	0	0	4	4	120635	13041.6
27-Sep	9.50	0	30	13	1	0	0	1	7	5	2	0	2	164723	0	9	0	1	2	0	3	0	0	0	5	0	0	2	0	0	1	0	164807	17348.1
28-Sep	9.00	0	47	33	2	0	0	10	15	29	6	5	5	90981	0	13	0	0	13	0	0	0	0	0	28	7	0	26	0	0	3	2	91225	10136.1
29-Sep	9.25	0	64	36	30	1	2	7	57	37	6	0	2	37431	0	13	0	0	3	0	0	0	0	0	117	2	0	40	0	0	1	2	37851	4092.0
30-Sep	8.00	0	8	19	2	0	0	7	11	8	1	0	0	66742	0	8	0	0	2	0	1	0	0	0	18	0	0	20	0	1	0	0	66849	8356.1
1-Oct	8.00	1	34	12	1	0	0	2	11	3	0	0	0	118	0	5	3	2	2	0	2	1	0	0	5	0	0	24	0	0	0	0	227	28.4
2-Oct	7.50	10	78	2	3	0	0	0	5	8	1	0	1	73	0	2	1	0	1	0	0	0	0	1	6	0	0	8	0	0	0	2	202	26.9
3-Oct	8.00	14	9	1	6	0	0	2	34	14	7	0	0	895	0	1	0	0	3	0	2	1	0	0	20	2	0	17	0	0	0	1	1029	128.6
4-Oct	8.00	18	54	13	11	0	0	0	70	39	29	1	7	3214	0	8	0	0	5	0	1	0	1	0	35	3	0	17	0	0	1	5	3532	441.5
5-Oct	7.00	0	44	6	9	0	0	0	32	27	11	0	1	1714	0	10	0	0	3	0	2	0	0	0	39	1	1	5	0	0	0	3	1908	272.6
6-Oct	8.00	101	264	3	15	0	0	0	34	17	18	0	0	12299	0	4506	0	0	0	0	1	0	0	0	28	1	0	6	0	0	0	5	17298	2162.3
7-Oct	6.50	0	11	5	17	0	0	0	70	65	9	0	0	3992	0	23	0	0	1	0	0	0	0	0	33	3	0	1	0	0	0	1	4231	650.9
8-Oct	7.50	0	153	2	17	0	0	1	54	66	24	1	1	4880	0	18	0	0	3	1	1	0	0	0	33	0	0	1	0	0	0	2	5258	701.1
9-Oct	8.00	0	60	3	8	0	0	0	64	51	8	0	1	749	0	12	0	0	1	0	0	0	0	0	26	0	0	4	0	0	0	0	987	123.4
10-Oct	6.25	0	98	7	3	0	0	0	18	25	4	0	0	829	0	9	0	1	0	0	1	0	0	0	5	0	0	1	0	0	0	1	1002	160.3
11-Oct	9.00	0	110	6	11	0	0	0	157	92	13	0	0	2287	0	201	0	0	6	0	0	0	0	0	43	5	0	9	0	0	0	1	2941	326.8
12-Oct	8.00	12	110	0	2	0	0	0	26	18	2	0	0	95	0	20	3	0	0	0	0	0	0	0	5	1	1	2	0	0	0	1	298	37.3
13-Oct	6.50	0	53	4	9	0	0	0	91	46	3	2	0	148	0	4	0	0	0	0	0	0	0	0	23	3	0	4	0	0	0	1	391	60.2
14-Oct	7.00	0	8	5	18	0	0	0	66	28	2	1	0	10	0	7	0	0	1	0	0	0	0	0	39	3	0	2	0	0	0	1	191	27.3
15-Oct	5.25	9	123	5	18	0	0	0	36	20	2	0	0	240	0	273	0	0	2	0	0	0	0	0	20	0	0	9	0	0	0	3	760	144.8
16-Oct	8.00	4	95	0	6	0	0	0	48	30	4	0	0	13	0	42	2	0	1	1	8	0	0	0	22	2	0	0	0	0	0	0	278	34.8
17-Oct	7.50	28	629	3	23	0	0	0	131	141	11	1	1	84	0	706	1	0	2	0	1	0	0	0	58	1	0	7	0	0	0	0	1828	243.7
18-Oct	7.50	0	52	1	8	0	0	0	14	34	3	0	0	2	0	2	0	0	1	0	2	0	0	0	12	1	0	1	0	0	0	0	133	17.7
19-Oct	7.75	115	6249	1	17	0	0	0	39	33	5	1	3	36	0	604	0	0	7	0	0	0	0	0	13	1	0	0	0	0	0	0	7124	919.2
20-Oct	8.00	10	4093	3	60	0	1	1	137	259	39	0	17	263	0	146	0	0	29	1	5	0	1	0	52	3	0	5	0	0	0	8	5133	641.6
21-Oct	8.00	31	261	5	20	0	1	0	33	78	4	2	0	119	0	63	1	0	6	0	3	0	1	1	6	2	0	0	0	0	0	3	640	80.0
22-Oct	1.25	0	0	0	0	0	0	0	5	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	5.6
23-Oct	8.75	37	472	1	32	0	1	0	45	93	9	1	6	238	0	15	1	0	29	0	6	0	1	1	13	0	1	3	0	0	0	7	1012	115.7
24-Oct	7.50	0	45	0	0	0	0	0	2	3	0	0	0	4	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	2	59	7.9
25-Oct	6.50	1	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	27	4.2
26-Oct	7.50	106	382	0	3	0	0	0	3	12	2	0	0	10	0	1	3	0	2	0	2	0	0	0	2	0	0	3	0	0	0	0	531	70.8
27-Oct	9.00	26	3829	1	3	0	0	0	21	21	2	4	1	20	0	80	1	1	29	0	1	0	0	1	4	1	0	0	0	0	0	4046	449.6	

Appendix D. continued

DATE	OBSERV.			SPECIES ¹																								BIRDS									
	HOURS	BV	TV	OS	NH	SK	WK	MK	SS	CH	UA	HH	RS	BW	ST	SW	WT	ZT	RT	FH	UB	GE	BE	CC	AK	ML	PR	PG	AF	SF	UF	UU	TOTAL	/HOUR			
28-Oct	8.00	8	5083	2	12	0	0	0	36	41	3	1	7	34	0	9	0	0	28	0	0	0	0	1	4	0	0	0	0	0	0	0	0	0	0	5270	658.8
29-Oct	7.50	21	966	0	8	0	0	0	7	19	1	0	0	20	0	7	4	0	2	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	1058	141.1	
30-Oct	7.50	23	168	0	0	0	0	0	0	1	1	0	0	0	0	1	1	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	198	26.4	
31-Oct	7.50	9	763	0	4	0	0	0	4	5	2	0	0	0	0	4	0	0	7	0	0	0	0	0	0	0	0	1	0	0	1	0	0	800	106.7		
1-Nov	7.50	6	552	0	18	0	0	0	13	17	1	1	3	1	0	2	1	0	10	0	0	0	0	1	9	0	0	1	0	0	0	0	0	636	84.8		
2-Nov	8.50	5	353	0	27	0	0	0	15	32	2	1	5	12	0	1	0	0	25	1	2	0	0	2	4	1	0	1	0	0	0	1	0	490	57.6		
3-Nov	7.75	26	503	1	19	0	0	0	20	16	3	1	4	24	0	2	1	0	34	0	2	0	0	1	4	0	0	2	0	0	0	0	0	663	85.5		
4-Nov	7.50	27	485	0	1	0	0	0	2	0	0	0	0	0	0	0	1	0	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0	520	69.3		
5-Nov	7.50	19	1102	1	1	0	0	0	3	13	1	0	1	3	0	0	5	1	12	1	2	0	0	3	0	0	0	4	0	0	0	0	0	1172	156.3		
6-Nov	6.25	10	103	0	4	0	0	0	6	8	1	1	0	0	0	0	1	0	3	0	0	0	0	0	2	0	0	1	0	0	0	0	0	140	22.4		
7-Nov	7.50	1	168	0	0	0	0	0	2	1	0	2	3	2	0	0	0	0	3	0	1	0	0	0	1	0	0	1	0	0	0	0	0	185	24.7		
8-Nov	7.00	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0.9		
9-Nov	7.00	3	73	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	78	11.1		
10-Nov	6.50	0	118	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1	123	18.9		
11-Nov	7.50	18	471	1	1	0	0	0	0	1	0	0	2	0	0	0	2	0	4	0	0	0	0	2	2	0	0	0	0	0	0	0	0	504	67.2		
12-Nov	7.50	10	17	0	8	0	0	0	14	7	0	0	0	0	0	0	0	0	4	0	1	0	0	0	0	0	0	3	0	0	0	0	0	64	8.5		
13-Nov	7.25	4	270	0	22	0	0	0	2	12	0	0	0	3	0	1	2	1	12	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	332	45.8	
14-Nov	6.50	0	178	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	184	28.3		
15-Nov	4.50	0	96	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	109	24.2		
Total	704.50	893	29115	321	614	99	8	14073	1643	1719	290	39	101	767730	2	7225	39	7	363	8	79	2	5	20	1137	50	10	309	1	2	15	135	826058	1172.5			

¹ See Appendix A for explanation of species codes.

Appendix E. Annual observation effort and fall raptor migration counts by species at Hazel Bazemore Park near Corpus Christi, Texas: 1997–2006.

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	MEAN
Start date	15-Aug	15-Aug	14-Aug	15-Aug	15-Aug	15-Aug	15-Aug	15-Aug	15-Aug	15-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
Observation days	89	83	90	91	93	89	86	93	92	93	90
Observation hours	725.00	585.50	719.75	728.58	723.50	676.50	643.00	701.00	715.75	704.50	692.31
SPECIES	RAPTOR COUNT										
Black Vulture	431	138	1,398	491	222	470	241	1,016	445	893	575
Turkey Vulture	11,221	5,011	30,027	36,690	4,870	42,536	22,900	17,750	19,090	29,115	21,921
Unidentified vulture	0	0	0	0	0	0	0	9	0	0	1
Total vultures	11,652	5,149	31,425	37,181	5,092	43,006	23,141	18,766	19,535	30,008	22,496
Osprey	81	179	181	88	114	146	199	207	241	321	176
Northern Harrier	93	180	331	153	162	109	100	101	157	614	200
Hook-billed Kite	0	0	0	0	0	0	1	0	0	0	0
Swallow-tailed Kite	7	6	31	0	37	57	22	34	56	99	35
White-tailed Kite	4	6	6	2	2	2	1	2	9	8	4
Mississippi Kite	2,974	3,584	5,513	4,569	10,155	8,394	9,753	4,441	10,004	14,073	7,346
TOTAL KITES	2,985	3,596	5,550	4,571	10,194	8,453	9,776	4,477	10,069	14,180	7,385
Sharp-shinned Hawk	936	1,208	1,348	929	698	1,869	1,193	892	880	1,643	1,160
Cooper's Hawk	418	260	1,092	555	473	645	1,083	483	815	1,719	754
Northern Goshawk	0	0	1	0	0	1	0	0	0	2	0
Unidentified accipiter	308	316	310	379	298	108	344	252	174	290	278
TOTAL ACCIPITERS	1,662	1,784	2,751	1,863	1,767	2,649	2,620	1,627	1,869	3,654	2,192
Common Black Hawk	0	0	0	0	0	1	0	0	0	0	0
Harris' Hawk	5	5	28	10	14	10	6	23	25	39	17
Red-shouldered Hawk	79	38	77	81	45	92	26	24	37	101	60
Broad-winged Hawk	823,602	970,025	640,258	396,774	864,355	464,772	684,815	989,957	263,101	767,730	686,539
Short-tailed Hawk	0	0	2	0	0	0	0	1	4	2	1
Swainson's Hawk	300	6,790	1,246	2,085	14,260	7,912	5,633	14,751	1,347	7,225	6,155
White-tailed Hawk	4	5	13	0	7	4	6	19	25	39	12
Zone-tailed Hawk	2	0	6	0	1	2	7	2	10	7	4
Red-tailed Hawk	112	121	282	237	96	182	192	180	103	363	187
Ferruginous Hawk	1	0	14	1	1	2	1	2	5	8	4
Rough-legged Hawk	1	0	4	0	0	0	0	0	0	0	1
Unidentified buteo	18	25	62	215	368	80	71	53	34	79	101
TOTAL BUTEOS	824,124	977,009	641,992	399,403	879,147	473,057	690,757	1,005,012	264,691	775,593	693,078
Golden Eagle	1	0	4	1	1	1	2	1	2	2	2
Bald Eagle	0	2	4	0	2	1	1	3	4	5	2
Unidentified eagle	0	0	1	0	0	0	0	0	0	0	0
TOTAL EAGLES	1	2	9	1	3	2	3	4	6	7	4
Crested Caracara	9	1	18	4	21	12	21	3	11	20	12
American Kestrel	189	438	483	509	292	811	860	365	485	1,137	557
Merlin	25	29	34	31	26	18	57	32	36	50	34
Prairie Falcon	8	5	33	6	7	4	15	2	3	10	9
Peregrine Falcon	76	163	241	65	114	176	169	144	230	309	169
Aplomado Falcon	0	0	1	0	0	0	1	0	1	1	0
Unknown small falcon	-	-	-	-	0	4	5	4	1	2	3
Unknown large falcon	-	-	-	-	0	5	9	0	0	2	3
Unidentified falcon	14	39	92	103	41	25	47	11	5	15	37
TOTAL FALCONS	312	674	884	714	480	1,043	1,163	554	761	1,526	809
Unidentified raptor	220	4,376	3,874	506	837	98	133	89	35	135	1,030
GRAND TOTAL	841,139	992,950	687,015	444,484	897,519	528,540	727,900	1,030,849	297,375	826,058	727,383