FALL 2007 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, in press). The project is a collaborative venture between HawkWatch International (HWI), Gulf Coast Bird Observatory (GCBO), and Texas Parks and Wildlife (site managers). During fall 2007, HWI and GCBO conducted the 11th consecutive standardized, full-season migration count at this site on Galveston Bay. Since 1997, 25 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 2007 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 other trained volunteers, conducted daily counts of the raptor migration through the area from a single traditional observation platform. Official observer Kevin Georg had 1 full-season of previous experience counting migrating raptors plus had served as a periodic volunteer counter at an eastern hawkwatch for about another decade. This was the first season of experience for official observer Brittany Moe (see Appendix A for a history of observer participation). Trained local volunteers, which this year included Bill Saulmon, Winnie Burkett, and Joe Kennedy, routinely assisted as supplemental and substitute observers, as has been the case since the project's inception. GCBO monitoring coordinator John Arvin also assisted regularly.

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

Calculation of "adjusted" (to standardize sampling periods and adjust for incompletely identified birds) passage rates (migrants counted per 100 hours of observation) and analysis of trends updated through 2007 follows Hoffman and Smith (2003). In comparing 2007 annual statistics against means and 95% confidence intervals for previous seasons, we equate significance with a 2007 value falling outside the bounds of the confidence interval for the associated mean.

RESULTS AND DISCUSSION

WEATHER

Inclement weather hampered observations at an average level in 2007, with a tropical storm fully precluding two full days of observation in mid-September and four other days reduced to ≤4 hours of observation due to heavy rain and thunderstorms (see Appendix C for daily weather records). The 1997–2006 averages for the site are 2.0 full and 4.4 partial days. Otherwise, generally fair skies prevailed on a significantly below average 30% of the active observation days (average 45%), transitional skies (i.e., skies changed from fair to mostly cloudy/overcast, or vice versa, during the day) on an above-average 43% (average 29%), and mostly cloudy to overcast skies on an average 27% of the active days. In addition, the proportion of active days during which visibility reducing fog and especially haze occurred was well above average (61% vs. average of 28% of active days), whereas the proportion of active days during which scattered rain and thundershowers occurred was near average (26% vs. average of 23%).

The wind-speed conditions at the site in 2007 were lighter than average. Light winds (≤12 kph) prevailed on 87% of the active observation days, moderate winds (12–28 kph) on 13%, and stronger winds on no days. The comparative 1997–2006 averages are 73% light, 25% moderate, and 2% strong. The shift toward lighter winds has been common 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 1997–2006, the most common wind direction patterns were variable N–E (on average, prevailing during most or all of 21% of the active observation days, and during portions of another 12% of the active days), E–S (most or all of 18% and portions of another 4%), NE–SE (most or all of 11% and portions of another 1%), SE–SW (most or all of 8% and portions of another 9%), NW–NE (most or all of 7% and portions of 1%), and W–N (most or all of 5% and portions of 1%). In addition, on average 13% of the active observation days feature distinct shifts in wind direction; e.g., from northeasterly winds during a portion of the day to southeasterly or southwesterly winds during the remainder of the day, or vice versa. In 2007, patterns that were noticeably more common than usual included NE–SE winds (17% of active days vs. average of 11%), E–S winds (24% vs. average of 18%), and days where the pattern shifted from N–E to SE–SW during the day (13% vs. average of 6%). Conversely, patterns that were noticeably less common than usual included N–E winds (13% vs. average of 19%) and W–N winds (1% vs. average of 5%).

The temperature during active observation periods averaged 28.3°C (average of daily values, which in turn were averages of hourly readings), ranging from 17.4–33.8°C. The average value is more than two degrees higher than the long-term average (third highest to date behind 2003 and 2005), and the low was a new record-high minimum for the site. The barometric pressure during active observation periods averaged 30.01 in Hg (the average of daily values, which in turn were averages of hourly readings), ranging from 29.59–30.36°C. The average was among the highest recorded to date. In 2007, 36% of the active observation days received a median (of hourly ratings) thermal-lift rating of fair to poor, which is the lowest proportion recorded to date (1997–2006 average of 58%, range 39–72%).

In summary, except for one tropical storm that kept the observers away for two days in mid-September, inclement weather was not much of problem for the count in 2007. That said, the skies during active observation periods were cloudier as well as much hazier than usual, in part reflecting lighter than average winds, which also translated to a relatively high prevalence of favorable thermal-lift conditions. Otherwise, easterly winds were a bit more common than usual, temperatures were warmer than normal, and high pressure prevailed more often than usual.

OBSERVATION EFFORT

The observers logged 90 days and 765.83 hours of observation between 15 August and 14 November 2007. The season was curtailed 1 day earlier than usual to accommodate observer travel needs. The numbers of observation days and hours were a non-significant 1% below and 2% above average, respectively. The number of observers averaged 2.2 per hour in 2007, which is a significant 20% higher than the 1997–2006 average of 1.9 ± 95% CI of 0.14 observers/hour.

MIGRATION SUMMARY

The observers tallied 33,521 migrant raptors of 22 species during the 2007season, which is a significant 36% lower than the 1997–2006 average total count (Table 1, and see Appendix D for daily count records). With Broad-winged Hawks excluded, however, the combined-species count was a significant 19% above average. As usual, buteos, accipiters, and kites were the predominant species groups. With Broad-winged Hawks included, the proportion of buteos was significantly below average, whereas the relative abundance of all other groups was above average. With Broad-winged Hawks excluded, the relative abundances of accipiters, falcons, and other miscellaneous species (Ospreys and Northern Harriers) were significantly above average, whereas the relative abundance of kites was significantly below average (Figure 2). Species that accounted for >1% of the total count included Broad-winged Hawk (56%), Sharp-shinned Hawk (13%), Mississippi Kite (11%), American Kestrel (7%), Turkey Vulture (6%), Cooper's Hawk (3%), and Northern Harrier (2%).

Highlights of the season included the first Prairie Falcon recorded since full-season counts began in 1997; two uncommon Ferruginous Hawks, including a dark-morph bird; and only the second year since 1997 in which three Golden Eagles were recorded. New record-high counts occurred in 2007 for Bald Eagles and American Kestrels, and the tally of Sharp-shinned Hawks was the second highest recorded since 1997 (see Appendix E for annual count summaries). In contrast, a new record-low count was recorded for Red-shouldered Hawks, and the Broad-winged Hawk count was the second lowest recorded to date.

Passage Rates and Long-Term Trends

Adjusted passage rates were significantly above average for five species (Turkey Vulture, Northern Harrier, Sharp-shinned Hawk, American Kestrel, and Merlin), and significantly below average for six species (Osprey, Swallow-tailed Kite, and Cooper's, Red-shouldered, White-tailed and Broad-winged Hawks; Table 1). Updated regression analyses (after Hoffman and Smith 2003) of adjusted passage rates through 2007 revealed at least marginally significant ($P \leq 0.01$) linear increasing trends for Swainson's Hawks (Figure 6) and Peregrine Falcons (Figure 8), and significant quadratic (second-order polynomial)

regressions for Ospreys, Swallow-tailed and Mississippi Kites, and Red-shouldered and White-tailed Hawks. For Ospreys, the quadratic fit tracked an essentially flat trajectory through 2002, then a strong increasing trend after that (Figure 3). For the two kites, the quadratic fits tracked increasing patterns through the early 2000s, but a relatively stable pattern after that for Mississippi Kites and a recent decline for Swallow-tailed Kites (Figure 4). Note that for both species, however, marginally significant overall increases were indicated. For Red-shouldered Hawks, the quadratic fit tracked a mostly stable pattern, but then a sharp drop off in the past few years (Figure 6). For White-tailed Hawks, the quadratic fit tracked a strong increasing pattern through 2005, but then a pronounced drop off in the past two years (Figure 6). No significant trends were indicated for other species.

Smith et al. (in press) present trend analyses of data collected through 2005 at four Gulf Coast watchsites, including Smith Point. These analyses (hereafter called the Raptor Population Index or "RPI" analyses; see http://www.rpi-project.org) are based on a more complex analytical approach (also see Farmer et al. 2007) than that represented in Hoffman and Smith (2003) and used herein to present analyses updated through 2007. Among other refinements, this new approach both fits polynomial trajectories to the complete series of annual count indexes 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 in this case included White-tailed Hawk and Crested Caracara.

The overall patterns of change and derived trend estimates suggested by the new modeling technique yielded similar inferences as those derived using the simpler methodology of Hoffman and Smith (2003) and presented herein to provide trend assessments updated through 2007. Differences between the RPI results and those presented herein that clearly relate to addition of two more years of data include: a) tapering off of what had been relatively strong increasing trends for Swallow-tailed and Mississippi Kites; and b) the recent drop-off of Red-shouldered Hawk activity, which newly yielded a significant quadratic model fit, but not a significant overall decline.

Elsewhere in coastal Texas, the overall count at Corpus Christi of 649,762 migrants was a non-significant 11% lower than the 1997–2006 average for that site (Smith and Neal 2008). Both Texas sites tallied record high counts of Bald Eagles in 2007; the second year in a row that such occurred. Both sites also recorded the second highest counts of Sharp-shinned Hawks, but no other common new record-high counts. In contrast, both sites recorded new record-low counts of Red-shouldered Hawks in 2007. Both sites also atypically recorded multiple Ferruginous Hawks, as well as at least one Golden Eagle. Other commonalities included significantly above-average counts of Turkey Vultures, American Kestrels, and Merlins, and below-average counts of Broad-winged Hawks (significant at Smith Point, not significant at Corpus Christi). Notable differences included a higher proportion of significantly above-average counts at Corpus Christi: 10 commonly occurring and 4 rare species, compared to 4 common and 4 rare species at Smith Point. In addition, significantly above-average counts for Swallow-tailed and Mississippi Kites, Cooper's Hawks, and Peregrine Falcons at Corpus Christi contrasted with non-significantly below-average counts for these species at Smith Point. Comparing trends in passage rates over the course of the two studies (both begun in 1997), both projects show similar long-term increasing patterns for Ospreys, Mississippi and Swallow-tailed Kites, White-tailed Hawks (although for the previous three species the trends have tapered off recently at Smith Point but not at Corpus Christi), and Peregrine Falcons. Both sites were also showing significant long-term increases in Swainson's Hawks, but a three-year decline at Corpus Christi has now reduced the long-term trend there to non-significant. Otherwise, the only species that is currently showing noticeably divergent patterns at the two sites is the Cooper's Hawks: significant increase at Corpus Christi, non-significant decline at Smith Point.

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

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

Age Ratios

All nine species for which comparisons of immature : adult ratios were possible showed significantly below average age ratios in 2007; however, low proportions of aged birds and/or substantial variation in those proportions across years preclude attaching great importance to age-ratio data for most such 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. The numbers of identified immature birds were below average for all species except Mississippi Kites, suggesting that low recruitment may have contributed to the low age ratios for several species (Table 2). However, above average tallies of identified adults also contributed to the low age ratios for Swallow-tailed and Mississippi Kites, Red-tailed Hawks, and Peregrine Falcons, potentially reflecting high overwinter survival of these species.

Seasonal Timing

The 2007 median passage date for Broad-winged Hawks of 28 September was a non-significant three days later than average (Table 3). The combined-species seasonal activity pattern with Broad-winged Hawks included showed a fairly typical pattern, but with generally below average activity through early September and, conversely, several five-day periods with significantly above-average activity in October (Figure 9). The combined-species seasonal activity pattern with Broad-winged Hawks excluded also showed well below-average activity through the first three weeks of the season, followed by three atypically high peaks in activity interspersed with two periods of significantly below average activity in late September and mid-October (Figure 9). The first of these peaks in activity corresponded primarily to peak passage of Mississippi Kites, the second primarily accipiters and kestrels, and the third Turkey Vultures. Among commonly encountered species, only Swallow-tailed Kites showed a significantly early median passage date in 2007, whereas seven species showed significantly late timing (Osprey, Northern Harrier, Mississippi Kite, Red-shouldered and Swainson's Hawks, Merlins, and Peregrine Falcons), and the remaining 10 species showed median passage dates that were within normal ranges of variation (Table 3). Age- and sex-specific data for 10 species further indicated a greater tendency for late passage among immatures of several species and, conversely, several instances of significantly early timing among adults (Table 4). In particular, passage of adult harriers of both sexes was significantly early, whereas passage of immatures was significantly late.

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.

Approximately 15–20 resident Turkey Vultures and at least 6–8 resident Black Vultures routinely patrolled the peninsula throughout the season. There appeared to be a family of Ospreys living in the area, with an adult and a juvenile seen in mid-August, and other individuals observed periodically throughout the season. Single White-tailed Kites were observed hunting in the field north of observation for about a week in late September and again in mid-November. One juvenile Cooper's Hawk frequented the area from mid-August through mid-September.

Local buteos included Broad-winged, Red-tailed, Red-shouldered, and White-tailed Hawks, plus short-term transient Swainson's Hawks. At least one juvenile Broad-wing Hawk was present in the area from mid-August through early November, tending to reside around the mottes west of observation. A light-morph, adult Red-tailed Hawk was present in the area throughout the season, and routinely hunted in the fields surrounding the observation point. The observers believed that there may have been a family of Red-shouldered Hawks present in the area early in the season, but by mid-season only a single juvenile was routinely heard and seen hunting in the area, especially in the field west of observation. A family of three White-tailed Hawks was observed regularly for a few days in mid-August and again in late August, typically flying in from the northeast to hunt over the west fields. Two Swainson's Hawks also frequented the west fields for a few days in late August.

Other than Crested Caracaras, no resident falcons were ever routinely seen from observation. There may have been a transient-resident Merlin, but observations of such were recorded on only three days through the season, with all such observations involving birds moving west to east along the shoreline. A family of six Crested Caracaras lived a few miles north of the watchsite, and individuals from this family were observed periodically hunting in the fields to the west and north of the watchsite throughout the season.

This is a fairly typical resident assemblage for the site, except that transient-resident Merlins typically are seen more regularly, at least one juvenile Red-tailed Hawk is often a regular presence, and at least transient-resident Northern Harriers are usually evident.

VISITOR PARTICIPATION AND PUBLIC OUTREACH

Documented visitation in 2007 totaled 612 individuals, which is similar to last year and only slightly below average. Documented visitors originated in eight states besides Texas (LA, MI, NJ, CO, NY, TN, FL, and GA), as well as El Salvador. Organized groups included folks from Penfeathers Tours and Houston Audubon Society. GCBO also coordinated a special weekend Raptor Identification Workshop on 28–30 September, with renowned raptor expert Bill Clark as presenter, which was attended by 25 participants plus three members of the GCBO staff.

In 2007, 776 hourly assessments by the official observers of visitor disturbance resulted in the following ratings: 77% none, 18% low, 5% moderate, and <1% high. This is a slightly higher-than-average level of observer disturbance, which may simply reflect the relative sensitivities of individual observers. Having GCBO staff and knowledgeable and dedicated local volunteers available at least most weekends to assist the official observers and facilitate visitor interactions helps ensure enjoyable and informative visits for all guests without unnecessarily distracting the official observers from documenting the migration.

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long-time local volunteers Bill Saulmon and Winnie Burkett, and to Joe Kennedy for helping with the count. As always, we are extremely grateful for the continued generosity of Joe and Annette Whitehead in provided housing, good food, and friendship for our primary observers. Lastly, thanks to the Texas Ornithological Society for sharing expenses with GCBO that enabled bringing Bill Clark to the site for a special raptor identification workshop.

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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: 1997–2006 versus 2007.

	COUNTS			RAPTORS/100 HOURS		
SPECIES	1997–2006[1]	2007	% CHANGE	1997–2006[1]	2007	% CHANGE
Black Vulture	167 ± 86.8	143	-14	33.3 ± 9.9	27.9	-16
Turkey Vulture	1,477 ± 511.2	1,964	+33	446.7 ± 88.4	577.9	+29
TOTAL VULTURES	1,643 ± 576.1	2,107	+28	–	–	–
Osprey	68 ± 9.3	64	-6	11.6 ± 1.1	9.9	-14
Northern Harrier	336 ± 78.5	524	+56	58.7 ± 8.2	91.0	+55
Hook-billed Kite	0 ± 0.2	0	-100	–	–	–
Swallow-tailed Kite	82 ± 26.3	62	-25	26.6 ± 5.1	21.5	-19
White-tailed Kite	10 ± 5.2	7	-32	–	–	–
Mississippi Kite	4,261 ± 1,283.6	3,739	-12	1387.4 ± 280.1	1245.9	-10
TOTAL KITES	4,359 ± 1,298.4	3,818	-12	–	–	–
Sharp-shinned Hawk	2,754 ± 749.4	4,326	+57	681.0 ± 103.0	986.5	+45
Cooper's Hawk	1,044 ± 185.1	890	-15	180.3 ± 19.4	152.4	-15
Unknown accipiter	52 ± 36.0	27	-48	–	–	–
TOTAL ACCIPITERS	3,850 ± 891.5	5,243	+36	–	–	–
Harris' Hawk	1 ± 0.9	0	-100	–	–	–
Red-shouldered Hawk	44 ± 12.4	9	-80	6.2 ± 0.9	1.1	-82
Broad-winged Hawk	39,736 ± 16,632.4	18,827	-53	9845.6 ± 2462.5	4372.8	-56
Swainson's Hawk	289 ± 172.2	321	+11	40.1 ± 13.5	44.3	+11
White-tailed Hawk	10 ± 5.2	7	-32	1.6 ± 0.5	1.1	-32
Red-tailed Hawk	136 ± 63.4	138	+2	19.3 ± 4.8	20.6	+7
Ferruginous Hawk	1 ± 0.6	2	+150	–	–	–
Rough-legged Hawk	1 ± 0.7	0	-100	–	–	–
Unidentified buteo	19 ± 16.1	16	-15	–	–	–
TOTAL BUTEOS	40,236 ± 16,639.6	19,320	-52	–	–	–
Golden Eagle	1 ± 0.6	3	+400	–	–	–
Bald Eagle	3 ± 1.5	11	+255	–	–	–
Unknown eagle	0 ± 0.2	0	-100	–	–	–
TOTAL EAGLES	4 ± 1.7	14	+268	–	–	–
Crested Caracara	10 ± 4.3	8	-18	1.3 ± 0.3	1.1	-17
American Kestrel	1,298 ± 237.5	2,255	+74	286.1 ± 30.6	488.5	+71
Merlin	58 ± 12.6	72	+25	12.8 ± 1.5	15.6	+22
Prairie Falcon	0 ± 0.0	1	#DIV/0!	–	–	–
Peregrine Falcon	89 ± 10.3	86	-3	19.3 ± 1.5	18.8	-3
Unknown falcon	7 ± 4.5	2	-73	–	–	–
TOTAL FALCONS	1,462 ± 236.9	2,424	+66	–	–	–
Unidentified raptor	84 ± 94.2	7	-92	–	–	–
GRAND TOTAL	52,043 ± 17,170.3	33,521	-36	–	–	–

[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	
	1997–2006 Average			2007			% Unknown Age		Ratio	
	Total	Imm.	Adult	Total	Imm.	Adult	1997–2006[1]	2007	1997–2006[1]	2007
Northern Harrier	336	139	71	524	49	58	38±11.5	80	2.5 ± 1.0	0.8
Swallow-tailed Kite	82	10	15	62	4	28	79±17.1	48	1.2 ± 0.9	0.1
Mississippi Kite	4,261	670	204	3,739	700	256	70±18.7	74	10.2 ± 9.0	2.7
Sharp-shinned Hawk	2,754	747	85	4,326	6	12	69±12.8	100	9.5 ± 4.3	0.5
Cooper's Hawk	1,044	321	65	890	29	16	64±13.7	95	4.6 ± 1.6	1.8
Red-shouldered Hawk	44	16	3	9	1	2	57±18.2	67	9.3 ± 8.0	0.5
Broad-winged Hawk	39,736	1,034	196	18,827	30	20	97±1.8	100	4.3 ± 2.1	1.5
Red-tailed Hawk	136	42	37	138	24	68	35±15.2	33	1.1 ± 0.3	0.4
Peregrine Falcon	89	10	21	86	6	20	66±20.1	70	0.5 ± 0.2	0.3

[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 2007 and 1997–2006 average median passage dates.

	2007				1997–2006
Species	First Observed	Last Observed	Bulk Passage Dates[1]	Median Passage Date[2]	Median Passage Date[2, 3]
Black Vulture	20-Sep	10-Nov	20-Sep – 10-Nov	25-Oct	24-Oct ± 5.8
Turkey Vulture	5-Oct	11-Nov	24-Oct – 6-Nov	27-Oct	28-Oct ± 3.8
Osprey	30-Aug	13-Nov	14-Sep – 5-Nov	4-Oct	28-Sep ± 3.4
Northern Harrier	8-Sep	14-Nov	29-Sep – 3-Nov	24-Oct	15-Oct ± 4.9
Swallow-tailed Kite	15-Aug	19-Sep	19-Aug – 9-Sep	22-Aug	26-Aug ± 3.3
White-tailed Kite	19-Sep	27-Oct	21-Sep – 27-Oct	8-Oct	06-Oct ± 9.4
Mississippi Kite	15-Aug	1-Nov	8-Sep – 20-Sep	15-Sep	04-Sep ± 3.6
Sharp-shinned Hawk	26-Aug	13-Nov	20-Sep – 25-Oct	3-Oct	05-Oct ± 4.0
Cooper's Hawk	26-Aug	13-Nov	22-Sep – 28-Oct	10-Oct	07-Oct ± 3.2
Red-shouldered Hawk	25-Oct	13-Nov	25-Oct – 13-Nov	7-Nov	21-Sep ± 8.3
Broad-winged Hawk	15-Aug	11-Nov	19-Sep – 24-Oct	28-Sep	25-Sep ± 3.6
Swainson's Hawk	15-Aug	7-Nov	22-Sep – 26-Oct	24-Oct	19-Oct ± 3.4
White-tailed Hawk	25-Sep	3-Nov	25-Sep – 3-Nov	13-Oct	01-Oct ± 16.1
Red-tailed Hawk	30-Aug	13-Nov	16-Oct – 11-Nov	29-Oct	26-Oct ± 8.9
Ferruginous Hawk	20-Sep	25-Oct	–	–	–
Golden Eagle	23-Oct	7-Nov	–	–	–
Bald Eagle	3-Oct	2-Nov	10-Oct – 26-Oct	25-Oct	27-Oct ± 13.0
Crested Caracara	16-Aug	12-Nov	16-Aug – 12-Nov	25-Sep	29-Sep ± 18.1
American Kestrel	31-Aug	13-Nov	1-Oct – 28-Oct	9-Oct	09-Oct ± 3.4
Merlin	6-Sep	12-Nov	26-Sep – 24-Oct	9-Oct	30-Sep ± 2.9
Prairie Falcon	9-Oct	9-Oct	–	–	–
Peregrine Falcon	16-Sep	6-Nov	28-Sep – 21-Oct	6-Oct	02-Oct ± 1.7
Total	17-Aug	14-Nov	16-Sep – 25-Oct	1-Oct	25-Sep ± 3.6

[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 and sex for selected species of migrating raptors at Smith Point, TX: 1997–2006 versus 2007.

	ADULT		IMMATURE	
SPECIES	1997–2006[1]	2007	1997–2006[1]	2007
Northern Harrier	28-Oct ± 5.2	24-Oct	12-Oct ± 4.6	27-Oct
Swallow-tailed Kite	22-Aug ± 6.3	30-Aug	28-Aug ± 6.6	–
Mississippi Kite	03-Sep ± 4.3	14-Sep	11-Sep ± 3.6	17-Sep
Sharp-shinned Hawk	17-Oct ± 6.9	23-Oct	02-Oct ± 5.2	10-Oct
Cooper's Hawk	17-Oct ± 13.2	10-Oct	04-Oct ± 7.7	10-Oct
Broad-winged Hawk	18-Sep ± 4.8	8-Sep	21-Sep ± 9.2	23-Sep
White-tailed Hawk	21-Oct ± 6.9[2]	13-Oct	07-Oct ± 12.8	–
Red-tailed Hawk	17-Oct ± 14.9	27-Oct	17-Oct ± 9.9	27-Oct
Bald Eagle	–	–	02-Nov ± 10.8[3]	24-Oct
Peregrine Falcon	02-Oct ± 5.1	5-Oct	02-Oct ± 8.9	9-Oct
	Male		Female	
Adult Northern Harrier	29-Oct ± 4.7	24-Oct	24-Oct ± 8.3	19-Sep
American Kestrel	10-Oct ± 5.1	8-Oct	06-Oct ± 5.3	4-Oct

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] Values based on data for 2001 and 2003 only.

[3] Values based on data for 2000 and 2006 only.

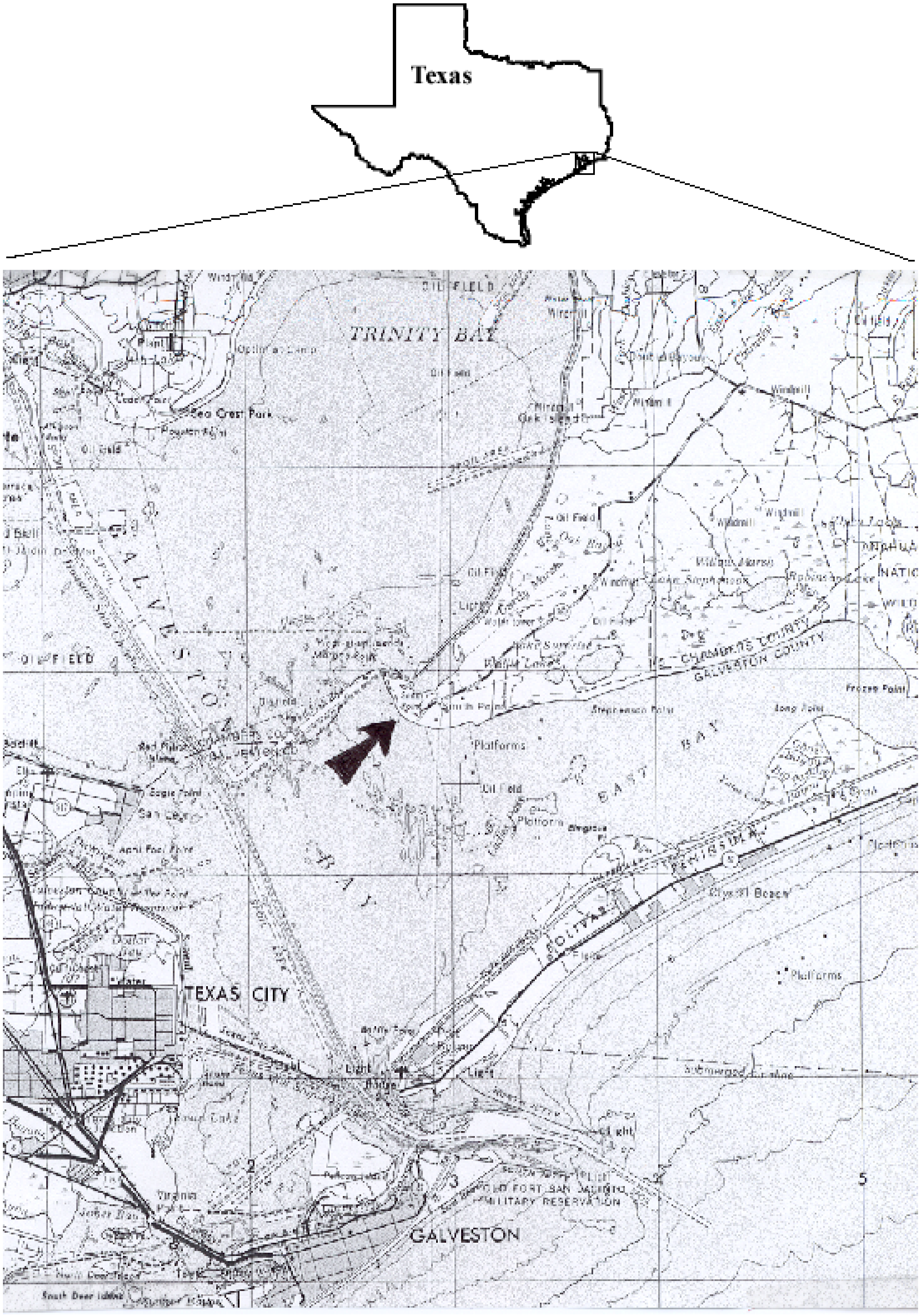

Figure 1. Location of the Smith Point Raptor Migration Project study site in southeast Texas.

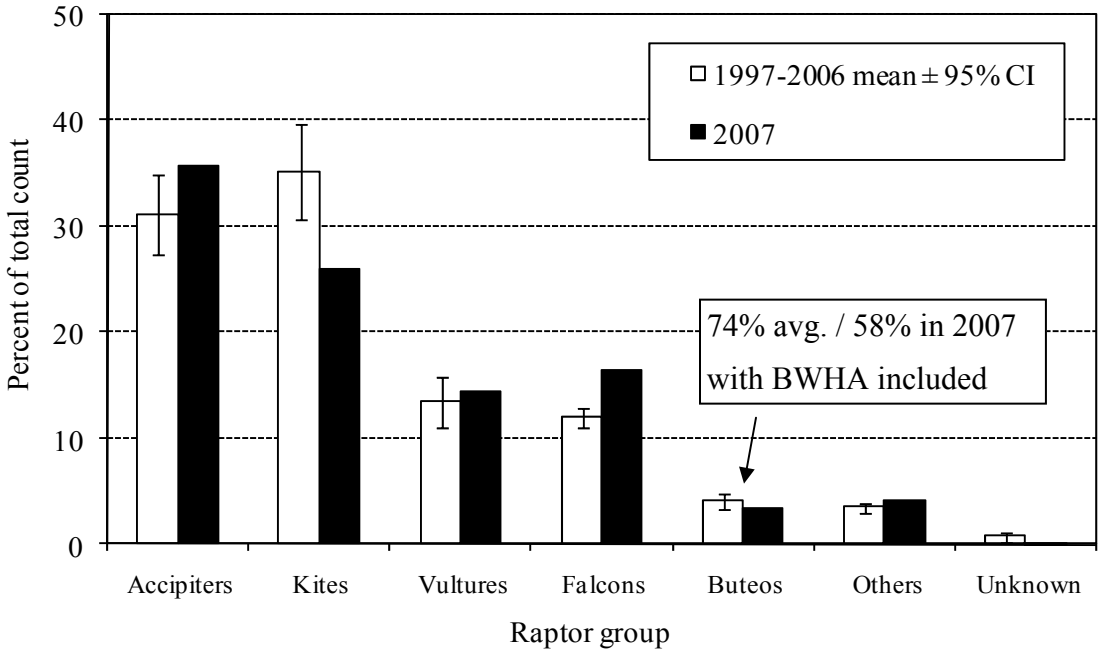

Figure 2. Composition of autumn raptor migration by major species groups at Smith Point, Texas: 1997–2006 versus 2007.

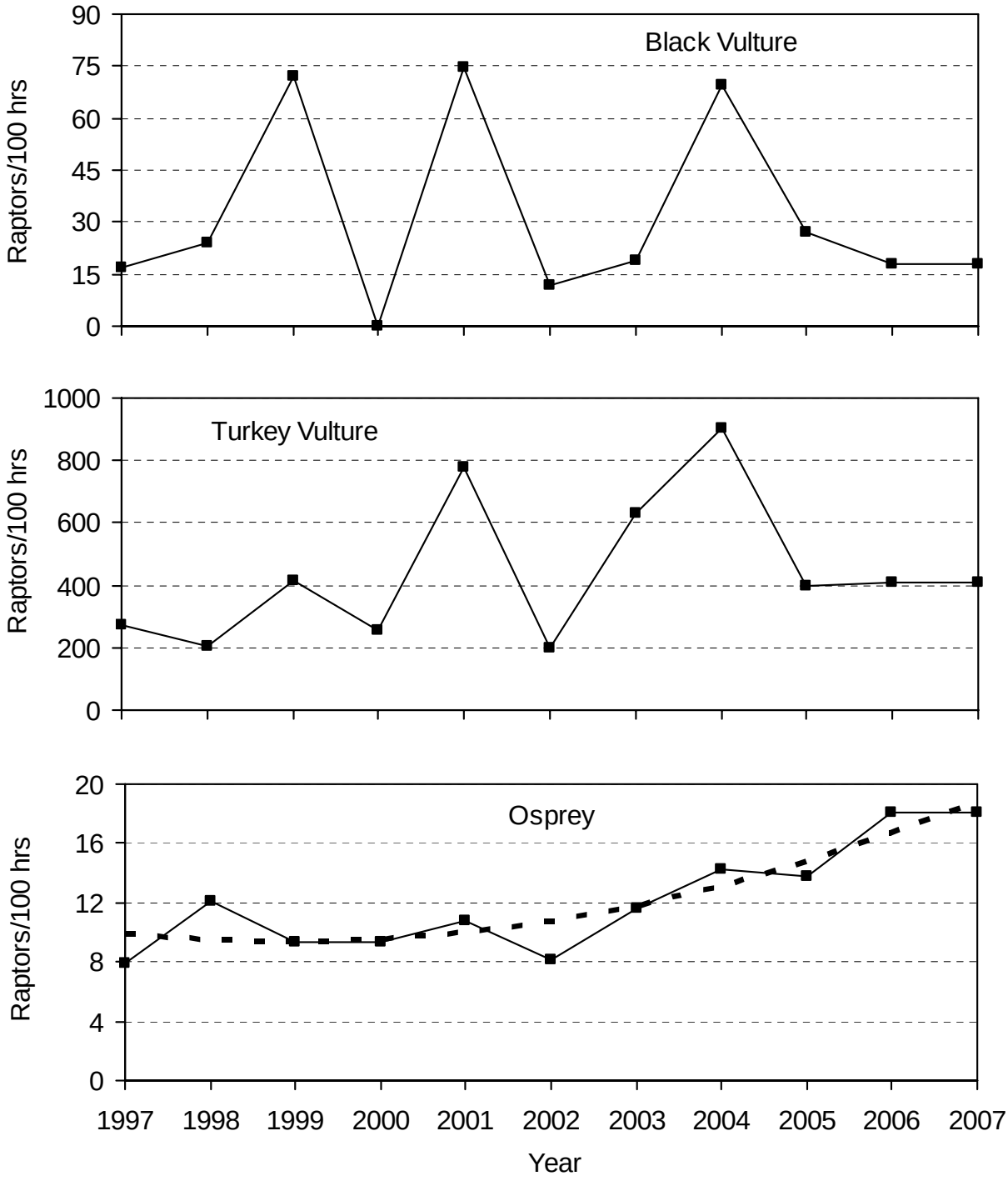

Figure 3. Adjusted fall-migration passage rates at Smith Point, Texas for Black Vultures, Turkey Vultures, and Ospreys: 1997–2007. Dashed lines indicate significant ($P \leq 0.10$) linear or quadratic regressions.

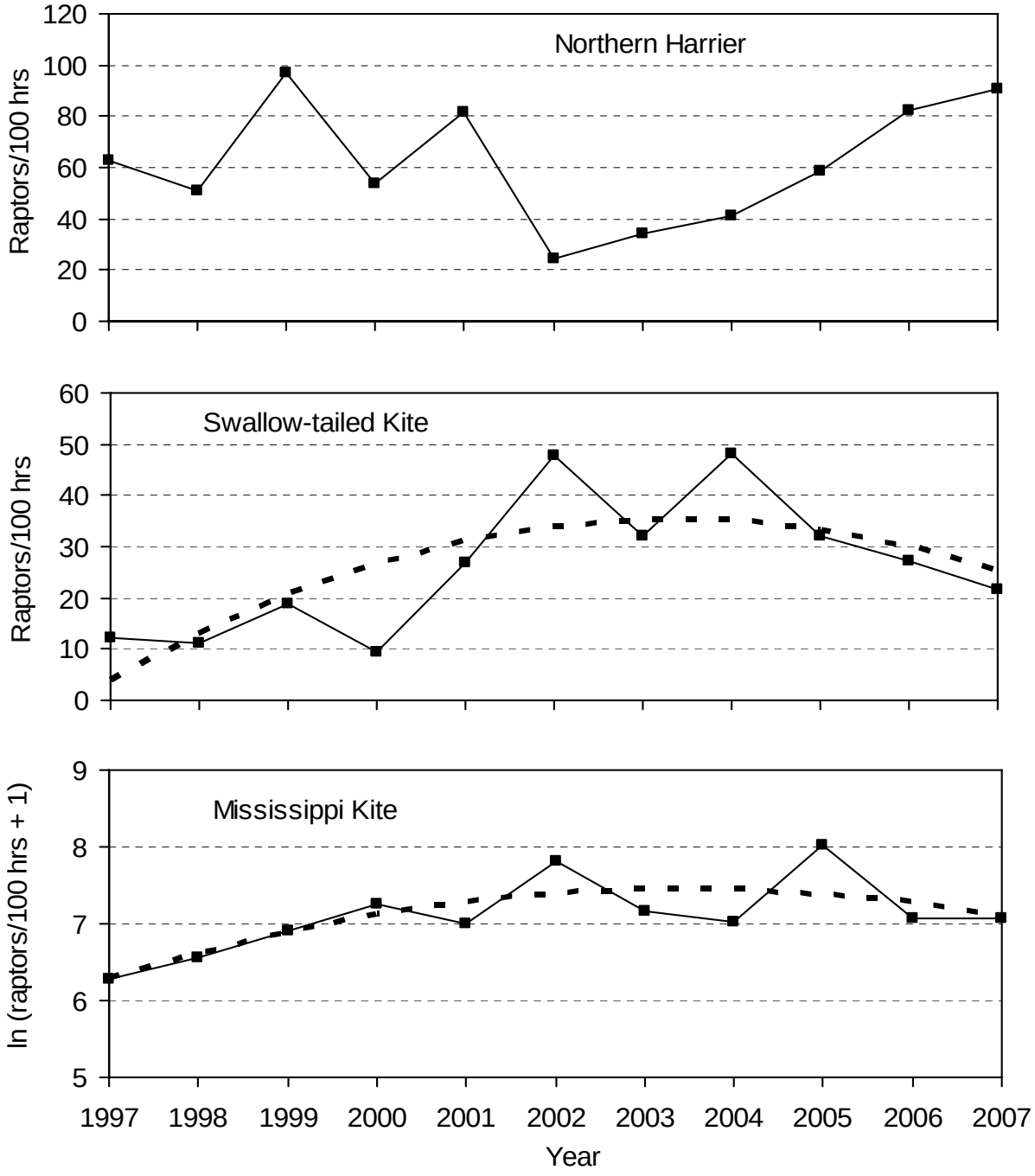

Figure 4. Adjusted fall-migration passage rates at Smith Point, Texas for Northern Harriers, Swallow-tailed Kites, and Mississippi Kites: 1997–2007. Dashed lines indicate significant ($P \leq 0.10$) linear or quadratic regressions.

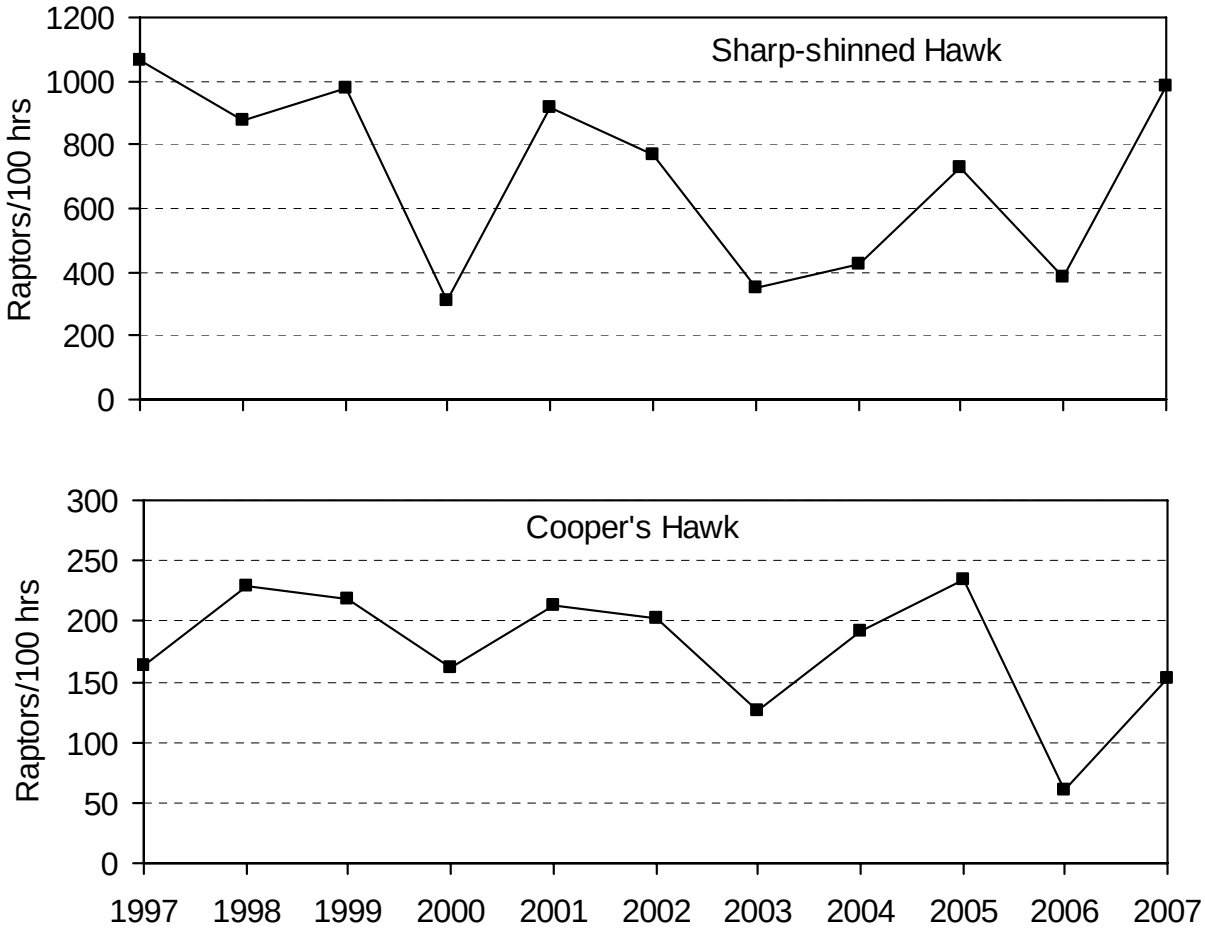

Figure 5. Adjusted fall-migration passage rates at Smith Point, Texas for Sharp-shinned and Cooper's Hawks: 1997–2007. Dashed lines indicate significant ($P \leq 0.10$) linear or quadratic regressions.

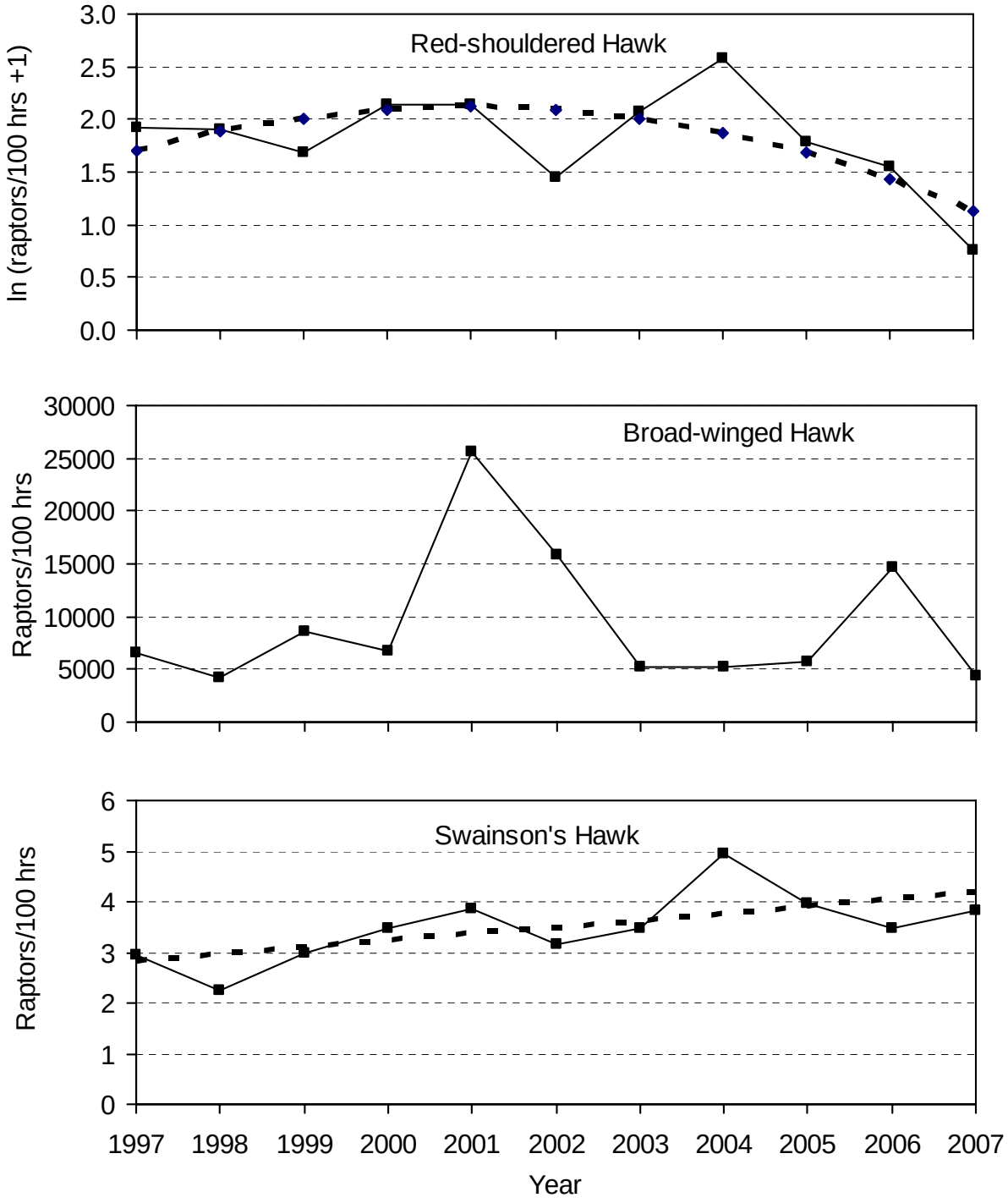

Figure 6. Adjusted fall-migration passage rates at Smith Point, Texas for Red-shouldered, Broad-winged, and Swainson's Hawks: 1997–2007. Dashed lines indicate significant ($P \leq 0.10$) linear or quadratic regressions.

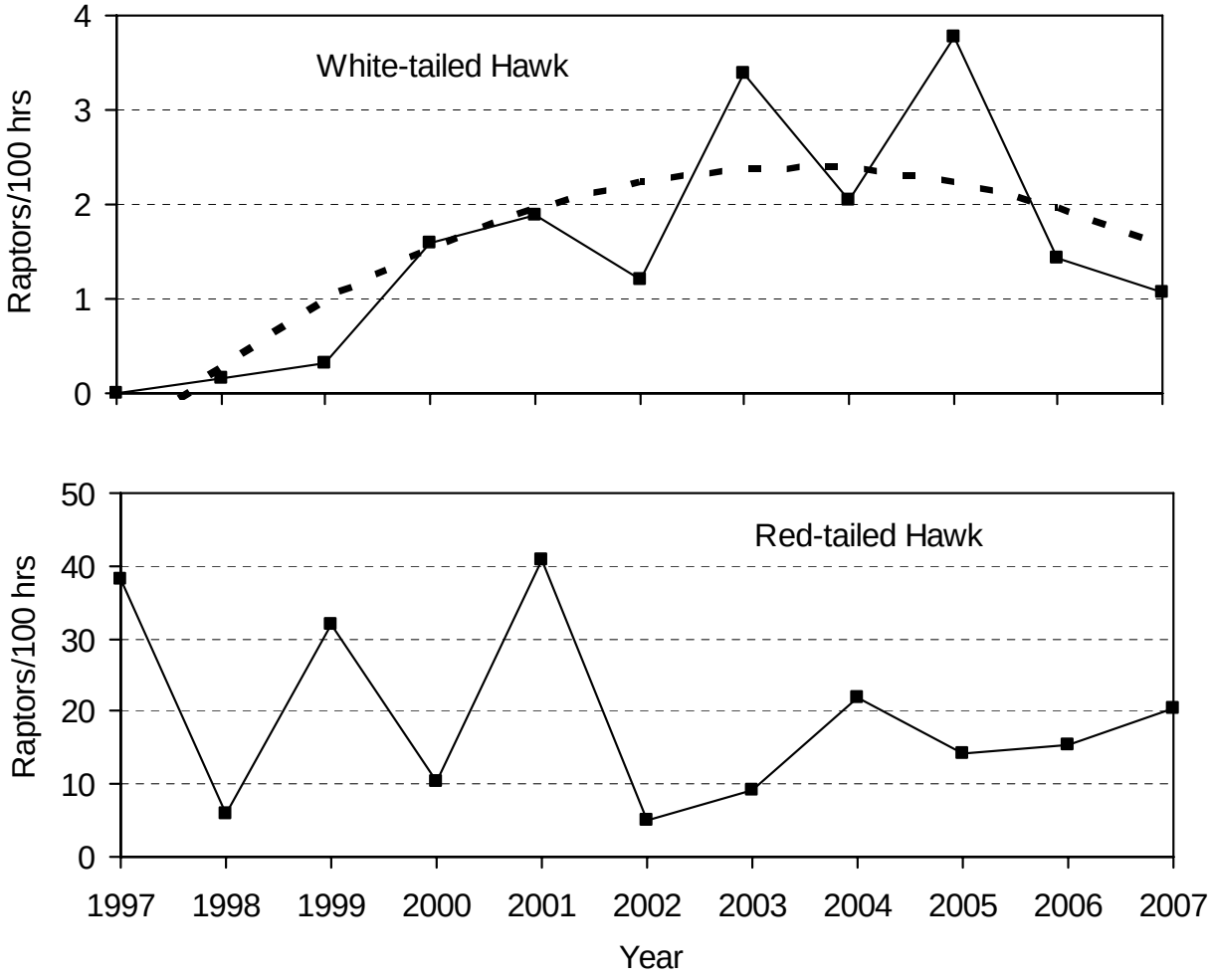

Figure 7. Adjusted fall-migration passage rates at Smith Point, Texas for White-tailed and Red-tailed and Hawks: 1997–2007. Dashed lines indicate significant ($P \leq 0.10$) linear or quadratic regressions.

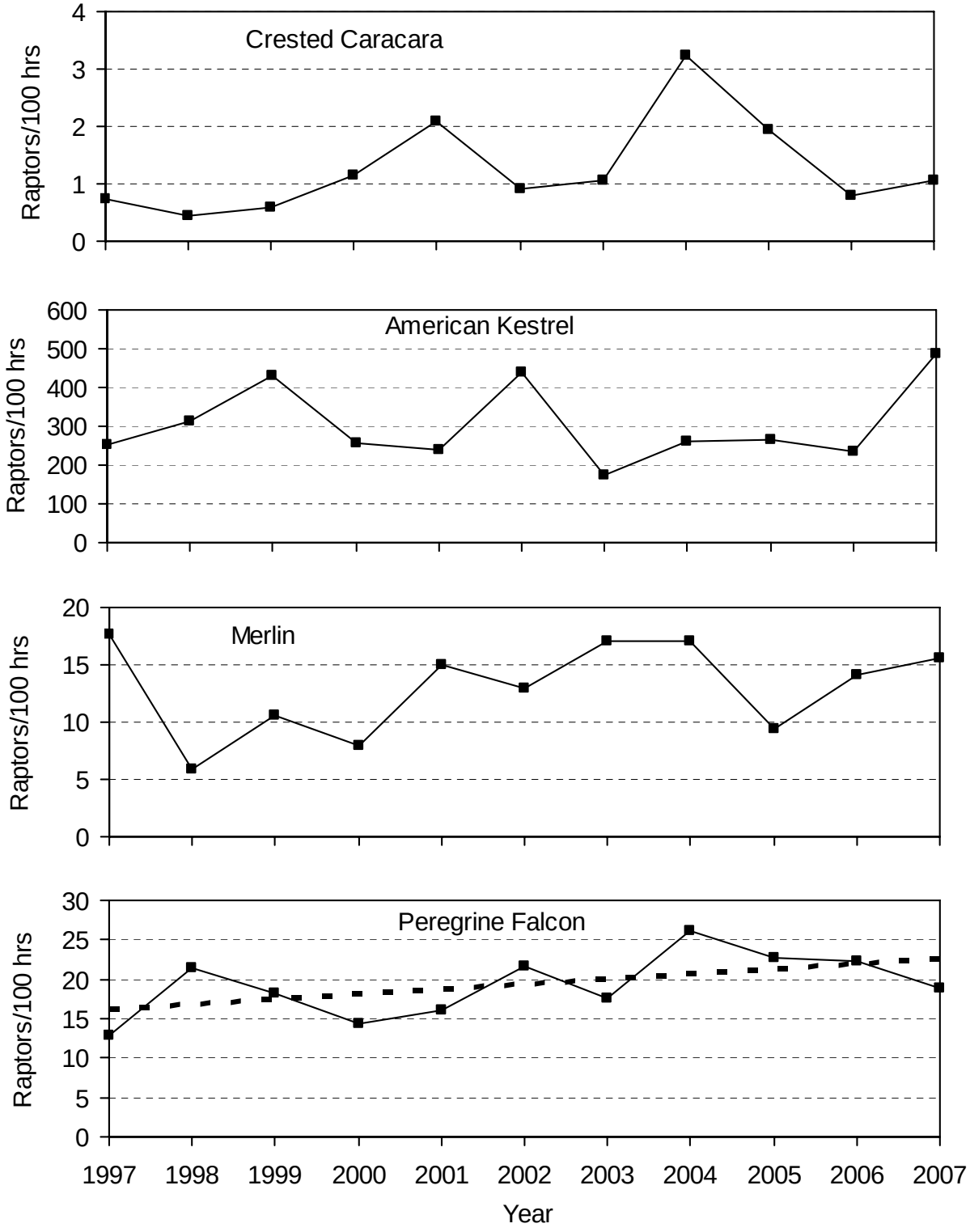

Figure 8. Adjusted fall-migration passage rates at Smith Point, Texas for Crested Caracaras, American Kestrels, Merlins, and Peregrine Falcons: 1997–2007. Dashed lines indicate significant ($P \leq 0.10$) linear or quadratic regressions.

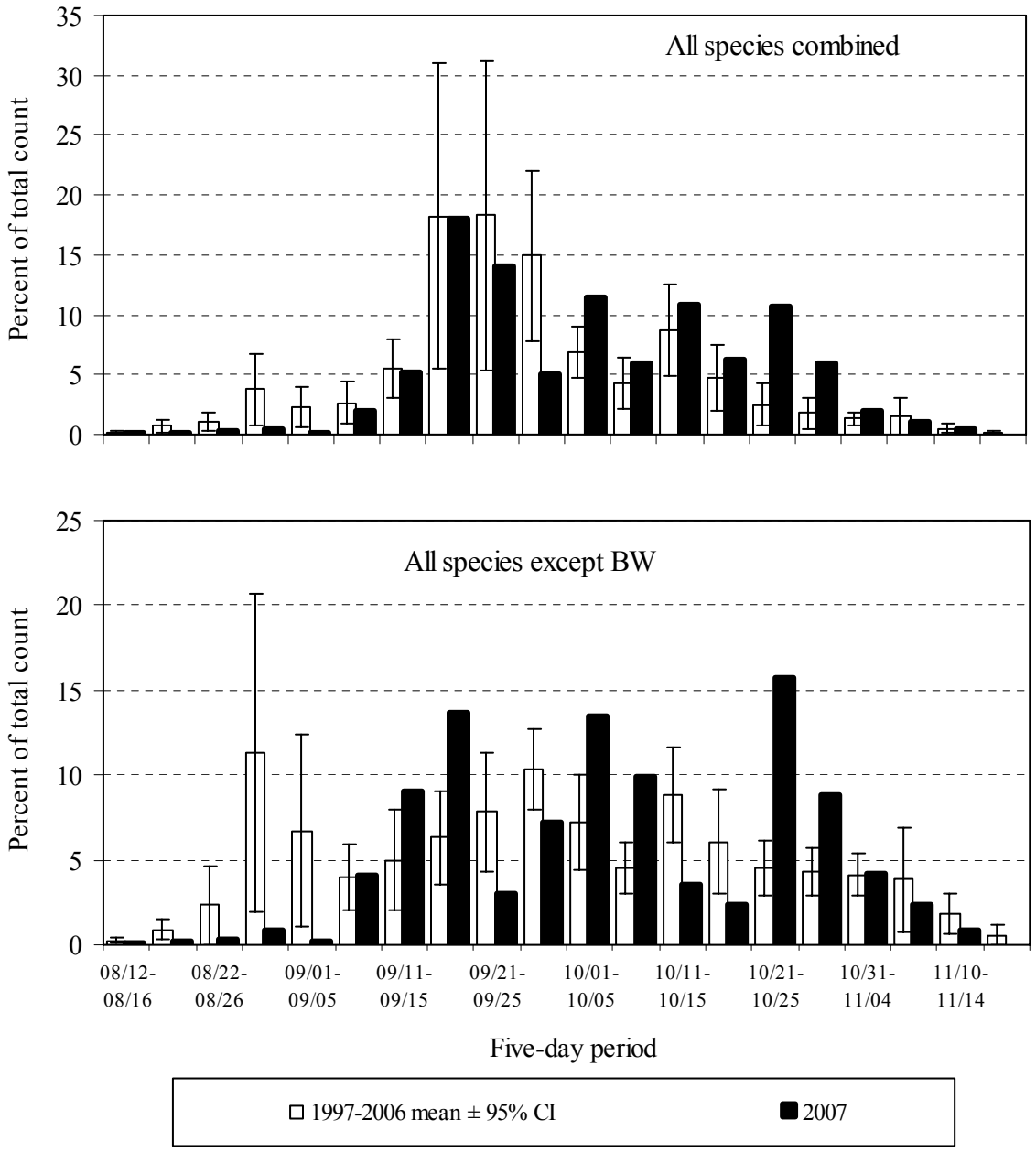

Figure 9. Combined-species flight volume by five-day periods for the autumn raptor migration at Smith Point, Texas, with and without Broad-winged Hawks: 1997–2006 versus 2007.

Appendix A. A history of official observer participation in the Smith Point Raptor Migration Project: 1997–2007.

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 and GCBO staff.

2007: Two designated observers throughout: Kevin Georg (1 plus at least a decade of additional partial volunteer service) and Brittany Moe (0), regularly assisted by several local, experienced volunteers and GCBO staff.

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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
Prairie Falcon	*Falco mexicanus*	PR	U	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: 2007.

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	9.00	3.0	0	mc-ovc, AM fog, scat ts	9.8	nne-e/var	32.0	29.82	3	16	25	3	2.9
16-Aug	4.50	2.9	0	ovc, ts/rain	12.7	ene-ese	28.7	29.92	4	16	19	2	0.9
17-Aug	9.00	4.6	0	mc-ovc	13.6	sse-s	32.7	30.02	2	33	35	3	0.3
18-Aug	8.08	2.4	0	mc-ovc, scat rain	7.9	sse, e, se	30.4	30.06	3	23	26	-	0.0
19-Aug	9.00	2.8	0	pc-mc	7.4	se-sse	32.6	30.02	2	30	30	3	2.8
20-Aug	9.00	2.1	0	pc	8.6	se	32.7	30.01	2	35	33	3	0.2
21-Aug	9.00	2.0	0	pc-mc	9.2	e-ese	33.0	30.05	2	35	33	3	1.7
22-Aug	9.00	2.0	0	ovc-mc, AM ts	10.3	e-ese	33.8	30.07	2	34	34	3	0.4
23-Aug	9.00	2.0	0	pc-ovc	9.9	ese-se	33.1	30.04	2	35	35	3	1.3
24-Aug	9.00	1.8	0	pc	5.5	calm, ese	33.1	30.00	2	35	35	2	1.7
25-Aug	9.00	2.5	0	pc-mc	10.8	se-s	33.0	30.01	2	35	35	3	0.7
26-Aug	9.00	3.2	0	ovc	5.9	n-ene/var	33.0	29.99	2	35	35	2	6.0
27-Aug	9.00	2.0	0	ovc-pc, PM haze	4.9	var	32.7	30.01	2	33	31	3	3.2
28-Aug	9.00	2.0	0	ovc, scat rain	3.9	se-s, ne, se	30.5	30.03	3	34	33	3	0.8
29-Aug	4.25	2.0	0	ovc, ts/rain	0.8	calm/sw	29.8	30.08	4	35	33	-	0.0
30-Aug	9.00	1.9	0	pc-mc, AM haze	5.7	ene, nw	30.9	30.08	2	34	34	2	13.6
31-Aug	9.00	1.8	0	ovc, PM ts, scat haze	6.7	nw-nnw, s	31.5	29.99	2	32	32	2	1.2
01-Sep	9.00	2.3	0	ovc-mc, haze	6.4	ne, se, nw	30.5	30.00	4	24	21	1	2.3
02-Sep	2.00	1.6	0	mc-ovc, AM fog/ts	4.5	ene, calm/var	25.8	30.06	4	15	15	-	0.0
03-Sep	3.75	2.3	0	ovc	2.0	calm/var	30.8	30.10	4	33	32	3	1.6
04-Sep	9.00	2.0	0	ovc, scat ts	5.0	ne-ene, se	30.5	30.03	3	33	32	3	0.9
05-Sep	9.00	2.0	0	ovc, PM ts	14.0	se-ssw	31.0	29.96	3	35	33	-	0.0
06-Sep	9.00	2.0	0	pc-ovc, scat ts	11.2	s-ssw	31.8	30.02	3	35	35	1	1.0
07-Sep	8.75	1.0	0	pc-ovc, AM haze, PM ts	9.1	s-ssw	31.6	30.02	2	35	34	2	3.7
08-Sep	9.00	2.0	1	mc-ovc	6.6	ene-se	32.5	29.98	2	35	35	2	23.9
09-Sep	9.00	2.6	0	pc-ovc	4.2	se/calm	31.7	29.99	3	35	35	3	1.4
10-Sep	9.00	2.0	0	pc-ovc, scat haze	6.2	e, se-sse	31.1	30.01	2	33	35	3	41.3
11-Sep	6.75	2.0	0	pc-ovc, AM haze	7.9	nne-ne	30.0	29.96	1	33	35	2	35.6
12-Sep	0.00			no obs - tropical storm									
13-Sep	0.00			no obs - tropical storm									
14-Sep	7.50	2.3	0	clr-ovc, AM haze	3.7	nw-n, se	32.1	30.06	2	35	35	2	41.5
15-Sep	9.17	2.7	1	pc-mc, AM haze	7.9	ne-ene	31.4	30.12	1	35	35	2	131.7
16-Sep	9.00	2.9	1	clr, haze	7.3	ne-e	29.9	30.12	2	35	35	2	80.0
17-Sep	9.00	2.0	0	pc, haze	6.3	ene, se	29.5	30.05	2	35	35	2	34.2
18-Sep	9.00	1.9	0	pc-ovc, haze	9.0	ne-ese	30.1	30.02	2	30	35	3	45.1
19-Sep	9.00	1.9	2	ovc-pc, AM rain	10.5	ene-ese	30.8	30.04	2	33	33	3	219.8
20-Sep	9.00	2.0	0	clr-pc, haze	5.6	n-ne, se	30.3	29.99	2	32	30	3	293.8
21-Sep	9.00	2.0	0	clr	5.1	nnw	29.5	29.91	2	35	35	-	360.8
22-Sep	9.00	2.8	2	clr-ovc, AM haze	5.2	nnw-n	30.8	29.93	2	25	30	2	135.6
23-Sep	9.00	2.7	0	ovc-clr, haze	4.7	n/calm, sw, se	31.4	29.95	2	26	28	2	16.3
24-Sep	9.00	2.0	0	pc, haze	6.0	ne-e	31.1	29.95	2	30	31	3	8.2
25-Sep	9.00	2.0	0	mc-ovc, scat ts/rain	4.9	e	29.9	29.97	2	36	35	3	3.8
26-Sep	8.50	2.0	0	ovc-pc, AM fog, scat ts/rain	3.0	ne, se	29.0	29.95	3	30	29	2	11.6
27-Sep	3.25	2.0	3	pc, fog/haze - stopped by rain	3.0	ne	28.0	29.95	3	29	31	2	18.5
28-Sep	9.00	2.5	1	pc-mc, haze	4.2	ne, se	30.2	30.02	1	31	31	2	71.4
29-Sep	8.50	3.1	2	pc-ovc, haze, PM ts	6.4	ne, se	28.7	30.04	3	25	28	2	30.0
30-Sep	9.00	2.0	0	mc-ovc, AM rain	3.9	se-s	30.4	30.09	4	25	25	2	69.8
01-Oct	9.00	2.0	0	ovc-clr, AM rain	6.6	se	29.9	30.13	2	29	30	2	183.9
02-Oct	9.00	2.0	1	clr-mc, AM haze	3.5	se-s	30.0	30.01	1	35	35	3	64.7
03-Oct	9.00	2.7	0	mc-pc	5.5	ne, nw	29.0	29.90	1	33	35	2	108.4
04-Oct	9.00	3.0	0	clr-mc, haze	7.4	n, se	28.5	29.83	1	31	32	2	59.8

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
05-Oct	5.83	1.8	0	pc-ovc, scat rain	5.3	nne-ne	28.6	29.87	3	27	29	2	13.9
06-Oct	9.00	1.9	1	mc-ovc, haze, scat rain	5.1	sw, se-s	30.1	29.88	2	31	31	3	7.7
07-Oct	8.00	2.0	1	mc-ovc, PM rain	11.1	ese, ne	29.5	29.85	2	34	31	3	33.3
08-Oct	9.00	1.5	0	mc-ovc, AM fog, scat ts	5.4	ene-ese	29.5	29.89	1	34	30	2	92.4
09-Oct	9.50	2.5	1	clr-mc, AM haze	6.7	n-ne, s	29.4	29.99	1	33	34	2	55.5
10-Oct	9.00	2.8	0	clr, haze	7.0	n-ne	27.4	29.97	1	34	35	3	35.3
11-Oct	9.00	2.0	0	clr, haze	6.5	nne-ne, se	27.9	29.89	1	35	35	3	13.6
12-Oct	9.00	2.0	0	clr, haze	5.7	nne-ene	26.2	29.93	2	35	32	3	66.7
13-Oct	9.00	2.2	2	clr, haze	6.3	ne, se	26.8	29.90	2	35	35	3	218.8
14-Oct	9.00	2.5	1	clr-ovc, AM haze	11.3	se	28.0	29.85	3	33	34	3	89.7
15-Oct	9.00	1.6	0	ovc, haze	10.5	se-sse	29.5	29.82	3	33	33	3	14.0
16-Oct	9.00	2.5	0	ovc-pc, AM fog	6.5	nne/var, se	25.9	29.84	2	16	15	3	167.9
17-Oct	8.50	1.3	0	ovc-pc, scat rain	19.3	se, ssw	29.2	29.59	3	28	33	2	2.6
18-Oct	8.00	1.9	0	pc-ovc, haze	22.0	ssw	29.8	29.66	3	25	30	2	0.1
19-Oct	9.00	1.4	0	clr-pc	7.2	n-ne, se	27.5	29.89	1	35	35	3	53.2
20-Oct	9.00	1.9	0	clr, haze	8.2	ne-ene, se	28.4	29.98	2	32	34	3	7.1
21-Oct	9.00	2.0	0	pc-ovc	11.3	sse	29.0	29.89	3	35	35	3	5.2
22-Oct	3.17	2.0	0	ovc, AM fog - stopped by rain	1.6	calm/var	27.2	29.87	3	33	25	-	1.3
23-Oct	9.00	2.8	0	clr	21.8	nw-nnw	19.6	30.11	3	35	35	2	60.7
24-Oct	9.00	2.5	0	clr	12.5	w-nnw, n	21.2	29.99	3	35	35	2	122.9
25-Oct	9.00	2.3	0	clr	10.1	nw-n	18.5	29.97	2	35	35	3	208.8
26-Oct	9.00	1.0	0	clr, haze	3.5	ne, sw/var	20.4	30.07	1	35	35	3	68.7
27-Oct	9.00	2.0	1	clr, haze	7.8	ne, n	20.8	30.28	1	35	35	3	47.6
28-Oct	9.00	3.2	0	clr, haze	12.0	ne, n	20.5	30.36	2	35	35	3	56.9
29-Oct	8.83	1.6	0	clr-pc, haze	10.5	n	20.5	30.31	2	35	35	3	30.4
30-Oct	9.00	1.9	0	pc, haze	5.5	ne, sw	20.7	30.23	1	28	28	3	18.7
31-Oct	9.00	2.0	1	AM ovc/fog, clr/haze	5.0	n-ene, se	23.3	30.09	2	26	24	3	13.4
01-Nov	9.00	2.0	0	pc, AM fog, haze	7.2	n, wsw	24.8	30.07	2	23	23	3	13.6
02-Nov	9.00	1.7	0	clr, AM fog, haze	6.8	ne-e, se	24.4	30.09	2	22	22	2	6.0
03-Nov	9.00	2.0	0	clr-ovc, haze	5.7	ne, se	24.2	30.19	2	20	20	3	20.6
04-Nov	9.00	2.7	0	clr, AM fog, haze	4.3	calm/var, wnw	25.0	30.19	2	21	21	3	19.1
05-Nov	9.00	1.9	0	clr-pc, haze	12.4	sse-s	25.5	30.08	3	29	29	3	8.6
06-Nov	9.00	2.3	0	ovc, haze	10.5	n-ne	23.2	30.19	3	26	26	2	10.0
07-Nov	9.00	1.9	0	clr-ovc	9.2	ne-ene, se	17.4	30.32	2	35	35	3	22.1
08-Nov	9.00	2.0	0	ovc, haze	6.2	e, se	21.5	30.11	2	31	29	2	0.9
09-Nov	9.00	1.0	0	pc-ovc, AM haze	11.9	se, s	25.7	30.12	3	25	25	3	0.6
10-Nov	9.00	2.0	0	pc-mc	9.5	e-s	25.4	30.06	3	32	33	3	5.6
11-Nov	9.00	1.8	0	pc-mc, haze	8.8	e, s	24.4	30.03	3	30	33	3	4.7
12-Nov	9.00	1.9	0	pc-ovc, AM haze	6.9	ene-se	24.5	30.13	3	32	34	2	1.8
13-Nov	9.00	1.8	0	pc-ovc, AM fog/haze	11.5	ene-s	25.2	30.10	3	30	27	3	2.6
14-Nov	9.00	1.9	0	pc, AM haze	21.6	s-ssw	25.5	29.95	3	30	33	1	0.3

[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. Daily fall raptor migration counts at Smith Point, Texas: 2007.

		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	PR	PG	UF	UU	Total	/ Hr
15-Aug	9.00	0	0	0	0	0	3	0	4	0	0	0	0	0	12	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	26	2.9
16-Aug	4.50	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	4	0.9
17-Aug	9.00	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0.3
18-Aug	8.08	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
19-Aug	9.00	0	0	0	0	0	17	0	0	0	0	0	0	0	7	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	25	2.8
20-Aug	9.00	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0.2
21-Aug	9.00	0	0	0	0	0	7	0	6	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	1.7
22-Aug	9.00	0	0	0	0	0	1	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0.4
23-Aug	9.00	0	0	0	0	0	0	0	7	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	1.3
24-Aug	9.00	0	0	0	0	0	1	0	4	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	1.7
25-Aug	9.00	0	0	0	0	0	0	0	1	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0.7
26-Aug	9.00	0	0	0	0	0	1	0	19	1	6	2	0	0	19	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	54	6.0
27-Aug	9.00	0	0	0	0	0	1	0	5	0	0	0	0	0	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	3.2
28-Aug	9.00	0	0	0	0	0	0	0	2	0	1	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0.8
29-Aug	4.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
30-Aug	9.00	0	0	1	0	0	7	0	101	0	2	0	0	0	9	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	122	13.6
31-Aug	9.00	0	0	0	0	0	0	0	6	0	1	0	0	0	0	3	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	11	1.2
01-Sep	9.00	0	0	0	0	0	1	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	2.3
02-Sep	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	0.0
03-Sep	3.75	0	0	0	0	0	2	0	0	0	1	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	1.6
04-Sep	9.00	0	0	0	0	0	1	0	1	0	1	0	0	0	2	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	8	0.9
05-Sep	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	0.0
06-Sep	9.00	0	0	0	0	0	5	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	9	1.0
07-Sep	8.75	0	0	0	0	0	5	0	9	3	1	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32	3.7
08-Sep	9.00	0	0	1	1	0	0	0	192	2	1	0	0	0	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	215	23.9
09-Sep	9.00	0	0	0	0	0	2	0	9	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	1.4
10-Sep	9.00	0	0	1	0	0	3	0	353	1	2	0	0	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	372	41.3
11-Sep	6.75	0	0	0	1	0	0	0	79	1	3	0	0	0	152	3	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	240	35.6
12-Sep	0.00																																
13-Sep	0.00																																
14-Sep	7.50	0	0	7	2	0	0	0	234	13	9	0	0	0	37	1	0	0	0	0	0	0	0	0	0	7	1	0	0	0	0	311	41.5
15-Sep	9.17	0	0	7	1	0	1	0	940	8	4	1	0	0	246	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1208	131.7

Appendix D. continued

Date	Hours	Species[1]																													Total	Birds / Hr
		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	PR	PG	UF	UU		
16-Sep	9.00	0	0	1	3	0	0	0	577	20	1	4	0	0	98	0	0	0	0	0	0	0	0	0	0	13	0	0	2	1	0	720	80.0
17-Sep	9.00	0	0	1	2	0	0	0	207	44	1	0	0	0	46	0	0	0	0	0	0	0	0	0	0	4	1	0	1	0	1	308	34.2
18-Sep	9.00	0	0	0	3	0	0	0	183	137	2	2	0	0	71	1	0	0	0	0	0	0	0	0	0	6	0	0	0	0	1	406	45.1
19-Sep	9.00	0	0	0	2	0	1	1	306	175	4	8	0	0	1468	0	0	0	0	0	3	0	0	0	0	10	0	0	0	0	0	1978	219.8
20-Sep	9.00	24	0	1	1	0	0	0	121	111	7	0	0	0	2368	3	0	0	1	0	0	0	0	0	0	7	0	0	0	0	0	2644	293.8
21-Sep	9.00	0	0	1	9	0	0	1	62	28	19	0	0	0	3114	1	0	0	0	0	0	0	0	0	0	10	2	0	0	0	0	3247	360.8
22-Sep	9.00	0	0	1	12	0	0	0	57	40	44	3	0	0	1042	4	0	1	0	0	0	0	0	0	0	14	2	0	0	0	0	1220	135.6
23-Sep	9.00	0	0	1	3	0	0	1	25	15	6	1	0	0	91	1	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	147	16.3
24-Sep	9.00	0	0	0	1	0	0	0	22	16	6	0	0	0	29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	74	8.2
25-Sep	9.00	0	0	0	1	0	0	1	4	12	5	0	0	0	4	0	1	1	0	0	0	0	0	0	1	1	0	0	3	0	0	34	3.8
26-Sep	8.50	0	0	1	2	0	0	0	4	32	13	1	0	0	38	0	0	2	0	0	0	0	0	0	0	2	2	0	2	0	0	99	11.6
27-Sep	3.25	0	0	0	1	0	0	0	9	19	4	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	60	18.5
28-Sep	9.00	0	0	1	6	0	0	0	13	97	19	1	0	0	458	0	0	0	0	0	1	0	0	0	0	37	5	0	5	0	0	643	71.4
29-Sep	8.50	0	0	1	3	0	0	0	14	113	1	0	0	0	79	0	0	0	0	0	0	0	0	0	0	41	1	0	2	0	0	255	30.0
30-Sep	9.00	0	0	2	7	0	0	0	13	502	12	1	0	0	25	0	0	0	0	0	0	0	0	0	0	53	2	0	11	0	0	628	69.8
01-Oct	9.00	0	0	2	5	0	0	0	41	556	32	0	0	0	660	0	0	0	0	0	2	0	0	0	0	347	3	0	7	0	0	1655	183.9
02-Oct	9.00	0	0	1	5	0	0	0	11	184	19	0	0	0	292	0	0	0	0	0	0	0	0	0	0	66	1	0	2	0	1	582	64.7
03-Oct	9.00	15	0	0	10	0	0	0	7	187	31	0	0	0	638	1	0	2	0	0	0	0	1	0	0	82	1	0	0	0	1	976	108.4
04-Oct	9.00	11	0	1	19	0	0	3	18	107	46	0	0	0	257	2	0	3	0	0	0	0	0	0	0	69	2	0	0	0	0	538	59.8
05-Oct	5.83	11	18	1	0	0	0	0	2	21	5	0	0	0	10	0	0	0	0	0	0	0	0	0	0	11	0	0	2	0	0	81	13.9
06-Oct	9.00	0	0	0	5	0	0	1	3	36	6	0	0	0	5	0	0	0	0	0	0	0	0	0	0	6	1	0	6	0	0	69	7.7
07-Oct	8.00	0	0	0	2	0	0	0	12	154	19	0	0	0	18	0	0	0	0	0	0	0	0	0	0	55	2	0	4	0	0	266	33.3
08-Oct	9.00	0	0	4	1	0	0	1	15	344	27	0	0	0	185	0	0	0	0	0	0	0	0	0	0	250	1	0	4	0	0	832	92.4
09-Oct	9.50	0	15	3	3	0	0	0	11	175	44	0	0	0	204	2	1	0	0	0	0	0	0	0	0	58	6	1	4	0	0	527	55.5
10-Oct	9.00	0	0	1	7	0	0	0	1	59	49	0	0	0	141	3	0	2	0	0	0	0	1	0	0	48	3	0	3	0	0	318	35.3
11-Oct	9.00	0	0	0	8	0	0	0	0	22	19	0	0	0	50	0	0	0	0	0	0	0	1	0	0	20	1	0	1	0	0	122	13.6
12-Oct	9.00	0	0	1	9	0	0	2	1	23	20	0	0	0	466	1	1	0	0	0	0	0	0	0	0	70	5	0	1	0	0	600	66.7
13-Oct	9.00	0	14	0	7	0	0	0	0	28	17	0	0	0	1812	0	1	0	0	0	0	0	0	0	0	88	2	0	0	0	0	1969	218.8
14-Oct	9.00	0	0	2	26	0	0	1	0	34	9	2	0	0	680	0	0	0	0	0	0	0	0	0	2	44	2	0	5	0	0	807	89.7
15-Oct	9.00	0	0	0	5	0	0	1	0	3	7	0	0	0	91	0	0	0	0	0	0	0	0	0	0	17	0	0	2	0	0	126	14.0
16-Oct	9.00	0	0	3	5	0	0	0	0	35	26	0	0	0	1320	8	0	1	0	0	0	0	0	0	0	106	2	0	5	0	0	1511	167.9
17-Oct	8.50	0	0	1	1	0	0	0	0	15	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0	0	22	2.6

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	PR	PG	UF	UU	Total	/ Hr
18-Oct	8.00	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	0	1	0.1
19-Oct	9.00	0	20	0	10	0	0	0	0	5	9	0	0	0	414	1	1	0	0	0	0	0	0	0	0	12	4	0	2	1	0	479	53.2
20-Oct	9.00	0	20	1	2	0	0	0	0	19	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	2	0	1	0	0	64	7.1
21-Oct	9.00	0	0	2	3	0	0	0	1	8	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	3	0	3	0	0	47	5.2
22-Oct	3.17	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	4	1.3
23-Oct	9.00	5	40	1	44	0	0	0	1	187	25	0	0	0	82	9	0	1	0	0	0	1	0	0	0	146	3	0	1	0	0	546	60.7
24-Oct	9.00	5	308	1	68	0	0	2	3	250	42	0	0	0	109	154	0	3	0	0	0	0	2	0	0	154	4	0	1	0	0	1106	122.9
25-Oct	9.00	7	312	0	57	0	0	0	0	197	67	0	0	1	1087	71	0	17	1	0	0	0	3	0	1	58	0	0	0	0	0	1879	208.8
26-Oct	9.00	0	201	1	20	0	0	0	0	26	22	0	0	0	291	9	0	13	0	0	0	0	2	0	0	31	1	0	1	0	0	618	68.7
27-Oct	9.00	0	191	0	18	0	0	2	0	29	20	0	0	0	121	9	0	13	0	0	4	1	0	0	0	18	2	0	0	0	0	428	47.6
28-Oct	9.00	6	95	0	19	0	0	0	0	109	50	0	0	0	150	5	1	6	0	0	0	0	0	0	0	71	0	0	0	0	0	512	56.9
29-Oct	8.83	0	45	0	13	0	0	0	0	44	25	0	0	0	97	4	0	4	0	0	0	0	0	0	0	36	0	0	0	0	0	268	30.4
30-Oct	9.00	0	49	0	7	0	0	0	0	13	6	0	0	1	35	1	0	5	0	0	2	0	0	0	0	49	0	0	0	0	0	168	18.7
31-Oct	9.00	0	42	0	13	0	0	0	0	11	9	0	0	0	6	0	0	5	0	0	0	0	0	0	0	35	0	0	0	0	0	121	13.4
01-Nov	9.00	0	40	0	11	0	0	0	1	13	12	0	0	1	14	0	0	6	0	0	0	0	0	0	0	23	0	0	1	0	0	122	13.6
02-Nov	9.00	0	30	0	4	0	0	0	0	5	3	0	0	0	6	0	0	2	0	0	0	0	1	0	0	3	0	0	0	0	0	54	6.0
03-Nov	9.00	0	138	1	7	0	0	0	0	6	5	0	0	0	13	0	1	1	0	0	0	0	0	0	0	12	1	0	0	0	0	185	20.6
04-Nov	9.00	0	139	1	9	0	0	0	0	2	6	0	0	1	3	2	0	5	0	0	1	0	0	0	0	3	0	0	0	0	0	172	19.1
05-Nov	9.00	39	30	1	3	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	1	77	8.6
06-Nov	9.00	0	47	1	5	0	0	0	0	7	8	0	0	0	8	2	0	6	0	0	0	0	0	0	0	5	0	0	1	0	0	90	10.0
07-Nov	9.00	0	119	2	7	0	0	0	0	9	6	0	0	4	21	2	0	19	0	0	0	1	0	0	0	9	0	0	0	0	0	199	22.1
08-Nov	9.00	0	0	2	4	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	8	0.9
09-Nov	9.00	0	0	0	2	0	0	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0.6
10-Nov	9.00	20	25	0	3	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	50	5.6
11-Nov	9.00	0	26	0	4	0	0	0	0	0	1	0	0	0	2	0	0	7	0	0	1	0	0	0	0	1	0	0	0	0	0	42	4.7
12-Nov	9.00	0	0	0	3	0	0	0	0	7	1	0	0	0	0	0	0	2	0	0	1	0	0	0	1	0	1	0	0	0	0	16	1.8
13-Nov	9.00	0	0	1	6	0	0	0	0	3	3	0	0	1	0	0	0	6	0	0	0	0	0	0	0	3	0	0	0	0	0	23	2.6
14-Nov	9.00	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	0	0	0	3	0.3
Total	765.83	143	1964	64	524	0	62	17	3739	4326	890	27	0	9	18827	321	7	138	2	0	16	3	11	0	8	2255	72	1	86	2	7	33521	43.8

[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: 1997–2007.

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	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	15-Aug
End date	20-Nov	15-Nov	12-Nov	15-Nov	15-Nov	15-Nov	15-Nov	15-Nov	15-Nov	11-Nov	14-Nov	15-Nov
Observation days	94	91	89	94	93	91	92	93	86	86	90	91
Observation hours	860.11	677.25	696.68	823.08	743.33	775.66	777.75	796.34	688.92	637.52	765.83	749.31
SPECIES	RAPTOR COUNTS											
Black Vulture	130	105	341	4	379	59	96	368	112	71	143	164
Turkey Vulture	1,225	581	1,295	1,059	2,488	678	2,163	3,091	1,185	1,002	1,964	1,521
TOTAL VULTURES	1,355	686	1,636	1,063	2,867	737	2,259	3,459	1,297	1,073	2,107	1,685
Osprey	54	68	54	60	62	48	78	87	76	93	64	68
Northern Harrier	445	262	537	372	472	144	203	246	296	385	524	353
Hook-billed Kite	0	0	0	0	0	0	1	0	0	0	0	0
Swallow-tailed Kite	40	34	52	46	74	150	98	151	99	80	62	81
White-tailed Kite	0	1	2	11	12	8	23	14	24	8	7	10
Mississippi Kite	2,124	2,362	2,975	4,788	3,253	7,879	3,809	3,786	7,952	3,682	3,739	4,214
TOTAL KITES	2,164	2,397	3,029	4,845	3,339	8,037	3,930	3,951	8,075	3,770	3,808	4,304
Sharp-shinned Hawk	4,780	3,231	3,896	1,484	3,878	3,142	1,508	1,923	2,407	1,295	4,326	2,897
Cooper's Hawk	1,137	1,136	1,207	1,088	1,281	1,233	738	1,162	1,150	305	890	1,030
Unknown accipiter	49	170	113	14	15	18	4	14	104	14	27	50
TOTAL ACCIPITERS	5,966	4,537	5,216	2,586	5,174	4,393	2,250	3,099	3,668	1,614	5,243	3,977
Harris' Hawk	0	0	0	0	2	0	0	0	3	4	0	1
Red-shouldered Hawk	45	36	34	61	54	23	49	88	31	22	9	41
Broad-winged Hawk	30,417	16,137	34,243	29,956	103,612	65,255	21,799	26,032	20,380	49,527	18,827	37,835
Swainson's Hawk	137	56	129	255	321	168	228	1,036	360	201	321	292
White-tailed Hawk	0	1	2	11	12	8	23	14	24	8	7	10
Red-tailed Hawk	331	35	204	77	273	44	64	159	84	88	138	136
Ferruginous Hawk	0	0	2	0	2	1	2	1	0	0	2	1
Rough-legged Hawk	0	0	2	0	3	0	0	0	0	0	0	0
Unidentified buteo	86	26	31	3	4	5	6	5	21	1	16	19
TOTAL BUTEOS	31,016	16,291	34,647	30,363	104,283	65,504	22,171	27,335	20,903	49,851	19,320	38,335
Golden Eagle	3	0	1	1	0	0	0	0	0	1	3	1
Bald Eagle	2	0	2	7	2	3	2	1	5	7	11	4
Unknown eagle	0	0	0	0	0	0	1	0	0	0	0	0
TOTAL EAGLES	5	0	3	8	2	3	3	1	5	8	14	5
Crested Caracara	6	3	4	9	16	7	8	26	13	5	8	10
American Kestrel	1,297	1,334	1,938	1,311	1,140	1,949	816	1,272	1,011	916	2,255	1,385
Merlin	88	26	47	43	70	56	79	78	37	51	72	59
Prairie Falcon	0	0	0	0	0	0	0	0	0	0	1	0
Peregrine Falcon	65	92	85	79	77	94	88	129	92	85	86	88
Unknown falcon	25	13	9	5	1	8	3	5	2	2	2	7
TOTAL FALCONS	1,475	1,465	2,079	1,438	1,288	2,107	986	1,484	1,142	1,054	2,416	1,539
Unidentified raptor	496	91	116	16	0	5	1	12	101	1	7	77
GRAND TOTAL	42,993	25,824	47,337	40,766	117,517	80,984	31,885	39,698	35,570	57,851	33,521	50,359