# FALL 2006 RAPTOR MIGRATION STUDY AT SMITH POINT, TEXAS


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

**Gulf Coast Bird Observatory**
**Lake Jackson, Texas**


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## INTRODUCTION

The Smith Point 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). The project is a collaborative venture between HawkWatch International (HWI), Gulf Coast Bird Observatory (GCBO), and Texas Parks and Wildlife (site managers). During fall 2006, HWI and GCBO conducted the 10th consecutive standardized, full-season migration count at this site on Galveston Bay. Since 1997, 24 species of raptors have been observed migrating through the area, with annual counts ranging from ~26,000 to 115,000 migrants. This report summarizes the 2006 count results.

## STUDY SITE

The Smith Point project site is located on the Candy Abshier Wildlife Management Area administered by Texas Parks and Wildlife (29°31'39"N, 94°45'54"W; Figure 1). The site is near the southern tip of Chambers County on the east side of State Route 562 where it intersects the management area, approximately 50 km southeast of Houston. The observers work from atop a 7-m tower situated at the southwestern tip of a sharply tapering peninsula that juts into Galveston Bay. The terrain is predominantly coastal marsh, interspersed with weedy, fallow fields and oak mottes. Trinity Bay borders the peninsula to the north. East Bay borders the peninsula to the southeast, separated from the Gulf of Mexico by a long barrier island called the Bolivar Peninsula. Some birds migrating to the southwest along the Gulf of Mexico probably continue down the Bolivar Peninsula. A larger portion of the flight follows the mainland until it tapers towards Smith Point. On days with favorable winds, many migrants proceed directly from Smith Point across the bay to Eagle Point, the nearest landfall to the west about 12 km away, or head to the southwest across the bay towards the tip of Bolivar Peninsula. When winds are less favorable, many migrants retreat back to the east or northeast after reaching Smith Point, some returning later to try the crossing under more favorable conditions and others heading to the northwest around Trinity Bay.

## METHODS

Two primary full-time observers assisted by several other trained volunteers, conducted daily counts of the raptor migration through the area from a single traditional observation platform. This was the fifth full-season of migration counting experience for Lead Observer Johannes Van Dort, and Assistant Observer Heidi Trudell had volunteered at the site in previous seasons (see Appendix A for a history of observer participation). Trained local volunteers, which this year included Bill Saulmon, Dick Benoit, Winnie Burkett, and Debbie McWhorter, periodically assisted as supplemental and substitute observers, as has been the case since the project's inception. GCBO monitoring coordinator John Arvin and HWI Conservation Science Director Jeff Smith and Field Studies Coordinator Mike Neal also assisted with the count at various times during the season.

The flight lines at Smith Point generally follow the shorelines, which trend east–west (Figure 1). The observers recorded all birds seen heading to the southwest, west, or northwest as migrants, but did not count birds heading to the northeast. Migrants often retreat when faced with crossing the bay and poor weather, but it is highly likely that many make repeated attempts to cross. Thus, double counting undoubtedly occurs and it is therefore best to consider counts at this site an activity index rather than a count of distinct individuals.

Weather permitting, observations usually began between 0600 and 0800 hrs and ended between 1400 and 1600 hrs Central Standard Time (CST). The observers routinely recorded the following data:

1. Species, age, sex, and color morph of each migrant raptor, whenever possible and applicable (Appendix B lists common and scientific names for all species, information about the applicability of

age, sex, and color morph distinctions, and two-letter codes used to identify species in some tables and figures).

2. Hour of passage for each migrant; e.g., the 1000–1059 hrs CST.
3. Wind speed and direction, air temperature, percent cloud cover, predominant cloud type(s), presence or of precipitation, visibility, and an assessment of thermal-lift conditions, recorded for each hour of observation on the half hour.
4. Predominant direction, altitude, and distance from the lookout of the flight during each hour.
5. Total minutes observed and the mean number of observers present during each hour (included designated observers plus volunteers/visitors who actively contributed to the count [active scanning, pointing out birds, recording data, etc.] for more than 10 minutes in a given hour), recorded on the hour.
6. A subjective visitor-disturbance rating for each hour, recorded on the hour.
7. Daily start and end times for each official observer.

Calculation of "adjusted" (to standardize sampling periods and adjust for incompletely identified birds) passage rates (migrants counted per 100 hours of observation) and analysis of trends follows Hoffman and Smith (2003). In comparing 2006 annual statistics against means and 95% confidence intervals for previous seasons, we equate significance with a 2006 value falling outside the bounds of the confidence interval for the associated mean.

## RESULTS AND DISCUSSION

### WEATHER

This year, despite a mild hurricane season, inclement weather hampered observations more than usual, precluding at least 1 full day of observations in mid-October (2 other days missed around this time, but records uncertain as to reason) and reducing observation time to ≤4 hours on 8 other days (see Appendix C for daily weather records). The 1997–2005 averages for the site are 1.9 and 3.9 days, respectively. Otherwise, generally fair skies predominated on 40% of the active observation days, transitional weather (i.e., skies changed from fair to mostly cloudy/overcast, or vice versa, during the day) on 34%, and mostly cloudy to overcast skies on 27%. The comparative averages for these variables are 46%, 28%, and 26%, respectively, indicating that, transitional weather prevailed more often than usual in 2006. However, visibility reducing fog and especially haze occurred on only 9% of the active observation days, which is considerably lower than the long-term average of 30%, and dissimilar to the past two years. Thundershowers and rain occurred during some portion of 16% of the active observation days, which is significantly less than the long-term average of 23%.

The wind-speed conditions at the site in 2006 appeared calmer than average, showing a significant shift toward lighter winds. Light winds (≤12 kph) prevailed on a record high 93% of the active observation days, moderate winds (12–28 kph) on a record low 5%, and stronger winds on 2%. The comparative 1997–2005 averages are 71% light, 28% moderate, and 2% strong. The shift toward lighter winds is a pattern similar to that shown since 2001, but differs from the pattern shown from 1997–2000 when light winds prevailed on only 41–65% of the active days. In terms of wind directions, the norm at Smith Point is high variability. From 1997–2005, the most common wind direction patterns were variable N–E (on average, prevailing on 20% of the active observation days), E–S (19%), NE–SE (12%), SE–SW (7%), NW–NE (6%), and days where a distinct shift from NW–NE to SE–SW winds occurred (6%). Noteworthy differences in 2006 included more than twice the usual proportion of days with prevailing S–W winds (13% of days), and above average portions of days where SW–NW winds interspersed with periods of calm/variable winds (3%) and days with over calm/variable winds (3%) prevailed.

The temperature during active observation periods averaged 27.3°C (average of daily values, which in turn were averages of hourly readings), ranging from 16–34°C. The average value is 1.4 degrees higher than the long-term average, and the low was a near record high for the site. The barometric pressure during active observation periods averaged 29.94 in Hg (the average of daily values, which in turn were averages of hourly readings), ranging from 29.67–30.30°C. In 2006, 66% of the active observation days received a median (of hourly ratings) thermal-lift rating of fair to poor, which is the second highest proportion recorded for the project (1997–2005 average of 57%, range 39–72%).

In summary, regular electrical storms partially precluded observations for a near record high 8 days in 2006. Otherwise, the weather during active observation periods was generally fairer, warmer, and clearer than usual, but even with lighter winds prevailing the observers' subjective ratings suggested that thermal activity was poorer than average. A slight but nonetheless distinct shift in wind directions also occurred in 2006, with S–W (quartering to head winds for migrants), SW–NW with a calm/variable component, and overall calm/variable winds each more than twice as common as usual.

### OBSERVATION EFFORT

The observers logged 86 days and 637.52 hours of observation between 15 August and 11 November 2006. The season was curtailed 4 days earlier than usual to accommodate the Lead Observer's international travel needs. The numbers of observation days and hours were a significant 6% and 16% lower than average, respectively. The number of observers averaged 1.8 per hour in 2006, which is a non-significant 10% below the 1997–2005 average of 1.9 ± 95% CI of 0.92 observers/hour.

### MIGRATION SUMMARY

The observers tallied 57,851 migrant raptors of 21 species during the 2006 season, which is a non-significant 13% above the 1997–2005 average total count (Table 1, and see Appendix D for daily count records). As usual, buteos, accipiters, and kites were the predominant species groups; however, with Broad-winged Hawks excluded, the relative proportion of eagles was double the average, whereas the proportions of vultures, accipiters, kites, falcons, and other miscellaneous species (Ospreys and Northern Harriers) were all significantly below average (Figure 2). Species that accounted for 1% or more of the total count included Broad-winged Hawk (86% – record high proportion), Mississippi Kite (6%), Sharp-shinned Hawk (2%), Turkey Vulture (2%), and American Kestrel (2%). Highlights of the season included a likely sighting of a single distant Rough-legged Hawk, which has only been recorded at the site in two years since full-season counts began, and not since 2001, and only the sixth Golden Eagle ever recorded at the site since 1997 (last one in 2000).

## Interannual Count Trends and Regional Comparisons

Record high counts occurred in 2006 for Ospreys, Harris's Hawks, and Bald Eagles, whereas record low counts occurred for Sharp-shinned, Cooper's, and Red-shouldered Hawks (see Appendix E for annual count summaries). The Broad-winged Hawk count (49,527) was the third highest on record and 28% above the 1997–2005 average; however, this increase was not significant, reflecting high interannual variability in counts of this species (Table 1).

Adjusted passage rates were below average for 10 of 18 commonly observed species, with the differences significant for Black and Turkey Vultures, and Sharp-shinned, Cooper's, Red-shouldered, Swainson's and Red-tailed Hawks (Table 1). In contrast, adjusted passage rates were significantly above average for Ospreys, Northern Harriers, Harris's Hawks, Broad-winged Hawks, Merlins, and Peregrine Falcons.

After 10 years of data collection, for the first time we also statistically analyzed adjusted passage rates to discern long-term trends. At least marginally significant ($P \leq 0.10$) increasing trends were indicated for Ospreys, Swallow-tailed and Mississippi Kites, White-tailed Hawks, Crested Caracaras, and Peregrine Falcons (Figures 3–9). The only species for which at least a marginally significant decreasing trend was

indicated was the Sharp-shinned Hawk (Figure 4). No significant long-term trends were indicated for any other species.

Elsewhere in coastal Texas, the overall count at Corpus Christi of 826,058 migrants was a non-significant 15% higher than the 1997–2005 average (Smith and Neal 2007). Both Texas sites tallied record high counts of Ospreys, Harris' Hawks, and Bald Eagles in 2006, whereas Corpus Christi also noted record high counts for 11 of the remaining 24 species. 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 Turkey Vultures, Ospreys, Mississippi and Swallow-tailed Kites, and Peregrine Falcons; both have shown at least recent increasing patterns for White-tailed Hawks; and both have generally shown increasing patterns for Swainson's Hawks (the count at Smith Point was low in 2006, while the count at Corpus Christi rebounded above average). Species that are currently showing noticeably divergent patterns at the two sites include Sharp-shinned and Cooper's Hawks (recent declining trend at Smith Point; overall stable–increasing pattern at Corpus Christi), American Kestrels (slight increasing trend at Corpus Christi; stable pattern at Smith Point), and Crested Caracaras (overall stable pattern at Corpus Christi; strong increasing pattern at Smith Point).

Elsewhere around the Gulf Coast, in the Florida Keys the total southbound count was 21% below average and was the second lowest combined-species total to date (HWI unpublished data). The only species for which counts were above average were Bald Eagle, Red-shouldered Hawk, Short-tailed Hawk, and Peregrine Falcon. Record low counts were observed for both American Kestrels and Merlins. Nevertheless, unlike last year, thankfully the crew was spared from experiencing another severe hurricane season. This also undoubtedly contributed to improved counts for most species, after last year's count fell more than 40% below average presumably in large part due to the effects of three major hurricanes keeping birds from proceeding down into Florida.

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

## Age Ratios

Five of 8 species for which comparisons of immature : adult ratios were possible showed significantly below average age ratios in 2006, though low proportions of aged birds and/or substantial variation in those proportions across years preclude attaching great importance to age-ratio data for most species, especially Sharp-shinned Hawks, Broad-winged Hawks, and Mississippi Kites (Table 2). Such problems reflect the fact that consistent tracking of age and sex-specific details is difficult when overall flight volume is as high as it is at Smith Point. Age ratios for Mississippi Kites and Sharp-shinned, Cooper's, Red-shouldered, and Broad-winged Hawks were significantly below average, but the proportions of unaged Sharp-shinned, Cooper's, and Red-shouldered Hawks were significantly above average (Table 2), indicating that a decreased degree of confidence can be assigned to those comparisons. For all species, except Broad-winged Hawks, the low 2006 age ratios were due to marked decreases in the numbers of identified immature birds. For Broad-winged Hawks, the number of identified immatures was low but the number of identified adults was also high. Thus for most species, the 2006 low age ratios may reflect, at least in part, declines in abundance due to low juvenile recruitment. For Broad-winged Hawks, however, the indication of a low age ratio may also reflect the influence of good adult survival during the past year.

## Seasonal Timing

The 2006 median passage date for Broad-winged Hawks of 25 September matched the 1997–2005 average (Table 3). Examination of the overall seasonal activity pattern with Broad-winged Hawks included showed an unusually high activity spike during the 22–25 September five-day period, immediately following a period of scattered rain showers (Figure 7). In contrast, examination of the combined-species seasonal activity pattern with Broad-winged Hawks excluded, and further examination of other species-specific patterns, indicated a high activity spike during the 16–21 September five-day period, suggesting a pre-showers surge in activity. Among commonly encountered species, four showed significantly early median passage dates in 2006, four showed significantly late timing, and 11 showed median passage dates that were within normal ranges of variation (6 slightly earlier than average and 5 slightly later than average; Table 3). Further examination of age-specific data for 10 species revealed no other clear multi-species patterns, but for most species must be considered lightly due to generally low proportions of aged birds (Table 4).

### Resident and Local Raptor Activity

Distinguishing "resident" from migrating raptors can be a tough challenge at Smith Point for several reasons. The habitat on the Smith Point peninsula provides abundant and diverse foraging options for a variety of species, hosts diverse resident raptor populations during both summer and winter, and provides valuable stopover habitat for many other individuals and species. This means that the resident population is generally diverse and, especially during migration seasons, ever changing with mixes of permanent residents, summer residents that depart during the fall season, winter residents that arrive during the season, and a wide range of shorter-term transients. In addition, movement dynamics at the end of the peninsula where the count site is located can be highly complex due to the water-crossing wariness of most raptor species. To help track local activities and patterns, the observers keep detailed journals of their observations of birds recorded as residents, relying on behavioral clues, recognition of common patterns, and in some cases distinct plumage characteristics to distinguish resident from migrating birds.

In 2006, resident Broad-winged, Red-shouldered, White-tailed, Harris's, and Red-tailed Hawks were recorded throughout the season. Immature Red-shouldered, Red-tailed, and Broad-winged Hawks were noted as locals most days, although sightings of local Broad-winged Hawks thinned out considerably by early October. Adult Red-tailed and Broad-winged Hawks were recorded as locals regularly throughout the season, whereas adult White-tailed and Harris's Hawks were not documented as locals until mid-October.

Transient Mississippi Kites that remained in the area for a couple of days were recorded on a few occasions from late September through mid-October. Single transient White-tailed Kites were recorded in mid and late October, and showed evidence of setting up in the local area for the winter.

Local Cooper's Hawks were commonly recorded throughout the season. This species is particularly abundant at Smith Point, with the adjacent oak mottes routinely harboring >10 local Cooper's Hawk's, mostly immature birds. Locals tended to stay low and hunt passerines. Over-wintering Sharp-shinned Hawks, both adults and immatures, were so abundant at the site after mid-September that one or more birds could be seen just about any time at the watch site. Most of the time, these local birds stayed low, hunting the oak mottes in the area. On some days (late September through early October), local sharpies were observed soaring at very high altitudes, acting as migrants. Careful tracking of these birds showed them to be locals, however.

A few sightings of transient local American Kestrels occurred in mid-October, but by late October, it appeared that several birds had taken up winter residence in the area. At least one adult and one immature Peregrine Falcon were seen interacting and frequenting the area in early October.

Many Northern Harriers were recorded as locals throughout the season. At least two distinct individual Ospreys were recorded as locals throughout October and November. As usual, resident Black and Turkey Vultures were present throughout the season; however, the observers did not record specific numbers. As usual, a large roost was present a few miles north of the observation site.

### VISITOR PARTICIPATION AND PUBLIC OUTREACH

Documented visitation in 2006 totaled an estimated 697 individuals, including some repeats. This total is slightly below average; however, a number of individuals participated in the special open-house event that GCBO coordinated at the site in October and many of these folks were not recorded on the official visitor logs. Documented visitors originated in 10 states besides Texas, but visitors from other countries were not represented in 2006.

In 2006, 641 hourly assessments by the observers of visitor disturbance resulted in the following ratings: 91% none, 8% low, 1% moderate, and 0% high. This low level of disturbance testifies to the advantages of having GCBO staff and several additional knowledgeable and dedicated local volunteers available at most times to facilitate visitor interactions and ensure enjoyable and informative visits for all guests without unnecessarily distracting the official observers from documenting the migration.

## ACKNOWLEDGMENTS

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**Table 1. Annual raptor migration counts and adjusted (truncated to standardized annual sampling periods and adjusted for incompletely identified birds) annual passage rates by species in at Smith Point, TX: 1997–2005 versus 2006.**

| | COUNTS | | | RAPTORS/100 HOURS | | |
|---|---|---|---|---|---|---|
| SPECIES | 1997–2005[1] | 2006 | % CHANGE | 1997–2005[1] | 2006 | % CHANGE |
| Black Vulture | 177 ± 94.2 | 71 | -60 | 34.6 ± 10.7 | 3.5 | -90 |
| Turkey Vulture | 1,529 ± 559.7 | 1,002 | -34 | 451.0 ± 97.8 | 78.2 | -83 |
| TOTAL VULTURES | 1,707 ± 629.0 | 1,073 | -37 | – | – | – |
| Osprey | 65 ± 8.5 | 93 | +43 | 11.0 ± 0.9 | 14.4 | +32 |
| Northern Harrier | 331 ± 86.9 | 385 | +16 | 55.3 ± 8.4 | 88.1 | +59 |
| Hook-billed Kite | 0.1 ± 0.2 | 0 | -100 | – | – | – |
| Swallow-tailed Kite | 83 ± 29.4 | 80 | -3 | 26.1 ± 5.5 | 26.9 | +3 |
| White-tailed Kite | 11 ± 5.8 | 8 | -24 | – | – | – |
| Mississippi Kite | 4,325 ± 1,428.1 | 3,682 | -15 | 1,448.6 ± 320.0 | 1,191.7 | -18 |
| TOTAL KITES | 4,425 ± 1,444.5 | 3,767 | -15 | – | – | – |
| Sharp-shinned Hawk | 2,917 ± 758.7 | 1,295 | -56 | 714.0 ± 106.4 | 564.4 | -21 |
| Cooper's Hawk | 1,126 ± 102.3 | 305 | -73 | 189.2 ± 13.2 | 66.7 | -65 |
| Unknown accipiter | 56 ± 39.1 | 14 | -75 | – | – | – |
| TOTAL ACCIPITERS | 4099 ± 834.8 | 1,614 | -61 | – | – | – |
| Harris' Hawk | 1 ± 0.7 | 4 | +620 | 0.1 ± 0.1 | 1.0 | +629 |
| Red-shouldered Hawk | 47 ± 12.8 | 22 | -53 | 6.5 ± 1.0 | 2.8 | -57 |
| Broad-winged Hawk | 38,648 ± 18,442.2 | 49,527 | +28 | 9,320.4 ± 2,662.9 | 17,277.4 | +85 |
| Swainson's Hawk | 299 ± 191.3 | 201 | -33 | 41.0 ± 14.9 | 11.5 | -72 |
| White-tailed Hawk | 11 ± 5.8 | 8 | -24 | 1.6 ± 0.5 | 1.9 | +17 |
| Red-tailed Hawk | 141 ± 70.0 | 88 | -38 | 19.7 ± 5.3 | 5.5 | -72 |
| Ferruginous Hawk | 1 ± 0.6 | 0 | -100 | – | – | – |
| Rough-legged Hawk | 1 ± 0.7 | 0 | -100 | – | – | – |
| Unidentified buteo | 21 ± 17.4 | 1 | -95 | – | – | – |
| TOTAL BUTEOS | 39,168 ± 18,455.7 | 49,851 | +27 | – | – | – |
| Golden Eagle | 1 ± 0.7 | 1 | +80 | – | – | – |
| Bald Eagle | 3 ± 1.4 | 7 | +163 | – | – | – |
| Unknown eagle | 0 ± 0.2 | 0 | -100 | – | – | – |
| TOTAL EAGLES | 3 ± 1.6 | 8 | +140 | – | – | – |
| Crested Caracara | 10 ± 4.7 | 5 | -51 | 1.4 ± 0.3 | 1.2 | -11 |
| American Kestrel | 1,341 ± 248.6 | 916 | -32 | 286.6 ± 32.5 | 276.6 | -3 |
| Merlin | 58 ± 14.0 | 51 | -12 | 12.4 ± 1.6 | 18.7 | +50 |
| Peregrine Falcon | 89 ± 11.5 | 85 | -4 | 18.8 ± 1.6 | 27.9 | +49 |
| Unknown falcon | 8 ± 4.9 | 2 | -75 | – | – | – |
| TOTAL FALCONS | 1,496 ± 247.4 | 1,054 | -30 | – | – | – |
| Unidentified raptor | 93 ± 103.4 | 1 | -99 | – | – | – |
| GRAND TOTAL | 51,397 ± 19,144.8 | 57,851 | +13 | – | – | – |

[1] Mean ± 95% confidence interval.

**Table 2. Fall counts by age class and immature : adult ratios for selected species of migrating raptors at Smith Point, TX: 1997–2005 versus 2006.**

| | Total and Age-classified Counts | | | | | | | | Immature : Adult | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1997–2005 Average | | | 2006 | | | % Unknown Age | | Ratio | |
| | Total | Imm. | Adult | Total | Imm. | Adult | 1997–2005[1] | 2006 | 1997–2005[1] | 2006 |
| Northern Harrier | 331 | 141 | 73 | 385 | 118 | 50 | 36±12.0 | 56 | 2.5 ± 1.11 | 2.4 |
| Swallow-tailed Kite | 83 | 11 | 14 | 80 | 0 | 0 | 77±18.4 | 100 | 1.2 ± 0.88 | – |
| Mississippi Kite | 4325 | 666 | 198 | 3682 | 509 | 228 | 69±20.8 | 80 | 11.1 ± 9.88 | 2.2 |
| Sharp-shinned Hawk | 2917 | 823 | 89 | 1295 | 56 | 44 | 67±13.2 | 92 | 10.5 ± 4.39 | 1.3 |
| Cooper's Hawk | 1126 | 355 | 71 | 305 | 21 | 14 | 62±14.2 | 89 | 5.0 ± 1.63 | 1.5 |
| Red-shouldered Hawk | 47 | 17 | 3 | 22 | 4 | 1 | 55±19.7 | 77 | 9.9 ± 8.80 | 4.0 |
| Broad-winged Hawk | 38648 | 1112 | 183 | 49527 | 336 | 315 | 97±1.9 | 99 | 4.7 ± 2.20 | 1.1 |
| Red-tailed Hawk | 141 | 44 | 38 | 88 | 26 | 25 | 34±16.9 | 42 | 1.1 ± 0.36 | 1.0 |
| Peregrine Falcon | 89 | 8 | 19 | 85 | 21 | 39 | 70±20.7 | 29 | 0.5 ± 0.28 | 0.5 |

[1] Mean ± 95% confidence interval. For age ratios, note that long-term mean immature : adult ratios are averages of annual ratios and may differ from values obtained by dividing average numbers of immatures and adults. Discrepancies in the two values reflect high annual variability in the observed age ratio.

**Table 3. First and last observed, bulk-passage, and median-passage dates by species for migrating raptors at Smith Point, TX in 2006, with a comparison of 2006 and 1997–2005 average median passage dates.**

| | 2006 | | | | 1997–2005 |
|---|---|---|---|---|---|
| Species | First Observed | Last Observed | Bulk Passage Dates[1] | Median Passage Date[2] | Median Passage Date[2, 3] |
| Black Vulture | 26-Sep | 11-Nov | 11-Oct – 7-Nov | 2-Nov | 22-Oct ± 6.1 |
| Turkey Vulture | 3-Oct | 11-Nov | 20-Oct – 11-Nov | 1-Nov | 27-Oct ± 4.1 |
| Osprey | 16-Aug | 4-Nov | 13-Sep – 23-Oct | 4-Oct | 28-Sep ± 3.6 |
| Northern Harrier | 21-Aug | 11-Nov | 19-Sep – 1-Nov | 2-Oct | 17-Oct ± 4.4 |
| Swallow-tailed Kite | 16-Aug | 24-Sep | 17-Aug – 9-Sep | 20-Aug | 27-Aug ± 3.4 |
| White-tailed Kite | 2-Oct | 9-Nov | 2-Oct – 9-Nov | 7-Oct | 06-Oct ± 10.5 |
| Mississippi Kite | 17-Aug | 13-Oct | 30-Aug – 20-Sep | 6-Sep | 04-Sep ± 4.0 |
| Sharp-shinned Hawk | 1-Sep | 11-Nov | 25-Sep – 27-Oct | 2-Oct | 05-Oct ± 4.4 |
| Cooper's Hawk | 16-Aug | 11-Nov | 13-Sep – 1-Nov | 4-Oct | 07-Oct ± 3.5 |
| Harris's Hawk | 15-Sep | 28-Oct | – | – | – |
| Red-shouldered Hawk | 30-Aug | 6-Nov | 12-Sep – 28-Oct | 5-Oct | 20-Sep ± 8.7 |
| Broad-winged Hawk | 16-Aug | 11-Nov | 25-Sep – 1-Nov | 25-Sep | 25-Sep ± 4.0 |
| Swainson's Hawk | 16-Aug | 11-Nov | 12-Sep – 2-Nov | 20-Oct | 19-Oct ± 3.8 |
| White-tailed Hawk | 24-Aug | 1-Nov | 24-Aug – 1-Nov | 5-Oct | 30-Sep ± 19.0 |
| Red-tailed Hawk | 22-Aug | 11-Nov | 3-Oct – 7-Nov | 31-Oct | 26-Oct ± 9.9 |
| Golden Eagle | 20-Oct | 20-Oct | – | – | – |
| Bald Eagle | 5-Oct | 11-Nov | 5-Oct – 11-Nov | 28-Oct | 27-Oct ± 22.5 |
| Crested Caracara | 18-Aug | 26-Sep | 18-Aug – 26-Sep | 12-Sep | 02-Oct ± 20.2 |
| American Kestrel | 19-Aug | 11-Nov | 20-Sep – 22-Oct | 3-Oct | 10-Oct ± 3.4 |
| Merlin | 15-Sep | 2-Nov | 20-Sep – 22-Oct | 29-Sep | 30-Sep ± 3.3 |
| Peregrine Falcon | 17-Aug | 1-Nov | 19-Sep – 11-Oct | 28-Sep | 02-Oct ± 1.6 |
| Total | 17-Aug | 11-Nov | 14-Sep – 6-Oct | 25-Sep | 25-Sep ± 4.0 |

[1] Dates between which the central 80% of the flight passed the lookout; calculated only for species with annual counts of ≥5 birds.

[2] Date by which 50% of the flight had passed the lookout; calculated only for species with annual counts of ≥5 birds.

[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 unless noted otherwise.

**Table 4. Median passage dates by age for selected species of migrating raptors at Smith Point, TX: 1997–2005 versus 2006.**

| | ADULT | | IMMATURE | |
|---|---|---|---|---|
| SPECIES | 1997–2005[1] | 2006 | 1997–2005[1] | 2006 |
| Northern Harrier | 29-Oct ± 4.5 | 13-Oct | 14-Oct ± 3.4 | 27-Sep |
| Mississippi Kite | 03-Sep ± 4.8 | 5-Sep | 12-Sep ± 4.0 | 8-Sep |
| Sharp-shinned Hawk | 19-Oct ± 6.6 | 1-Oct | 02-Oct ± 5.7 | 28-Sep |
| Cooper's Hawk | 21-Oct ± 12.1 | 13-Sep | 05-Oct ± 8.5 | 29-Sep |
| Broad-winged Hawk | 19-Sep ± 4.2 | 6-Sep | 23-Sep ± 9.6 | 6-Sep |
| Red-tailed Hawk | 17-Oct ± 16.7 | 20-Oct | 17-Oct ± 11.1 | 23-Oct |
| Bald Eagle | – | – | 08-Nov [2] | 28-Oct |
| Peregrine Falcon | 03-Oct ± 5.9 | 28-Sep | 03-Oct ± 10.7 | 28-Sep |

Note: Median passage dates are dates by which 50% of species/age-specific flights had passed; values are based only on annual counts ≥5 birds.

[1] Mean ± 95% confidence interval in days; values are given only for species with annual counts ≥5 birds for ≥3 years unless noted otherwise.

[2] Value for 2000 only.


**Figure 1. Location of the Smith Point Raptor Migration Project study site in southeast Texas.**

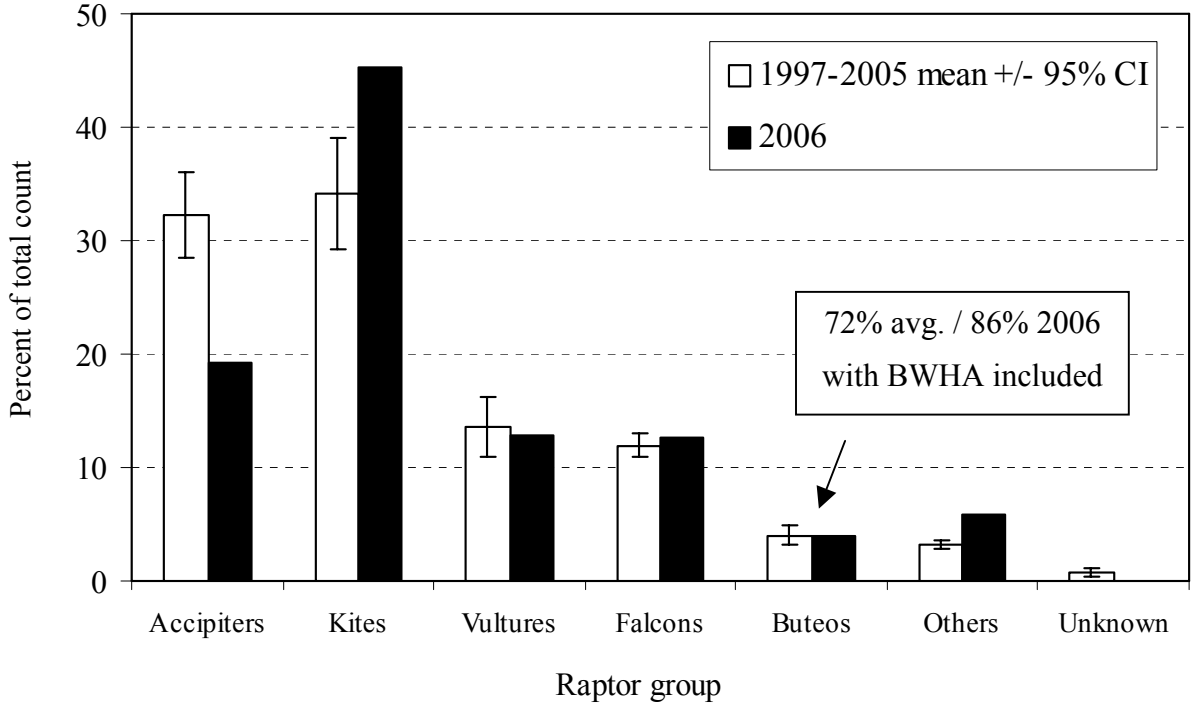


**Figure 2. Composition of autumn raptor migration by major species groups at Smith Point, Texas: 1997–2005 versus 2006.**

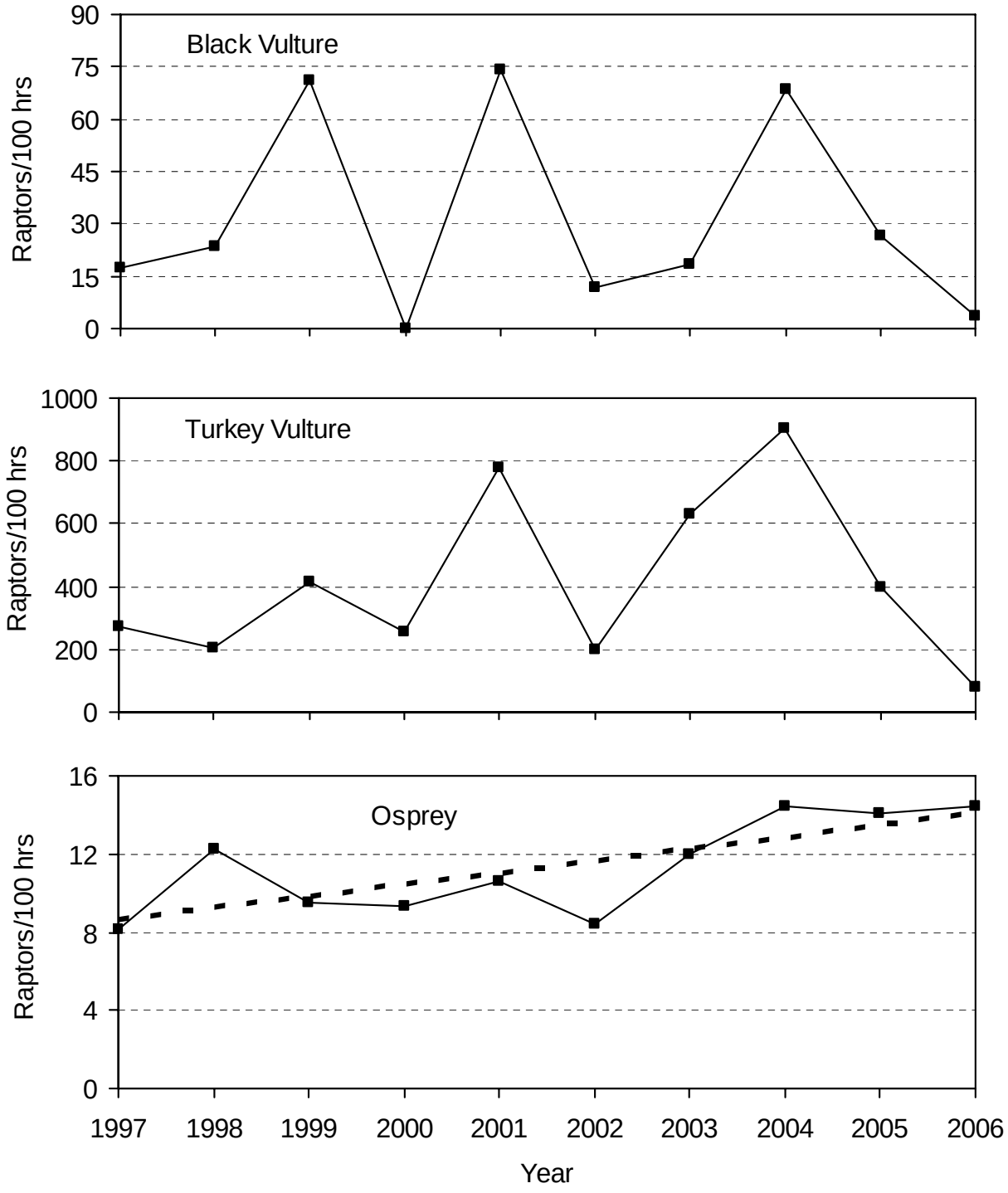


**Figure 3. Adjusted fall-migration passage rates at Smith Point, Texas for Black Vultures, Turkey Vultures, and Ospreys: 1997–2006. Dashed lines indicate significant ($P \leq 0.10$) linear or quadratic regressions.**

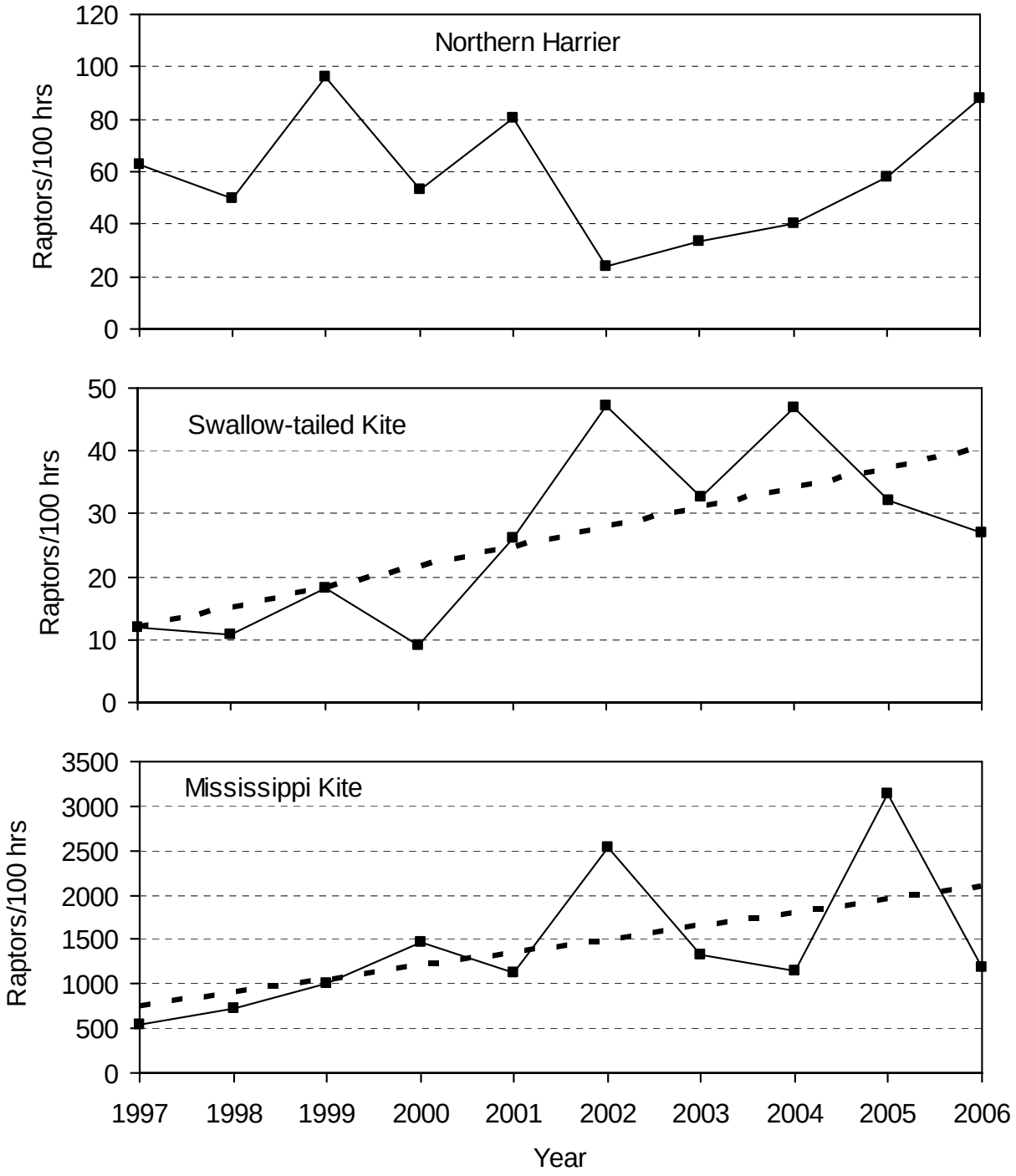


**Figure 4. Adjusted fall-migration passage rates at Smith Point, Texas for Northern Harriers, Swallow-tailed Kites, and Mississippi Kites: 1997–2006. Dashed lines indicate significant ($P \leq 0.10$) linear or quadratic regressions.**

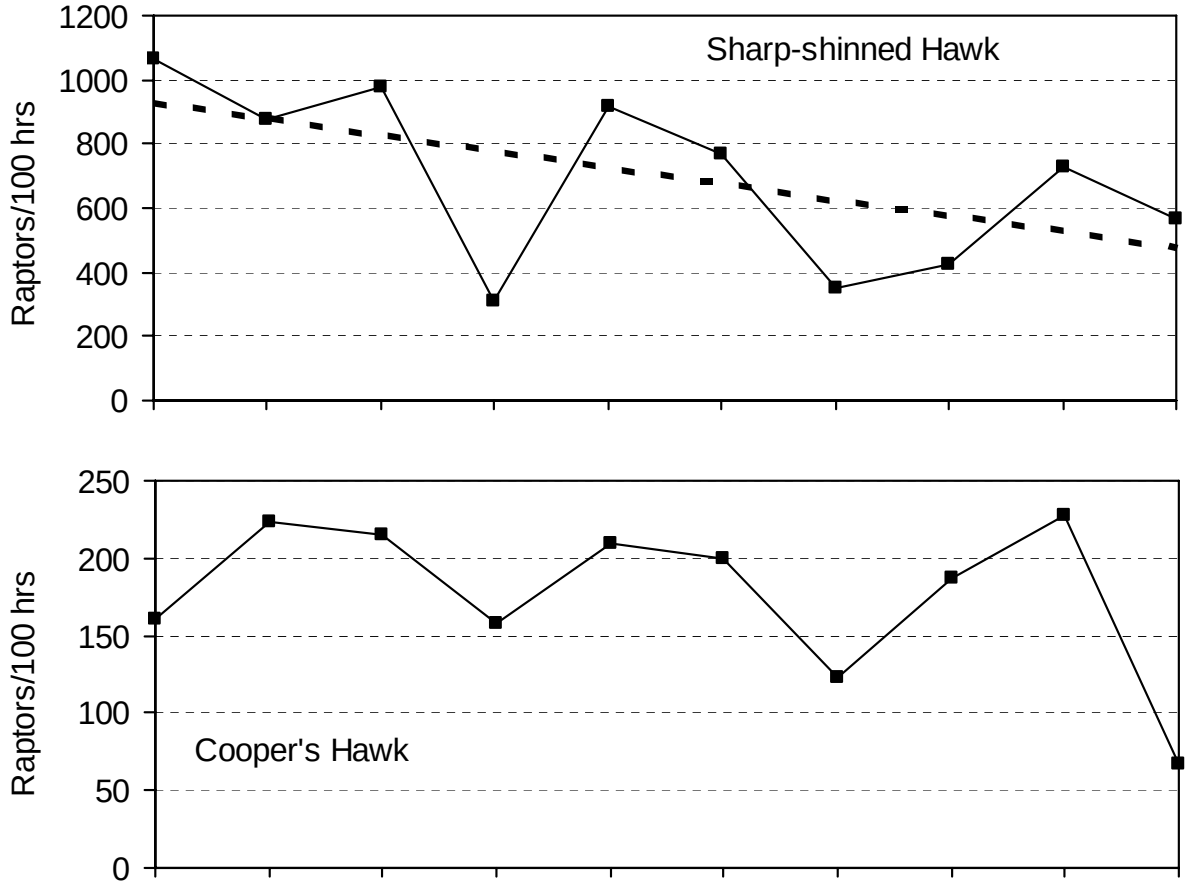


**Figure 5. Adjusted fall-migration passage rates at Smith Point, Texas for Sharp-shinned and Cooper's Hawks: 1997–2006. Dashed lines indicate significant ($P \leq 0.10$) linear or quadratic regressions.**

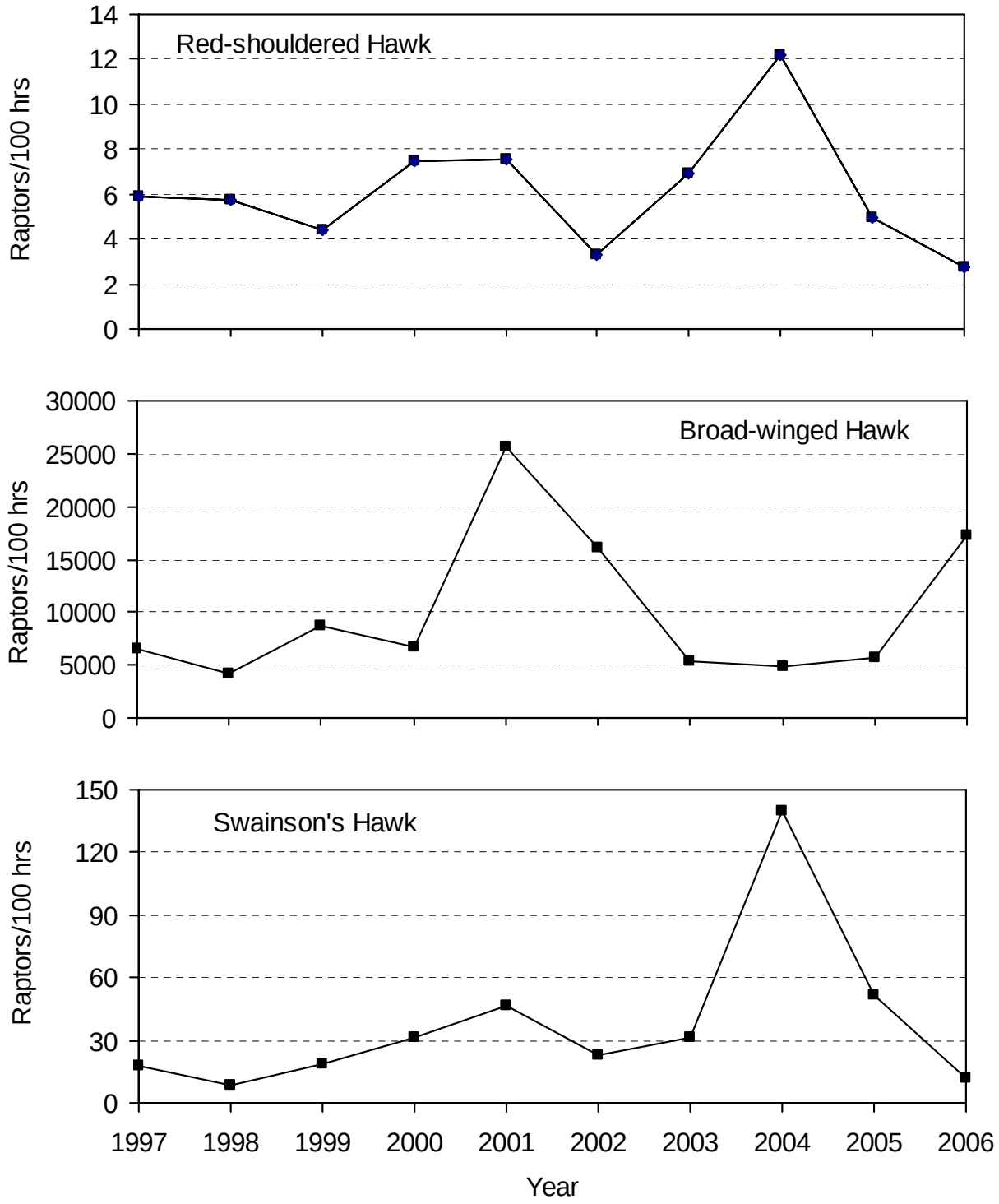


**Figure 6. Adjusted fall-migration passage rates at Smith Point, Texas for Red-shouldered, Broad-winged, and Swainson's Hawks: 1997–2006. Dashed lines indicate significant ($P \leq 0.10$) linear or quadratic regressions.**

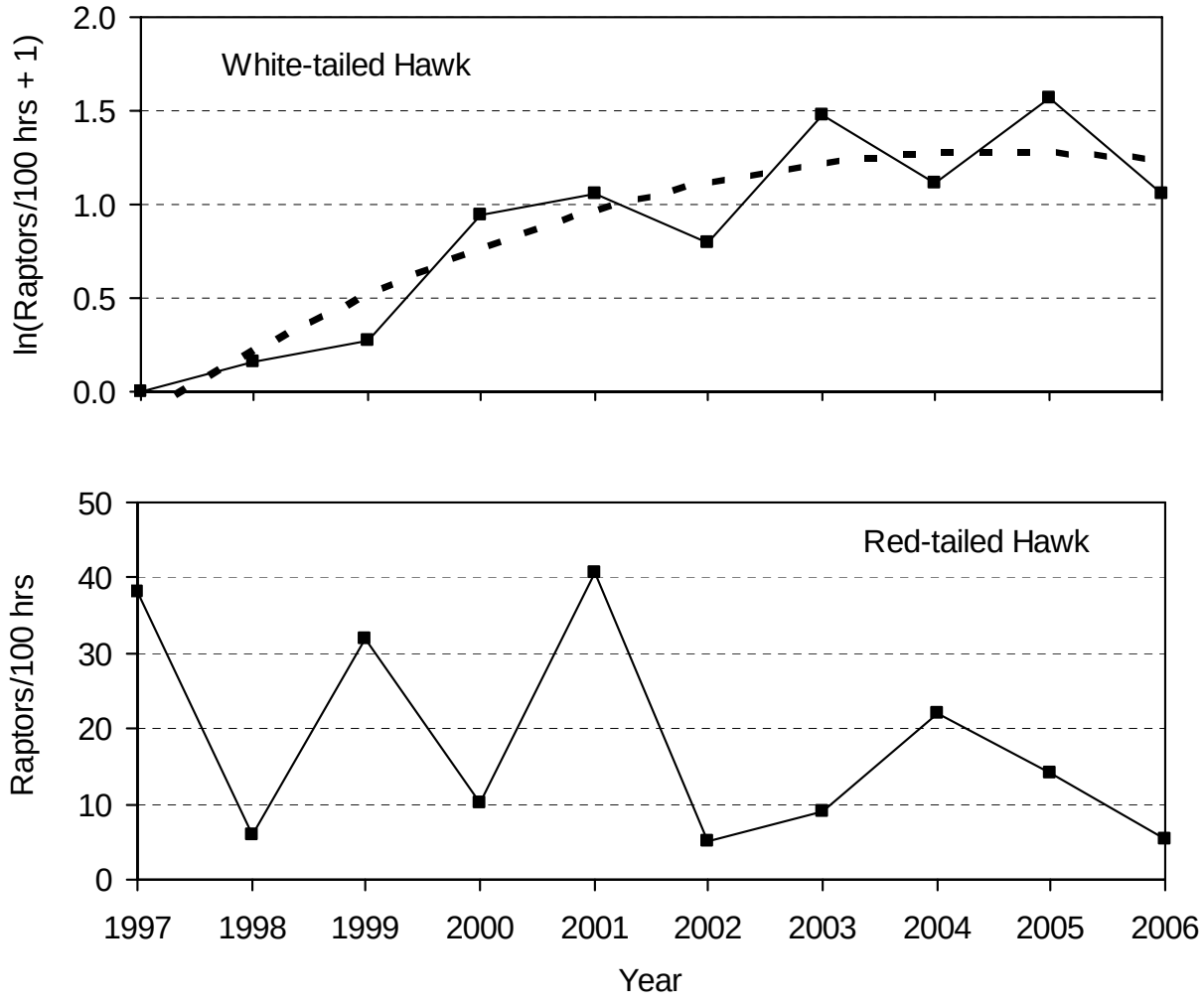


**Figure 7. Adjusted fall-migration passage rates at Smith Point, Texas for White-tailed and Red-tailed and Hawks: 1997–2006. Dashed lines indicate significant ($P \leq 0.10$) linear or quadratic regressions.**

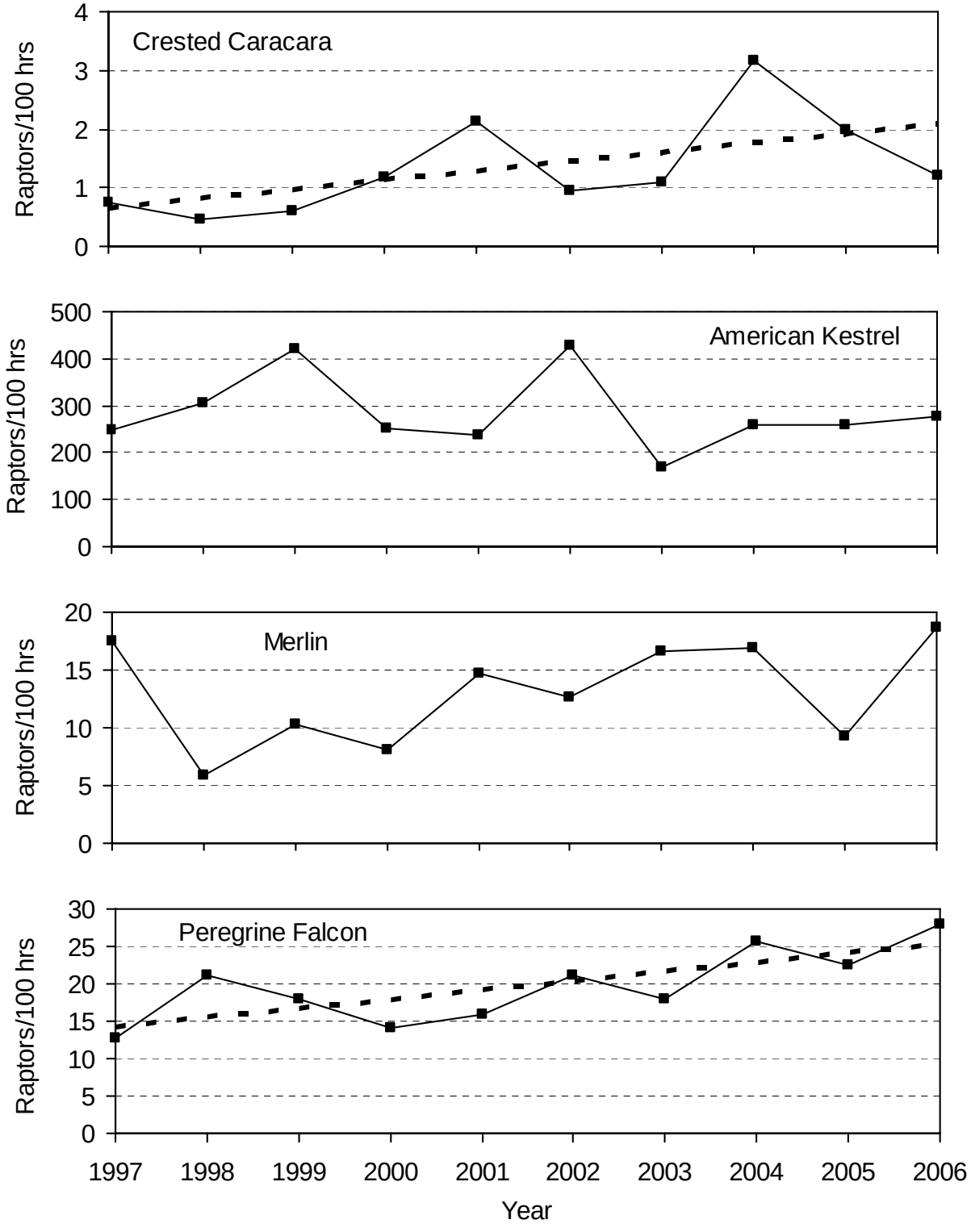


**Figure 8. Adjusted fall-migration passage rates at Smith Point, Texas for Crested Caracaras, American Kestrels, Merlins, and Peregrine Falcons: 1997–2006. Dashed lines indicate significant ($P \leq 0.10$) linear or quadratic regressions.**

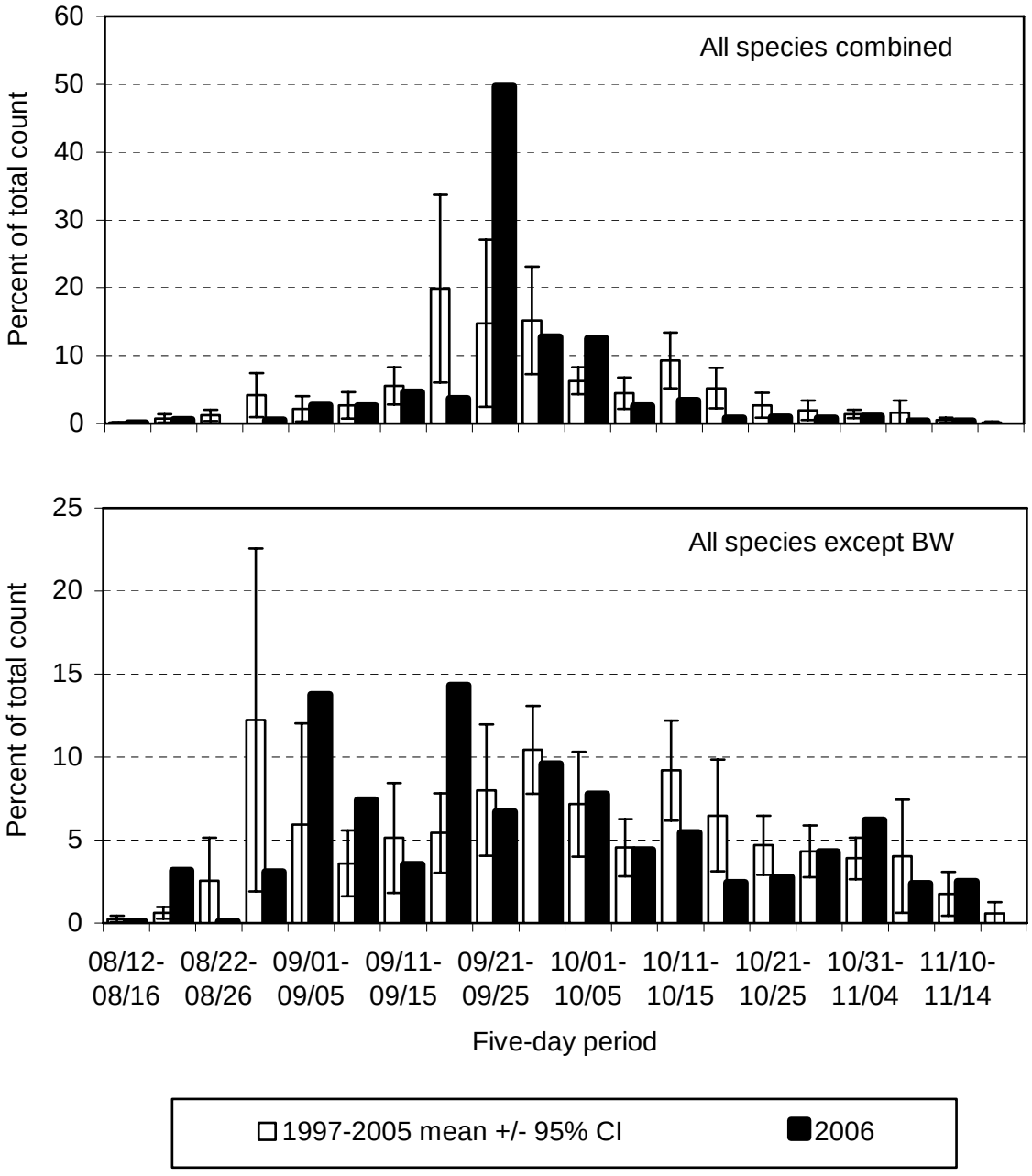


**Figure 9. Combined-species flight volume by five-day periods for the autumn raptor migration at Smith Point, Texas, with and without Broad-winged Hawks: 1997–2005 versus 2006.**

**Appendix A. A history of official observer participation in the Smith Point Raptor Migration Project: 1997–2006.**

**1997:** One designated observer throughout plus participation by many local, experienced volunteers in an effort to ensure the presence of two observers most of the season: designated observers—Doug Cooper (0; first 2.5 weeks), Bob Galloway (~1; middle 3 weeks), Robin Lawford (0; last 8 weeks).

**1998:** Two designated observers throughout: Rebecca Smith (0), Steve Seibel (0; first half), Richard Gibbons (0; second half), regularly assisted by several local, experienced volunteers.

**1999:** One designated observer throughout plus participation by several local, experienced volunteers in an effort to ensure the presence of two observers most of the season: designated observer, Kyle McCarty (2).

**2000:** Two designated observers throughout: Zach Smith (2+), Wendy Beard (0), regularly assisted by several local, experienced volunteers.

**2001:** Two designated observers throughout: Bob Diebold (2) and Corrie Borgmann (0), regularly assisted by several local, experienced volunteers.

**2002:** Two designated observers throughout: Erin McEldowney (0) and Josh Berman (0), regularly assisted by several local, experienced volunteers.

**2003:** Two designated observers throughout: Dan Russell (0) and Dane Ferrell (0), regularly assisted by several local, experienced volunteers.

**2005:** Two designated observers throughout: Samantha Burrell (1) and Carl Bullock (1), regularly assisted by several local, experienced volunteers.

**2005:** One to two designated observers throughout: Kyle McCarty (4, full season), Jim and Bea Harrison (0, September), and James Carrey (0, early October), regularly assisted by several local, experienced volunteers.

**2006:** Two designated observers throughout: Johannes Van Dort (4) and Heidi Trudell (+), regularly assisted by several local, experienced volunteers.

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

**Appendix B. Common and scientific names, species codes, and regularly applied age, sex, and color-morph classifications for all migrant raptors observed at Smith Point, Texas.**

| Common Name | Scientific Name | Species Code | Age[1] | Sex[2] | Color Morph[3] |
|---|---|---|---|---|---|
| Black Vulture | *Coragyps atratus* | BV | U | U | NA |
| Turkey Vulture | *Cathartes aura* | TV | U | U | NA |
| Osprey | *Pandion haliaetus* | OS | U | U | NA |
| Northern Harrier | *Circus cyaneus* | NH | A I Br U | M F U | NA |
| Hook-billed Kite | *Chondrohierax uncinatus* | HK | A I U | AM AF U | D L U |
| Swallow-tailed Kite | *Elanoides forficatus* | SK | U | U | NA |
| White-tailed Kite | *Elanus leucurus* | WK | U | U | NA |
| Mississippi Kite | *Ictinia mississippiensis* | MK | A I U | U | NA |
| Unknown kite | *see above* | UK | U | U | NA |
| Sharp-shinned Hawk | *Accipiter striatus* | SS | A I U | U | NA |
| Cooper's Hawk | *Accipiter cooperii* | CH | A I U | U | NA |
| Unknown accipiter | *Accipiter* spp. | UA | U | U | NA |
| Harris's Hawk | *Parabuteo unicinctus* | HH | A I U | U | NA |
| Red-shouldered Hawk | *Buteo lineatus* | RS | A I U | U | NA |
| Broad-winged Hawk | *Buteo platypterus* | BW | A I U | U | D L U |
| Swainson's Hawk | *Buteo swainsoni* | SW | U | U | D L U |
| White-tailed Hawk | *Buteo albicaudatus* | WT | A I U | U | NA |
| Red-tailed Hawk | *Buteo jamaicensis* | RT | A I U | U | D L U |
| Ferruginous Hawk | *Buteo regalis* | FH | A I U | U | D L U |
| Rough-legged Hawk | *Buteo lagopus* | RL | U | U | D L U |
| Unknown buteo | *Buteo* spp. | UB | U | U | D L U |
| Golden Eagle | *Aquila chrysaetos* | GE | A S I NA U[4] | U | NA |
| Bald Eagle | *Haliaeetus leucocephalus* | BE | A S2 S1 I NA U[5] | U | NA |
| Unknown eagle | *see above* | UE | U | U | NA |
| Crested Caracara | *Caracara cheriway* | CC | U | U | NA |
| American Kestrel | *Falco sparverius* | AK | U | M F U | NA |
| Merlin | *Falco columbarius* | ML | AM Br | M U | NA |
| Peregrine Falcon | *Falco peregrinus* | PG | A I U | U | NA |
| Unknown falcon | *Falco* spp. | UF | U | U | NA |
| Unknown raptor | Falconiformes | UU | U | U | NA |

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

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

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

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

[5] Bald Eagle age codes: I = immature, first-year bird, dark breast and tawny belly; S1 = young subadult, Basic I and II plumages, light belly or upside-down white triangle on the back; S2 = older subadult, Basic III plumage, head mostly white with osprey-like dark eye line and dark band on tail; NA = not adult, unknown age immature/subadult; A = adult, includes near-adult with dark flecks in head and dark tip to tail (may be hard to see in field) and adult with pure white head and tail; U = plumage not adequately observed to make an age determination.

**Appendix C. Daily observation effort, visitor disturbance ratings, weather records, and flight summaries during fall migration for raptors at Smith Point, Texas: 2006.**

| Date | Obs. Hours | Obsrvr / Hour[1] | Median Visitor Disturb[2] | Predominant Weather[3] | Wind Speed (kph)[1] | Wind Direction | Temp (°C)[1] | Barom. Press. (in Hg)[1] | Median Thermal Lift[4] | Visib. East (km)[1] | Visib. West (km)[1] | Median Flight Distance[5] | Birds / Hour |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15-Aug | 8.50 | 2.9 | 0 | clr | 2.3 | sse, wsw | 34.0 | – | 2 | 12 | 12 | 1 | 0.0 |
| 16-Aug | 8.50 | 2.0 | 0 | clr | 1.9 | s, w-nw | 34.0 | – | 2 | 12 | 12 | 2 | 4.4 |
| 17-Aug | 10.00 | 2.0 | 0 | clr-pc | 1.5 | ne, nw | 31.1 | – | 2 | 12 | 12 | 2 | 29.6 |
| 18-Aug | 6.50 | 2.0 | 0 | pc | 3.3 | ene | 31.8 | 30.00 | 3 |  | 40 | 2 | 0.5 |
| 19-Aug | 8.75 | 2.0 | 0 | pc-ovc, AM scat rain | 4.5 | ne-e, sse | 28.2 | 29.95 | 4 | 16 |  | 2 | 2.5 |
| 20-Aug | 9.00 | 2.7 | 0 | clr-pc | 3.3 | ne, sse | 32.5 | 29.84 | 3 | 12 |  | 3 | 0.3 |
| 21-Aug | 8.00 | 2.4 | 0 | clr-pc | 4.1 | ne-e, sse | 31.5 | 30.04 | 3 | 20 |  | 2 | 0.3 |
| 22-Aug | 5.50 | 2.0 | 0 | pc, rain | 1.2 | calm/var | 30.2 | 30.02 | 4 | 20 |  | 2 | 1.5 |
| 23-Aug | 3.50 | 2.0 | 0 | ovc, ts | 1.3 | ne | 30.3 | 29.97 | 4 |  |  | - | 0.0 |
| 24-Aug | 9.00 | 2.0 | 0 | pc-mc | 1.6 | s, wsw-w | 29.3 | 29.83 | 3 | 20 |  | 3 | 0.6 |
| 25-Aug | 3.00 | 2.0 | 0 | mc | 2.4 | wsw | 28.2 | 29.82 | 4 | 24 |  | - | 0.0 |
| 26-Aug | 4.00 | 1.0 | 0 | mc-ovc | 10.3 | sw, w | 29.5 | 29.85 | 4 | 1 | 13 | - | 0.0 |
| 27-Aug | 8.00 | 2.9 | 0 | mc-ovc | 10.4 | ssw | 29.9 | 29.89 | 3 | 10 |  | 2 | 0.5 |
| 28-Aug | 9.00 | 2.0 | 0 | pc-ovc | 13.0 | ssw | 30.1 | 29.88 | 3 | 11 |  | - | 0.0 |
| 29-Aug | 9.00 | 2.0 | 0 | pc-mc | 7.4 | w, nw, n | 29.9 | 29.88 | 3 | 10 |  | 3 | 1.3 |
| 30-Aug | 9.00 | 1.9 | 0 | pc-mc | 7.4 | nne, nw | 28.5 | 29.87 | 3 | 20 |  | 2 | 31.2 |
| 31-Aug | 8.00 | 2.0 | 0 | clr | 3.6 | ene, sse, sw | 28.9 | 29.91 | 3 | 30 |  | - | 0.0 |
| 01-Sep | 9.00 | 2.0 | 0 | clr-pc | 3.5 | ne, sw, nw | 30.7 | 29.89 | 2 | 14 |  | 2 | 59.0 |
| 02-Sep | 9.00 | 2.0 | 0 | clr-mc | 4.2 | ne, sse, nnw | 31.2 | 29.89 | 3 | 12 | 15 | 3 | 16.1 |
| 03-Sep | 8.00 | 2.4 | 0 | clr-pc | 4.5 | nne, sse | 30.6 | 29.92 | 3 | 10 |  | 2 | 8.4 |
| 04-Sep | 8.00 | 2.0 | 0 | clr-mc | 6.2 | ene, nnw | 29.6 | 29.95 | 3 | 10 |  | 2 | 4.9 |
| 05-Sep | 9.00 | 2.0 | 0 | mc-ovc | 8.7 | nne, nnw | 27.2 | 29.99 | 3 | 12 |  | 1 | 86.2 |
| 06-Sep | 9.00 | 2.0 | 0 | clr-mc | 5.5 | nw | 28.2 | 29.94 | 2 | 12 |  | 2 | 105.0 |
| 07-Sep | 7.50 | 2.0 | 0 | pc-mc | 6.6 | ne, se | 27.7 | 29.91 | 2 | 10 |  | 2 | 14.8 |
| 08-Sep | 7.00 | 2.9 | 0 | clr-mc | 5.0 | ene, ese | 29.6 | 29.92 | 3 | 11 |  | 2 | 18.6 |
| 09-Sep | 5.00 | 3.0 | 0 | ovc, rain | 7.7 | ne | 23.7 | 29.90 | 4 |  |  | 1 | 19.4 |
| 10-Sep | 9.00 | 1.1 | 0 | pc-mc | 5.5 | ne, se | 29.2 | 29.85 | 3 |  |  | 2 | 24.6 |
| 11-Sep | 7.50 | 2.0 | 0 | pc-mc, PM rain | 4.0 | ene, ssw | 30.2 | 29.90 | 2 | 30 |  | 2 | 48.1 |
| 12-Sep | 8.00 | 2.0 | 0 | mc-ovc | 3.4 | nw | 27.7 | 29.91 | 3 | 21 |  | 3 | 29.1 |
| 13-Sep | 9.00 | 2.0 | 0 | clr-mc | 5.6 | nw-nnw | 28.2 | 29.85 | 2 | 13 |  | 2 | 130.3 |
| 14-Sep | 7.00 | 2.0 | 0 | clr-pc | 6.0 | ene, ese | 27.6 | 29.86 | 3 | 12 |  | 2 | 120.6 |
| 15-Sep | 7.00 | 2.0 | 0 | mc, AM rain | 6.0 | ne-e, s | 28.0 | 29.89 | 4 | 30 |  | 2 | 8.0 |
| 16-Sep | 8.00 | 2.0 | 1 | pc-mc | 7.7 | s | 30.1 | 29.89 | 2 | 27 |  | 2 | 71.5 |
| 17-Sep | 9.00 | 2.7 | 1 | mc-ovc, scat rain | 8.4 | s, sw | 29.8 | 29.80 | 4 | 28 | 26 | 1 | 7.2 |
| 18-Sep | 4.00 | 2.0 | 0 | ovc, rain | 9.2 | w | 26.8 | 29.81 | 3 | 33 | 37 | - | 0.0 |
| 19-Sep | 9.00 | 1.8 | 0 | clr-mc | 8.1 | ne | 24.9 | 29.98 | 2 | 23 | 38 | 2 | 89.6 |
| 20-Sep | 9.00 | 2.0 | 0 | clr | 6.0 | e, ese | 25.1 | 29.96 | 2 | 30 | 39 | 2 | 75.6 |
| 21-Sep | 4.27 | 2.0 | 0 | pc-ovc, scat rain | 20.8 | s | 27.0 | 29.71 | 4 | 20 | 18 | 1 | 1.4 |
| 22-Sep | 6.00 | 1.8 | 0 | pc-mc | 31.9 | s | – | 29.71 | 4 | 11 | 9 | 1 | 1.0 |
| 23-Sep | 7.00 | 2.0 | 0 | clr-pc | 29.9 | s | – | 29.78 | 4 | 4 | 4 | 2 | 1.3 |
| 24-Sep | 10.00 | 2.0 | 0 | ovc | 9.7 | nne, nnw | 27.6 | 29.94 | 4 | 30 | 40 | 2 | 32.2 |
| 25-Sep | 10.00 | 2.9 | 0 | clr-pc | 8.3 | nne, nnw | 25.3 | 30.08 | 2 | 35 | 65 | 3 | 2841.0 |
| 26-Sep | 9.00 | 2.0 | 0 | clr-pc | 4.0 | ne, nnw | 26.5 | 30.08 | 2 | 29 | 41 | 2 | 410.9 |
| 27-Sep | 7.00 | 2.0 | 0 | clr-pc | 5.4 | s | 29.9 | 29.98 | 2 | 23 | 30 | 1 | 4.3 |
| 28-Sep | 9.00 | 1.9 | 0 | pc-ovc | 4.4 | e, w | 31.6 | 29.95 | 3 | 23 | 24 | 2 | 42.1 |
| 29-Sep | 8.00 | 2.0 | 0 | pc-mc | 6.9 | ene, ese | 26.8 | 29.98 | 3 | 33 | 47 | 2 | 234.8 |
| 30-Sep | 8.00 | 2.0 | 1 | clr-pc | 9.3 | ssw | 32.8 | 29.97 | 2 | 24 | 33 | 2 | 173.6 |

Appendix C. continued

| Date | Obs. Hours | Obsrvr / Hour[1] | Median Visitor Disturb[2] | Predominant Weather[3] | Wind Speed (kph)[1] | Wind Direction | Temp (°C)[1] | Barom. Press. (in Hg)[1] | Median Thermal Lift[4] | Visib. East (km)[1] | Visib. West (km)[1] | Median Flight Distance[5] | Birds / Hour |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01-Oct | 9.00 | 2.5 | 0 | pc-mc | 7.8 | sse | 31.8 | 30.04 | 2 | 29 | 31 | 2 | 50.8 |
| 02-Oct | 9.00 | 1.8 | 2 | mc-ovc | 7.0 | ssw | 31.7 | 30.07 | 2 | 19 | 17 | 2 | 153.9 |
| 03-Oct | 7.50 | 1.6 | 0 | mc | 5.4 | ese | 32.9 | 30.07 | 2 | 8 | 9 | 2 | 187.6 |
| 04-Oct | 8.00 | 2.0 | 0 | clr-pc, AM haze | 4.0 | ne, ese | 32.7 | 30.06 | 1 | 7 | 6 | 2 | 225.8 |
| 05-Oct | 8.00 | 2.0 | 0 | clr-pc, haze | 3.4 | nne, nw | 31.6 | 30.12 | 2 | 4 | 4 | 2 | 274.3 |
| 06-Oct | 7.00 | 1.9 | 0 | clr, haze | 6.3 | ene | 31.5 | 30.07 | 2 | 2 | 4 | 2 | 76.4 |
| 07-Oct | 8.00 | 2.0 | 2 | clr-pc | 2.4 | ne-e, nnw | 26.9 | 30.05 | 1 | 2 | 6 | 2 | 76.9 |
| 08-Oct | 8.00 | 2.5 | 0 | pc-mc | 2.8 | ne-e | 25.9 | 30.01 | 2 | 9 | 24 | 2 | 29.3 |
| 09-Oct | 7.50 | 2.0 | 0 | ovc | 1.8 | ne-e | 27.8 | 29.98 | 4 | 4 | 10 | 2 | 14.5 |
| 10-Oct | 5.00 | 2.0 | 0 | ovc, scat rain | 8.3 | se | 29.8 | 29.88 | 4 | 20 | 23 | 2 | 1.2 |
| 11-Oct | 8.00 | 2.0 | 0 | clr-ovc | 4.4 | wsw-nw | 27.3 | 29.83 | 2 | 17 | 20 | 2 | 218.3 |
| 12-Oct | 4.00 | 1.8 | 0 | mc | 5.0 | sse | 29.8 | 29.82 | 3 | 29 | 44 | 2 | 0.3 |
| 13-Oct | 8.00 | 1.8 | 0 | mc-ovc | 6.6 | ne | 22.0 | 29.72 | 4 | 20 | 20 | 2 | 17.0 |
| 14-Oct | 8.00 | 1.6 | 0 | pc-mc | 7.1 | ne-e | 26.3 | 29.95 | 3 | 20 | 20 | 2 | 8.0 |
| 15-Oct | 5.00 | 1.0 | 0 | ovc, rain | 5.0 | e | 26.0 | 29.74 | 4 | 10 | 10 | - | 0.0 |
| 16-Oct | 0.00 | | | weather day - heavy rain | | | | | | | | | |
| 17-Oct | 5.00 | 1.8 | 0 | pc-mc | 5.0 | s | 30.5 | 29.67 | 3 | 9 | 9 | - | 0.0 |
| 18-Oct | 0.00 | | | weather day? - uncertain records | | | | | | | | | |
| 19-Oct | 0.00 | | | weather day? - uncertain records | | | | | | | | | |
| 20-Oct | 8.00 | 1.0 | 0 | clr | 4.7 | calm, ne | 20.2 | 29.91 | 2 | 30 | 30 | - | 56.8 |
| 21-Oct | 7.00 | 1.0 | 0 | ovc, rain | 3.2 | ene, se | 27.8 | 29.76 | 4 | 11 | 11 | 1 | 0.0 |
| 22-Oct | 7.00 | 1.0 | 0 | ovc, AM rain | 7.9 | calm | 18.0 | 30.11 | 4 | 15 | 15 | 1 | 35.4 |
| 23-Oct | 8.00 | 1.0 | 0 | clr | 6.4 | ne-e | 18.2 | 30.22 | 2 | 21 | 21 | 1 | 34.8 |
| 24-Oct | 8.00 | 2.0 | 0 | clr-pc | 6.1 | e | 21.3 | 30.12 | 2 | 38 | 48 | 1 | 0.3 |
| 25-Oct | 8.00 | 2.0 | 0 | ovc | 7.3 | se, s | 25.7 | 29.95 | 4 | 22 | 17 | - | 0.0 |
| 26-Oct | 2.00 | 1.8 | 0 | ovc, rain | 13.0 | s | 26.0 | 29.82 | 4 | 10 | 5 | - | 0.0 |
| 27-Oct | 7.50 | 1.0 | 0 | clr-pc | 14.1 | nw | 22.1 | 29.85 | 4 | 39 | 40 | 1 | 6.5 |
| 28-Oct | 8.00 | 1.0 | 0 | clr | 4.3 | calm, w | 20.6 | 30.13 | 3 | 40 | 40 | 1 | 50.9 |
| 29-Oct | 2.50 | 1.0 | 0 | clr | 1.7 | wsw | 26.0 | 30.11 | 3 | 40 | 40 | 2 | 5.6 |
| 30-Oct | 7.50 | 1.0 | 0 | pc-mc | 8.9 | sse | 26.5 | 29.92 | 4 | 12 | 12 | 1 | 0.8 |
| 31-Oct | 8.00 | 1.0 | 0 | pc-mc | 4.3 | se, s | 28.1 | 29.91 | 3 | 20 | 20 | 2 | 3.9 |
| 01-Nov | 8.00 | 1.0 | 0 | pc-mc | 6.8 | calm, nnw | 24.0 | 29.98 | 4 | 10 | 10 | 1 | 28.3 |
| 02-Nov | 8.00 | 1.0 | 0 | clr-ovc | 10.6 | calm, nne | 16.9 | 30.19 | 3 | 23 | 23 | 2 | 34.8 |
| 03-Nov | 7.00 | 1.0 | 0 | clr | 8.9 | ne-e | 16.0 | 30.30 | 3 | 25 | 25 | 2 | 5.1 |
| 04-Nov | 9.00 | 1.0 | 0 | clr-pc | 8.2 | ene, e | 19.9 | 30.24 | 4 | 23 | 23 | 2 | 4.3 |
| 05-Nov | 4.00 | 1.0 | 0 | ovc, scat rain | 10.0 | e | 22.8 | 30.07 | 4 | 4 | 4 | 2 | 1.0 |
| 06-Nov | 4.00 | 1.0 | 0 | pc, AM fog/rain | 6.0 | ne-e | 23.2 | 29.84 | 3 | 11 | 11 | 2 | 4.0 |
| 07-Nov | 8.00 | 1.0 | 0 | clr-pc | 5.8 | calm, nw | 21.1 | 29.87 | 3 | 14 | 14 | 2 | 18.1 |
| 08-Nov | 7.50 | 1.0 | 0 | clr, AM haze | 7.1 | ssw, w | 24.6 | 29.80 | 3 | 7 | 7 | 2 | 7.1 |
| 09-Nov | 8.00 | 1.0 | 0 | clr, AM haze | 6.7 | sse | 26.2 | 29.74 | 3 | 4 | 4 | 1 | 0.5 |
| 10-Nov | 7.00 | 1.0 | 0 | pc-mc, AM haze | 8.6 | ssw | 28.0 | 29.81 | 4 | 2 | 2 | - | 0.0 |
| 11-Nov | 7.00 | 1.0 | 0 | clr-pc | 12.0 | calm | 18.1 | 30.16 | 4 | 15 | 15 | 2 | 30.6 |

[1] Average of hourly records.

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

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

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

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

**Appendix D. Daily fall raptor migration counts at Smith Point, Texas: 2006.**

| | | Species[1] | | | | | | | | | | | | | | | | | | | | | | | | | | | | Birds |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Hours | BV | TV | OS | NH | HK | SK | WK | MK | SS | CH | UA | HH | RS | BW | SW | WT | RT | FH | RL | UB | GE | BE | UE | CC | AK | ML | PG | UF | UU | Total | / Hr |
| 15-Aug | 8.50 | 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 |
| 16-Aug | 8.50 | 0 | 0 | 1 | 0 | 0 | 2 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 29 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 37 | 4.4 |
| 17-Aug | 10.00 | 0 | 0 | 0 | 0 | 0 | 14 | 0 | 215 | 0 | 0 | 0 | 0 | 0 | 61 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 296 | 29.6 |
| 18-Aug | 6.50 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 3 | 0.5 |
| 19-Aug | 8.75 | 0 | 0 | 0 | 0 | 0 | 21 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 22 | 2.5 |
| 20-Aug | 9.00 | 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 | 0 | 0 | 3 | 0.3 |
| 21-Aug | 8.00 | 0 | 0 | 0 | 1 | 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 | 2 | 0.3 |
| 22-Aug | 5.50 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 1.5 |
| 23-Aug | 3.50 | 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 |
| 24-Aug | 9.00 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0.6 |
| 25-Aug | 3.00 | 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 |
| 26-Aug | 4.00 | 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 |
| 27-Aug | 8.00 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0.5 |
| 28-Aug | 9.00 | 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 |
| 29-Aug | 9.00 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 0 | 2 | 0 | 0 | 0 | 6 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 1.3 |
| 30-Aug | 9.00 | 0 | 0 | 0 | 1 | 0 | 4 | 0 | 236 | 0 | 1 | 0 | 0 | 3 | 33 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 281 | 31.2 |
| 31-Aug | 8.00 | 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 |
| 01-Sep | 9.00 | 0 | 0 | 2 | 3 | 0 | 6 | 0 | 433 | 1 | 3 | 0 | 0 | 3 | 78 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 531 | 59.0 |
| 02-Sep | 9.00 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 76 | 0 | 3 | 0 | 0 | 1 | 56 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 145 | 16.1 |
| 03-Sep | 8.00 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 31 | 0 | 2 | 0 | 0 | 1 | 30 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 67 | 8.4 |
| 04-Sep | 8.00 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 26 | 0 | 2 | 0 | 0 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 39 | 4.9 |
| 05-Sep | 9.00 | 0 | 0 | 1 | 0 | 0 | 3 | 0 | 527 | 1 | 2 | 0 | 0 | 0 | 241 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 776 | 86.2 |
| 06-Sep | 9.00 | 0 | 0 | 1 | 1 | 0 | 2 | 0 | 341 | 0 | 2 | 0 | 0 | 0 | 597 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 945 | 105.0 |
| 07-Sep | 7.50 | 0 | 0 | 0 | 7 | 0 | 2 | 0 | 33 | 1 | 0 | 0 | 0 | 0 | 64 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 111 | 14.8 |
| 08-Sep | 7.00 | 0 | 0 | 0 | 1 | 0 | 2 | 0 | 50 | 1 | 1 | 0 | 0 | 0 | 74 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 130 | 18.6 |
| 09-Sep | 5.00 | 0 | 0 | 1 | 0 | 0 | 3 | 0 | 79 | 0 | 0 | 0 | 0 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 97 | 19.4 |
| 10-Sep | 9.00 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 73 | 0 | 0 | 0 | 0 | 0 | 139 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 0 | 0 | 221 | 24.6 |
| 11-Sep | 7.50 | 0 | 0 | 1 | 2 | 0 | 2 | 0 | 43 | 0 | 1 | 0 | 0 | 0 | 310 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 361 | 48.1 |
| 12-Sep | 8.00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 1 | 2 | 0 | 0 | 0 | 218 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 233 | 29.1 |
| 13-Sep | 9.00 | 0 | 0 | 3 | 10 | 0 | 1 | 0 | 61 | 6 | 14 | 0 | 0 | 1 | 1035 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 37 | 0 | 0 | 0 | 0 | 1173 | 130.3 |
| 14-Sep | 7.00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 31 | 4 | 0 | 0 | 0 | 0 | 800 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 0 | 0 | 1 | 0 | 844 | 120.6 |

Appendix D. continued

| | | Species[1] | | | | | | | | | | | | | | | | | | | | | | | | | | | | Birds |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Hours | BV | TV | OS | NH | HK | SK | WK | MK | SS | CH | UA | HH | RS | BW | SW | WT | RT | FH | RL | UB | GE | BE | UE | CC | AK | ML | PG | UF | UU | Total | / Hr |
| 15-Sep | 7.00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 43 | 0 | 0 | 0 | 1 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 56 | 8.0 |
| 16-Sep | 8.00 | 0 | 0 | 0 | 2 | 0 | 1 | 0 | 562 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 1 | 0 | 0 | 572 | 71.5 |
| 17-Sep | 9.00 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 53 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 1 | 0 | 0 | 65 | 7.2 |
| 18-Sep | 4.00 | 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 |
| 19-Sep | 9.00 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 161 | 4 | 5 | 0 | 0 | 0 | 617 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 2 | 3 | 0 | 0 | 806 | 89.6 |
| 20-Sep | 9.00 | 0 | 0 | 0 | 12 | 0 | 0 | 0 | 262 | 9 | 0 | 2 | 0 | 0 | 312 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 79 | 3 | 0 | 0 | 0 | 680 | 75.6 |
| 21-Sep | 4.27 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 1 | 1 | 0 | 0 | 6 | 1.4 |
| 22-Sep | 6.00 | 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 | 2 | 2 | 0 | 0 | 6 | 1.0 |
| 23-Sep | 7.00 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 4 | 0 | 0 | 9 | 1.3 |
| 24-Sep | 10.00 | 0 | 0 | 2 | 14 | 0 | 2 | 0 | 112 | 66 | 12 | 0 | 0 | 0 | 41 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 42 | 10 | 15 | 1 | 1 | 322 | 32.2 |
| 25-Sep | 10.00 | 0 | 0 | 10 | 46 | 0 | 0 | 0 | 21 | 78 | 32 | 1 | 0 | 0 | 28155 | 3 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 57 | 3 | 3 | 0 | 0 | 28410 | 2841.0 |
| 26-Sep | 9.00 | 2 | 0 | 4 | 4 | 0 | 0 | 0 | 8 | 22 | 5 | 0 | 0 | 0 | 3630 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 17 | 1 | 3 | 0 | 0 | 3698 | 410.9 |
| 27-Sep | 7.00 | 0 | 0 | 1 | 4 | 0 | 0 | 0 | 10 | 6 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 1 | 0 | 0 | 0 | 30 | 4.3 |
| 28-Sep | 9.00 | 0 | 0 | 2 | 1 | 0 | 0 | 0 | 44 | 40 | 8 | 0 | 0 | 0 | 267 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 14 | 0 | 0 | 379 | 42.1 |
| 29-Sep | 8.00 | 0 | 0 | 6 | 24 | 0 | 0 | 0 | 58 | 97 | 11 | 0 | 0 | 0 | 1610 | 3 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 62 | 4 | 2 | 0 | 0 | 1878 | 234.8 |
| 30-Sep | 8.00 | 0 | 0 | 6 | 16 | 0 | 0 | 0 | 27 | 186 | 12 | 0 | 0 | 0 | 1067 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 69 | 0 | 4 | 0 | 0 | 1389 | 173.6 |
| 01-Oct | 9.00 | 0 | 0 | 1 | 15 | 0 | 0 | 0 | 21 | 83 | 6 | 0 | 0 | 0 | 305 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 22 | 2 | 2 | 0 | 0 | 457 | 50.8 |
| 02-Oct | 9.00 | 0 | 0 | 1 | 20 | 0 | 0 | 1 | 17 | 99 | 14 | 0 | 1 | 0 | 1210 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 4 | 3 | 0 | 0 | 1385 | 153.9 |
| 03-Oct | 7.50 | 0 | 12 | 0 | 3 | 0 | 0 | 0 | 0 | 49 | 7 | 1 | 0 | 0 | 1318 | 1 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 2 | 1 | 0 | 0 | 1407 | 187.6 |
| 04-Oct | 8.00 | 4 | 9 | 4 | 9 | 0 | 0 | 1 | 0 | 28 | 9 | 2 | 0 | 1 | 1706 | 1 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 21 | 1 | 4 | 0 | 0 | 1806 | 225.8 |
| 05-Oct | 8.00 | 0 | 3 | 2 | 15 | 0 | 0 | 0 | 2 | 68 | 10 | 0 | 0 | 1 | 2063 | 3 | 1 | 3 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 20 | 0 | 2 | 0 | 0 | 2194 | 274.3 |
| 06-Oct | 7.00 | 1 | 21 | 0 | 2 | 0 | 0 | 0 | 0 | 18 | 5 | 0 | 0 | 0 | 475 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 0 | 1 | 0 | 0 | 535 | 76.4 |
| 07-Oct | 8.00 | 0 | 10 | 1 | 4 | 0 | 0 | 1 | 0 | 24 | 14 | 0 | 0 | 0 | 535 | 9 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 | 0 | 1 | 0 | 0 | 615 | 76.9 |
| 08-Oct | 8.00 | 0 | 0 | 0 | 9 | 0 | 0 | 0 | 4 | 50 | 12 | 0 | 0 | 0 | 121 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 35 | 0 | 2 | 0 | 0 | 234 | 29.3 |
| 09-Oct | 7.50 | 0 | 0 | 2 | 5 | 0 | 0 | 0 | 0 | 38 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 52 | 1 | 0 | 0 | 0 | 109 | 14.5 |
| 10-Oct | 5.00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 1 | 0 | 0 | 6 | 1.2 |
| 11-Oct | 8.00 | 12 | 18 | 12 | 9 | 0 | 0 | 0 | 6 | 66 | 33 | 5 | 1 | 6 | 1459 | 13 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 98 | 3 | 3 | 0 | 0 | 1746 | 218.3 |
| 12-Oct | 4.00 | 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 | 0.3 |
| 13-Oct | 8.00 | 0 | 18 | 7 | 15 | 0 | 0 | 0 | 1 | 10 | 6 | 0 | 0 | 0 | 36 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 38 | 2 | 2 | 0 | 0 | 136 | 17.0 |
| 14-Oct | 8.00 | 0 | 0 | 2 | 7 | 0 | 0 | 0 | 0 | 28 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 19 | 1 | 2 | 0 | 0 | 64 | 8.0 |
| 15-Oct | 5.00 | 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 |

Appendix D. continued

| | | Species[1] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | Birds |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Hours | BV | TV | OS | NH | HK | SK | WK | MK | SS | CH | UA | HH | RS | BW | SW | WT | RT | FH | RL | UB | GE | BE | UE | CC | AK | ML | PG | UF | UU | Total | / Hr |
| 16-Oct | 0.00 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 17-Oct | 5.00 | 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 |
| 18-Oct | 0.00 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 19-Oct | 0.00 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 20-Oct | 8.00 | 0 | 110 | 2 | 14 | 0 | 0 | 0 | 0 | 18 | 3 | 0 | 0 | 0 | 250 | 45 | 0 | 3 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 7 | 0 | 1 | 0 | 0 | 454 | 56.8 |
| 21-Oct | 7.00 | 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 |
| 22-Oct | 7.00 | 0 | 1 | 7 | 3 | 0 | 0 | 0 | 0 | 34 | 4 | 0 | 0 | 0 | 106 | 7 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 82 | 2 | 1 | 0 | 0 | 248 | 35.4 |
| 23-Oct | 8.00 | 0 | 45 | 1 | 3 | 0 | 0 | 0 | 0 | 5 | 3 | 0 | 0 | 1 | 192 | 20 | 0 | 4 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 278 | 34.8 |
| 24-Oct | 8.00 | 0 | 0 | 0 | 1 | 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 | 2 | 0.3 |
| 25-Oct | 8.00 | 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 |
| 26-Oct | 2.00 | 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 |
| 27-Oct | 7.50 | 0 | 0 | 1 | 4 | 0 | 0 | 0 | 0 | 20 | 1 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 17 | 1 | 0 | 0 | 0 | 49 | 6.5 |
| 28-Oct | 8.00 | 0 | 195 | 1 | 26 | 0 | 0 | 1 | 0 | 31 | 6 | 0 | 1 | 2 | 102 | 22 | 0 | 11 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 4 | 0 | 1 | 0 | 0 | 407 | 50.9 |
| 29-Oct | 2.50 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 10 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 5.6 |
| 30-Oct | 7.50 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 6 | 0.8 |
| 31-Oct | 8.00 | 0 | 25 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 31 | 3.9 |
| 01-Nov | 8.00 | 3 | 125 | 1 | 22 | 0 | 0 | 0 | 0 | 26 | 9 | 0 | 0 | 1 | 6 | 7 | 1 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 2 | 1 | 0 | 0 | 226 | 28.3 |
| 02-Nov | 8.00 | 24 | 90 | 5 | 13 | 0 | 0 | 0 | 0 | 28 | 13 | 1 | 0 | 0 | 66 | 18 | 0 | 13 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 5 | 1 | 0 | 0 | 0 | 278 | 34.8 |
| 03-Nov | 7.00 | 0 | 12 | 0 | 5 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 9 | 3 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 36 | 5.1 |
| 04-Nov | 9.00 | 0 | 13 | 1 | 2 | 0 | 0 | 0 | 0 | 4 | 3 | 0 | 0 | 0 | 10 | 4 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 39 | 4.3 |
| 05-Nov | 4.00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 1.0 |
| 06-Nov | 4.00 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 16 | 4.0 |
| 07-Nov | 8.00 | 22 | 64 | 0 | 6 | 0 | 0 | 0 | 0 | 8 | 8 | 1 | 0 | 0 | 21 | 2 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 145 | 18.1 |
| 08-Nov | 7.50 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 53 | 7.1 |
| 09-Nov | 8.00 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0.5 |
| 10-Nov | 7.00 | 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 |
| 11-Nov | 7.00 | 3 | 178 | 0 | 5 | 0 | 0 | 0 | 0 | 10 | 1 | 0 | 0 | 0 | 7 | 1 | 0 | 4 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 214 | 30.6 |
| Total | 637.52 | 71 | 1,002 | 93 | 385 | 0 | 80 | 5 | 3,682 | 1,295 | 305 | 14 | 4 | 22 | 49,527 | 201 | 8 | 88 | 0 | 0 | 1 | 1 | 7 | 0 | 5 | 916 | 51 | 85 | 2 | 1 | 57,851 | 90.7 |

[1] See Appendix B for full names associated with species codes.

**Appendix E. Annual observation effort and fall raptor migration counts by species at Smith Point, Texas: 1997–2006.**

| | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | MEAN |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Start date | 17-Aug | 15-Aug | 15-Aug | 12-Aug | 15-Aug | 15-Aug | 15-Aug | 15-Aug | 15-Aug | 15-Aug | 15-Aug |
| End date | 20-Nov | 15-Nov | 12-Nov | 15-Nov | 15-Nov | 15-Nov | 15-Nov | 15-Nov | 15-Nov | 11-Nov | 15-Nov |
| Observation days | 94 | 91 | 89 | 94 | 93 | 91 | 92 | 93 | 86 | 86 | 91 |
| Observation hours | 860.11 | 677.25 | 696.68 | 823.08 | 743.33 | 775.66 | 777.75 | 796.34 | 688.92 | 637.52 | 747.66 |
| Black Vulture | 130 | 105 | 341 | 4 | 379 | 59 | 96 | 368 | 112 | 71 | 167 |
| Turkey Vulture | 1,225 | 581 | 1,295 | 1,059 | 2,488 | 678 | 2,163 | 3,091 | 1,185 | 1,002 | 1,477 |
| TOTAL VULTURES | 1,355 | 686 | 1,636 | 1,063 | 2,867 | 737 | 2,259 | 3,459 | 1,297 | 1,073 | 1,643 |
| Osprey | 54 | 68 | 54 | 60 | 62 | 48 | 78 | 87 | 76 | 93 | 68 |
| Northern Harrier | 445 | 262 | 537 | 372 | 472 | 144 | 203 | 246 | 296 | 385 | 336 |
| Hook-billed Kite | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| Swallow-tailed Kite | 40 | 34 | 52 | 46 | 74 | 150 | 98 | 151 | 99 | 80 | 82 |
| White-tailed Kite | 0 | 1 | 2 | 11 | 12 | 8 | 23 | 14 | 24 | 8 | 10 |
| Mississippi Kite | 2,124 | 2,362 | 2,975 | 4,788 | 3,253 | 7,879 | 3,809 | 3,786 | 7,952 | 3,682 | 4,261 |
| TOTAL KITES | 2,164 | 2,397 | 3,029 | 4,845 | 3,339 | 8,037 | 3,930 | 3,951 | 8,075 | 3,770 | 4,354 |
| Sharp-shinned Hawk | 4,780 | 3,231 | 3,896 | 1,484 | 3,878 | 3,142 | 1,508 | 1,923 | 2,407 | 1,295 | 2,754 |
| Cooper's Hawk | 1,137 | 1,136 | 1,207 | 1,088 | 1,281 | 1,233 | 738 | 1,162 | 1,150 | 305 | 1,044 |
| Unknown accipiter | 49 | 170 | 113 | 14 | 15 | 18 | 4 | 14 | 104 | 14 | 52 |
| TOTAL ACCIPITERS | 5,966 | 4,537 | 5,216 | 2,586 | 5,174 | 4,393 | 2,250 | 3,099 | 3,668 | 1,614 | 3,850 |
| Harris' Hawk | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 3 | 4 | 1 |
| Red-shouldered Hawk | 45 | 36 | 34 | 61 | 54 | 23 | 49 | 88 | 31 | 22 | 44 |
| Broad-winged Hawk | 30,417 | 16,137 | 34,243 | 29,956 | 103,612 | 65,255 | 21,799 | 26,032 | 20,380 | 49,527 | 39,736 |
| Swainson's Hawk | 137 | 56 | 129 | 255 | 321 | 168 | 228 | 1,036 | 360 | 201 | 289 |
| White-tailed Hawk | 0 | 1 | 2 | 11 | 12 | 8 | 23 | 14 | 24 | 8 | 10 |
| Red-tailed Hawk | 331 | 35 | 204 | 77 | 273 | 44 | 64 | 159 | 84 | 88 | 136 |
| Ferruginous Hawk | 0 | 0 | 2 | 0 | 2 | 1 | 2 | 1 | 0 | 0 | 1 |
| Rough-legged Hawk | 0 | 0 | 2 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0.5 |
| Unidentified buteo | 86 | 26 | 31 | 3 | 4 | 5 | 6 | 5 | 21 | 1 | 19 |
| TOTAL BUTEOS | 31,016 | 16,291 | 34,647 | 30,363 | 104,283 | 65,504 | 22,171 | 27,335 | 20,903 | 49,851 | 40,236 |
| Golden Eagle | 3 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0.6 |
| Bald Eagle | 2 | 0 | 2 | 7 | 2 | 3 | 2 | 1 | 5 | 7 | 3 |
| Unknown eagle | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0.1 |
| TOTAL EAGLES | 5 | 0 | 3 | 8 | 2 | 3 | 3 | 1 | 5 | 8 | 4 |
| Crested Caracara | 6 | 3 | 4 | 9 | 16 | 7 | 8 | 26 | 13 | 5 | 10 |
| American Kestrel | 1,297 | 1,334 | 1,938 | 1,311 | 1,140 | 1,949 | 816 | 1,272 | 1,011 | 916 | 1,298 |
| Merlin | 88 | 26 | 47 | 43 | 70 | 56 | 79 | 78 | 37 | 51 | 58 |
| Peregrine Falcon | 65 | 92 | 85 | 79 | 77 | 94 | 88 | 129 | 92 | 85 | 89 |
| Unknown falcon | 25 | 13 | 9 | 5 | 1 | 8 | 3 | 5 | 2 | 2 | 7 |
| TOTAL FALCONS | 1,475 | 1,465 | 2,079 | 1,438 | 1,288 | 2,107 | 986 | 1,484 | 1,142 | 1,054 | 1,452 |
| Unidentified raptor | 496 | 91 | 116 | 16 | 0 | 5 | 1 | 12 | 101 | 1 | 84 |
| GRAND TOTAL | 42,993 | 25,824 | 47,337 | 40,766 | 117,517 | 80,984 | 31,885 | 39,698 | 35,570 | 57,851 | 52,043 |