

**FALL 2009 RAPTOR MIGRATION STUDY
NEAR CORPUS CHRISTI, TEXAS**



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



December 2009

**FALL 2009 RAPTOR MIGRATION STUDY
NEAR CORPUS CHRISTI, TEXAS**

Report prepared by:

Jeff P. Smith and Mike C. Neal

Counts conducted by:

**Libby Even, Kevin Georg, and Dane Ferrell
Assisted by Local Volunteers**

Local project coordination by:

Libby Even and Joel Simon

Community education conducted by:

Beth Hoekje

Overall project coordination by:

**HawkWatch International, Inc.
Principal Investigator: Dr. Jeff P. Smith
2240 South 900 East, Salt Lake City, UT 84106
(801) 484-6808**

December 2009

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
Seasonal Timing.....	5
Resident and Local Raptor Activity	5
Visitor Participation and Public Outreach.....	6
Acknowledgements.....	6
Literature Cited.....	7
Tables.....	8
Figures	10
Appendix A. Common and scientific names, species codes, and regularly applied age, sex, and color-morph classifications.	20
Appendix B. History of official observer participation in the Corpus Christi Raptor Migration Project: 1997–2009.....	21
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: 2009.....	22
Appendix D. Daily fall raptor migration counts by species at Hazel Bazemore Park near Corpus Christi, Texas: 2009.	24
Appendix E. Annual observation effort and fall raptor migration counts by species at Hazel Bazemore Park near Corpus Christi, Texas: 1997–2009.....	27

LIST OF TABLES

Table 1. Fall counts and passage rates by species for migrating raptors at Hazel Bazemore Park near Corpus Christi, Texas: 1997–2008 versus 2009.....	8
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 2009, with a comparison of 2009 and 1997–2008 average median passage dates.....	9

LIST OF FIGURES

Figure 1. Location of Hazel Bazemore County Park count site near Corpus Christi, Texas.....	10
Figure 2. Composition of the fall raptor migration by species groups at Hazel Bazemore Park near Corpus Christi, Texas: 1997–2008 versus 2009.....	11
Figure 3. Adjusted fall-migration passage rates at Hazel Bazemore Park near Corpus Christi, Texas for Black Vultures, Turkey Vultures, and Ospreys: 1997–2009. Dashed lines indicate significant ($P \leq 0.10$) linear or quadratic regressions.	12
Figure 4. Adjusted fall-migration passage rates at Hazel Bazemore Park near Corpus Christi, Texas for Northern Harriers, Swallow-tailed Kites, and Mississippi Kites: 1997–2009. Dashed lines indicate significant ($P \leq 0.10$) linear or quadratic regressions.	13
Figure 5. Adjusted fall-migration passage rates at Hazel Bazemore Park near Corpus Christi, Texas for Sharp-shinned, Cooper’s, and Harris’s Hawks: 1997–2009. Dashed lines indicate significant ($P \leq 0.10$) linear or quadratic regressions.	14
Figure 6. Adjusted fall-migration passage rates at Hazel Bazemore Park near Corpus Christi, Texas for Red-shouldered, Broad-winged, and Swainson’s Hawks: 1997–2009. Dashed lines indicate significant ($P \leq 0.10$) linear or quadratic regressions.	15
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: 1997–2009. Dashed lines indicate significant ($P \leq 0.10$) linear or quadratic regressions.	16
Figure 8. Adjusted fall-migration passage rates at Hazel Bazemore Park near Corpus Christi, Texas for Crested Caracaras, American Kestrels, and Merlins: 1997–2009. Dashed lines indicate significant ($P \leq 0.10$) linear or quadratic regressions.	17
Figure 9. Adjusted fall-migration passage rates at Hazel Bazemore Park near Corpus Christi, Texas for Prairie and Peregrine Falcons: 1997–2009. Dashed lines indicate significant ($P \leq 0.10$) linear or quadratic regressions.	18
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: 1997–2008 versus 2009.....	19

INTRODUCTION

The Corpus Christi Raptor Migration Project in southern Texas is an ongoing effort to monitor long-term population trends of raptors using the Gulf Coast migratory flyway (Smith et al. 2001, 2008a). During fall 2009, HawkWatch International (HWI) conducted the thirteenth consecutive, full-season migration count at Hazel Bazemore County Park near Corpus Christi. Previously, local 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 2009 season.

The Corpus Christi project was 1 of 10 long-term, annual migration counts conducted or sponsored by HWI in North America during 2009. The primary objective of these efforts is to track long-term population trends of diurnal raptors in western North America and around 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, 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. Fall 2009 marked the second season of use for a new viewing platform centered atop the grassy area that previously served as the central viewshed. The deck-like structure can hold up to 150 people, affords a sweeping 180° viewscape, and includes a backside ramada for shade. The watch site offers clear visibility to the west, north, and east, but trees and topography at a similar elevation restrict the southward view. The Nueces River bottomlands feature a transitional riparian forest. Characteristic plants include hackberry (*Celtis* spp.), Mexican ash (*Fraxinus berlandieriana*), anacua (*Ehretia anacua*), black persimmon (*Diospyros texana*), chittimwood (*Bumelia lanuginosa*), and cedar elm (*Ulmus crassifolia*). Many species of raptors use this forested area for nocturnal roosting during migration (Rappole and Blacklock 1985). Open farmland predominates to the north and south, open ranchland to the west. Corpus Christi Bay, which is an industrial and urbanized area, lies to the east.

METHODS

This season, three official or designated observers worked throughout the season, with previous lead observer Dane Ferrell (ninth season with HWI) serving in a half-time capacity (see Appendix B for a complete history of official observer participation). Full-time official observer Libby Even served previously as a half- or full-time observer at the site in 2006 and 2007, and in 2008 and 2009 took the lead in coordinating local volunteers, fundraising, and events. Kevin Georg had three previous full seasons of experience (two with HWI in Texas), plus an additional decade of periodic volunteer experience at eastern hawkwatches. Several other experienced local volunteers, in particular former site coordinator Joel Simon and long-time local observer Bob Creglow, routinely assisted with the count, as has been the case 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 2009 follows Hoffman and Smith (2003). In comparing 2009 annual statistics against means and 95% confidence intervals for previous seasons, we equate significance with a 2009 value falling outside the bounds of the confidence interval for the associated mean.

RESULTS AND DISCUSSION

WEATHER

Inclement weather precluded only one full day of potential observations in 2009 and reduced observation time to ≤ 4 hours on three additional days (see Appendix C for daily weather records). The long-term averages for the site are 2.8 and 2.6 days, respectively. Fair skies predominated on only 18% of the active observation days, transitional weather (i.e., skies changed from fair to mostly cloudy/overcast, or vice versa, during the day) on 37%, and mostly cloudy to overcast skies on 45% of the active days. The long-term averages for the site are 33% fair, 40% transitional, and 27% mostly cloudy to overcast. The proportion of days with scattered rain and thunderstorms (29%) was a record high and significantly above average (15%). The proportion of days with visibility-reducing fog and especially haze (85%) also was substantially above average (60%); however, this resulted in only slight reductions in average visibility ratings: 7 km east (average 9.3 km) and 10 km west (average 10.3 km).

The 2009 season was about as windy as usual, with light winds (<12 kph) prevailing on 70% of the active observation days (average 71%), moderate winds (12–28 kph) on 30% (average 28%), and strong winds (>28 kph) on no days (average 1%). Overall, the basic distribution of prevailing wind directions was unusual compared to the long-term average pattern for the site in that, despite no obvious overall reduction in average winds speeds, periods of calm/variable conditions occurred much more often than usual in 2009. For example, the proportions of days with W–N, N–E, NW–NE, or E–S winds throughout the day were all average to below average; however, the proportions of days with those patterns for part of the day but with noteworthy periods of calm/variable conditions during other parts of the day all ranked at record or near-record high levels. Otherwise, as is typical for the site, E–S winds were most prevalent, prevailing on 29% of the active observation days (average 32%), with E–S winds plus a calm/variable component prevailing on another 15% of the active days (average 7%). In contrast, N–E winds typically rank as the second most common pattern, but in 2009 were about half as prevalent as usual (N–E: 4% vs. average of 24%; N–E plus calm/variable: 11% vs. average of 5%), whereas the prevalence of NW–NE winds (including calm/variable components) averages only 4% but rose to 13%, and the prevalence of W–N winds (including calm/variable components) averages 9% but rose to 14% in 2009.

Daily-average (mean of hourly readings) temperatures during active observation periods averaged 30.2°C, ranging from 20.1–36.7°C, with all three values among the highest yet recorded. Daily-average (mean of hourly readings) barometric pressure readings during active observation periods averaged 29.96 inHg, ranging from 29.6–30.33 inHg, with all three values typical for the site. In 2009, 61% of the active observation days received a median thermal-lift rating of good to excellent, which is significantly above the long-term average of 39%.

In summary, weather data collected on site by our observers during active observation periods revealed overall cloudier conditions than usual; a record-high prevalence of scattered thundershowers; an above-average prevalence of fog and haze, but with only slight reductions in average visibility; above average temperatures; an overall average array of wind speeds, but with periods of calm/variable conditions more prevalent than usual and the prevalence of northeasterly winds diminished in favor of more northwesterly winds; 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). The number of observation days and hours (688.00) were a non-significant 1% and 3% lower, respectively, than the 1997–2008 averages of $93 \pm 95\%$ CI of 4.0 days and 712.69 ± 35.94 hours of observation per season. The 2009 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 1997–2008 average of 3.7 ± 0.22 observers/hr.

MIGRATION SUMMARY

The observers tallied 457,607 migrating raptors of 26 species during the 2009 season, which is a significant 34% below the long-term average for the site (Table 1), but very similar to last year's count (see Appendix E for complete annual summaries). Note that similar to the last two years, even without addition of birds recorded during the first half of August, the 2009 tallies for Swallow-tailed and Mississippi Kites were well above average (Table 1, Appendix E), reflecting another big year for both species.

The 2009 Broad-winged Hawk count was a significant 38% below average, whereas the total count of all other species combined (54,415) was a non-significant 14% above the long-term mean, owing primarily to the above average count of Mississippi Kites (Table 1). Species that comprised 1% or more of the 2009 count, with Broad-winged Hawks excluded, included Mississippi Kite (42%), Turkey Vulture (39%), Swainson's Hawk (9%), Sharp-shinned Hawk (3%), and Cooper's Hawk (2%). Vultures, kites, and buteos were the predominant species groups (Figure 2). With Broad-winged Hawks excluded, the proportions of kites and falcons were significantly above average in 2009, whereas the proportions of all other species groups were significantly below average. Highlights of the season included the sixth season in a row that a Short-tailed Hawk was sighted moving through, and the fifth year in a row that at least one Aplomado Falcon was recorded moving through the area (second year in a row that two individuals were seen). No record high counts occurred for commonly recorded species, whereas the count of Red-tailed Hawks fell to a new record low in 2009 (Appendix E).

Passage Rates and Long-Term Trends

The adjusted passage rate for Broad-winged Hawks in 2009 was a significant 43% below average (Table 1). Among the remaining 19 species for which adjusted passage rates were calculated, rates were significantly below average for seven species (Black Vulture, Harris's Hawk, Red-shouldered Hawk, Swainson's Hawk, Red-tailed Hawk, Crested Caracara, and Prairie Falcon), were significantly above average for 10 species, and did not differ significantly from average for Turkey Vultures and White-tailed Hawks (Table 1, Figures 3–9).

Regression analyses of trends in adjusted passage rates updated through 2009 (after Hoffman and Smith 2003) indicated significant ($P \leq 0.05$) linear increasing trends for Ospreys (Figure 3), Mississippi Kites (Figure 4), Cooper's Hawks (Figure 5), White-tailed and Zone-tailed Hawks (Figure 7), American Kestrels (Figure 8), and Peregrine Falcons (Figure 9). Significant second-order, or quadratic, models provided the best fit to the data for Swallow-tailed Kites (Figure 4) and Merlins (Figure 8), in both cases tracking patterns of accelerating increase since about 2002–2003. In contrast, marginally significant long-term decreases are now indicated for both Red-shouldered and Broad-winged Hawks (Figure 6). All remaining species showed no significant ($P > 0.10$) long-term trends.

Smith et al. (2008a) present trend analyses of data collected through 2005 for four long-term 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 2009. 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's, 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 four more years of data include: a) addition of four more years of relatively high passage rates from 2006–2009 resulted in significant overall increases for Swallow-tailed and Mississippi Kites (Figure 4), Cooper's Hawks (Figure 5), American Kestrels and Merlins (Figure 8), and Peregrine Falcons (Figure 9), whereas the RPI analyses revealed only non-significant increases for these species through 2005; b) addition of three years of low to moderate counts from 2006–2009 resulted in a marginally significant declining trend for Broad-winged Hawks (Figure 6), whereas the RPI analyses indicated only a non-significant decline; and c) the RPI analysis indicated a significant increase for Swainson's Hawks through 2005, whereas, although the 2008 passage rate rose to a new record high, three other years of low to at best moderate passage rates since 2005 resulted in no significant overall trend through 2009 (Figure 6). No other noteworthy differences were apparent among the inferences generated by the RPI and updated Hoffman and Smith (2003) analyses.

Seasonal Timing

The median passage date for Broad-winged Hawks of 28 September 2009 was a marginally significant 2 days later than average (Table 3) and the overall seasonal passage pattern confirmed a typical pattern for the species, except for two blips of increased activity in early and mid October (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 high passage of Swallow-tailed and Mississippi Kites, and one in mid October corresponding to late spikes in activity for several species (Turkey Vulture, Northern Harrier, Sharp-shinned Hawk, Cooper's Hawk, Red-tailed Hawk, and American Kestrel; Figure 10). Overall, 9 of 21 species for which a comparison was possible showed median passage dates in 2009 that differed significantly from the long-term averages (Table 3), with Northern Harriers, White-tailed Kites, Harris's Hawks, Red-shouldered Hawks, Broad-winged Hawks, Red-tailed Hawks, and Peregrine Falcons later than average, and only Swallow-tailed Kites and Cooper's Hawks earlier than average.

RESIDENT AND LOCAL RAPTOR ACTIVITY

Although local roost numbers fluctuated throughout the season with migrants moving in and out, the resident population size remained steady throughout the season at about 40 Turkey Vultures and 50 Black Vultures. One Osprey began appearing with regularity on 2 September and was joined by another on 20 October, with both seen hunting in the area on the last day of the count. An adult male Northern Harrier first appeared on 8 September and was joined by an adult female in early October, with both still present at the end of the season.

Local breeders that resided in the area this season included single pairs of White-tailed Hawks (1 fledgling), Red-tailed Hawks (1), Red-shouldered Hawks (1), and Crested Caracaras (3). Also present were two adult Swainson's Hawks and one adult and one immature Harris's Hawks. These birds were present throughout the season, except that the Swainson's Hawks were not seen after 25 September and the immature Caracaras left at the end of October. The adult Red-tailed Hawks were still pair bonding and tending their nest in mid-October. The first transient-resident Broad-winged Hawk, an immature bird, was first spotted 19 August and remained in the area for about 10 days. Texas State Aquarium released two rehabilitated, immature Red-shouldered Hawks from the count platform on 9 August. After that, the crew never recorded more than one immature bird at a time and, therefore, presumed that the local family of Red-shouldered Hawks did not allow the released birds to stick around.

An immature Cooper's Hawk was first seen on 20 August and remained in the area through the end of the season. A second Cooper's Hawk and two Sharp-shinned Hawks were seen behaving like locals beginning in early October. These four accipiters made daily hunting stoops on passerines at the park feeders.

The first local American Kestrel was an adult male seen during the second week of October, with a female appearing a week later and both still in the area at season's end. A Peregrine Falcon resided in the area between weeks one and four of the season.

This is a typical array of resident activity for the site.

VISITOR PARTICIPATION AND PUBLIC OUTREACH

During the 2009 season, 909 individuals signed in at the project site, which is one of the highest visitation rates to date. As usual, visitation was highest during the 12th annual *Celebration of Flight* event in late September, with roughly 200 people visiting during this three-day period. The event included special presentations by long-time local affiliate John Economidy and HWI SW Monitoring Coordinator Mike Neal. Most visitors originated in Texas, but 26 other states (CA, WA, KY, FL, CO, NM, WI, OH, PA, GA, AZ, MA, NY, SC, CT, RI, LA, NE, MT, KS, IL, HI, NC, MI, MO, IA) and 2 foreign countries (United Kingdom and Norway) also were represented. Organized groups that visited during the season included a class of fifth graders from Sanders Elementary in Corpus Christi and a group of advanced high school students from Ingleside High School. In addition, volunteer Site Interpreter and Environmental Educator Beth Hojke did 13 off-site educational programs during the 2009 season, which reached another 352 people. The programs were for general, adult, and school-aged audiences at venues such as the McAllen Library, the Portland Kiwanis Club, Texas Master Naturalists, Rotary Clubs, and various schools and churches.

In 2009, 714 hourly assessments by the official observers of visitor disturbance resulted in the following ratings: >97% none, <3% low, and <1% moderate. This is an average level of observer disturbance for the site, but is lower than last year when opening of the new observation platform created quite a stir.

ACKNOWLEDGEMENTS

Funding for the 2009 project and *Celebration of Flight* event was provided by the Walbridge Fund, Palladium Foundation, Swarovski Optik, The Law Office of John Gilmore, Brush Country Hotshot, Audubon Outdoor Club of Corpus Christi, and HWI private donors and members. We 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. 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>). Other local volunteers who contributed mightily during the 2009 season include Bill Beasley, Mike Clifford, Peter Collins, Jo and Bob Creglow, Lynn Guerra, Mary Hagar, Phyllis Hibdon, Pat Makris, Miles Merwin, Vicki and Joel Simon, Grace, Debbie and Clay Taylor, James Witten, and Stacy Zarpentine. Lastly, special thanks to Beth Hoekje for volunteering her time to present a new program about raptor identification and conservation to student and community groups throughout the Coastal Bend area, to Carol Kilgore for housing Kevin, and to representatives of the Texas confederated tribes for conducting the Sunday blessing ceremony at the *Celebration of Flight*.

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, E. Ruelas Inzunza, and R. R. Veit (Editors). 2008. *State of North America's birds of prey*. Series in Ornithology No. 3. Nuttall Ornithological Club, Cambridge, Massachusetts, and American Ornithologists' Union, Washington, DC U.S.A.
- 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, G. S. Kaltenecker, K. Z. Woodruff, and P. Sherrington. 2008b. Trends in autumn counts of migratory raptors in western North America. Pages 217–252 *in* K. L. Bildstein, J. P. Smith, E. Ruelas Inzunza, and R. R. Veit (Editors), *State of North America's birds of prey*. Series in Ornithology No. 3. Nuttall Ornithological Club, Cambridge, Massachusetts, and American Ornithologists' Union, Washington, DC U.S.A.
- 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. Pages 253–278 *in* K. L. Bildstein, J. P. Smith, E. Ruelas Inzunza, and R. R. Veit (Editors), *State of North America's birds of prey*. Series in Ornithology No. 3. Nuttall Ornithological Club, Cambridge, Massachusetts, and American Ornithologists' Union, Washington, DC U.S.A.
- 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: 1997–2008 versus 2009.

SPECIES	COUNTS			RAPTORS/100 HOURS		
	1997–2008 ¹	2009	% CHANGE	1997–2008 ¹	2009	% CHANGE
Black Vulture	532 ± 213.5	245	-54	112.0 ± 25.12	52.1	-53
Turkey Vulture	24,520 ± 7714.6	21,018	-14	9927.3 ± 1884.95	8524.6	-14
Unidentified vulture	0.8 ± 1.5	0	-100	–	–	–
TOTAL VULTURES	25,053 ± 7762.0	21,263	-15	–	–	–
Osprey	183 ± 38.9	256	+40	38.1 ± 4.97	53.0	+39
Northern Harrier	204 ± 82.7	282	+39	39.4 ± 9.07	55.9	+42
Hook-billed Kite	0.1 ± 0.2	0	-100	–	–	–
Swallow-tailed Kite	72 ± 56.0	183	+154	21.8 ± 7.86	72.9	+234
White-tailed Kite	5 ± 2.3	7	+47	–	–	–
Mississippi Kite	10,150 ± 4216.6	23,114	+128	3555.3 ± 836.35	8301.6	+133
TOTAL KITES	10,227 ± 4262.4	23,304	+128	–	–	–
Sharp-shinned Hawk	1,271 ± 241.4	1,621	+28	387.2 ± 39.77	454.9	+17
Cooper’s Hawk	839 ± 250.5	1,078	+28	222.3 ± 36.19	269.6	+21
Northern Goshawk	0.6 ± 0.6	0	-100	–	–	–
Unidentified accipiter	272 ± 42.6	149	-45	–	–	–
TOTAL ACCIPITERS	2,382 ± 436.4	2,848	+20	–	–	–
Common Black Hawk	0.1 ± 0.2	0	-100	–	–	–
Harris’s Hawk	16 ± 6.2	6	-62	2.4 ± 0.53	0.9	-60
Red-shouldered Hawk	55 ± 16.6	17	-69	8.3 ± 1.54	2.7	-67
Broad-winged Hawk	650,443 ± 136704.6	403,192	-38	344165.3 ± 46366.03	196807.0	-43
Short-tailed Hawk	1.0 ± 0.7	1	0	–	–	–
Swainson’s Hawk	7,338 ± 4370.3	4,792	-35	3926.4 ± 1370.53	2376.0	-39
White-tailed Hawk	17 ± 9.2	19	+11	2.4 ± 0.75	2.9	+18
Zone-tailed Hawk	6 ± 3.6	8	+37	0.8 ± 0.29	1.2	+49
Red-tailed Hawk	176 ± 46.6	80	-55	27.8 ± 4.28	12.9	-54
Ferruginous Hawk	4 ± 2.4	3	-22	–	–	–
Rough-legged Hawk	0.4 ± 0.7	0	-100	–	–	–
Unidentified buteo	98 ± 56.1	154	+57	–	–	–
TOTAL BUTEOS	658,154 ± 137075.3	408,272	-38	–	–	–
Golden Eagle	1.5 ± 0.6	3	+100	–	–	–
Bald Eagle	3 ± 1.7	1	-69	–	–	–
Unidentified eagle	0.2 ± 0.2	0	-100	–	–	–
TOTAL EAGLES	5 ± 2.1	4	-19	–	–	–
Crested Caracara	12 ± 4.0	4	-66	1.7 ± 0.36	0.6	-64
American Kestrel	629 ± 179.8	869	+38	165.0 ± 27.11	223.3	+35
Merlin	43 ± 13.7	81	+88	10.7 ± 1.93	20.8	+95
Prairie Falcon	9 ± 4.7	4	-56	2.5 ± 0.81	0.8	-70
Peregrine Falcon	178 ± 41.1	289	+62	42.9 ± 5.57	68.2	+59
Aplomado Falcon	0.8 ± 0.7	2	+140	–	–	–
Unknown small falcon	2 ± 1.4	14	+500	–	–	–
Unknown large falcon	2 ± 2.0	3	+24	–	–	–
Unidentified falcon	31 ± 19.1	2	-94	–	–	–
TOTAL FALCONS	896 ± 217.2	1,264	+41	–	–	–
Unidentified raptor	886 ± 867.4	110	-88	–	–	–
GRAND TOTAL	698,000 ± 131217.2	457,607	-34	–	–	–

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 2009, with a comparison of 2009 and 1997–2008 average median passage dates.

SPECIES	2009				1997–2008	
	FIRST OBSERVED	LAST OBSERVED	BULK PASSAGE DATES ¹	MEDIAN PASSAGE DATE ²	MEDIAN PASSAGE DATE ^{2,3}	
Black Vulture	28-Sep	14-Nov	1-Oct – 9-Nov	30-Oct	27-Oct	± 5.2
Turkey Vulture	27-Sep	15-Nov	14-Oct – 4-Nov	23-Oct	21-Oct	± 3.1
Osprey	16-Aug	13-Nov	12-Sep – 14-Oct	29-Sep	28-Sep	± 1.5
Northern Harrier	29-Aug	11-Nov	19-Sep – 1-Nov	22-Oct	10-Oct	± 4.8
Swallow-tailed Kite	15-Aug	20-Sep	15-Aug – 2-Sep	18-Aug	23-Aug	± 2.8
White-tailed Kite	9-Sep	9-Nov	9-Sep – 9-Nov	14-Oct	06-Oct	± 6.7
Mississippi Kite	15-Aug	16-Oct	28-Aug – 16-Sep	29-Aug	29-Aug	± 3.2
Sharp-shinned Hawk	12-Sep	14-Nov	24-Sep – 27-Oct	11-Oct	08-Oct	± 3.2
Cooper's Hawk	26-Aug	12-Nov	24-Sep – 30-Oct	3-Oct	08-Oct	± 3.1
Harris's Hawk	13-Sep	2-Nov	13-Sep – 2-Nov	15-Oct	04-Oct	± 6.8
Red-shouldered Hawk	12-Sep	3-Nov	18-Sep – 31-Oct	23-Oct	03-Oct	± 6.7
Broad-winged Hawk	21-Aug	11-Nov	24-Sep – 9-Oct	28-Sep	26-Sep	± 1.6
Short-tailed Hawk	3-Sep	3-Sep	–	–	–	–
Swainson's Hawk	21-Aug	13-Nov	10-Oct – 16-Oct	10-Oct	09-Oct	± 3.0
White-tailed Hawk	21-Aug	10-Nov	25-Sep – 31-Oct	9-Oct	03-Oct	± 8.3
Zone-tailed Hawk	23-Aug	30-Sep	23-Aug – 30-Sep	21-Sep	23-Sep	± 12.6
Red-tailed Hawk	26-Aug	12-Nov	20-Sep – 10-Nov	27-Oct	20-Oct	± 6.3
Ferruginous Hawk	17-Sep	7-Nov	–	–	12-Oct	± 8.2
Golden Eagle	12-Oct	23-Oct	–	–	–	–
Bald Eagle	19-Oct	19-Oct	–	–	10-Oct	± 11.3
Crested Caracara	13-Sep	23-Oct	–	–	12-Oct	± 7.6
American Kestrel	29-Aug	11-Nov	20-Sep – 22-Oct	2-Oct	03-Oct	± 2.3
Merlin	19-Sep	4-Nov	23-Sep – 22-Oct	2-Oct	30-Sep	± 3.0
Prairie Falcon	3-Oct	3-Nov	–	–	01-Oct	± 4.0
Peregrine Falcon	15-Aug	10-Nov	23-Sep – 14-Oct	2-Oct	30-Sep	± 1.4
Aplomado Falcon	28-Aug	3-Oct	–	–	–	–
ALL SPECIES	15-Aug	15-Nov	22-Sep – 15-Oct	28-Sep	26-Sep	± 1.5

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.

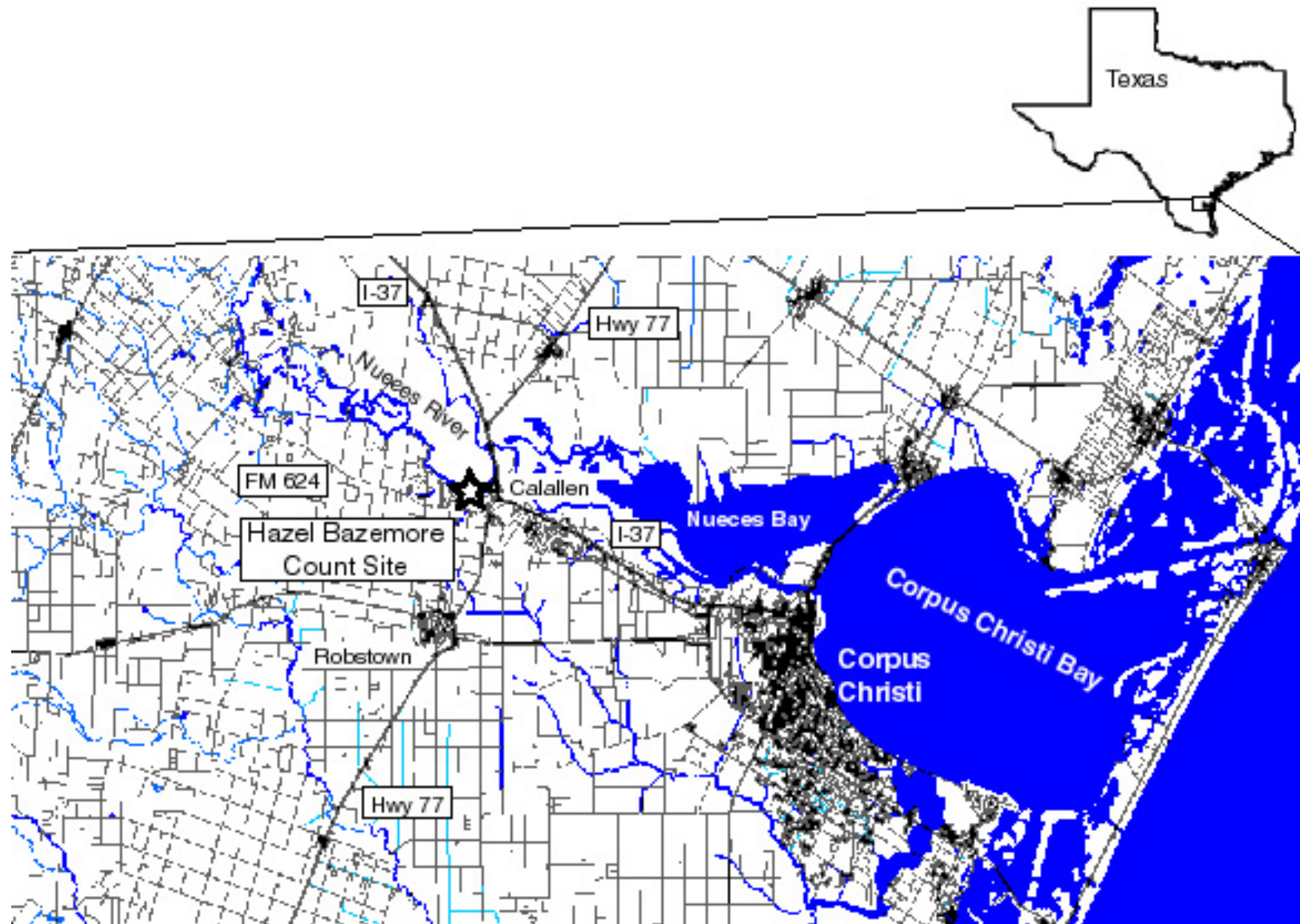


Figure 1. Location of Hazel Bazemore County Park count site near Corpus Christi, Texas.

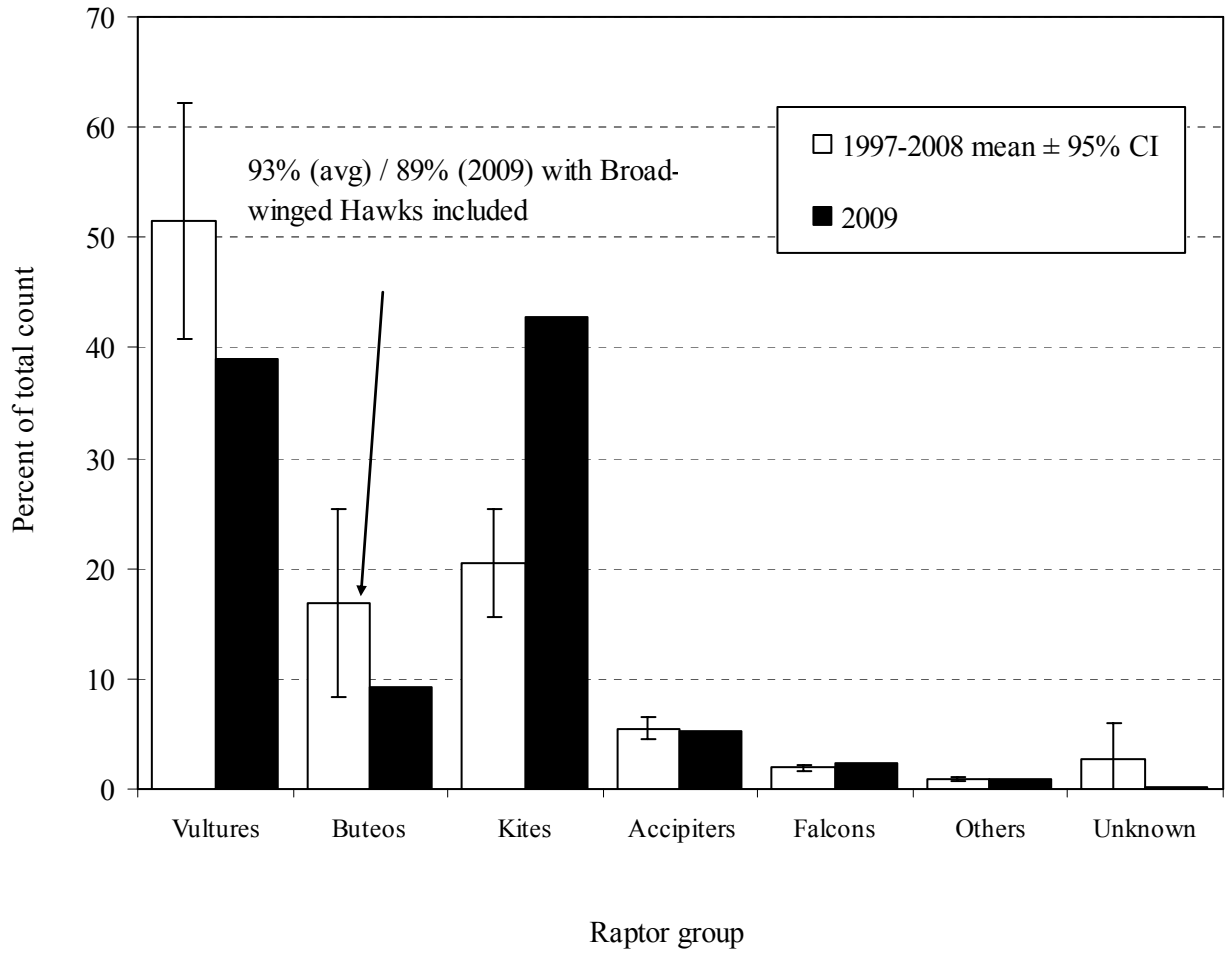


Figure 2. Composition of the fall raptor migration by species groups at Hazel Bazemore Park near Corpus Christi, Texas: 1997–2008 versus 2009.

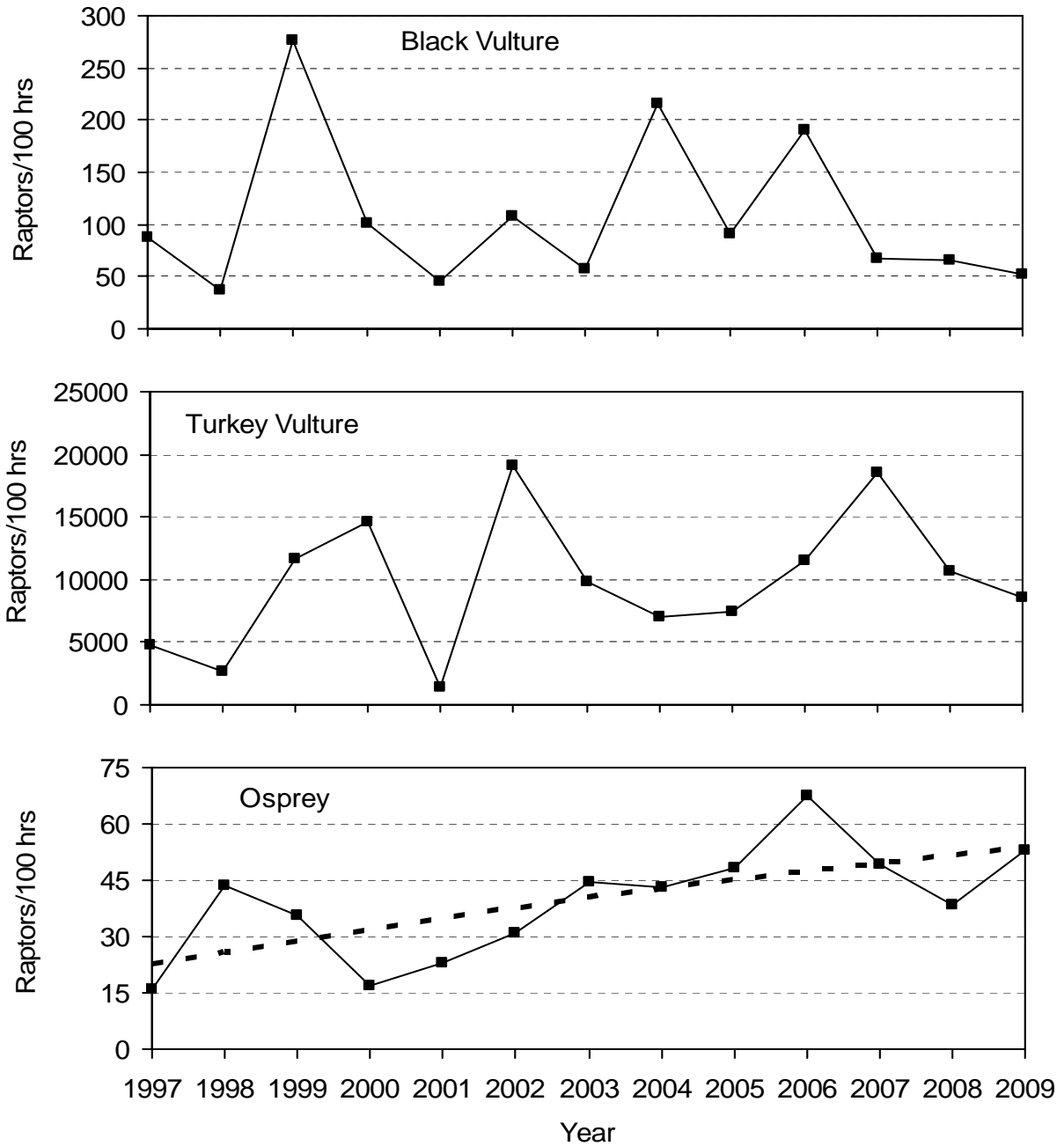


Figure 3. Adjusted fall-migration passage rates at Hazel Bazemore Park near Corpus Christi, Texas for Black Vultures, Turkey Vultures, and Ospreys: 1997–2009. Dashed lines indicate significant ($P \leq 0.10$) linear or quadratic regressions.

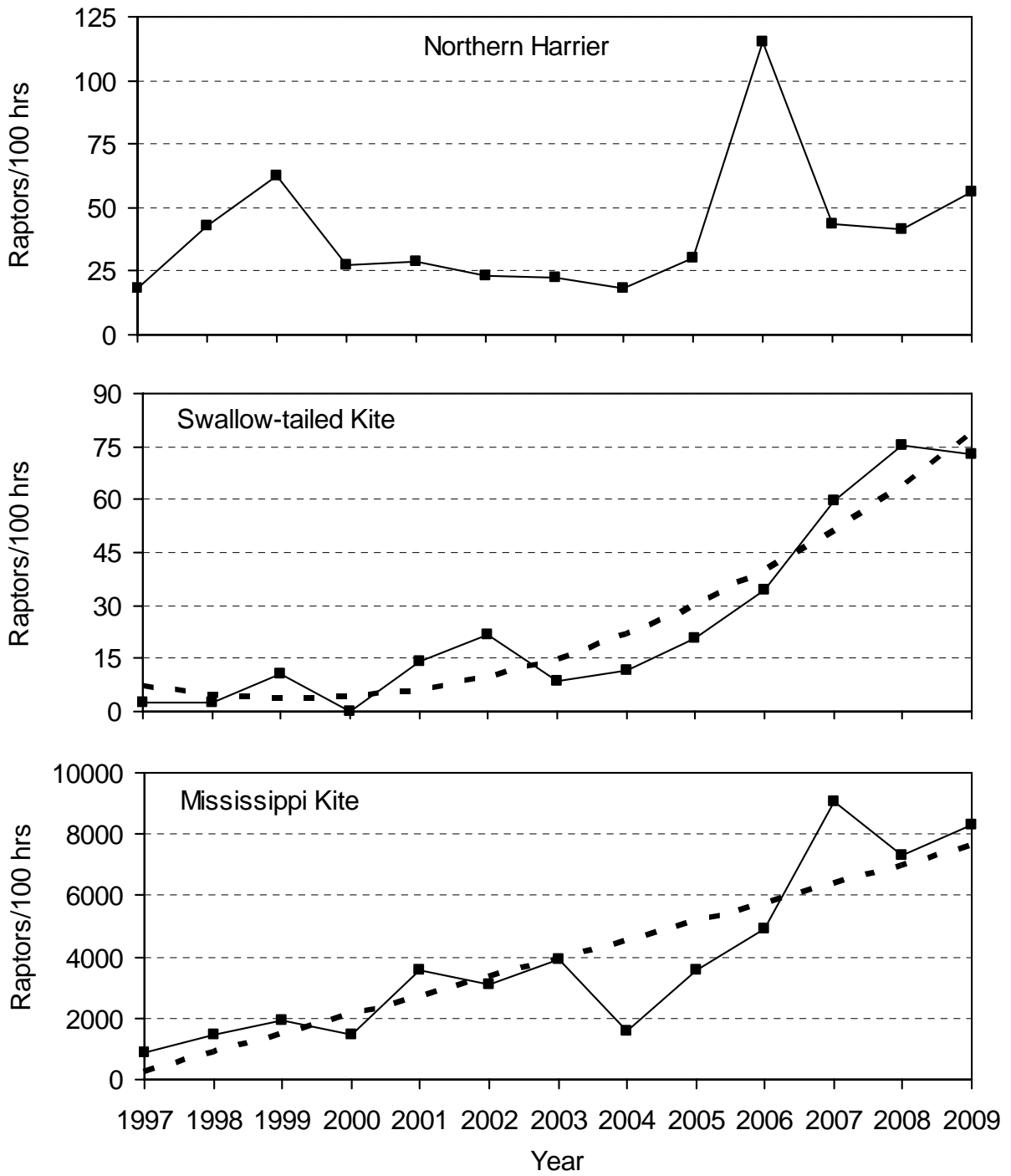


Figure 4. Adjusted fall-migration passage rates at Hazel Bazemore Park near Corpus Christi, Texas for Northern Harriers, Swallow-tailed Kites, and Mississippi Kites: 1997–2009. Dashed lines indicate significant ($P \leq 0.10$) linear or quadratic regressions.

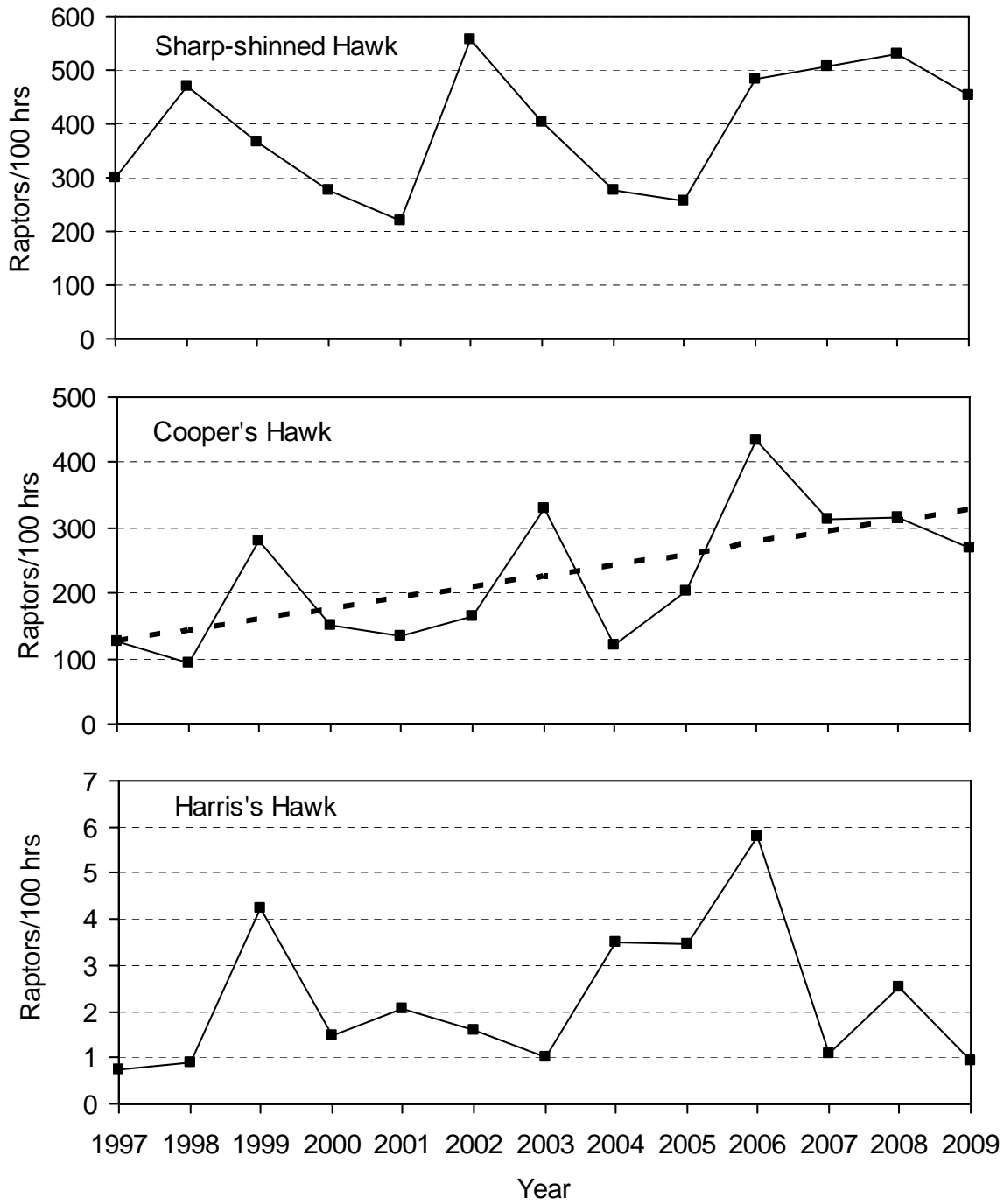


Figure 5. Adjusted fall-migration passage rates at Hazel Bazemore Park near Corpus Christi, Texas for Sharp-shinned, Cooper's, and Harris's Hawks: 1997–2009. Dashed lines indicate significant ($P \leq 0.10$) linear or quadratic regressions.

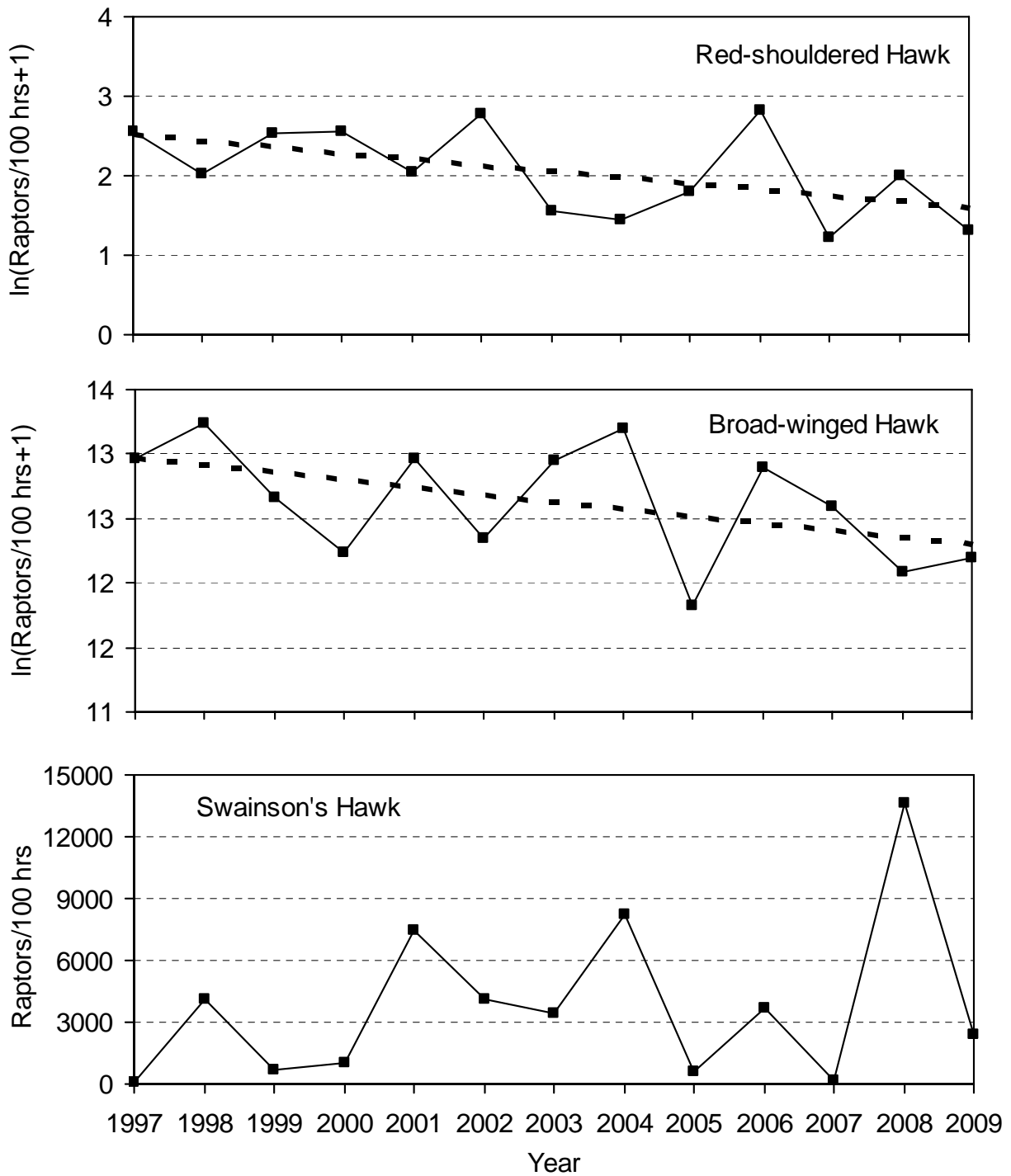


Figure 6. Adjusted fall-migration passage rates at Hazel Bazemore Park near Corpus Christi, Texas for Red-shouldered, Broad-winged, and Swainson's Hawks: 1997–2009. Dashed lines indicate significant ($P \leq 0.10$) linear or quadratic regressions.

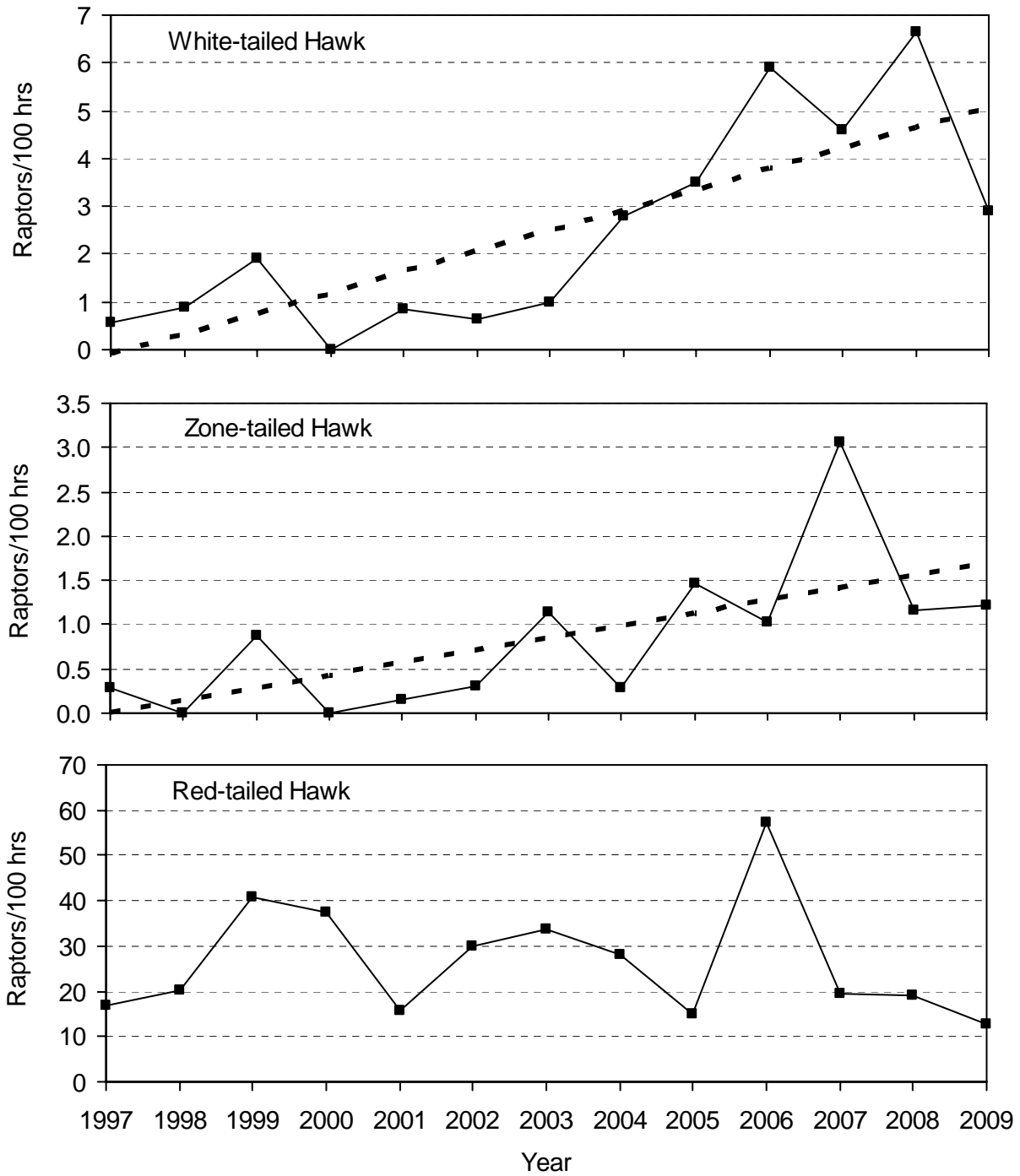


Figure 7. Adjusted fall-migration passage rates at Hazel Bazemore Park near Corpus Christi, Texas for White-tailed, Zone-tailed, and Red-tailed and Hawks: 1997–2009. Dashed lines indicate significant ($P \leq 0.10$) linear or quadratic regressions.

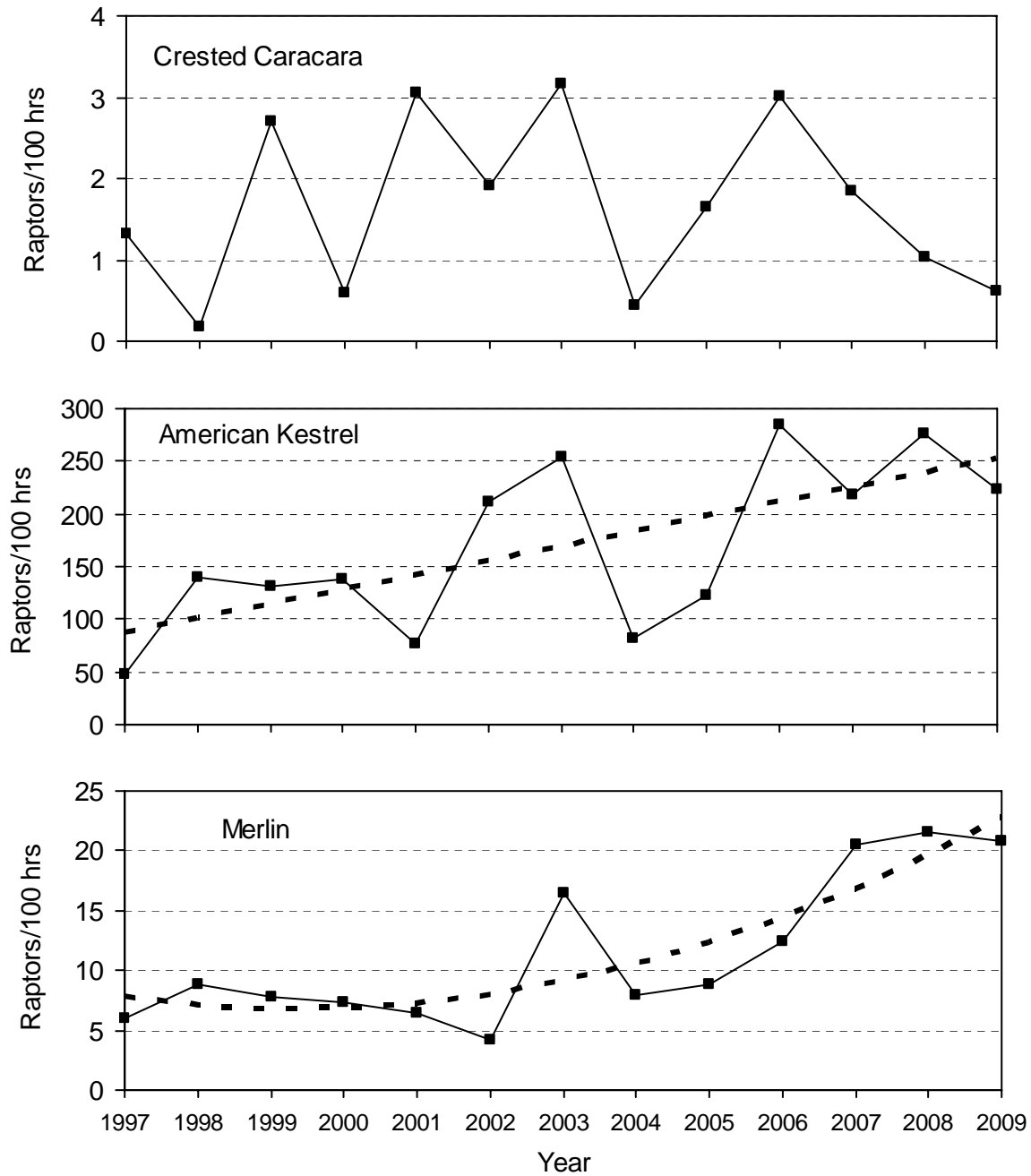


Figure 8. Adjusted fall-migration passage rates at Hazel Bazemore Park near Corpus Christi, Texas for Crested Caracaras, American Kestrels, and Merlins: 1997–2009. Dashed lines indicate significant ($P \leq 0.10$) linear or quadratic regressions.

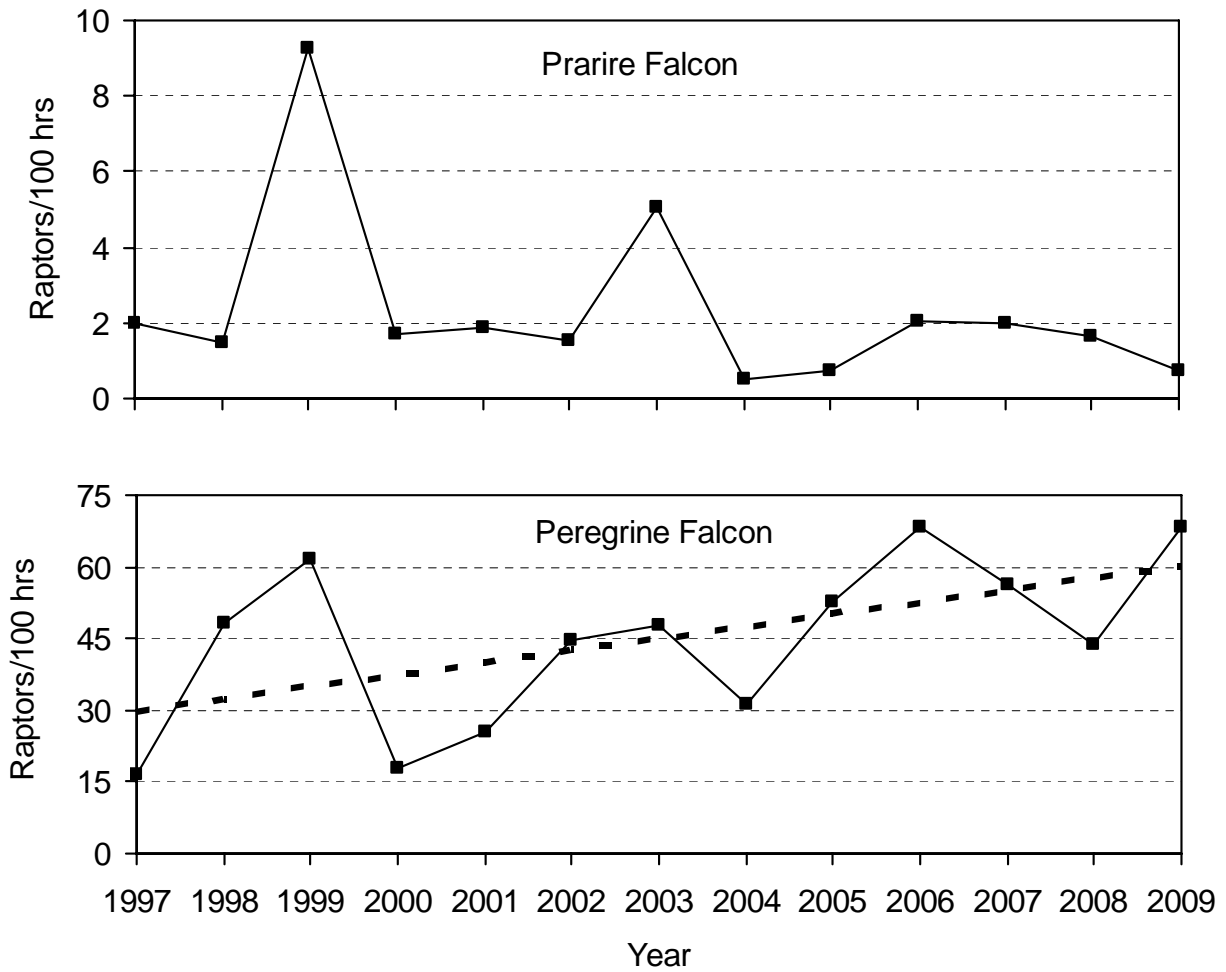


Figure 9. Adjusted fall-migration passage rates at Hazel Bazemore Park near Corpus Christi, Texas for Prairie and Peregrine Falcons: 1997–2009. Dashed lines indicate significant ($P \leq 0.10$) linear or quadratic regressions.

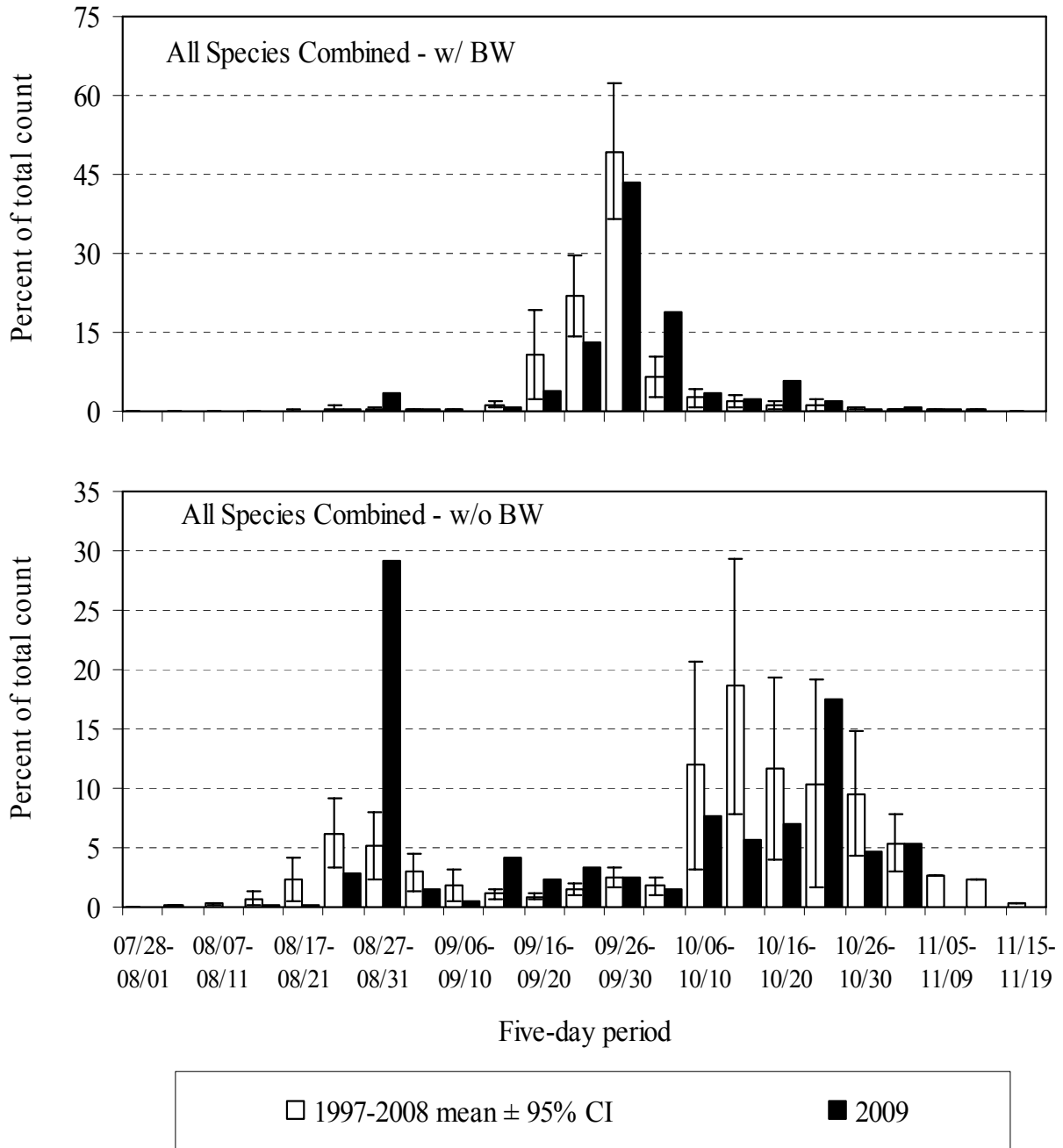


Figure 10. Combined-species flight volume by five-day periods, with and without Broad-wing Hawks, for the fall raptor migration at Hazel Bazemore Park near Corpus Christi, Texas: 1997–2008 versus 2009.

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's 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: 1997–2009.

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

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

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

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

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

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

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

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

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

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

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

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

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

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: 2009.

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	5.9	0	mc-ovc, PM haze	5.4	se, ene	35.4	29.90	2	11	13	3	11.6
16-Aug	7.50	4.8	0	clr-ovc, haze	2.9	se	36.0	29.90	1	7	11	3	3.1
17-Aug	7.50	3.2	0	mc-ovc	4.9	ese-se	36.1	29.95	1	8	11	3	4.9
18-Aug	7.50	2.6	0	ovc, haze, scat ts	4.8	s, e-se	35.8	29.96	3	8	8	2	2.7
19-Aug	7.50	2.6	0	mc-ovc	4.4	ese-se	36.2	29.88	2	9	11	3	4.7
20-Aug	7.50	2.0	0	pc-mc, haze	8.0	ese-sse	36.7	29.85	1	9	11	3	0.7
21-Aug	7.50	3.9	0	pc-ovc, haze, scat ts	3.2	e-sse	36.3	29.95	1	9	11	2	2.0
22-Aug	7.50	3.6	0	mc-clr, haze	2.6	e-se/calm	36.1	29.98	2	4	7	3	155.6
23-Aug	7.50	3.9	0	ovc-clr, haze	3.3	ese-s	36.2	29.96	1	7	9	2	7.2
24-Aug	7.50	4.0	0	clr-pc, haze	4.1	ese-s	36.4	29.98	1	8	10	3	25.7
25-Aug	7.50	3.1	0	clr-ovc, haze	4.8	sse-s	36.3	29.98	1	5	9	3	1.9
26-Aug	8.00	3.9	0	clr-pc, haze	4.4	sse-ssw, ne-e	35.2	29.97	1	4	9	3	15.0
27-Aug	7.50	2.9	0	clr-mc, haze	1.7	calm, e-se	35.3	29.91	1	8	10	3	2.5
28-Aug	8.00	3.8	0	clr-ovc, haze, scat rain	0.3	w/calm, ne/calm	35.9	29.91	2	5	10	3	454.6
29-Aug	8.00	4.9	0	ovc, haze, PM ts	0.6	nw, calm	33.2	29.91	2	8	11	3	1180.3
30-Aug	7.75	3.4	0	pc-ovc, haze	1.8	calm/var	35.2	29.94	2	7	11	3	354.2
31-Aug	7.00	2.9	0	ovc	2.6	e/var	34.1	30.02	2	6	7	2	5.9
01-Sep	4.50	3.0	0	ovc, haze, scat rain	4.0	ne, ese-se	30.2	30.09	4	4	5	2	5.1
02-Sep	7.75	2.6	0	ovc, AM/PM fog	0.9	e-se/calm	32.9	30.06	2	2	4	4	78.3
03-Sep	7.50	2.8	0	pc-ovc, haze	1.0	s-sw/calm, se	34.8	29.97	2	7	9	3	27.6
04-Sep	7.50	3.6	0	ovc, haze	0.8	calm, ese-sse	32.4	29.90	3	3	5	2	12.5
05-Sep	7.00	3.2	0	ovc, haze, AM rain	2.1	nne-ne/calm	31.5	29.98	3	4	8	2	28.1
06-Sep	7.50	3.9	0	mc-ovc, haze, scat ts	4.8	nne-ese	33.1	29.99	1	7	12	3	43.2
07-Sep	7.00	5.6	0	clr-ovc, haze, PM ts/rain	3.1	calm, ne-ese	33.1	29.95	2	8	10	2	20.3
08-Sep	6.50	2.3	0	ovc, haze, PM ts/rain	3.6	e-sse/calm	33.5	29.89	3	6	9	3	17.4
09-Sep	5.50	2.3	0	ovc, haze, scat ts/rain	2.7	s/calm, e-ese	33.6	29.91	4	5	8	2	16.9
10-Sep	3.50	4.1	0	mc-ovc, haze	5.8	e-ese	31.8	29.92	3	14	16	2	1.7
11-Sep	0.00			weather day: rain									
12-Sep	8.75	6.2	0	ovc, fog/haze, scat rain	1.3	nw/calm	31.0	29.73	3	9	12	2	250.7
13-Sep	8.00	6.1	0	clr-ovc	4.7	nw	30.8	29.78	2	15	16	2	104.6
14-Sep	7.50	3.0	0	clr-mc, haze	5.6	nw-n	31.7	29.86	2	14	17	3	17.5
15-Sep	7.50	2.6	0	clr/haze	2.2	nw	31.7	29.90	1	8	10	3	39.6
16-Sep	8.50	3.9	0	clr-ovc, haze	2.5	wnw-nnw/calm	34.0	29.88	1	5	10	3	68.9
17-Sep	8.00	3.3	0	clr/haze	2.7	nw	32.7	29.89	1	7	9	3	17.1
18-Sep	8.00	3.6	0	clr-ovc, haze	1.9	nw-ne/calm	31.6	29.96	1	7	10	3	131.4
19-Sep	9.00	4.9	0	clr-ovc, haze	1.4	nw-ne/calm	33.1	30.00	2	8	9	2	98.7
20-Sep	8.50	3.9	0	ovc/haze	1.5	calm, se	34.3	29.96	1	5	9	3	1845.8
21-Sep	8.50	3.5	0	clr-mc	3.8	se-ssw	34.3	29.88	2	9	11	2	455.6
22-Sep	4.00	5.8	0	ovc, scat rain	5.1	se/calm, n-ne	29.0	29.93	4	6	7	2	2563.5
23-Sep	7.50	7.0	0	ovc, fog, AM rain	7.9	nw	21.1	30.09	4	6	6	2	368.5
24-Sep	8.00	9.6	0	ovc/fog	4.0	nw	22.2	30.07	2	4	7	4	3710.0
25-Sep	8.50	12.7	0	pc-ovc, haze	1.7	nw, calm	26.9	30.06	3	6	9	3	1594.0
26-Sep	10.00	14.1	1	pc-ovc, fog/haze	2.0	n-ne/calm, se/calm	31.3	30.00	2	6	7	3	5754.6
27-Sep	9.50	14.5	0	pc-mc, AM fog	2.0	se-s, s/calm	33.9	29.88	1	14	14	3	3744.4
28-Sep	9.00	8.4	0	pc-mc, haze	1.8	se-sse	34.6	29.92	1	12	14	3	10306.4
29-Sep	9.00	6.3	0	mc-ovc, AM rain	3.3	ne, se	30.8	30.03	3	9	14	3	1287.6
30-Sep	8.50	6.7	0	clr-ovc, haze	3.8	e-ese	32.7	29.95	2	12	13	3	240.5
01-Oct	8.00	4.1	0	pc-mc, haze	5.9	se-s	34.1	29.83	1	12	14	3	2670.5
02-Oct	8.50	5.8	0	mc-ovc, haze, AM rain	5.7	ne	27.9	29.90	1	9	12	4	7580.6
03-Oct	8.00	4.8	0	ovc, haze, AM fog/rain	5.6	ne-se	31.7	29.83	3	3	3	2	56.0
04-Oct	8.00	3.9	0	ovc, fog, scat rain	7.7	se-s, e	32.1	29.74	4	2	4	3	0.6
05-Oct	8.00	3.1	0	mc-ovc, haze	6.2	se-s	33.8	29.80	2	4	5	3	72.4

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. (IN HG) ¹	MEDIAN THERMAL LIFT ⁴	VISIB. EAST (KM) ¹	VISIB. WEST (KM) ¹	FLIGHT DIST. ⁵	RAPTORS / HOUR
06-Oct	8.00	4.0	0	mc-ovc, haze	6.6	se-sse	34.4	29.77	1	5	8	3	40.3
07-Oct	8.00	3.8	0	pc-ovc, AM haze/rain	7.7	sse	34.2	29.91	2	8	11	3	20.1
08-Oct	7.00	2.8	0	mc-ovc, haze	15.0	se	33.8	29.84	4	4	6	2	2.7
09-Oct	5.00	2.8	0	ovc, scat rain	7.1	s, nw-ne	26.4	29.85	4	6	10	3	754.8
10-Oct	9.00	5.0	0	ovc, AM fog/rain, PM haze	3.5	nw-n	20.1	30.09	4	5	5	3	1284.4
11-Oct	7.00	4.7	0	ovc, AM rain, fog	5.3	nw-ne	20.8	30.01	4	2	2	2	205.9
12-Oct	8.00	2.9	0	ovc, AM fog/rain, PM haze	0.6	nw-n, calm	25.3	29.95	4	4	4	2	179.8
13-Oct	8.00	2.7	0	ovc, AM fog/rain, PM haze	4.6	calm, se	32.0	29.93	3	2	6	3	221.5
14-Oct	8.50	2.3	0	ovc-clr, haze	3.5	sse-s	33.5	29.90	1	8	10	3	259.6
15-Oct	8.50	2.3	0	ovc-pc, haze	3.6	sse-s, s/calm	33.8	29.76	1	6	8	4	447.9
16-Oct	8.75	3.1	0	ovc-clr, haze	5.3	nw-ne	26.4	30.02	3	10	10	2	711.3
17-Oct	9.00	3.9	0	clr	3.1	n, ne, calm	24.3	30.32	1	9	11	4	1582.9
18-Oct	8.00	3.3	0	clr/haze	2.6	calm, se	25.4	30.32	2	13	15	3	600.5
19-Oct	8.00	2.7	0	clr-ovc, haze	6.0	se-s	29.0	30.13	1	7	10	3	90.8
20-Oct	7.00	3.2	0	pc-ovc, AM haze	6.6	se-s	29.1	29.98	3	7	12	2	9.7
21-Oct	7.00	2.0	0	ovc, AM fog, haze	8.8	se-sse	28.6	29.80	4	4	5	2	22.9
22-Oct	7.00	3.3	0	pc-ovc	9.6	wnw-nw	25.3	29.79	4	16	17	3	643.4
23-Oct	8.00	3.8	0	clr-pc	6.9	nw-nne	22.2	30.01	2	16	17	2	384.0
24-Oct	8.00	4.3	0	clr-pc, haze	3.0	calm, ene	24.9	29.98	2	5	8	3	235.4
25-Oct	5.00	3.6	0	mc-ovc, haze, ts/rain	6.5	se	28.3	29.87	4	8	11	2	8.2
26-Oct	2.50	2.0	0	mc-ovc, haze, ts/rain	1.3	sse/calm	29.0	29.86	4	2	3	3	80.0
27-Oct	8.00	3.4	0	clr/haze	2.3	nw, calm	20.1	29.95	3	11	14	3	144.9
28-Oct	7.00	2.0	0	clr-ovc, haze	16.4	se-sse	29.4	29.65	4	2	5	3	67.4
29-Oct	7.00	2.6	0	ovc, fog/haze	14.3	sse-s	30.9	29.60	4	4	6	1	8.6
30-Oct	8.00	2.4	0	ovc	5.4	nw	20.6	29.97	4	14	16	3	88.5
31-Oct	7.50	3.8	0	clr/haze	0.7	calm, nw/calm/var	21.4	30.16	2	11	13	2	110.4
01-Nov	8.00	3.6	0	clr	3.2	calm, ne	22.4	30.16	2	6	11	3	55.9
02-Nov	7.50	2.0	0	clr-mc, haze	2.3	nw-n/calm	25.0	30.17	2	13	15	3	42.7
03-Nov	7.50	2.7	0	clr/haze	2.6	ne-ene	24.6	30.24	2	12	14	3	43.1
04-Nov	7.50	2.6	0	clr-pc, haze	2.1	ne-e/calm	25.5	30.27	2	10	13	2	138.1
05-Nov	7.50	2.2	0	clr, fog/haze	1.1	ne-e/calm	25.4	30.33	2	10	12	3	79.3
06-Nov	7.00	3.2	0	clr-mc, haze	4.9	ene-e/calm	25.5	30.18	3	4	8	3	56.3
07-Nov	7.50	4.1	0	mc-ovc, fog/haze	7.0	calm, ene-e	25.8	30.05	4	8	9	2	8.5
08-Nov	1.50	2.0	0	ovc/rain	1.0	ene	23.5	30.02	4	4	4	-	0.0
09-Nov	7.50	2.1	0	ovc, fog/haze, scat rain	6.3	nw-n	24.5	30.04	4	5	6	2	21.1
10-Nov	7.00	2.7	0	clr-mc, fog/haze	7.5	nnw-n	25.8	30.18	3	2	6	3	60.4
11-Nov	7.50	2.1	0	clr-pc, fog/haze	1.0	nnw-n	25.9	30.20	2	9	10	2	27.9
12-Nov	7.50	2.0	0	clr, fog/haze	0.8	calm/var	25.6	30.04	3	4	6	4	9.7
13-Nov	7.00	2.1	0	pc, fog/haze	2.1	se/calm	26.6	29.86	2	8	9	3	13.3
14-Nov	7.50	2.1	0	mc-ovc, haze	8.9	sse-s	28.8	29.85	3	4	9	4	8.7
15-Nov	7.00	4.4	0	mc-ovc, fog/haze	6.3	sse-s	29.4	29.88	3	5	7	3	2.3

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. continued

DATE	HOURS										SPECIES ¹																										BIRDS									
	OBSERV.	BV	TV	UV	OS	NH	HK	SK	WK	MK	UK	SS	CH	NG	UA	HH	RS	BW	SW	WT	ZT	ST	CB	RT	FH	RL	UB	GE	BE	UE	CC	AK	ML	PR	PG	AF	SF	LF	UF	UU	TOTAL	/HOUR				
17-Sep	8.00	0	0	0	1	1	0	0	0	80	0	1	0	0	0	0	0	49	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	137	17.1
18-Sep	8.00	0	0	0	7	2	0	1	0	179	0	6	8	0	2	0	1	837	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	1	0	0	0	0	0	0	0	0	1051	131.4	
19-Sep	9.00	0	0	0	5	4	0	0	1	155	0	6	6	0	1	0	0	689	0	0	0	0	0	1	0	0	1	0	0	0	12	3	0	4	0	0	0	0	0	0	0	0	888	98.7		
20-Sep	8.50	0	0	0	18	3	0	1	1	307	0	19	11	0	1	0	0	15278	5	0	0	0	0	2	0	0	0	0	0	0	38	1	0	4	0	0	0	0	0	0	0	0	15689	1845.8		
21-Sep	8.50	0	0	0	3	3	0	0	0	4	0	2	2	0	0	0	0	3849	0	0	1	0	0	1	0	0	0	0	0	0	2	0	6	0	0	0	0	0	0	0	0	3873	455.6			
22-Sep	4.00	0	0	0	0	0	0	0	0	27	0	11	7	0	0	0	0	10199	0	0	2	0	0	0	0	0	0	0	0	5	2	0	1	0	0	0	0	0	0	0	0	10254	2563.5			
23-Sep	7.50	0	0	0	3	4	0	0	0	236	0	54	10	0	2	0	0	2431	0	0	0	0	0	0	0	0	0	0	0	19	1	0	2	0	0	0	0	0	0	2	2764	368.5				
24-Sep	8.00	0	0	0	0	7	0	0	0	793	0	123	57	0	6	0	0	28666	0	0	0	0	0	0	0	0	0	0	0	23	2	0	2	0	0	0	0	0	0	1	29680	3710.0				
25-Sep	8.50	0	0	0	7	7	0	0	0	166	0	53	72	0	1	0	1	13159	0	2	0	0	0	2	0	0	0	0	0	60	3	0	6	0	1	1	0	8	13549	1594.0						
26-Sep	10.00	0	0	0	15	8	0	0	0	75	0	79	112	0	5	0	1	57102	14	1	0	0	0	1	0	0	2	0	0	108	7	0	7	0	2	1	0	6	57546	5754.6						
27-Sep	9.50	0	39	0	7	1	0	0	0	53	0	25	24	0	1	0	1	35373	23	1	0	0	0	1	0	0	1	0	0	12	0	0	6	0	1	0	0	3	35572	3744.4						
28-Sep	9.00	1	53	0	4	1	0	0	0	6	0	10	12	0	3	0	0	92572	73	1	0	0	0	0	0	0	2	0	0	6	0	0	11	0	0	0	0	3	92758	10306.4						
29-Sep	9.00	0	0	0	28	3	0	0	0	36	0	73	51	0	5	0	0	11286	14	0	0	0	0	1	0	0	0	0	0	43	8	0	26	0	1	1	0	12	11588	1287.6						
30-Sep	8.50	0	16	0	17	2	0	0	0	11	0	66	31	0	10	0	0	1792	5	1	2	0	0	2	0	0	0	0	30	10	0	39	0	3	0	0	7	2044	240.5							
01-Oct	8.00	40	53	0	11	2	0	0	0	13	0	8	7	0	0	0	21164	39	0	0	0	0	1	0	0	2	0	0	8	1	0	12	0	1	0	0	2	21364	2670.5							
02-Oct	8.50	0	22	0	6	1	0	0	0	39	0	108	80	0	6	0	0	64045	7	0	0	0	0	0	0	0	0	0	95	6	0	12	0	2	0	0	6	64435	7580.6							
03-Oct	8.00	0	6	0	15	6	0	0	0	2	0	41	31	0	10	0	0	299	0	0	0	0	0	0	0	1	0	0	11	2	1	18	1	1	0	0	3	448	56.0							
04-Oct	8.00	0	0	0	2	1	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	0	0	0	0	0	0	0	0	5	0.6				
05-Oct	8.00	0	3	0	0	11	0	0	0	1	0	11	3	0	4	0	0	537	0	0	0	0	0	0	0	0	0	0	2	0	0	5	0	0	0	0	2	579	72.4							
06-Oct	8.00	0	34	0	7	2	0	0	0	0	0	2	0	0	0	0	0	167	91	1	0	0	0	1	0	0	0	0	0	1	0	0	14	0	1	0	0	1	322	40.3						
07-Oct	8.00	0	26	0	4	1	0	0	0	0	0	6	3	0	0	0	0	11	71	0	0	0	0	3	0	0	0	0	0	1	0	0	34	0	0	0	0	1	161	20.1						
08-Oct	7.00	0	0	0	0	1	0	0	0	0	0	0	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	19	2.7					
09-Oct	5.00	0	28	0	4	5	0	0	0	0	0	39	22	0	4	0	2	3593	8	2	0	0	0	3	0	0	2	0	0	43	11	0	7	0	1	0	0	0	3774	754.8						
10-Oct	9.00	0	507	0	0	2	0	0	0	0	0	35	19	0	5	1	0	7932	3036	0	0	0	0	0	0	0	0	0	17	2	0	1	0	0	0	1	2	11560	1284.4							
11-Oct	7.00	0	238	0	3	1	0	0	0	1	0	23	10	0	2	0	0	1005	78	0	0	0	0	0	0	0	75	0	0	0	2	0	0	1	0	0	0	0	2	1441	205.9					
12-Oct	8.00	3	176	0	2	0	0	0	0	1	0	57	21	0	1	0	0	729	433	1	0	0	0	1	0	0	1	0	0	1	4	2	0	2	0	0	0	3	1438	179.8						
13-Oct	8.00	0	269	0	4	2	0	0	0	0	0	20	12	0	2	0	0	1438	14	0	0	0	0	0	0	0	0	0	3	0	0	8	0	0	0	0	0	0	1772	221.5						
14-Oct	8.50	45	789	0	5	5	0	0	1	1	0	36	12	0	3	0	0	1087	193	1	0	0	0	0	0	0	1	0	0	17	3	0	7	0	0	0	1	0	2207	259.6						
15-Oct	8.50	21	285	0	2	3	0	0	0	0	0	62	28	0	4	2	0	3284	48	1	0	0	0	1	0	0	45	0	0	0	11	0	0	10	0	0	0	0	3807	447.9						
16-Oct	8.75	0	662	0	3	6	0	0	2	1	0	134	51	0	17	1	0	5004	265	1	0	0	0	2	0	0	0	0	0	67	4	0	3	0	0	0	0	1	6224	711.3						
17-Oct	9.00	0	1345	0	1	8	0	0	0	0	0	126	28	0	7	0	1	12666	22	0	0	0	0	0	0	0	5	0	0	0	36	0	0	1	0	0	0	0	14246	1582.9						
18-Oct	8.00	0	242	0	1	2	0	0	0	0	0	62	30	0	0	0	0	4437	6	0	0	0	0	2	0	0	0	0	0	21	1	0	0	0	0	0	0	0	4804	600.5						
19-Oct	8.00	0	509	0	4	7	0	0	0	0	0	18	11	0	3	0	0	143	15	0	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	3	726	90.8							

Appendix D. continued

DATE	HOURS											SPECIES ¹																				BIRDS												
	OBSERV.	BV	TV	UV	OS	NH	HK	SK	WK	MK	UK	SS	CH	NG	UA	HH	RS	BW	SW	WT	ZT	ST	CB	RT	FH	RL	UB	GE	BE	UE	CC	AK	ML	PR	PG	AF	SF	LF	UF	UU	TOTAL	/HOUR		
20-Oct	7.00	2	42	0	0	1	0	0	0	0	0	2	7	0	1	0	0	4	1	1	0	0	0	1	0	0	0	0	0	0	1	0	0	0	2	0	0	0	0	3	68	9.7		
21-Oct	7.00	0	159	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	0	0	0	0	0	0	0	0	0	0	160	22.9
22-Oct	7.00	0	4334	0	0	12	0	0	0	0	0	30	34	0	6	0	0	20	40	0	0	0	2	0	0	1	0	0	0	17	2	0	1	0	0	0	0	5	4504	643.4				
23-Oct	8.00	0	2615	0	1	7	0	0	0	0	0	47	45	0	4	0	3	82	240	1	0	0	3	0	0	5	1	0	0	1	8	0	1	0	0	0	0	8	3072	384.0				
24-Oct	8.00	0	1707	0	2	7	0	0	0	0	0	50	53	0	9	0	1	20	8	1	0	0	1	0	0	1	0	0	0	16	3	0	1	0	0	0	0	3	1883	235.4				
25-Oct	5.00	0	30	0	0	6	0	0	0	0	0	0	3	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	41	8.2			
26-Oct	2.50	0	195	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	200	80.0		
27-Oct	8.00	0	1085	0	0	21	0	0	0	0	0	15	9	0	3	0	1	14	4	0	0	0	4	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1159	144.9		
28-Oct	7.00	0	454	0	1	1	0	0	0	0	0	9	3	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	472	67.4		
29-Oct	7.00	5	50	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	60	8.6			
30-Oct	8.00	90	400	0	0	46	0	0	0	0	0	52	45	0	3	0	2	19	8	0	0	0	6	0	0	1	0	0	0	30	1	0	4	0	0	0	0	1	708	88.5				
31-Oct	7.50	1	764	0	1	11	0	0	0	0	0	9	11	0	1	0	1	5	8	1	0	0	4	1	0	2	0	0	0	6	1	0	1	0	0	0	0	0	828	110.4				
01-Nov	8.00	11	365	0	1	11	0	0	0	0	0	23	14	0	2	0	0	4	5	0	0	0	2	0	0	1	0	0	0	6	0	0	2	0	0	0	0	0	0	447	55.9			
02-Nov	7.50	0	268	0	1	2	0	0	0	0	0	12	17	0	3	1	0	2	4	0	0	0	5	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	1	320	42.7			
03-Nov	7.50	0	303	0	0	4	0	0	0	0	0	2	4	0	1	0	1	3	2	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	323	43.1			
04-Nov	7.50	0	1013	0	1	1	0	0	0	0	0	6	3	0	4	0	0	1	0	0	0	0	2	0	0	1	0	0	0	2	1	0	0	0	0	0	0	0	1	1036	138.1			
05-Nov	7.50	0	580	0	0	2	0	0	0	0	0	2	6	0	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	595	79.3			
06-Nov	7.00	0	362	0	2	3	0	0	0	0	0	8	11	0	2	0	0	1	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	394	56.3		
07-Nov	7.50	0	41	0	0	0	0	0	0	0	0	10	8	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	64	8.5			
08-Nov	1.50	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	0	0	0	0	0	0	0	0.0
09-Nov	7.50	2	145	0	1	1	0	0	1	0	0	3	5	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	158	21.1		
10-Nov	7.00	0	399	0	2	2	0	0	0	0	0	5	4	0	0	0	0	0	2	1	0	0	4	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	1	423	60.4			
11-Nov	7.50	2	190	0	0	5	0	0	0	0	0	2	4	0	0	0	0	1	0	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	209	27.9			
12-Nov	7.50	0	66	0	0	0	0	0	0	0	0	4	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	73	9.7		
13-Nov	7.00	20	71	0	1	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	0	93	13.3		
14-Nov	7.50	2	62	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	0	0	0	0	0	0	0	0	65	8.7		
15-Nov	7.00	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	0	0	0	0	0	0	0	0	0	0	16	2.3		
Total	581.50	245	21018	0	253	282	0	23	7	17881	0	1621	1076	0	149	6	17	403171	4791	18	7	1	0	79	3	0	153	3	1	0	4	869	81	4	286	1	14	3	2	106	452175	777.6		

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: 1997–2009.

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	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	1-Aug	15-Aug	11-Aug
End date	15-Nov	15-Nov	15-Nov	15-Nov	15-Nov	15-Nov	15-Nov	15-Nov	15-Nov	15-NOV	15-NOV	15-Nov	15-Nov	15-Aug
Observation days	89	83	90	91	93	89	86	93	92	93	106	107	92	93
Observation hours	725.00	585.50	719.75	728.58	723.50	676.50	643.00	701.00	715.75	704.50	798.75	830.42	688.00	710.79
SPECIES	RAPTOR COUNTS													
Black Vulture	431	138	1,398	491	222	470	241	1,016	445	893	309	326	245	510
Turkey Vulture	11,221	5,011	30,027	36,690	4,870	42,536	22,900	17,750	19,090	29,115	46,503	28,530	21,018	24,251
Unidentified vulture	0	0	0	0	0	0	0	9	0	0	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	28,856	21,263	24,760
Osprey	81	179	181	88	114	146	199	207	241	321	237	197	256	188
Northern Harrier	93	180	331	153	162	109	100	101	157	614	223	219	282	210
Hook-billed Kite	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Swallow-tailed Kite	7	6	31	0	37	57	22	34	56	99	168	349	183	81
White-tailed Kite	4	6	6	2	2	2	1	2	9	8	1	14	7	5
Mississippi Kite	2,974	3,584	5,513	4,569	10,155	8,394	9,753	4,441	10,004	14,073	27,285	21,050	23,114	11,147
TOTAL KITES	2,985	3,596	5,550	4,571	10,194	8,453	9,776	4,477	10,069	14,180	27,454	21,413	23,304	11,232
Sharp-shinned Hawk	936	1,208	1,348	929	698	1,869	1,193	892	880	1,643	1,725	1,927	1,621	1,298
Cooper's Hawk	418	260	1,092	555	473	645	1,083	483	815	1,719	1,222	1,308	1,078	858
Northern Goshawk	0	0	1	0	0	1	0	0	0	2	3	0	0	1
Unidentified accipiter	308	316	310	379	298	108	344	252	174	290	217	264	149	262
TOTAL ACCIPITERS	1,662	1,784	2,751	1,863	1,767	2,649	2,620	1,627	1,869	3,654	3,167	3,499	2,848	2,418
Common Black Hawk	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Harris's Hawk	5	5	28	10	14	10	6	23	25	39	7	18	6	15
Red-shouldered Hawk	79	38	77	81	45	92	26	24	37	101	15	42	17	52
Broad-winged Hawk	823,602	970,025	640,258	396,774	864,355	464,772	684,815	989,957	263,101	767,730	569,839	370,088	403,192	631,424
Short-tailed Hawk	0	0	2	0	0	0	0	1	4	2	1	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	26,093	4,792	7,142
White-tailed Hawk	4	5	13	0	7	4	6	19	25	39	33	50	19	17
Zone-tailed Hawk	2	0	6	0	1	2	7	2	10	7	22	11	8	6
Red-tailed Hawk	112	121	282	237	96	182	192	180	103	363	122	126	80	169
Ferruginous Hawk	1	0	14	1	1	2	1	2	5	8	3	8	3	4
Rough-legged Hawk	1	0	4	0	0	0	0	0	0	0	0	0	0	0
Unidentified buteo	18	25	62	215	368	80	71	53	34	79	67	105	154	102
TOTAL BUTEOS	824,124	977,009	641,992	399,403	879,147	473,057	690,757	1,005,012	264,691	775,593	570,521	396,543	408,272	638,932
Golden Eagle	1	0	4	1	1	1	2	1	2	2	1	2	3	2
Bald Eagle	0	2	4	0	2	1	1	3	4	5	7	10	1	3
Unidentified eagle	0	0	1	0	0	0	0	0	0	0	0	1	0	0
TOTAL EAGLES	1	2	9	1	3	2	3	4	6	7	8	13	4	5
Crested Caracara	9	1	18	4	21	12	21	3	11	20	13	7	4	11
American Kestrel	189	438	483	509	292	811	860	365	485	1,137	850	1,127	869	647
Merlin	25	29	34	31	26	18	57	32	36	50	82	96	81	46
Prairie Falcon	8	5	33	6	7	4	15	2	3	10	7	8	4	9
Peregrine Falcon	76	163	241	65	114	176	169	144	230	309	247	205	289	187
Aplomado Falcon	0	0	1	0	0	0	1	0	1	1	4	2	2	1
Unknown small falcon ¹	-	-	-	-	-	4	5	4	1	2	6	6	14	5
Unknown large falcon ¹	-	-	-	-	-	5	9	0	0	2	9	4	3	4
Unidentified falcon	14	39	92	103	41	25	47	11	5	15	2	7	2	29
TOTAL FALCONS	312	674	884	714	480	1,043	1,163	554	761	1,526	1,207	1,455	1,264	924
Unidentified raptor	220	4,376	3,874	506	837	98	133	89	35	135	120	211	110	826
GRAND TOTAL	841,139	992,950	687,015	444,484	897,519	528,540	727,900	1,030,849	297,375	826,058	649,762	452,414	457,607	679,509

¹ Designations used consistently for the first time in 2002.