

**FALL 2007 RAPTOR MIGRATION STUDY  
NEAR CORPUS CHRISTI, TEXAS**



Copyright © 1998 Brian K. Wheeler

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



**April 2008**

**FALL 2007 RAPTOR MIGRATION STUDY  
NEAR CORPUS CHRISTI, TEXAS**

*Report prepared by:*

**Jeff P. Smith and Mike C. Neal**

*Counts conducted by:*

**Dane Ferrell, Libby Even, and Joel Simon**

**Assisted By Local Volunteers**

*Local project coordination by:*

**Joel Simon**

*Overall project coordination by:*

**HawkWatch International, Inc.**

**Principal Investigator: Dr. Jeff P. Smith**

**1800 South West Temple, Suite 226, Salt Lake City, UT 84115**

**(801) 484-6808**

**April 2008**

## TABLE OF CONTENTS

List of Tables .....	iii
List of Figures .....	iii
Introduction.....	1
Study Site.....	1
Methods .....	2
Results and Discussion .....	3
Weather .....	3
Observation Effort.....	3
Migration Summary .....	4
Passage Rates and Long-Term Trends.....	4
Regional Comparisons.....	5
Seasonal Timing.....	6
Resident and Local Raptor Activity .....	6
Visitor Participation and Public Outreach.....	6
Acknowledgements.....	7
Literature Cited.....	7
Tables.....	9
Figures .....	11
Appendix A. Common and scientific names, species codes, and regularly applied age, sex, and color-morph classifications. ....	21
Appendix B. History of official observer participation in the Corpus Christi Raptor Migration Project: 1997–2007.....	22
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: 2007.....	23
Appendix D. Daily fall raptor migration counts by species at Hazel Bazemore Park near Corpus Christi, Texas: 2007. ....	25
Appendix E. Annual observation effort and fall raptor migration counts by species at Hazel Bazemore Park near Corpus Christi, Texas: 1997–2007.....	28

## LIST OF TABLES

Table 1.	Fall counts and passage rates by species for migrating raptors at Hazel Bazemore Park near Corpus Christi, Texas: 1997–2006 versus 2007. ....	9
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 2007, with a comparison of 2007 and 1997–2006 average median passage dates. ....	10

## LIST OF FIGURES

Figure 1.	Location of Hazel Bazemore County Park count site near Corpus Christi, Texas. ....	11
Figure 2.	Composition of the fall raptor migration by species groups at Hazel Bazemore Park near Corpus Christi, Texas: 1997–2006 versus 2007. ....	12
Figure 3.	Adjusted fall-migration passage rates at Hazel Bazemore Park near Corpus Christi, Texas for Black Vultures, Turkey Vultures, and Ospreys: 1997–2007. Dashed lines indicate significant ( $P \leq 0.10$ ) linear or quadratic regressions. ....	13
Figure 4.	Adjusted fall-migration passage rates at Hazel Bazemore Park near Corpus Christi, Texas for Northern Harriers, Swallow-tailed Kites, and Mississippi Kites: 1997–2007. Dashed lines indicate significant ( $P \leq 0.10$ ) linear or quadratic regressions. ....	14
Figure 5.	Adjusted fall-migration passage rates at Hazel Bazemore Park near Corpus Christi, Texas for Sharp-shinned, Cooper’s, and Harris’s Hawks: 1997–2007. Dashed lines indicate significant ( $P \leq 0.10$ ) linear or quadratic regressions. ....	15
Figure 6.	Adjusted fall-migration passage rates at Hazel Bazemore Park near Corpus Christi, Texas for Red-shouldered, Broad-winged, and Swainson’s Hawks: 1997–2007. Dashed lines indicate significant ( $P \leq 0.10$ ) linear or quadratic regressions. ....	16
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: 1997–2007. Dashed lines indicate significant ( $P \leq 0.10$ ) linear or quadratic regressions. ....	17
Figure 8.	Adjusted fall-migration passage rates at Hazel Bazemore Park near Corpus Christi, Texas for Crested Caracaras, American Kestrels, and Merlins: 1997–2007. Dashed lines indicate significant ( $P \leq 0.10$ ) linear or quadratic regressions. ....	18
Figure 9.	Adjusted fall-migration passage rates at Hazel Bazemore Park near Corpus Christi, Texas for Prairie and Peregrine Falcons: 1997–2007. Dashed lines indicate significant ( $P \leq 0.10$ ) linear or quadratic regressions. ....	19
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: 1997–2006 versus 2007. ....	20

## 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, 2008a). During fall 2007, HawkWatch International (HWI) conducted the eleventh 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 roughly 445,000 to more than 1,000,000 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 2007 season.

The Corpus Christi project was 1 of 14 long-term, annual migration counts conducted or sponsored by HWI in North America during 2007. 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 (Hoffman and Smith 2003, Smith et al. 2008a, b). 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 (Zalles and Bildstein 2000, Hoffman and Smith 2003, Bildstein et al. 2008).

## 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 half-time as one of the official observers, which he has done at either a half or full-time level most years since 1997, and coordinated other local volunteers and our local public outreach efforts (see Appendix B for a complete history of official observer participation). Official observer Dane Ferrell had previously conducted six other full-season migration counts for HWI, including five seasons in Texas. This was official observer Libby Even's second full season of official migration counting at Corpus Christi, but she had gained extensive exposure to migration monitoring on-site as a volunteer in past seasons. Several other experienced local volunteers, 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 H and ended by 1600 H 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 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 2007 follows Hoffman and Smith (2003). In comparing 2007 annual statistics against means and 95% confidence intervals for previous seasons, we equate significance with a 2007 value falling outside the bounds of the confidence interval for the associated mean.

## RESULTS AND DISCUSSION

### WEATHER

Inclement weather fully precluded only one day of potential observations in 2007, and observation time was reduced to <4 hours due to inclement weather on 4 other days (see Appendix C for daily weather records). The long-term averages for the site are 3.1 and 2.6 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 45% of the active days, and mostly cloudy to overcast skies on 25% of the active days. The long-term averages for the site are 33% fair, 41% transitional, and 26% mostly cloudy to overcast. Scattered rain and thunderstorms occurred on 25% and visibility-reducing fog and/or haze occurred on 87% of the active observation days. Both of these values are substantially above average (15% and 55%, respectively), and likely contributed to reduced average visibility (7 km east and 8 km west versus long-term averages of 9.6 km east and 10.6 km west).

Compared to the long-term average, the 2007 season was slightly windier than average. Light winds (<12 kph) prevailed on 67% of the active observation days and moderate winds (12–28 kph) on 33%, compared to long-term averages of 71% light, 28% moderate, and 1% strong (>28 kph). In terms of wind directions, E–S winds prevailed throughout most or all of 41% of the active observation days, N–E winds on 27%, calm/variable winds on 11%, and a variety of other combinations 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, except that periods of calm/variable winds were more common than usual, occurring throughout or during significant portions of 33% of the active observation days compared to the long-term average of 20%.

Daily-average (mean of hourly readings) temperatures during active observation periods averaged 29.2°C, ranging from 18.9–34.0°C. The average and maximum are typical for the site, whereas the minimum is among the highest yet recorded. Daily-average (mean of hourly readings) barometric pressure during active observation periods averaged 29.96 in Hg, ranging from 29.58–30.95. The average and minimum are typical for the site, whereas the maximum is among the highest yet recorded.

In 2007, 51% of the active observation days received a median thermal-lift rating of good to excellent, which is the second highest recorded to date and well above the long-term average of 36%.

In summary, weather data collected on site by our observers during active observation periods revealed cloudier than average conditions; a higher than usual prevalence of scattered thundershowers and especially fog/haze, with attendant reductions in average visibility; close to average temperature and barometric pressure regimes; on average slightly stronger winds than usual; a fairly typical array of wind directions except for a higher than usual prevalence of calm/variable conditions; and a near-record high prevalence of thermal-lift conditions rated by the observers as good to excellent.

### OBSERVATION EFFORT

Observations occurred on 92 of 93 possible days within the usual study period of 15 August through 15 November (see Appendix D for daily count records). In 2007 for the first time, we initiated a two-year exploratory effort to assess the degree to which beginning the season two weeks earlier would better capture the migration of Swallow-tailed Kites. Official observer Dane Ferrell was the primary observer during this first two weeks, assisted by various local volunteers. The number of observation days and hours (683.75) conducted between the typical study period of 15 August through 15 November were 2% higher and 1% lower, respectively, than the 1997–2006 averages of  $90 \pm 95\%$  CI of 2.1 days and  $692.31 \pm 28.46$  hours of observation per season. The 2007 average of 4.0 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 1997–2006 average of  $3.5 \pm 0.20$  observers/hr, owing to regular participation of many local volunteers.

## **MIGRATION SUMMARY**

The observers tallied 649,762 migrating raptors of 27 species during the 2007 season (Table 1), which is a non-significant 11% below the long-term average for the site. The only species for which the extra, early two weeks of additional counting resulted in more than five additional birds were the Swallow-tailed Kite (17 birds; 10% of the 2007 total), Mississippi Kite (1,903, 7%), and Broad-winged Hawk (10, <1%). Note that, even without addition of the early birds, the 2007 tallies for Swallow-tailed and Mississippi Kite were well above average (see Table 1), making it difficult to know whether the documented early birds were typical for the flight or perhaps simply reflective of it being a big year for both species. We hope to gain further clarification through a second year of early counts in 2008.

The 2007 Broad-winged Hawk count was 17% below average, whereas the total count of all other species combined (79,923) was a new record high, owing primarily to new record high counts of Turkey Vultures and Mississippi Kites (again note that the record high count for this species would have applied even without the additional 1,903 birds counted before 15 August; see Appendix E for annual count summaries). Species that comprised 1% or more of the 2007 count with Broad-winged Hawks excluded included Turkey Vulture (58%), Mississippi Kite (34%), Sharp-shinned Hawk (2%), and Cooper's Hawk (1%). Buteos, vultures, and kites were the predominant species groups (Figure 2). With Broad-winged Hawks excluded, the proportion of kites was significantly above average in 2007, whereas the proportions of all other species groups except vultures and unknowns were significantly below average. Highlights of the season included the fourth season in a row that a Short-tailed Hawk was sighted moving through; a new record-high total of 22 migrating Zone-tailed Hawks plus the presence of resident bird; and new record-high counts of Northern Goshawks (3), Bald Eagles (7), Merlins (82), and Aplomado Falcons (4; third year in a row that this species has been recorded at the site; Appendix E). In contrast, the only commonly recorded species for which a new record low count occurred in 2007 was the Red-shouldered Hawk (15).

## **Passage Rates and Long-Term Trends**

The adjusted passage rate for Broad-winged Hawks in 2007 was a significant 20% below average (Table 1). Other species whose passage rates were significantly below average in 2007 included Black Vulture and Harris's, Red-shouldered, Swainson's and Red-tailed Hawks. In contrast, 11 of the 14 remaining, relevant species showed significantly above-average passage rates in 2007 (exceptions: Northern Harrier, Crested Caracara, and Prairie Falcon; Table 1).

Regression analyses of trends in adjusted passage rates updated through 2007 (after Hoffman and Smith 2003) indicated at least marginally significant ( $P \leq 0.10$ ) linear increasing trends for Mississippi Kites (Figure 4), Cooper's Hawks (Figure 5), American Kestrels and Merlins (Figure 8), and Peregrine Falcons (Figure 9). In addition, significant second-order, or quadratic, regressions fit the data for Ospreys, Swallow-tailed Kites, White-Tailed Hawks, Zone-tailed Hawks, and Swainson's Hawks. For the first four of these species, the quadratic models tracked patterns of accelerating increase, with significant upward inflections commencing around 2002–2003 (Figures 3, 4, and 7). Somewhat the opposite pattern applied to Swainson's Hawks; the quadratic model tracked a hill-shaped pattern with an inflection point centered on 2002–2003 (Figure 6). All remaining species showed no significant ( $P \leq 0.10$ ) long-term trends.

Smith et al. (2008a) present trend analyses of data collected through 2005 for four long-term, on-going, autumn migration studies around the Gulf of Mexico, including this Corpus Christi project for the first time. These analyses (hereafter called the Raptor Population Index or "RPI" analyses; see <http://www.rpi-project.org>) are based on a more sophisticated analytical approach (also see Farmer et al.



2007) than that represented in Hoffman and Smith (2003) and used herein to present analyses updated through 2007. Among other refinements, this new approach both fits polynomial trajectories to the complete series of annual count indices and allows for estimating rates of change between various periods, while also allowing for assessments of trend significance and precision. Note, however, that restrictions related to the mathematical assumptions behind the new approach precluded analyzing data for rare species, which, compared to those species analyzed herein based on the methods of Hoffman and Smith (2003), include Harris', White-tailed and Zone-tailed Hawks, Crested Caracaras, and Prairie Falcons. Otherwise, with a few notable exceptions, the overall patterns of change and derived trend estimates suggested by the new modeling technique generally yielded similar inferences as those derived using the simpler methodology of Hoffman and Smith (2003).

Differences between the RPI results and those presented herein that clearly relate to addition of two more years of data include: a) addition of two new record- or near-record-high passage rates in 2006 and 2007 resulted in significant overall increases for Swallow-tailed and Mississippi Kites, Cooper's Hawks, American Kestrels, Merlins, and Peregrine Falcons, whereas the RPI analyses revealed only non-significant increases through 2005; b) addition of a new record-high passage rate in 2006, but followed by a new record-low passage rate in 2007, rendered no significant overall trend through 2007 for Red-shouldered Hawks, whereas the RPI analysis suggested a significant decline; and c) the RPI analysis indicated a significant increase for Swainson's Hawks through 2005, but a below-average passage rate in 2005 and a near record-low passage rate in 2007 resulted in a significant second-order model fit that now tracks a declining pattern since 2004. No other noteworthy differences were apparent among the inferences generated by the RPI and updated Hoffman and Smith (2003) analyses.

### **Regional Comparisons**

Farther northeast in Texas at Smith Point on Galveston Bay, similar to the situation at Corpus Christi, the Broad-winged Hawk count (18,827) was significantly below average (53%), whereas the overall combined-species count excluding Broad-winged Hawks was above average (19%; Smith and Neal 2008). Both Texas sites tallied record high counts of Bald Eagles in 2007; the second year in a row that such occurred. Both sites also recorded the second highest counts of Sharp-shinned Hawks, but no other common new record-high counts. In contrast, both sites recorded new record-low counts of Red-shouldered Hawks in 2007. Both sites also atypically recorded multiple Ferruginous Hawks, as well as at least one Golden Eagle. Other commonalities included significantly above-average counts of Turkey Vultures, American Kestrels, and Merlins, and below-average counts of Broad-winged Hawks (significant at Smith Point, not significant at Corpus Christi). Notable differences included a higher proportion of significantly above-average counts at Corpus Christi: 10 commonly occurring and 4 rare species, compared to 4 common and 4 rare species at Smith Point. In addition, significantly above-average counts for Swallow-tailed and Mississippi Kites, Cooper's Hawks, and Peregrine Falcons at Corpus Christi contrasted with non-significantly below-average counts for these species at Smith Point. Comparing trends in passage rates over the course of the two studies (both begun in 1997), both projects show similar long-term increasing patterns for Ospreys, Mississippi and Swallow-tailed Kites, White-tailed Hawks (although for the previous three species the trends have tapered off recently at Smith Point but not at Corpus Christi), and Peregrine Falcons. Both sites were also showing significant long-term increases in Swainson's Hawks, but a three-year decline at Corpus Christi has now reduced the long-term trend there to non-significant. Otherwise, the only species that is currently showing noticeably divergent patterns at the two sites is the Cooper's Hawks: significant increase at Corpus Christi, non-significant decline at Smith Point.

In Veracruz, Mexico, along the far southwestern Gulf Coast, our partners at Pronatura Veracruz recorded an overall combined-species count (data from two count sites combined) that was 6% below the 1995–2006 average for that project (Pronatura Veracruz unpublished data). Among the four most common species, counts were 2% below average for Broad-winged Hawks, 15% below average for Turkey

Vultures, 67% above average for Mississippi Kites, and 6% above average for Swainson's Hawks. The 2007 tally also included a new record-high count of 563 Swallow-tailed Kites; however, for most other commonly observed species, the 2007 counts were well below average (e.g., -12% for Ospreys, -48% for Northern Harriers, -29% for Sharp-shinned Hawks, -15% for Cooper's Hawks, and -52% for American Kestrels).

### **Seasonal Timing**

The median passage date for Broad-winged Hawks (22 September) was a significant 4 days earlier than average in 2007 (Table 3); however, examination of the overall seasonal passage pattern confirmed that this did not reflect any overall early shift in activity, but rather only a slight shifting of peak activity both earlier and later than the average peak-activity period due to the occurrence of poor flight conditions during that time (Figure 10). Otherwise, the combined-species seasonal passage pattern with Broad-winged Hawks excluded showed two unusually high peaks in activity, one in late August corresponding to record-high passage of Mississippi Kites, and one in late October corresponding to record-high passage of Turkey Vultures (Figure 10). Overall, only 6 of 21 species for which a comparison was possible showed median passage dates in 2007 that differed significantly from the long-term averages (Table 3), with Turkey Vulture, Harris' Hawk, and White-tailed Hawk later than average, and Broad-winged Hawk, Bald Eagle, and Merlin earlier than average.

### **RESIDENT AND LOCAL RAPTOR ACTIVITY**

As usual, resident Black and Turkey Vultures were ever-present throughout the season, with maximum tallies generally hovering around 30–40 individuals of each species. A family of White-tailed Hawks resided in the count area for the eleventh consecutive year, with two juveniles present this year. Family groups of Red-shouldered Hawks (2 adults, 2 juveniles) and Harris's Hawks (2 adults, 1 juvenile) also frequented the area, and a pair of adult Red-tailed Hawks was present throughout the season and were seen copulating in early November. One adult Zone-tailed Hawk also resided in the area from at least early August through late October, which is a first for the project. An apparently local Cooper's Hawk was first noted during the first week of August, with two such birds confirmed by mid-August and again in mid-September, at which time an apparently local Sharp-shinned Hawk also was recorded. By mid-October, it appeared that two local Sharp-shinned Hawks were residing in the area, and at least two birds were still present in mid-November. At least two resident Crested Caracaras were present in the area early in the season. Three male American Kestrels moved into the area in early October, with a female first seen about week later. An adult female Northern Harrier and a single immature bird were first seen acting like locals in the area in late October. Other, apparently transient locals observed during the season included a Peregrine Falcon in early August, two adult Swainson's Hawks in late August, an Osprey seen in early September, and an immature Broad-winged Hawk in early October.

Except for the new treat of a resident Zone-tailed Hawk, this is a typical array of resident activity for the site.

### **VISITOR PARTICIPATION AND PUBLIC OUTREACH**

During the 2007 season, 523 individuals visited the project site, which is slightly below average. As usual, visitation was highest during the tenth annual *Celebration of Flight* event in late September; 321 guests visited the project site during this time. Most of the guests attended at least one of six live-raptor programs put on by the Texas State Aquarium and one or two of the talks presented by HWI Conservation Science Director, Jeff Smith. Visitors came from 21 states and 3 foreign countries, with many staying for up to 3–10 days during peak season. Outside of the *Celebration of Flight* event, local project coordinator Joel Simon gave on-site presentations to several organized groups, including 27 students representing a high school science club from Portland, Texas, a mixed-age group of 34 students from the Sacred Heart School, an ecotour group, and a field-trip group from a local bird club. Joel was

also a speaker at the HummerFest in Rockport, Texas, where 167 attended his program on hawk migration in the Texas Coastal Bend.

In 2007, 838 hourly assessments by the official observers of visitor disturbance resulted in the following ratings: >99% none, <1% low. This continued very low level of visitor disturbance experienced by the official observers is apt testimony to the benefits of having a large cadre of highly dedicated and knowledgeable local volunteers regularly available to assist with the count and facilitate visitor interactions.

## ACKNOWLEDGEMENTS

Funding for the 2007 project and *Celebration of Flight* event was provided by the U.S. Fish and Wildlife Service – Neotropical Migratory Bird Conservation Act grant program, Flint Hills Resources, Swarovski Optik, Hogan Homes, Northwest Business Association, Audubon Outdoor Club of Corpus Christi, Texas Hawking Association – Corpus Christi Chapter, and HWI private donors and members. We also extend our deepest appreciation to the Nueces County Parks and Recreation Department and their staff at Hazel Bazemore Park for providing such a magnificent place to watch hawks. With the hard work of County Commissioner Peggy Banales and HWI site coordinator Joel Simon, a world-class platform was constructed after the 2007 season at the park to support this world-class hawk watch. The new platform will be ready to enhance the project experience beginning fall 2008. Finally, thanks to all the dedicated local and visitor volunteers who assisted with the counts, on-site coordination, and public outreach, provided good company and treats, and whose interest and enthusiasm made it all worthwhile. Special thanks to Patty Beasley for her continued efforts as web master for the Texas Hawkwatch web page (<http://www.ccbirding.com>), as well as Bob Creglow. This was the ninth season in a row that Bob ranked as top volunteer of the year; in recognition of this exceptional service, during this season's *Celebration of Flight* event HWI recognized Bob with a Certificate of Appreciation for Outstanding Service and a Lifetime Membership Award. Other local volunteers who contributed mightily during the 2007 season include Linda Alley, Bill Beasley, Mike Clifford, Jo Creglow, Lynn Guerra, Margaret Haynie, Art and Barbara Olsen, Vicki Simon, Karen Smith, and Jimmy Swartz. Other out-of-towners that also contributed greatly included John Economidy, Peter Collins, Mary Hager, and Pat and Tony Makris.

## LITERATURE CITED

- Bildstein, K. L. 2001. Why migratory birds of prey make great biological indicators. Pages 169–179 in K. L. Bildstein and D. Klem (Editors). *Hawkwatching in the Americas*. Hawk Migration Association of North America, North Wales, Pennsylvania, USA.
- Bildstein, K. L., J. P. Smith, and E. Ruelas-Inzunza (Editors). 2008. *The state of North America's birds of prey*. Series in Ornithology No. 3. American Ornithologists' Union, Washington, DC, and Nuttall Ornithological Club, Cambridge, Massachusetts, USA.
- Farmer, C. J., D. J. T. Hussell, and D. Mizrahi. 2007. Detecting population trends in migratory birds of prey. *Auk* 124:1047–1062.
- Hoffman, S. W., and J. P. Smith. 2003. Population trends of migratory raptors in western North America, 1977–2001. *Condor* 105:397–419.
- Rappole, J. H., and G. W. Blacklock. 1985. *Birds of the Texas coastal bend*. Texas A & M University Press, College Station, Texas, USA.
- Smith, J. P., C. J. Farmer, S. W. Hoffman, C. A. Lott, L. J. Goodrich, J. Simon, C. Riley, and E. Ruelas Inzunza. 2008a. Trends in autumn counts of migratory raptors around the Gulf of Mexico, 1995–2005. In K. L. Bildstein, J. P. Smith, and E. Ruelas-Inzunza (Editors), *The state of North America's*

birds of prey. Series in Ornithology No. 3. American Ornithologists' Union, Washington, DC, and Nuttall Ornithological Club, Cambridge, Massachusetts, USA.

- Smith, J. P., C. J. Farmer, S. W. Hoffman, G. S. Kaltenecker, K. Z. Woodruff, and P. Sherrington. 2008b. Trends in autumn counts of migratory raptors in western North America, 1983–2005. *In* K. L. Bildstein, J. P. Smith, and E. Ruelas-Inzunza (Editors), *The state of North America's birds of prey*. Series in Ornithology No. 3. American Ornithologists' Union, Washington, DC, and Nuttall Ornithological Club, Cambridge, Massachusetts, USA.
- Smith, J. P., and M. C. Neal. 2008. Fall 2007 raptor migration study at Smith Point, Texas. HawkWatch International, Salt Lake City, Utah, and Gulf Coast Bird Observatory, Lake Jackson, Texas, USA. 30 pp.
- Smith, J. P., J. Simon, S. W. Hoffman, and C. Riley. 2001. New full-season autumn hawkwatches in coastal Texas. Pages 67–91 *in* K. L. Bildstein and D. Klem, editors. *Hawkwatching in the Americas*. Hawk Migration Association of North America, North Wales, Pennsylvania, USA.
- Zalles, J. I., and K. L. Bildstein (Editors). 2000. *Raptor watch: a global directory of raptor migration sites*. BirdLife Conservation Series No. 9. BirdLife International, Cambridge, United Kingdom, and Hawk Mountain Sanctuary Association, Kempton, Pennsylvania, USA.

**Table 1. Fall counts and passage rates by species for migrating raptors at Hazel Bazemore Park near Corpus Christi, Texas: 1997–2006 versus 2007.**

SPECIES	COUNTS			RAPTORS/100 HOURS		
	1997–2006 <sup>1</sup>	2007	% CHANGE	1997–2006 <sup>1</sup>	2007	% CHANGE
Black Vulture	575 ± 249.3	309	-46	119.4 ± 28.4	65.6	-45
Turkey Vulture	21,921 ± 7943	46,503	+112	8,996 ± 1,971	19,006	+111
Unidentified vulture	0.9 ± 1.8	0	-100	–	–	–
TOTAL VULTURES	22,496 ± 8047	46,812	+108	–	–	–
Osprey	176 ± 45.4	237	+35	36.9 ± 5.7	49.4	+34
Northern Harrier	200 ± 99.9	223	+12	38.6 ± 10.8	43.1	+12
Hook-billed Kite	0.1 ± 0.2	0	-100	–	–	–
Swallow-tailed Kite	35 ± 18.5	168	+381	12.5 ± 3.8	56.1	+348
White-tailed Kite	4 ± 1.8	1	-76	–	–	–
Mississippi Kite	7,346 ± 2262	27,285	+271	2,567 ± 472	9,396	+266
TOTAL KITES	7,385 ± 2278	27,454	+272	–	–	–
Sharp-shinned Hawk	1,160 ± 230	1,725	+49	356.8 ± 40.1	495.0	+39
Cooper's Hawk	754 ± 270.8	1,222	+62	200.5 ± 38.7	309.9	+55
Northern Goshawk	0.4 ± 0.4	3	+650	–	–	–
Unidentified accipiter	278 ± 50.1	217	-22	–	–	–
TOTAL ACCIPITERS	2,192 ± 429	3,167	+44	–	–	–
Common Black Hawk	0.1 ± 0.2	0	-100	–	–	–
Harris' Hawk	17 ± 7.2	7	-58	2.5 ± 0.6	1.1	-56
Red-shouldered Hawk	60 ± 17.9	15	-75	9.1 ± 1.6	2.4	-74
Broad-winged Hawk	686,539 ± 152384	569,839	-17	387,823 ± 52,620	311,585	-20
Short-tailed Hawk	0.9 ± 0.8	1	+11	–	–	–
Swainson's Hawk	6,155 ± 3218	412	-93	2,384 ± 726.9	127.6	-95
White-tailed Hawk	12 ± 7.5	33	+170	1.8 ± 0.6	4.5	+150
Zone-tailed Hawk	4 ± 2.2	22	+495	0.5 ± 0.2	3.0	+467
Red-tailed Hawk	187 ± 53.8	122	-35	28.7 ± 4.7	18.9	-34
Ferruginous Hawk	4 ± 2.7	3	-14	–	–	–
Rough-legged Hawk	0.5 ± 0.8	0	-100	–	–	–
Unidentified buteo	101 ± 67.6	67	-33	–	–	–
TOTAL BUTEOS	693,079 ± 154235	570,521	-18	–	–	–
Golden Eagle	1.5 ± 0.7	1	-33	–	–	–
Bald Eagle	2 ± 1.1	7	+218	–	–	–
Unidentified eagle	0.1 ± 0.2	0	-100	–	–	–
TOTAL EAGLES	4 ± 1.7	8	+111	–	–	–
Crested Caracara	12 ± 4.8	13	+8	1.8 ± 0.4	1.9	+3
American Kestrel	557 ± 180.4	850	+53	148.9 ± 27.9	219.2	+47
Merlin	34 ± 7.2	82	+143	8.6 ± 1.3	20.5	+138
Prairie Falcon	9 ± 5.7	7	-25	2.6 ± 1.0	2.0	-24
Peregrine Falcon	169 ± 47.0	247	+46	40.8 ± 6.3	55.2	+35
Aplomado Falcon	0.4 ± 0.3	4	+900	–	–	–
Unknown small falcon	2 ± 1.2	6	+275	–	–	–
Unknown large falcon	2 ± 1.9	9	+463	–	–	–
Unidentified falcon	37 ± 21.5	2	-95	–	–	–
TOTAL FALCONS	809 ± 220.2	1,207	+49	–	–	–
Unidentified raptor	1,030 ± 1025	120	-88	–	–	–
GRAND TOTAL	727,383 ± 149033	649,762	-11	–	–	–

<sup>1</sup> 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 2007, with a comparison of 2007 and 1997–2006 average median passage dates.**

SPECIES	2007				1997–2006	
	FIRST OBSERVED	LAST OBSERVED	BULK PASSAGE DATES <sup>1</sup>	MEDIAN PASSAGE DATE <sup>2</sup>	MEDIAN PASSAGE DATE <sup>2,3</sup>	
Black Vulture	24-Sep	14-Nov	6-Oct – 8-Nov	1-Nov	28-Oct	± 6.0
Turkey Vulture	31-Aug	15-Nov	23-Oct – 26-Oct	25-Oct	21-Oct	± 3.7
Osprey	9-Aug	8-Nov	13-Sep – 13-Oct	28-Sep	28-Sep	± 1.8
Northern Harrier	25-Aug	15-Nov	28-Sep – 2-Nov	11-Oct	10-Oct	± 5.7
Swallow-tailed Kite	4-Aug	3-Oct	13-Aug – 8-Sep	24-Aug	24-Aug	± 2.9
White-tailed Kite	1-Oct	1-Oct	–	–	03-Oct	± 4.9
Mississippi Kite	1-Aug	13-Oct	15-Aug – 8-Sep	31-Aug	29-Aug	± 3.4
Sharp-shinned Hawk	15-Sep	14-Nov	27-Sep – 26-Oct	6-Oct	09-Oct	± 3.7
Cooper's Hawk	2-Aug	15-Nov	22-Sep – 25-Oct	6-Oct	08-Oct	± 3.7
Northern Goshawk	31-Oct	13-Nov	–	–	–	–
Harris' Hawk	6-Sep	9-Nov	6-Sep – 9-Nov	16-Oct	03-Oct	± 7.8
Red-shouldered Hawk	28-Aug	4-Nov	28-Aug – 19-Oct	27-Sep	04-Oct	± 8.0
Broad-winged Hawk	10-Aug	15-Nov	20-Sep – 5-Oct	22-Sep	26-Sep	± 1.7
Short-tailed Hawk	25-Sep	25-Sep	–	–	–	–
Swainson's Hawk	2-Aug	14-Nov	21-Sep – 23-Oct	8-Oct	09-Oct	± 3.6
White-tailed Hawk	2-Aug	14-Nov	24-Aug – 9-Nov	13-Oct	01-Oct	± 10.3
Zone-tailed Hawk	4-Aug	6-Nov	23-Aug – 24-Oct	29-Sep	29-Sep	± 7.0
Red-tailed Hawk	7-Aug	15-Nov	16-Sep – 13-Nov	20-Oct	19-Oct	± 7.5
Ferruginous Hawk	3-Oct	8-Nov	–	–	12-Oct	± 11.6
Golden Eagle	15-Nov	15-Nov	–	–	–	–
Bald Eagle	3-Oct	29-Oct	3-Oct – 29-Oct	11-Oct	20-Oct	± 0.0
Crested Caracara	24-Aug	15-Nov	23-Sep – 8-Nov	18-Oct	14-Oct	± 8.7
American Kestrel	1-Sep	9-Nov	21-Sep – 11-Oct	2-Oct	04-Oct	± 2.8
Merlin	1-Sep	31-Oct	15-Sep – 5-Oct	27-Sep	01-Oct	± 3.5
Prairie Falcon	16-Sep	19-Oct	16-Sep – 19-Oct	4-Oct	01-Oct	± 5.2
Peregrine Falcon	2-Aug	11-Nov	19-Sep – 12-Oct	30-Sep	30-Sep	± 1.7
Aplomado Falcon	23-Sep	19-Oct	–	–	–	–
ALL SPECIES	1-Aug	15-Nov	19-Sep – 10-Oct	23-Sep	26-Sep	± 1.7

<sup>1</sup> Dates between which the central 80% of the flight passed the lookout.

<sup>2</sup> Date by which 50% of the flight had passed the lookout.

<sup>3</sup> 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.

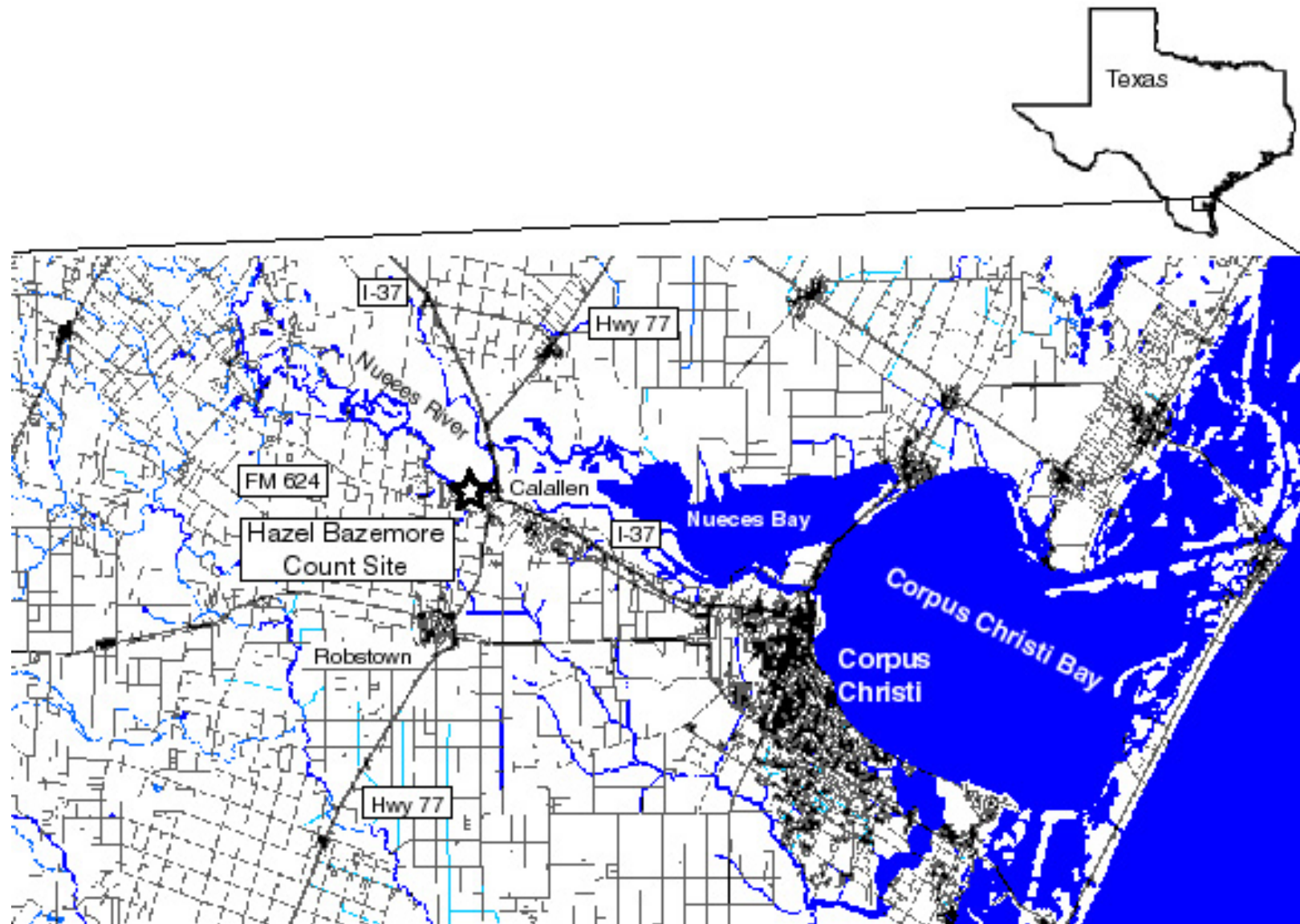
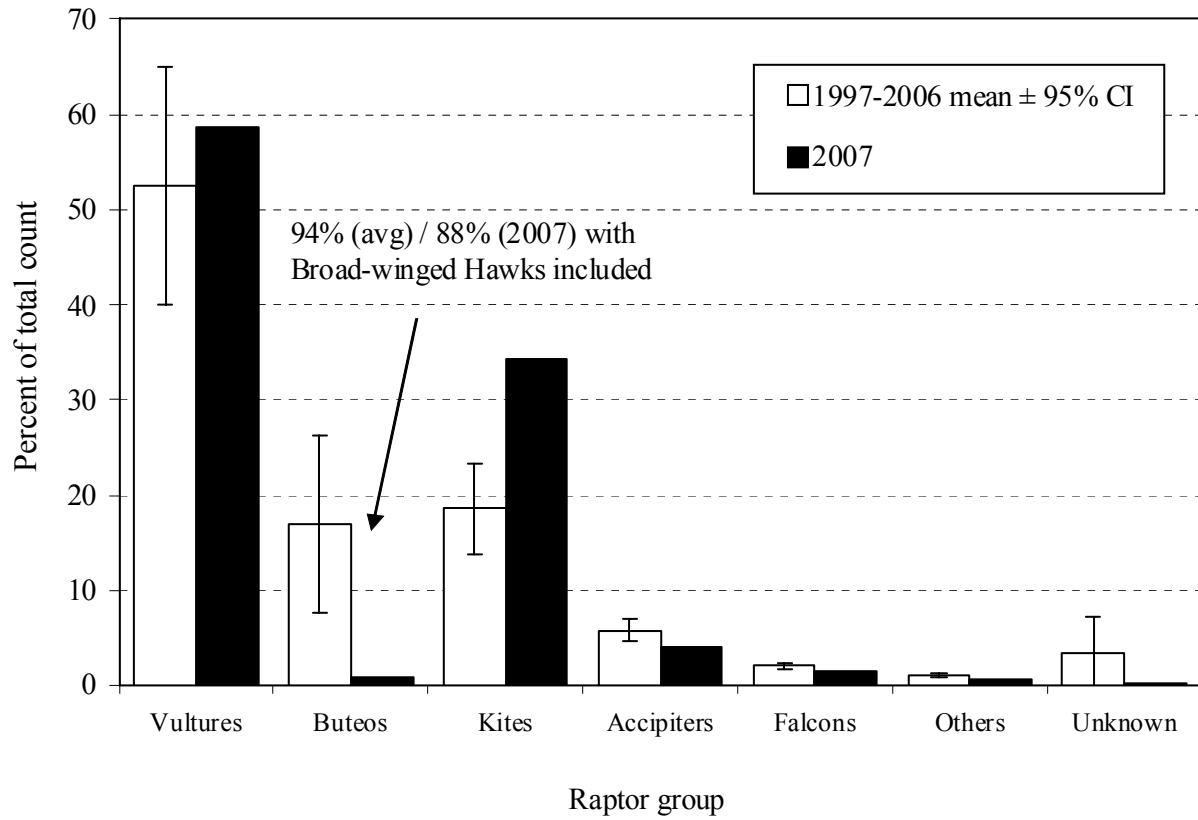
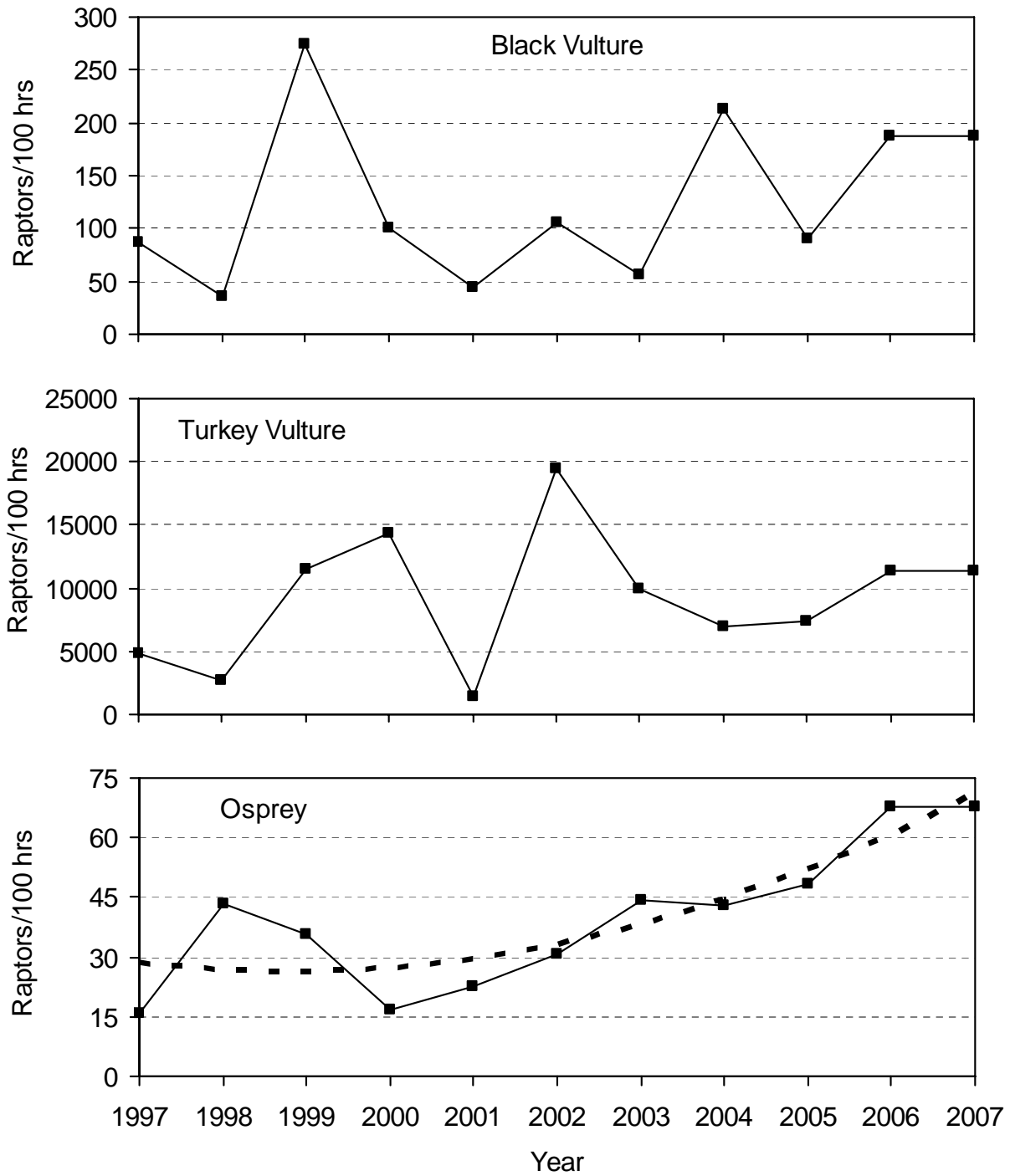


Figure 1. Location of Hazel Bazemore County Park count site near Corpus Christi, Texas.

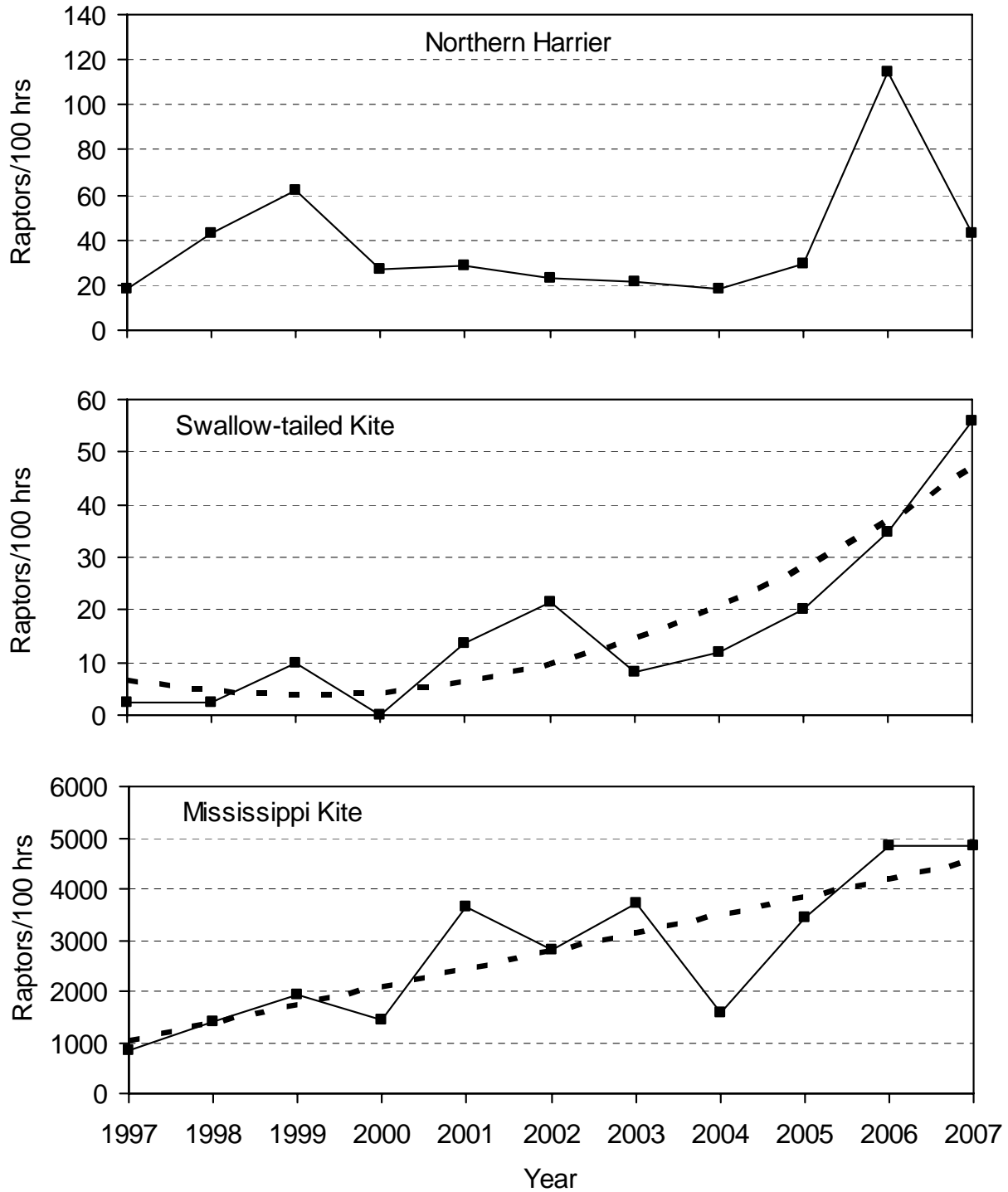


**Figure 2. Composition of the fall raptor migration by species groups at Hazel Bazemore Park near Corpus Christi, Texas: 1997–2006 versus 2007.**

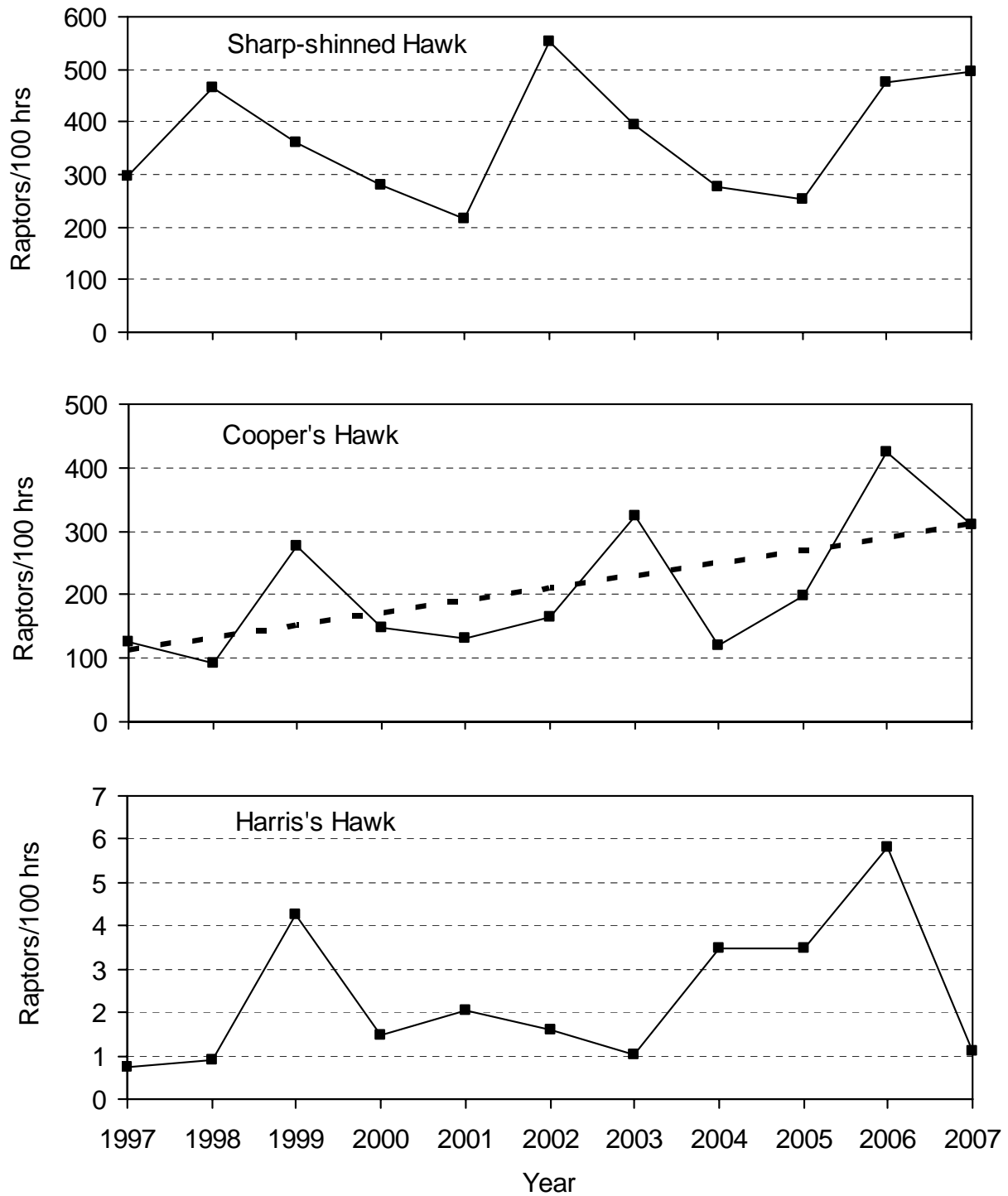




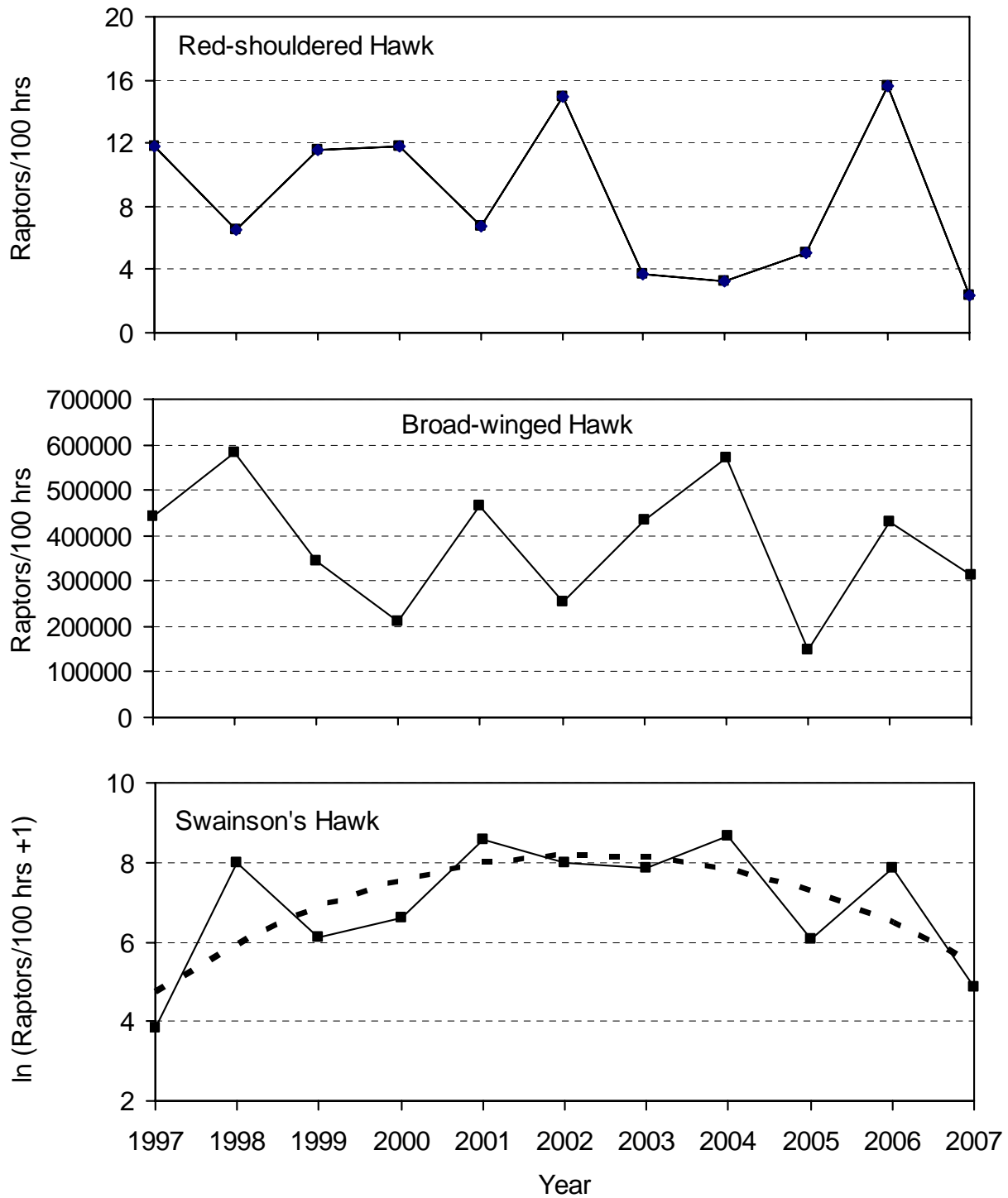
**Figure 3. Adjusted fall-migration passage rates at Hazel Bazemore Park near Corpus Christi, Texas for Black Vultures, Turkey Vultures, and Ospreys: 1997–2007. Dashed lines indicate significant ( $P \leq 0.10$ ) linear or quadratic regressions.**



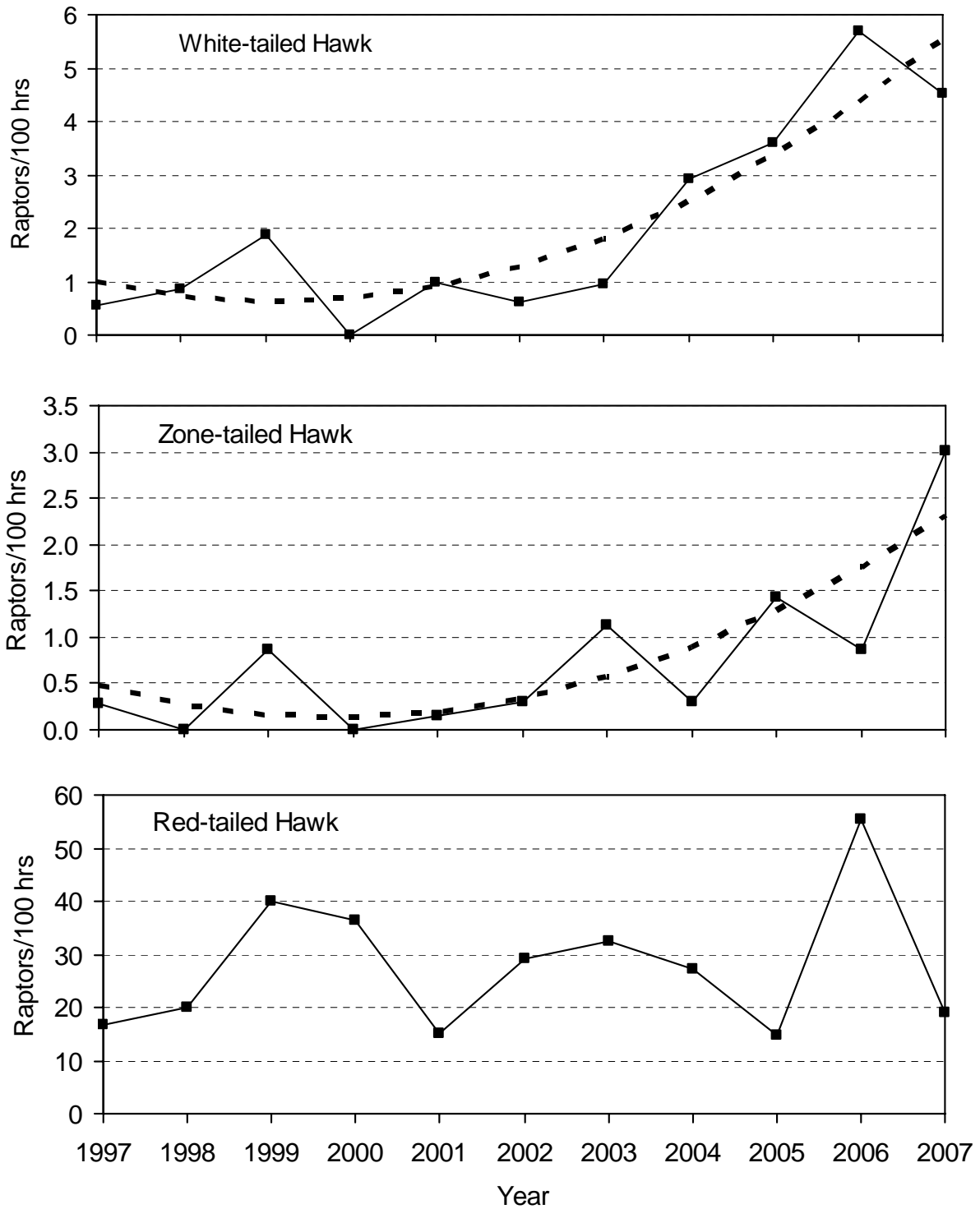
**Figure 4. Adjusted fall-migration passage rates at Hazel Bazemore Park near Corpus Christi, Texas for Northern Harriers, Swallow-tailed Kites, and Mississippi Kites: 1997–2007. Dashed lines indicate significant ( $P \leq 0.10$ ) linear or quadratic regressions.**



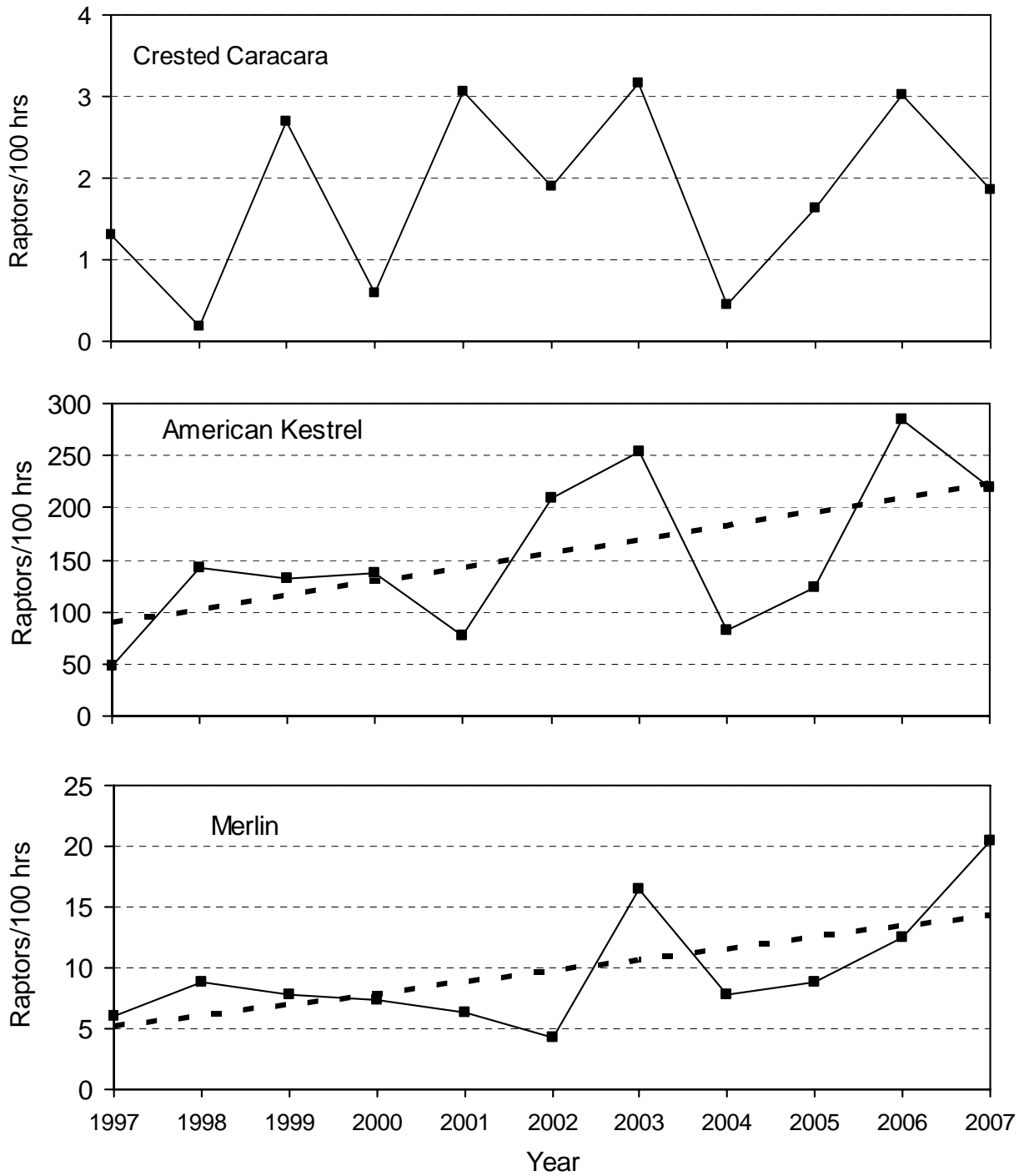
**Figure 5. Adjusted fall-migration passage rates at Hazel Bazemore Park near Corpus Christi, Texas for Sharp-shinned, Cooper's, and Harris's Hawks: 1997–2007. Dashed lines indicate significant ( $P \leq 0.10$ ) linear or quadratic regressions.**



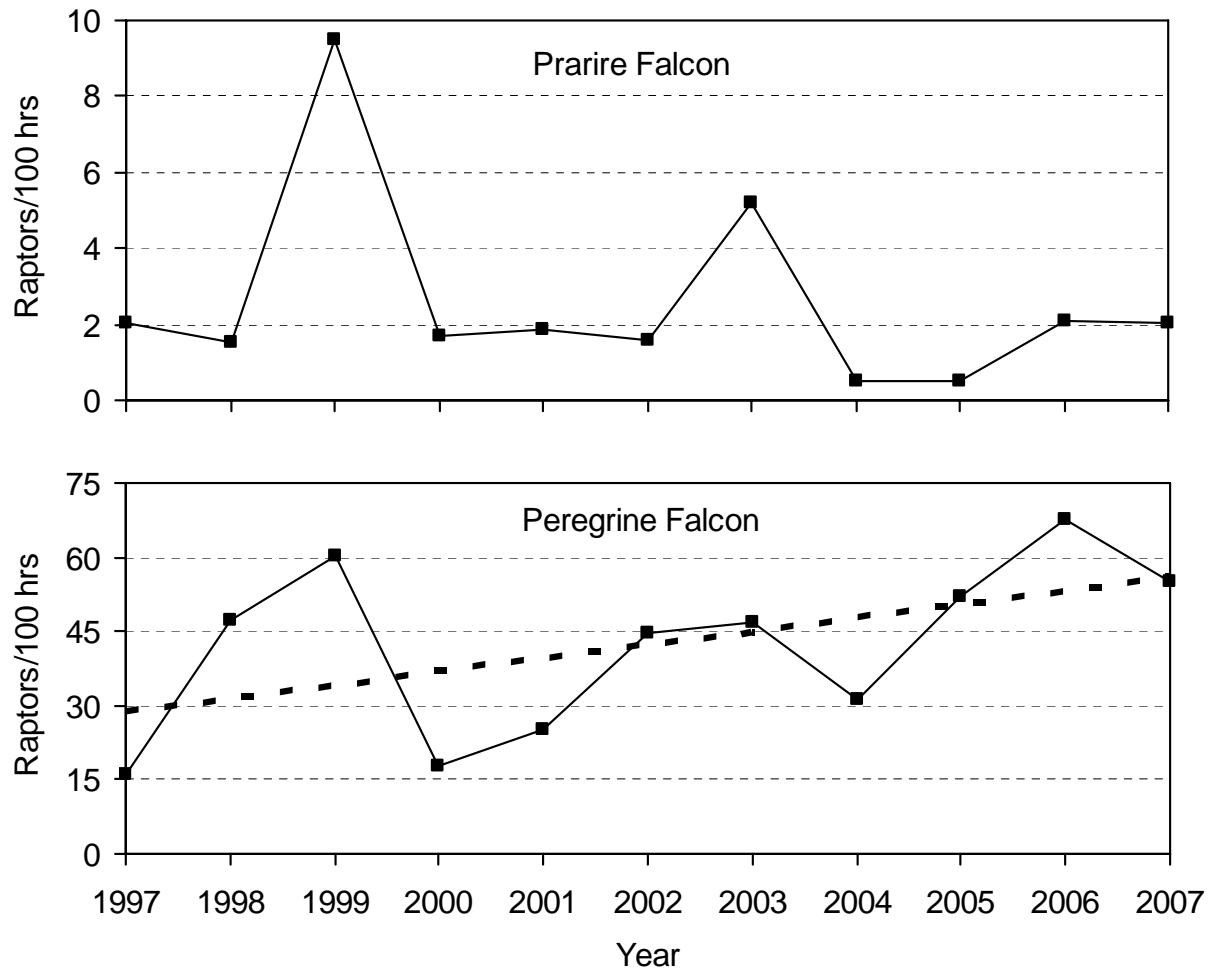
**Figure 6. Adjusted fall-migration passage rates at Hazel Bazemore Park near Corpus Christi, Texas for Red-shouldered, Broad-winged, and Swainson’s Hawks: 1997–2007. Dashed lines indicate significant ( $P \leq 0.10$ ) linear or quadratic regressions.**



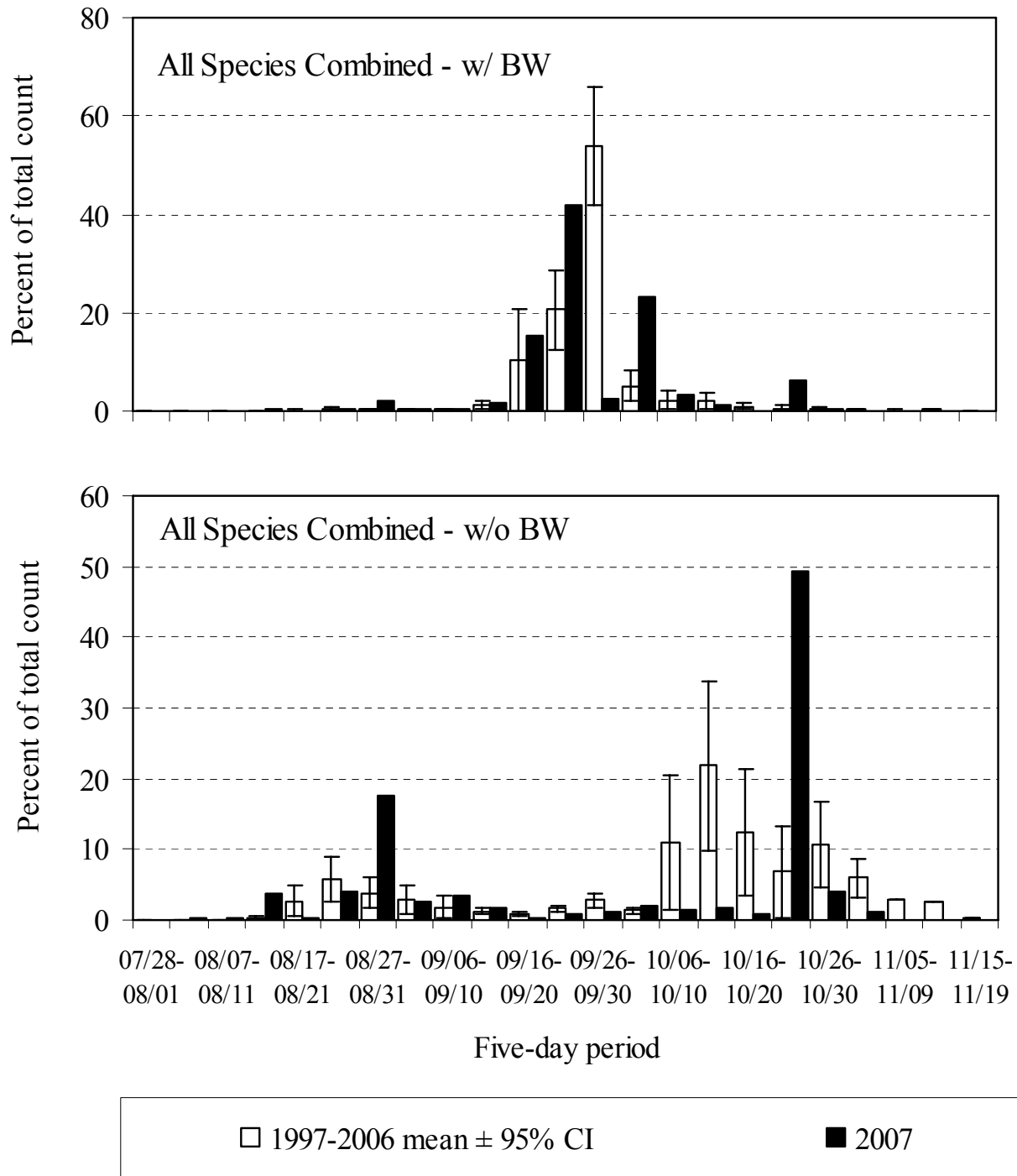
**Figure 7. Adjusted fall-migration passage rates at Hazel Bazemore Park near Corpus Christi, Texas for White-tailed, Zone-tailed, and Red-tailed and Hawks: 1997–2007. Dashed lines indicate significant ( $P \leq 0.10$ ) linear or quadratic regressions.**



**Figure 8. Adjusted fall-migration passage rates at Hazel Bazemore Park near Corpus Christi, Texas for Crested Caracaras, American Kestrels, and Merlins: 1997–2007. 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: 1997–2007. 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: 1997–2006 versus 2007.**



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

Common Name	Scientific Name	Species Code	Age <sup>1</sup>	Sex <sup>2</sup>	Color Morph <sup>3</sup>
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 <sup>4</sup>	U	NA
Bald Eagle	<i>Haliaeetus leucocephalus</i>	BE	A S2 S1 I NA U <sup>5</sup>	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

<sup>1</sup> A = adult, I = immature (HY), Br = brown (adult female or immature), U = unknown age.

<sup>2</sup> M = male, F = female, U = unknown.

<sup>3</sup> D = dark or rufous, L = light, U – unknown, NA = not applicable.

<sup>4</sup> 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.

<sup>5</sup> 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: 1997–2007.**

**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.

---

<sup>1</sup> 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: 2007.**

DATE	OBS. HOURS	NUMBER OBSRVRS <sup>1</sup>	VISITOR DISTURB <sup>2</sup>	SKY CONDITION <sup>3</sup>	WIND SPEED (KPH) <sup>1</sup>	WIND DIRECTION	TEMP. (°C) <sup>1</sup>	BARO. PRESS. (IN HG) <sup>1</sup>	MEDIAN THERMAL LIFT <sup>4</sup>	VISIB. EAST (KM) <sup>1</sup>	VISIB. WEST (KM) <sup>1</sup>	FLIGHT DIST. <sup>5</sup>	RAPTORS / HOUR
01-Aug	8.00	3.6	0	mc-ovc, haze	4.8	e, ssw	32.2	29.90	3	7	8	2	1.1
02-Aug	8.00	1.3	0	pc-ovc, PM rain	2.8	e, ssw	32.1	29.91	3	7	9	2	13.0
03-Aug	8.00	1.5	0	mc-ovc, AM haze	2.0	calm/var	31.1	29.98	4	3	6	2	0.9
04-Aug	8.25	2.1	0	mc-ovc, haze	3.1	se	31.9	30.03	3	5	7	1	1.5
05-Aug	8.00	3.8	0	mc-ovc, AM haze	4.2	se, s	32.8	30.02	3	8	12	2	0.4
06-Aug	8.00	1.3	0	pc-mc	4.3	se	32.9	30.00	2	11	12	3	2.0
07-Aug	8.00	1.6	0	pc-mc, haze	5.0	sse	33.0	29.99	2	6	8	2	0.4
08-Aug	8.00	1.8	0	clr-pc, haze	5.3	se, s	33.4	29.98	2	6	7	3	0.1
09-Aug	9.00	1.6	0	clr-mc, haze	3.4	e, se, s	32.9	30.01	1	7	8	2	8.1
10-Aug	8.25	1.8	0	pc-mc, haze	3.9	calm/var	33.1	30.00	2	6	7	3	6.5
11-Aug	8.00	3.6	0	clr-mc, haze	3.2	calm, ne, e	33.0	30.01	2	3	4	3	21.1
12-Aug	8.00	4.8	0	mc-ovc, haze	1.7	calm/var	33.3	30.06	2	2	4	2	169.0
13-Aug	8.00	3.4	0	clr-pc, AM haze	3.3	nne, e	34.0	29.98	1	7	9	3	18.3
14-Aug	9.50	2.3	0	clr-ovc, haze	3.7	calm/var	31.8	29.95	3	2	2	1	0.1
15-Aug	8.00	3.7	0	ovc, haze	4.1	calm/var	32.2	29.90	3	2	3	2	182.1
16-Aug	6.50	2.9	0	mc-ovc, haze, scat rain	2.0	calm, e, sw	30.6	29.84	4	7	9	2	0.8
17-Aug	8.00	3.3	0	pc-ovc, AM haze, PM ts	3.8	se, s	32.2	29.96	4	4	6	2	0.1
18-Aug	8.00	4.4	0	pc-mc, haze	6.1	e, se	32.9	29.99	2	8	8	2	0.5
19-Aug	8.00	3.7	0	pc-mc, haze	4.8	se	33.0	29.89	3	6	7	2	0.4
20-Aug	8.00	1.9	0	mc-ovc, haze, scat rain	6.0	calm, ese	31.7	29.85	3	7	8	2	1.3
21-Aug	7.50	3.8	0	pc-ovc, haze	5.6	ese	31.8	29.89	3	5	7	2	17.2
22-Aug	6.00	3.3	0	ovc, haze	8.7	e	32.3	29.91	4	4	4	2	7.2
23-Aug	8.00	3.3	0	pc-ovc, haze	5.7	ese	32.7	29.89	3	3	5	2	67.1
24-Aug	8.00	3.3	0	clr-mc, haze	4.7	calm, e, se	32.4	30.74	2	9	9	2	173.6
25-Aug	7.50	3.4	0	clr-ovc, haze	1.3	calm, ne	31.6	30.95	3	5	7	2	154.1
26-Aug	8.00	4.6	0	ovc, haze, scat rain	5.6	calm, ne, e	30.4	29.88	3	6	5	2	23.8
27-Aug	2.25	2.0	0	pc-ovc, haze, scat rain	3.0	e	29.3	29.90	4	3	6	-	0.0
28-Aug	6.00	3.2	0	pc-ovc, AM haze, PM rain	1.9	calm-var	31.6	29.92	2	8	9	3	243.0
29-Aug	3.75	2.8	0	ovc, AM haze, PM rain/fog	3.5	calm, se, nw	29.3	29.98	4	2	3	2	0.8
30-Aug	8.00	3.1	0	ovc, AM fog, PM haze/ts	4.9	se, nw	29.7	29.99	4	4	5	2	55.4
31-Aug	7.00	3.7	0	clr-ovc, AM haze, PM rain	2.9	calm/var	30.8	29.91	2	7	10	3	1756.9
01-Sep	8.00	4.9	0	ovc, AM fog, PM haze	2.6	ne, e	28.8	29.90	3	1	2	2	193.3
02-Sep	6.50	3.3	0	ovc, AM fog, PM scat rain	1.5	calm, e, nw	29.3	29.96	4	5	4	3	64.3
03-Sep	0.00			Weather Day									
04-Sep	8.00	2.9	0	ovc, AM haze, PM scat rain	3.3	calm, se	31.7	29.88	4	6	7	2	53.9
05-Sep	8.00	3.0	0	mc-ovc, haze	6.9	ssw	31.6	29.82	3	6	6	2	20.5
06-Sep	8.00	3.1	0	pc-ovc, haze	6.1	sse	31.9	29.87	3	7	8	2	17.5
07-Sep	8.00	3.4	0	pc-mc, haze	2.2	se, s	33.6	29.89	2	7	11	3	108.9
08-Sep	7.25	3.9	0	mc-ovc, haze, PM scat rain	2.9	e, ssw	31.7	29.85	2	5	6	2	232.6
09-Sep	8.25	4.4	0	mc-ovc, haze, scat rain	3.3	calm, ne, e	29.4	29.87	4	5	6	2	18.8
10-Sep	7.75	2.4	0	pc-mc, AM fog	3.2	e	32.1	29.80	2	10	10	3	22.8
11-Sep	8.00	2.7	0	clr-mc, haze	7.2	nne, ne	31.1	29.89	2	5	8	3	65.0
12-Sep	8.50	2.9	0	mc-ovc, AM fog, haze	7.9	nsw	29.9	29.87	3	3	4	2	110.4
13-Sep	8.25	3.2	0	clr-ovc, AM fog, haze	1.6	calm, ne	31.3	29.87	2	3	3	3	298.7
14-Sep	9.00	3.3	0	clr-mc, haze	5.4	calm/var	31.7	29.93	2	9	11	2	367.4
15-Sep	6.50	3.2	0	clr-ovc, AM fog, haze, PM ts	8.4	ne	30.3	30.04	3	4	7	3	346.2
16-Sep	7.75	5.2	0	mc-ovc, AM fog, haze	6.4	ne	29.3	30.01	2	5	7	2	1101.0
17-Sep	8.00	2.8	0	pc-mc, AM haze	11.2	ne, e	30.8	29.93	4	8	9	2	294.4
18-Sep	6.00	2.7	0	pc-ovc, AM haze, PM rain/ts	4.3	var	30.1	29.90	2	8	9	2	804.2
19-Sep	7.75	3.1	0	pc-ovc, AM rain/ts, haze	4.4	ne, e, s	30.7	29.92	3	4	6	3	2991.4
20-Sep	9.50	5.0	0	clr-mc, haze	5.0	ne, e	29.3	29.90	1	9	8	2	6276.7
21-Sep	8.50	5.2	0	clr-mc, AM fog, haze	2.4	calm, ne, e	30.4	29.86	1	5	6	3	10107.4
22-Sep	9.00	10.1	0	clr-pc, AM fog/haze	2.3	calm/var	29.2	29.88	1	7	8	3	10803.1
23-Sep	8.00	10.8	0	clr-pc, AM fog	4.0	calm, ne, e	28.4	29.88	2	7	8	3	7810.0
24-Sep	8.50	8.7	0	clr-pc, haze	2.8	calm, ne, e	29.9	29.89	1	7	10	3	2859.1
25-Sep	8.00	10.1	0	clr-mc, AM haze	4.7	n, e	30.1	29.89	2	10	10	3	108.5
26-Sep	9.00	10.7	0	clr-pc, AM fog, haze	3.1	ne	31.1	29.88	2	10	12	3	764.7
27-Sep	9.50	10.5	0	clr-mc, AM fog, haze	5.0	calm/var	30.2	29.86	1	10	9	2	844.9
28-Sep	8.25	12.7	0	clr-ovc, haze, scat rain	6.8	ene	29.3	29.94	4	6	8	3	52.1
29-Sep	2.50	11.7	0	ovc, haze/rain	1.7	ene	27.0	29.98	4	2	4	2	6.8
30-Sep	8.00	15.8	0	ovc, PM scat rain	2.9	calm, se, s	29.7	30.02	3	6	9	2	76.0

Appendix C. continued

DATE	OBS. HOURS	NUMBER OBSRVRS <sup>1</sup>	VISITOR DISTURB <sup>2</sup>	SKY CONDITION <sup>3</sup>	WIND SPEED (KPH) <sup>1</sup>	WIND DIRECTION	TEMP. (°C) <sup>1</sup>	BARO. PRESS. (IN HG) <sup>1</sup>	MEDIAN THERMAL LIFT <sup>4</sup>	VISIB. EAST (KM) <sup>1</sup>	VISIB. WEST (KM) <sup>1</sup>	FLIGHT DIST. <sup>5</sup>	RAPTORS / HOUR
01-Oct	8.50	6.2	0	pc-ovc, AM scat rain, haze	3.0	calm, ene	28.8	30.06	3	5	6	2	1038.7
02-Oct	9.00	6.8	0	clr-pc, haze	2.6	calm, e, s	29.8	29.93	2	7	10	3	4242.1
03-Oct	8.50	5.6	0	pc, haze	3.2	ne	28.3	29.84	1	10	10	2	4048.0
04-Oct	8.00	4.7	0	clr-pc, AM fog/haze	3.1	n, e	28.6	29.79	3	10	10	2	4364.8
05-Oct	8.50	3.6	0	clr-ovc, haze	2.2	calm, e	29.2	29.81	2	4	6	3	4006.4
06-Oct	7.50	4.9	0	clr-pc, AM haze	2.8	e, s	29.5	29.80	2	11	12	3	173.2
07-Oct	8.00	5.1	0	clr-pc, AM haze	2.4	e	29.7	29.77	2	9	10	3	57.1
08-Oct	4.50	2.0	0	pc-ovc, AM haze, PM rain/ts	4.0	ne	28.5	29.84	4	4	5	3	13.1
09-Oct	7.50	3.8	0	clr-mc, haze, PM rain	8.4	n, ne	28.3	29.94	2	8	8	2	1024.9
10-Oct	7.50	4.4	0	mc-ovc, AM fog	5.6	ne, e	28.0	29.93	3	6	7	2	1757.5
11-Oct	8.50	3.7	0	clr-pc, haze	2.8	ene	29.7	29.83	1	7	9	3	751.4
12-Oct	7.50	3.6	0	clr-pc	8.3	ne, e	27.3	29.85	2	13	14	2	164.5
13-Oct	8.00	3.4	0	clr-pc, haze	3.9	e, se, s	30.1	29.70	2	8	12	3	13.8
14-Oct	7.50	3.6	0	clr-ovc, haze, scat rain	6.1	s	31.1	29.71	4	7	9	2	60.1
15-Oct	7.50	2.9	0	clr-ovc	7.9	s, ssw	29.0	29.66	3	10	11	2	18.9
16-Oct	7.50	2.0	0	pc-mc, haze	8.1	ne, e, nw	28.4	29.74	3	6	6	2	17.7
17-Oct	7.50	2.6	0	clr, haze	6.6	s, wsw	31.1	29.58	3	6	8	3	16.8
18-Oct	7.75	3.2	0	mc, haze	7.0	ssw	30.6	29.61	2	5	6	3	35.9
19-Oct	7.50	3.8	0	clr	6.5	ne	26.4	29.84	2	15	15	2	27.5
20-Oct	7.50	3.1	0	clr, haze	4.3	se	29.4	29.89	2	9	11	2	12.7
21-Oct	7.50	3.4	0	pc-ovc, haze	5.9	e, sse	26.5	29.77	3	7	9	2	25.3
22-Oct	6.25	2.5	0	pc-ovc, AM rain, PM haze	14.6	nnw	18.9	30.07	4	10	11	3	197.6
23-Oct	7.50	2.8	0	clr-pc	11.5	nw	19.9	30.22	2	15	15	2	294.1
24-Oct	8.00	3.2	0	clr	10.1	nw	22.6	30.02	2	15	15	3	1627.5
25-Oct	8.50	4.1	0	clr	8.7	nw	21.0	29.96	2	15	15	3	2696.6
26-Oct	8.00	3.2	0	clr, AM haze	4.4	ne, e, nw	22.4	29.99	2	14	15	2	337.5
27-Oct	7.50	2.5	0	clr	8.1	ne, nw	23.5	30.23	4	13	13	2	11.2
28-Oct	7.50	3.1	0	clr, haze	6.4	nne	21.1	30.34	3	6	7	2	28.9
29-Oct	7.50	2.1	0	clr, haze	7.4	nne, nnw	22.1	30.28	2	11	11	3	17.1
30-Oct	7.50	2.6	0	clr, haze	4.3	ne, nnw	21.9	30.15	2	6	7	3	18.9
31-Oct	7.00	2.1	0	clr, AM fog, haze	2.4	calm, ne, e	23.5	30.03	3	5	5	3	40.1
01-Nov	6.50	2.8	0	clr, haze	4.0	nne, nnw	23.6	30.05	2	6	7	2	26.6
02-Nov	5.00	3.1	0	clr, haze	3.3	ne, e	26.7	30.01	3	5	5	3	32.6
03-Nov	7.50	4.6	0	mc-ovc, AM fog, haze	4.5	nne, e	24.3	30.15	2	6	8	2	27.9
04-Nov	7.00	2.5	0	clr-mc, haze	3.9	calm, ese	26.3	30.11	4	4	4	2	22.6
05-Nov	7.00	2.9	0	clr-pc, haze	5.5	s	29.1	29.98	2	8	8	3	35.7
06-Nov	7.50	3.2	0	mc-ovc, haze	7.4	n, ne	25.1	30.19	4	5	6	2	10.8
07-Nov	7.50	2.6	0	mc-ovc	7.6	ne, e	22.4	30.24	4	7	7	2	9.2
08-Nov	7.50	2.9	0	pc-mc, haze	3.0	calm/var	28.8	30.04	2	7	9	3	92.3
09-Nov	7.50	2.8	0	pc-mc, haze	7.6	ese	29.1	29.99	2	9	11	2	28.0
10-Nov	7.00	2.0	0	pc-ovc, haze	8.9	se	28.4	30.01	4	6	9	2	4.3
11-Nov	7.50	4.9	0	pc-ovc, haze	8.9	se	28.8	29.96	3	8	10	3	12.7
12-Nov	1.00	2.0	0	pc-ovc, scat rain	5.0	ese	27.3	30.09	4	6	7	2	9.0
13-Nov	7.00	3.1	0	pc-mc	3.1	e	29.6	30.06	3	12	13	2	48.3
14-Nov	7.50	2.5	0	clr-pc, PM haze	3.8	ese, ssw	29.7	29.94	1	12	13	3	50.0
15-Nov	7.00	4.8	0	clr-pc	11.3	nne	21.6	30.34	4	11	14	3	18.6

<sup>1</sup> Average of hourly records.

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

<sup>3</sup> 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.

<sup>4</sup> 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.

<sup>5</sup> 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: 2007.**

DATE	OBSERV.				SPECIES <sup>1</sup>																								BIRDS								
	HOURS	BV	TV	OS	NH	SK	WK	MK	SS	CH	NG	UA	HH	RS	BW	ST	SW	WT	ZT	RT	FH	UB	GE	BE	CC	AK	ML	PR	PG	AF	SF	LF	UF	TOTAL	/HOUR		
01-Aug	8.00	0	0	0	0	0	0	9	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	9
02-Aug	8.00	0	0	0	0	0	0	99	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	104
03-Aug	8.00	0	0	0	0	0	0	6	0	0	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	0	7
04-Aug	8.25	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	
05-Aug	8.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3	
06-Aug	8.00	0	0	0	0	0	0	16	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	16	
07-Aug	8.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	3	
08-Aug	8.00	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	0	0	0	0	0	0	0	1	
09-Aug	9.00	0	0	1	0	0	0	72	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	73	
10-Aug	8.25	0	0	0	0	0	0	52	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	54	
11-Aug	8.00	0	0	1	0	1	0	165	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	169	
12-Aug	8.00	0	0	0	0	4	0	1,343	0	1	0	0	0	0	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,352	
13-Aug	8.00	0	0	0	0	1	0	141	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	146	
14-Aug	9.50	0	0	0	0	0	0	0	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	0	0	1	
15-Aug	8.00	0	0	1	0	4	0	1,452	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	1,457	
16-Aug	6.50	0	0	0	0	0	0	4	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	5	
17-Aug	8.00	0	0	0	0	0	0	0	0	0	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	
18-Aug	8.00	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	4	
19-Aug	8.00	0	0	0	0	1	0	2	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	3	
20-Aug	8.00	0	0	0	0	7	0	3	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	10	
21-Aug	7.50	0	0	0	0	17	0	110	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	129	
22-Aug	6.00	0	0	0	0	4	0	39	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	43	
23-Aug	8.00	0	0	0	0	27	0	507	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	537	
24-Aug	8.00	0	0	1	0	15	0	1,366	0	0	0	0	0	0	3	0	0	2	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	1,389	
25-Aug	7.50	0	0	0	1	7	0	1,141	0	0	0	0	0	0	3	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	1,156	
26-Aug	8.00	0	0	0	0	22	0	167	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	1	190	
27-Aug	2.25	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	0	0	0	0	0	
28-Aug	6.00	0	0	0	0	4	0	1,441	0	0	0	0	0	2	8	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,458	
29-Aug	3.75	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	
30-Aug	8.00	0	0	0	1	0	0	436	0	0	0	0	0	0	5	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	443	
31-Aug	7.00	0	3	0	0	7	0	12,261	0	0	0	0	0	0	18	0	8	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	12,298	
1-Sep	8.00	0	0	0	0	6	0	1,532	0	0	0	0	0	0	4	0	0	0	1	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	1,546		
2-Sep	6.50	0	0	2	0	2	0	413	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	0	0	418	
3-Sep	0.00																																				
4-Sep	8.00	0	0	1	0	0	0	9	0	0	0	0	0	0	420	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	431	
5-Sep	8.00	0	0	0	0	0	0	162	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	164	
6-Sep	8.00	0	0	2	0	7	0	128	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	140	
7-Sep	8.00	0	0	1	0	1	0	861	0	0	0	0	0	0	3	0	3	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	871	
8-Sep	7.25	0	0	1	0	3	0	1,680	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,686	
9-Sep	8.25	0	0	2	1	4	0	122	0	0	0	0	0	0	22	0	1	1	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	155		
10-Sep	7.75	0	0	2	0	0	0	24	0	2	0	0	0	0	143	0	1	0	1	1	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	177	

Appendix D. continued

OBSERV.				SPECIES <sup>1</sup>																								BIRDS								
DATE	HOURS	BV	TV	OS	NH	SK	WK	MK	SS	CH	NG	UA	HH	RS	BW	ST	SW	WT	ZT	RT	FH	UB	GE	BE	CC	AK	ML	PR	PG	AF	SF	LF	UF	TOTAL	/HOUR	
11-Sep	8.00	0	0	1	0	0	0	376	0	3	0	0	0	0	135	0	2	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	520
12-Sep	8.50	0	0	6	1	0	0	413	0	3	0	0	0	1	486	0	1	0	0	2	0	2	0	0	0	21	1	0	1	0	0	0	0	0	0	938
13-Sep	8.25	0	0	7	2	1	0	143	0	6	0	0	0	0	2,287	0	0	0	0	1	0	2	0	0	0	10	2	0	0	0	0	0	0	0	3	2,464
14-Sep	9.00	0	0	11	0	2	0	177	0	2	0	1	0	0	3,096	0	2	0	0	1	0	1	0	0	0	13	0	0	1	0	0	0	0	0	0	3,307
15-Sep	6.50	0	0	2	2	0	0	43	4	3	0	2	0	0	2,181	0	0	0	1	0	0	0	0	0	0	4	4	0	1	0	0	0	0	0	3	2,250
16-Sep	7.75	0	0	10	1	7	0	32	3	3	0	0	0	1	8,456	0	4	1	0	1	0	0	0	0	0	7	1	1	4	0	1	0	0	0	8,533	
17-Sep	8.00	0	0	1	0	0	0	3	3	4	0	0	0	0	2,329	0	1	0	0	2	0	2	0	0	0	3	1	0	4	0	0	1	0	1	2,355	
18-Sep	6.00	0	8	2	0	0	0	2	1	1	0	0	0	0	4,806	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	4,825
19-Sep	7.75	0	1	3	0	1	0	52	10	5	0	2	0	0	23,097	0	3	0	0	0	0	0	0	0	0	2	3	0	3	0	0	0	0	0	1	23,183
20-Sep	9.50	0	13	6	1	0	0	31	10	15	0	5	1	0	59,520	0	5	0	0	2	0	2	0	0	0	9	4	0	2	0	0	0	0	0	3	59,629
21-Sep	8.50	0	8	12	0	0	0	36	33	47	0	7	0	0	85,739	0	6	0	0	1	0	0	0	0	0	15	1	0	6	0	0	0	0	0	2	85,913
22-Sep	9.00	0	4	2	1	0	0	32	11	33	0	8	0	0	97,123	0	0	1	0	0	0	1	0	0	0	8	0	0	4	0	0	0	0	0	0	97,228
23-Sep	8.00	0	0	11	1	0	0	26	12	24	0	1	0	0	62,361	0	10	0	0	0	0	1	0	0	1	18	4	0	8	2	0	0	0	0	0	62,480
24-Sep	8.50	6	9	5	1	0	0	38	11	14	0	4	0	1	24,190	0	6	0	0	0	0	1	0	0	0	6	5	0	1	0	0	1	0	3	24,302	
25-Sep	8.00	2	0	2	0	0	0	18	16	20	0	2	0	0	760	1	8	0	0	4	0	0	0	0	2	12	2	1	13	0	0	2	0	3	868	
26-Sep	9.00	0	0	8	3	0	0	27	38	41	0	7	0	2	6,696	0	7	2	0	1	0	2	0	0	18	3	0	18	0	1	2	0	0	6	6,882	
27-Sep	9.50	2	7	9	4	0	0	13	66	32	0	7	0	1	7,824	0	6	0	0	2	0	2	0	0	28	9	0	13	0	0	0	0	0	2	8,027	
28-Sep	8.25	0	0	7	13	0	0	25	58	31	0	9	0	0	181	0	2	0	0	0	0	1	0	0	0	73	7	0	17	0	0	0	0	0	6	430
29-Sep	2.50	0	0	0	0	0	0	0	8	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	5	0	0	2	0	0	0	0	0	0	0	17
30-Sep	8.00	0	20	3	3	0	0	4	53	19	0	3	0	0	417	0	6	2	2	3	0	3	0	0	0	44	2	0	20	0	0	0	0	4	608	
1-Oct	8.50	0	5	6	8	0	1	8	126	40	0	11	0	1	8,516	0	2	0	0	1	0	2	0	0	77	7	0	16	0	0	1	1	0	8,829		
2-Oct	9.00	6	27	8	12	0	0	2	93	59	0	18	0	1	37,802	0	32	0	0	6	0	4	0	0	1	69	3	0	29	1	3	0	0	3	38,179	
3-Oct	8.50	5	50	4	10	1	0	3	110	58	0	6	0	0	34,072	0	14	1	1	9	1	0	0	3	0	42	7	1	4	0	0	0	0	6	34,408	
4-Oct	8.00	1	26	4	3	0	0	6	69	43	0	8	0	0	34,674	0	9	0	1	3	0	2	0	0	55	5	2	5	0	0	0	0	0	2	34,918	
5-Oct	8.50	6	53	11	6	0	0	3	127	90	0	20	1	0	33,630	0	38	0	0	2	0	1	0	0	47	2	0	4	0	0	1	0	12	34,054		
6-Oct	7.50	3	47	20	4	0	0	5	88	52	0	8	0	0	1,020	0	10	0	0	2	0	1	0	0	29	1	0	9	0	0	0	0	0	0	1,299	
7-Oct	8.00	0	41	7	6	0	0	2	49	57	0	13	0	1	236	0	8	0	0	0	0	3	0	0	0	23	1	1	7	0	0	0	0	2	457	
8-Oct	4.50	0	0	0	1	0	0	0	12	15	0	2	0	0	14	0	2	0	1	1	0	1	0	0	3	0	0	3	0	0	0	0	0	4	59	
9-Oct	7.50	0	65	9	8	0	0	0	56	48	0	4	0	0	7,445	0	35	1	0	0	0	1	0	0	11	0	0	2	0	0	0	0	0	2	7,687	
10-Oct	7.50	8	92	8	17	0	0	0	90	71	0	3	0	0	12,766	0	49	2	0	0	0	1	0	0	67	0	0	5	0	0	0	0	2	13,181		
11-Oct	8.50	2	121	6	11	0	0	0	78	71	0	8	0	1	6,003	0	31	0	0	1	0	0	0	2	0	40	0	0	5	0	1	0	0	6	6,387	
12-Oct	7.50	0	117	7	7	0	0	0	46	41	0	6	0	0	972	0	6	0	1	1	0	0	0	0	21	2	0	3	0	0	0	0	4	1,234		
13-Oct	8.00	0	79	4	2	0	0	1	2	6	0	0	0	0	8	0	0	1	0	2	0	0	0	0	2	0	0	2	0	0	0	0	0	1	110	
14-Oct	7.50	2	434	2	1	0	0	0	1	1	0	2	0	0	2	0	2	0	0	0	0	1	0	0	0	1	0	0	2	0	0	0	0	0	451	
15-Oct	7.50	4	113	0	0	0	0	0	2	3	0	0	0	0	14	0	3	0	0	1	0	0	0	0	0	0	0	2	0	0	0	0	0	142		
16-Oct	7.50	2	40	1	5	0	0	0	27	10	0	2	1	1	28	0	0	1	1	0	0	1	0	0	6	1	0	5	0	0	0	0	1	133		
17-Oct	7.50	0	81	1	0	0	0	0	9	3	0	0	0	0	24	0	1	1	0	0	0	0	0	0	4	0	0	2	0	0	0	0	0	126		
18-Oct	7.75	8	146	1	2	0	0	0	17	17	0	2	1	0	60	0	12	1	0	2	1	2	0	0	2	1	0	0	2	0	0	0	0	1	278	
19-Oct	7.50	0	57	0	10	0	0	0	26	21	0	0	0	1	71	0	4	1	0	1	0	1	0	0	1	8	0	1	1	1	0	1	0	206		
20-Oct	7.50	0	48	2	3	0	0	0	14	7	0	6	0	0	6	0	0	0	0	3	0	0	0	0	2	3	0	0	1	0	0	0	0	95		
21-Oct	7.50	0	168	2	5	0	0	0	5	3	0	0	0	0	2	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	190		

Appendix D. continued

OBSERV.			SPECIES <sup>1</sup>																								BIRDS								
DATE	HOURS	BV	TV	OS	NH	SK	WK	MK	SS	CH	NG	UA	HH	RS	BW	ST	SW	WT	ZT	RT	FH	UB	GE	BE	CC	AK	ML	PR	PG	AF	SF	LF	UF	TOTAL	/HOUR
22-Oct	6.25	0	1,131	1	0	0	0	0	24	22	0	7	0	0	21	0	13	0	0	1	0	2	0	0	0	0	0	1	0	0	0	0	0	12	1,235
23-Oct	7.50	0	2,109	0	6	0	0	0	28	17	0	4	0	0	5	0	14	1	1	7	0	0	0	0	0	8	0	0	0	0	0	0	6	2,206	
24-Oct	8.00	40	12,820	3	6	0	0	0	41	33	0	6	0	0	42	0	2	0	1	7	0	2	0	1	0	10	1	0	0	0	0	0	5	13,020	
25-Oct	8.50	6	22,791	2	5	0	0	0	59	22	0	4	0	0	5	0	10	0	1	5	0	3	0	0	0	5	0	0	0	0	0	0	3	22,921	
26-Oct	8.00	0	2,461	1	11	0	0	0	122	40	0	4	0	0	43	0	7	1	0	1	0	2	0	0	0	5	0	0	1	0	0	1	0	2,700	
27-Oct	7.50	0	74	0	0	0	0	0	3	4	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	84	
28-Oct	7.50	0	190	0	2	0	0	0	12	3	0	1	0	0	2	0	0	1	0	1	0	2	0	0	1	2	0	0	0	0	0	0	0	217	
29-Oct	7.50	0	107	0	2	0	0	0	8	2	0	1	0	0	5	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	1	128	
30-Oct	7.50	0	133	1	0	0	0	0	1	1	0	1	0	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	142	
31-Oct	7.00	43	212	0	2	0	0	0	10	3	2	4	0	0	2	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	1	281	
1-Nov	6.50	40	122	0	2	0	0	0	0	3	0	0	0	0	0	0	0	2	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	173	
2-Nov	5.00	35	85	0	16	0	0	0	9	11	0	3	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	163	
3-Nov	7.50	18	153	0	3	0	0	0	6	15	0	1	0	0	2	0	4	1	0	2	0	4	0	0	0	0	0	0	0	0	0	0	0	209	
4-Nov	7.00	0	146	0	2	0	0	0	4	2	0	1	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	158	
5-Nov	7.00	35	201	0	0	0	0	0	2	3	0	1	0	0	0	0	3	0	0	0	0	2	0	0	0	1	0	0	2	0	0	0	0	250	
6-Nov	7.50	1	61	2	2	0	0	0	2	2	0	0	0	0	3	0	0	1	1	4	0	0	0	0	1	0	0	0	0	0	0	1	81		
7-Nov	7.50	1	60	0	1	0	0	0	1	4	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	69	
8-Nov	7.50	14	661	1	1	0	0	0	3	2	0	0	1	0	1	0	0	0	0	4	1	0	0	0	1	1	0	0	1	0	0	0	0	692	
9-Nov	7.50	4	195	0	0	0	0	0	1	1	0	0	1	0	0	0	1	3	0	0	0	0	0	0	1	0	0	1	0	0	0	0	2	210	
10-Nov	7.00	0	27	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	30	
11-Nov	7.50	4	83	0	1	0	0	0	0	1	0	0	0	0	1	0	1	1	0	2	0	0	0	0	0	0	0	1	0	0	0	0	95		
12-Nov	1.00	0	9	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	9	
13-Nov	7.00	9	307	0	1	0	0	0	2	2	1	0	0	0	6	0	1	0	0	7	0	2	0	0	0	0	0	0	0	0	0	0	0	338	
14-Nov	7.50	2	360	0	1	0	0	0	3	1	0	0	0	0	0	0	1	1	0	5	0	0	0	0	0	0	0	0	0	0	0	0	1	375	
15-Nov	7.00	0	122	0	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	3	0	0	1	0	0	0	0	0	0	0	0	0	0	130	
Total	798.75	309	46,503	237	223	168	1	27,285	1,725	1,222	3	217	7	15	569,839	1	412	33	22	122	3	67	1	7	13	850	82	7	247	4	6	9	2	120	649,762

<sup>1</sup> 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: 1997–2007.**

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	MEAN
Start date	15-Aug	15-Aug	14-Aug	15-Aug	15-Aug	15-Aug	15-Aug	15-Aug	15-Aug	15-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
Observation days	89	83	90	91	93	89	86	93	92	93	106	91
Observation hours	725.00	585.50	719.75	728.58	723.50	676.50	643.00	701.00	715.75	704.50	798.75	701.98
SPECIES												
Black Vulture	431	138	1,398	491	222	470	241	1,016	445	893	309	550
Turkey Vulture	11,221	5,011	30,027	36,690	4,870	42,536	22,900	17,750	19,090	29,115	46,503	24,156
Unidentified vulture	0	0	0	0	0	0	0	9	0	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	46,812	24,706
Osprey	81	179	181	88	114	146	199	207	241	321	237	181
Northern Harrier	93	180	331	153	162	109	100	101	157	614	223	202
Hook-billed Kite	0	0	0	0	0	0	1	0	0	0	0	0
Swallow-tailed Kite	7	6	31	0	37	57	22	34	56	99	168	47
White-tailed Kite	4	6	6	2	2	2	1	2	9	8	1	4
Mississippi Kite	2,974	3,584	5,513	4,569	10,155	8,394	9,753	4,441	10,004	14,073	27,285	9,159
TOTAL KITES	2,985	3,596	5,550	4,571	10,194	8,453	9,776	4,477	10,069	14,180	27,454	9,210
Sharp-shinned Hawk	936	1,208	1,348	929	698	1,869	1,193	892	880	1,643	1,725	1,211
Cooper's Hawk	418	260	1,092	555	473	645	1,083	483	815	1,719	1,222	797
Northern Goshawk	0	0	1	0	0	1	0	0	0	2	3	1
Unidentified accipiter	308	316	310	379	298	108	344	252	174	290	217	272
TOTAL ACCIPITERS	1,662	1,784	2,751	1,863	1,767	2,649	2,620	1,627	1,869	3,654	3,167	2,281
Common Black Hawk	0	0	0	0	0	1	0	0	0	0	0	0
Harris' Hawk	5	5	28	10	14	10	6	23	25	39	7	16
Red-shouldered Hawk	79	38	77	81	45	92	26	24	37	101	15	56
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	675,930
Short-tailed Hawk	0	0	2	0	0	0	0	1	4	2	1	1
Swainson's Hawk	300	6,790	1,246	2,085	14,260	7,912	5,633	14,751	1,347	7,225	412	5,633
White-tailed Hawk	4	5	13	0	7	4	6	19	25	39	33	14
Zone-tailed Hawk	2	0	6	0	1	2	7	2	10	7	22	5
Red-tailed Hawk	112	121	282	237	96	182	192	180	103	363	122	181
Ferruginous Hawk	1	0	14	1	1	2	1	2	5	8	3	3
Rough-legged Hawk	1	0	4	0	0	0	0	0	0	0	0	0
Unidentified buteo	18	25	62	215	368	80	71	53	34	79	67	97
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	681,937
Golden Eagle	1	0	4	1	1	1	2	1	2	2	1	1
Bald Eagle	0	2	4	0	2	1	1	3	4	5	7	3
Unidentified eagle	0	0	1	0	0	0	0	0	0	0	0	0
TOTAL EAGLES	1	2	9	1	3	2	3	4	6	7	8	4
Crested Caracara	9	1	18	4	21	12	21	3	11	20	13	12
American Kestrel	189	438	483	509	292	811	860	365	485	1,137	850	584
Merlin	25	29	34	31	26	18	57	32	36	50	82	38
Prairie Falcon	8	5	33	6	7	4	15	2	3	10	7	9
Peregrine Falcon	76	163	241	65	114	176	169	144	230	309	247	176
Aplomado Falcon	0	0	1	0	0	0	1	0	1	1	4	1
Unknown small falcon <sup>1</sup>	-	-	-	-	0	4	5	4	1	2	6	3
Unknown large falcon <sup>1</sup>	-	-	-	-	0	5	9	0	0	2	9	4
Unidentified falcon	14	39	92	103	41	25	47	11	5	15	2	33
TOTAL FALCONS	312	674	884	714	480	1,043	1,163	554	761	1,526	1,207	845
Unidentified raptor	220	4,376	3,874	506	837	98	133	89	35	135	120	948
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	720,326

<sup>1</sup> Designations used consistently for the first time in 2001.