

**FALL 2005 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 2005, HWI and GCBO conducted the 9th 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 2005 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

This season the migration count was conducted primarily by one experienced full-season observer, Kyle McCarty, who had four seasons of previous migration counting experience, including one previous season at this site (see Appendix A for a complete history of observer participation). Three other primary observers with no previous migration counting experience worked various portions of the season (Jim and Bea Harrison during most of September and James Carrey for two weeks in October). Additionally, as has been the case from project inception, a dedicated and experienced team of local volunteers regularly assisted the primary counters throughout the season (primarily Dick Benoit, Winnie Burkett, and Bill Saulmon, with additional assistance from Peggy Boston, Wayne Nicholas, and Debbie McWhorter). GCBO monitoring coordinator John Arvin and HWI Science Director Jeff Smith 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.

Otherwise, data gathering and recording followed standardized protocols used at all HWI migration sites (Hoffman and Smith 2003). In comparing 2005 annual statistics against means and 95% confidence intervals (mean \pm 95% CI) for 1997–2004, we equate significance with a 2005 value falling outside of the 95% CI for the associated mean.

RESULTS AND DISCUSSION

WEATHER

This year a dramatic hurricane season resulted in the crew having to evacuate the site completely for 7 full days in late September when Hurricane Rita struck, with two other days of observation reduced to ≤ 4 hours due to inclement weather (see Appendix C for daily weather records). The 1997–2004 averages for the site are 1.3 and 4.0 days, respectively. Otherwise, generally fair skies predominated on 57% of the active observation days, transitional weather (i.e., skies changed from fair to mostly cloudy/overcast, or vice versa, during the day) on 33%, and mostly cloudy to overcast skies on 10%. The comparative averages for these variables are 44%, 28%, and 28%, respectively, indicating that, outside of the hurricane, fair weather prevailed more often than usual in 2005. However, visibility reducing fog and especially haze occurred on 45% of the active observation days, which is considerably higher than the long-term average of 28%, but similar to 2004 (42%). In contrast, thundershowers and rain occurred during some portion of 21% of the active observation days, which is only slightly less than the long-term average of 23%.

The wind-speed conditions at the site in 2005 appeared calmer than average, showing a significant shift towards lighter winds. Light winds (≤ 12 kph) prevailed on 88% of the active days, moderate winds (12–28 kph) on 12%, and stronger winds on 0%. The comparative 1997–2004 averages are 69% light, 29% 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 1997–2004, the most common wind direction patterns were variable N–E (on average, prevailing on 21% of the active observation days), SE–SW (16%), E–S (12%), NE–SE (11%), NW–NE (9%), and days where a distinct shift from NW–NE to SE–SW winds occurred (9%). Noteworthy differences in 2005 included fewer days with prevailing N–E (13% of days) and NE–SE (6%) winds, and nearly twice the average prevalence of days where SE–SW winds prevailed (26%). This pattern was similar to 2004.

The temperature during active observation periods averaged 28.6°C (average of daily values, which in turn were averages of hourly readings), ranging from 17–34.3°C. The average value is three degrees

higher than the long-term average, and the low was a record high for the site. The barometric pressure during active observation periods averaged 29.96 in Hg (the average of daily values, which in turn were averages of hourly readings), ranging from 29.53–30.25°C

In 2005, 52% of the active observation days received a median (of hourly ratings) thermal-lift rating of good to excellent, which is the second highest proportion recorded for the project (1997–2004 average of 42%, range 35–61%).

In summary, a hurricane evacuation precluded observations for a record high seven days in 2005. Otherwise, the weather during active observation periods was generally fairer, warmer, and produced stronger thermal lift conditions than usual, but along with lighter than usual winds these conditions resulted in a higher than usual prevalence of visibility reducing fog and especially haze. A distinct shift in wind directions also occurred in 2005, with SE–SW winds (quartering to head winds for migrants) nearly twice as common as usual, and easterly and northeasterly winds (tail winds for migrants) proportionately less common.

OBSERVATION EFFORT

The observers logged 86 days and 688.92 hours of observation between 15 August and 15 November 2005. The numbers of observation days and hours were a significant 7% and 10% lower than average, respectively. The daily-average number of observers was 1.6, which is a significant 28% lower than the 1997–2004 average of $2.0 \pm 95\%$ CI of 0.1 observers/hour.

MIGRATION SUMMARY

The observers tallied 35,570 migrant raptors of 20 species during the 2005 season, which is a non-significant 33% below the 1997–2004 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 kites was significantly above average, whereas the proportions of accipiters, falcons, and other miscellaneous species (Ospreys, Northern Harriers and eagles) were significantly below average (Figure 2). Species that accounted for 1% or more of the total count included Broad-winged Hawk (57%), Mississippi Kite (22%), Sharp-shinned Hawk (7%), Turkey Vulture (3%), American Kestrel (3%), and Cooper's Hawk (3%).

Interannual Count Trends and Regional Comparisons

Record high counts occurred in 2005 for White-tailed and Mississippi Kites and Harris's and White-tailed Hawks (see Appendix E for annual count summaries). No record low counts occurred in 2005 for regularly counted species. The Broad-winged Hawk count (20,380) was the second lowest on record and 50% below the 1997–2004 average; however, this reduction was only marginally significant, reflecting high variability in counts of this species at this site (Table 1). No other count totals for regularly occurring migrants were significantly below average in 2005, whereas counts were significantly above average for four species (those previously mentioned as showing record high counts).

Nine years is still too short of a period to warrant detailed attention to long-term trends (10 years of data is usually the minimum goal), especially following an irregular hurricane season. Nevertheless, a cursory examination of apparent patterns in annual passage rates is instructive, especially in comparison to data from other similar Gulf Coast projects. Species showing distinct or probable increasing patterns over the period of record include the Turkey Vulture, Osprey, Swallow-tailed, White-tailed and Mississippi Kites, Swainson's and White-tailed Hawks, Peregrine Falcons, and Crested Caracaras (Figures 3–6). Species showing distinct or probable decreasing trends include the Northern Harrier (Figure 3), Sharp-shinned Hawk (Figure 4), and possibly American Kestrel (Figure 6).

Elsewhere in coastal Texas, the overall count at Corpus Christi of 297,375 was an all-time low for that site, primarily reflecting record-low counts of Broad-winged and Swainson's Hawks (Smith and Neal 2006). Hurricane Rita was undoubtedly the primary reason for the comparatively low Broad-winged Hawk counts at both Smith Point and Corpus Christi. The hurricane struck just as the main wave of Broad-winged Hawks moved down through Texas from the northeast, which undoubtedly caused many birds to remain farther inland than usual and remain undetectable at both the Corpus Christi and Smith Point sites. We know this was the case because the ~1.8 million Broad-winged Hawks that eventually passed through Veracruz, Mexico essentially matched the 1992–2004 average for that site (Pronatura Veracruz, HWI, and Hawk Mountain Sanctuary unpublished data). In contrast to the situation for Broad-winged Hawks, both Texas sites tallied record high counts of Mississippi Kites and significantly above-average counts of White-tailed Hawks in 2005.

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, Osprey, 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, although the count at Corpus Christi was low in 2005 while the count at Smith Point remained above average. Species that are currently showing noticeably divergent patterns at the two sites include Broad-winged Hawks (slight declining trend at Corpus Christi [though greatly accentuated by record-low 2005 rate]; overall stable pattern at Smith Point with major spike in 2001/2002), Red-shouldered Hawks (slight decreasing trend at Corpus Christi; slight increasing trend at Smith Point), American Kestrels (opposite of Red-shouldered Hawks), 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 overall southbound count was 41% below the 1999–2004 average for that site and was by far the lowest combined-species total yet recorded there (HWI unpublished data). In this case, three significant hurricanes spread out through the season directly affected both observation effort and the flow of migrants through Florida in 2005. Counts there were significantly below average for all species commonly recorded at the site, suggesting that the sequence of hurricanes most likely caused many migrants that would otherwise have ended up in south Florida to stay farther north and perhaps skirt around the northern Gulf Coast.

In Veracruz, Mexico, along the far southwestern Gulf Coast, the overall 2005 count (data from two count sites combined) was 22% above average and the third highest since the project began in 1992 (Pronatura Veracruz, HWI, and Hawk Mountain Sanctuary unpublished data). Among the four most common species, counts were 1% below average for Broad-winged Hawks, 38% above average for Turkey Vultures, 25% above average for Mississippi Kites, and 59% above average for Swainson's Hawks. In contrast, much like in 2004, counts were 0–53% below average for four that comprise the second tier of common species at this site: Osprey, Sharp-shinned and Cooper's Hawks, and American Kestrel. Similar to both Texas sites, Veracruz counts show distinct long-term increasing trends for Turkey Vultures, Mississippi and Swallow-tailed Kites, and Swainson's Hawks.

Age Ratios

Only 3 of 9 species for which comparisons of immature : adult ratios were possible showed significant variation in 2005, 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. Nevertheless, age ratios for Northern Harriers and Red-tailed Hawks were significantly above-average and the age ratio for Swallow-tailed Kites was significantly below average, and for each of these species variation in the proportion of unaged birds was not significantly different from average (Table 2), indicating that a reasonable degree of confidence can be assigned to the

comparisons. For both harriers and red-tails, the high 2005 age ratios were not due to high abundances of immature birds (below average for both species) but rather to low abundances of identified adults, suggesting that adult recruitment and/or survival was below average during 2005 for populations of these species that migrate through the region. In contrast, the low age ratio for Swallow-tailed Kites reflected both a well-below average tally of immature birds and a much higher than average tally of adults, suggesting that juvenile recruitment may have been low, but adult recruitment and survival was high for this species in 2005.

Seasonal Timing

The 2005 median passage date for Broad-winged Hawks of 20 September was a significant 6 days earlier than average (Table 3). Examination of the seasonal activity pattern with Broad-winged Hawks included shows an unusually high activity spike in late August corresponding to passage of Hurricane Katrina, and another moderately high activity spike at the end of the third week of September just before Hurricane Rita struck and shut down the count for 6 days (Figure 7). Examination of the combined-species seasonal activity pattern with Broad-winged Hawks excluded, and further examination of other species-specific patterns, confirmed that the late August spike involved most other species, apparently running ahead of the hurricane. Among commonly encountered species, five showed significantly early median passage dates in 2005, two showed significantly late timing, and 11 showed median passage dates that were within normal ranges of variation but for 10 species were at least slightly earlier than average (Table 3). All commonly observed kites, accipiters, and falcons showed at least slightly earlier than average timing. 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 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 2005, resident Broad-winged, Red-shouldered, White-tailed, Harris’s and Red-tailed Hawks were recorded throughout the season. One or more immature Red-shouldered, Red-tailed, and Broad-winged Hawks were noted as locals most days throughout the season, although sightings of local Broad-winged Hawks thinned out considerably by early October. Adult Red-shouldered, 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. Most were stopover transients that remained for a few days, but some birds remained in the area for longer periods and it appeared that at least a few individuals were likely to winter on the peninsula. Over-wintering Sharp-shinned Hawks, of either age class, were not recorded until late October.

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 residences in the area. At least one adult and one immature Peregrine Falcon were seen interacting and frequenting the area in late October.

At least one adult male, one adult female, and two immature Northern Harriers were recorded as locals on several occasions 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 this season.

VISITOR PARTICIPATION AND PUBLIC OUTREACH

Documented visitation in 2005 totaled 502 individual visits, including repeats. This is only about half the visitation of the past two years; however, an estimated 400 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 four states besides Texas, as well as from Costa Rica, but overall the geographic diversity of documented visitors was low compared to most years. The combination of low numbers and geographic diversity clearly testify to the impact that a severe hurricane season had on travel in the region and visitation to the project site. Most notably, Hurricane Rita, which struck during the peak Broad-winged Hawk activity period in late September, forced cancellation of the first of two open-house weekends that GCBO had planned for the season, and generally kept many visitors away during peak season.

In 2005, 726 hourly assessments by the observers of visitor disturbance resulted in the following ratings: 96% none, 3% low, <1% moderate, and <1% high. This very 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.

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Table 1. Fall counts and passage rates by species for migrating raptors at Smith Point, TX: 1997–2004 versus 2005.

SPECIES	COUNTS			RAPTORS/100 HOURS		
	1997–2004 ¹	2005	% CHANGE	1997–2003 ¹	2004	% CHANGE
Black Vulture	185 ± 105.2	112	-40	24.6 ± 14.2	16.3	-34
Turkey Vulture	1,573 ± 627.4	1,185	-25	203.9 ± 80.2	172.0	-16
TOTAL VULTURES	1,758 ± 704.1	1,297	-26	228.5 ± 90.7	188.3	-18
Osprey	64 ± 9.1	76	+19	8.4 ± 1.2	11.0	+32
Northern Harrier	335 ± 98.1	296	-12	44.0 ± 13.6	43.0	-2
Hook-billed Kite	0 ± 0.2	0	-100	0.0 ± 0.0	0.0	-100
Swallow-tailed Kite	81 ± 33.1	99	+23	10.4 ± 4.2	14.4	+38
White-tailed Kite	9 ± 5.4	24	+170	1.1 ± 0.7	3.5	+205
Mississippi Kite	3,872 ± 1,267.8	7,952	+105	502.9 ± 159.2	1,154.3	+130
TOTAL KITES	3,962 ± 1,291.8	8,075	+104	514.5 ± 162.2	1,172.1	+128
Sharp-shinned Hawk	2,980 ± 848.6	2,407	-19	391.8 ± 112.9	349.4	-11
Cooper's Hawk	1,123 ± 115.8	1,150	+2	147.2 ± 18.6	166.9	+13
Unknown accipiter	44 ± 44.5	104	+137	6.2 ± 6.5	15.1	+145
TOTAL ACCIPITERS	4,153 ± 939.0	3,668	-12	545.9 ± 129.7	532.4	-2
Harris' Hawk	0 ± 0.5	3	+1100	0.0 ± 0.1	0.4	+1195
Red-shouldered Hawk	49 ± 13.8	31	-36	6.3 ± 1.7	4.5	-29
Broad-winged Hawk	40,931 ± 20,286	20,380	-50	5,362 ± 2,737	2,958.3	-45
Swainson's Hawk	291 ± 216.2	360	+24	37.2 ± 27.0	52.3	+40
White-tailed Hawk	9 ± 5.4	24	+170	1.1 ± 0.7	3.5	+205
Red-tailed Hawk	148 ± 77.7	84	-43	19.1 ± 9.7	12.2	-36
Ferruginous Hawk	1 ± 0.6	0	-100	0.1 ± 0.1	0.0	-100
Rough-legged Hawk	1 ± 0.8	0	-100	0.1 ± 0.1	0.0	-100
Unidentified buteo	21 ± 19.8	21	+1	2.7 ± 2.3	3.0	+15
TOTAL BUTEOS	41,451 ± 20,302	20,903	-50	5,429 ± 2,739	3,034.2	-44
Golden Eagle	1 ± 0.7	0	-100	0.1 ± 0.1	0.0	-100
Bald Eagle	2 ± 1.4	5	+111	0.3 ± 0.2	0.7	+141
Unknown eagle	0 ± 0.2	0	-100	0.0 ± 0.0	0.0	-100
TOTAL EAGLES	3 ± 1.7	5	+60	0.4 ± 0.2	0.7	+84
Crested Caracara	10 ± 5.3	13	+32	1.3 ± 0.7	1.9	+49
American Kestrel	1,382 ± 266.6	1,011	-27	181.8 ± 39.7	146.8	-19
Merlin	61 ± 14.8	37	-39	7.8 ± 1.7	5.4	-31
Peregrine Falcon	89 ± 13.0	92	+4	11.6 ± 1.8	13.4	+15
Unknown falcon	8 ± 5.6	2	-74	1.0 ± 0.7	0.3	-71
TOTAL FALCONS	1,540 ± 262.7	1,142	-26	202.4 ± 39.5	165.8	-18
Unidentified raptor	92 ± 117.2	101	+10	11.5 ± 13.7	14.7	+28
GRAND TOTAL	53,376 ± 21,258	35,570	-33	6,987 ± 2,873	5,163.2	-26

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: 1997–2004 versus 2005.

	TOTAL AND AGE-CLASSIFIED COUNTS						IMMATURE : ADULT			
	1997–2004 AVERAGE			2005			% UNKNOWN AGE		RATIO	
	TOTAL	IMM.	ADULT	TOTAL	IMM.	ADULT	1997–2004 ¹	2005	1997–2004 ¹	2005
Northern Harrier	335	142	79	296	138	24	35 ± 13.4	45	2.1 ± 0.89	5.8
Swallow-tailed Kite	81	12	16	99	2	33	78 ± 20.6	65	1.4 ± 0.93	0.1
Mississippi Kite	3872	686	194	7952	351	137	66 ± 22.6	94	12.2 ± 10.94	2.6
Sharp-shinned Hawk	2980	883	97	2407	349	33	65 ± 14.2	84	10.5 ± 4.97	10.6
Cooper's Hawk	1123	361	72	1150	304	60	61 ± 16.0	68	5.0 ± 1.85	5.1
Red-shouldered Hawk	49	17	3	31	18	3	57 ± 21.4	32	10.3 ± 9.92	13.0
Broad-winged Hawk	40931	1168	182	20380	659	196	97 ± 2.2	96	4.9 ± 2.51	3.4
Red-tailed Hawk	148	45	40	84	37	20	34 ± 19.2	32	1.0 ± 0.34	1.9
Peregrine Falcon	89	8	19	92	11	26	71 ± 23.3	60	0.5 ± 0.36	0.4

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 2005, with a comparison of 2005 and 1997–2004 average median passage dates.

SPECIES	2005				1997–2004	
	FIRST OBSERVED	LAST OBSERVED	BULK PASSAGE DATES ¹	MEDIAN PASSAGE DATE ²	MEDIAN PASSAGE DATE ^{2,3}	
Black Vulture	30-Sep	10-Nov	30-Sep – 6-Nov	2-Nov	21-Oct	± 6.3
Turkey Vulture	4-Oct	10-Nov	16-Oct – 10-Nov	25-Oct	28-Oct	± 4.6
Osprey	16-Aug	14-Nov	3-Sep – 11-Oct	20-Sep	29-Sep	± 3.4
Northern Harrier	30-Aug	14-Nov	19-Sep – 8-Nov	12-Oct	17-Oct	± 4.8
Swallow-tailed Kite	16-Aug	18-Sep	17-Aug – 28-Aug	24-Aug	27-Aug	± 3.7
White-tailed Kite	21-Aug	6-Nov	22-Aug – 6-Nov	2-Oct	06-Oct	± 11.8
Mississippi Kite	18-Aug	14-Oct	28-Aug – 19-Sep	28-Aug	05-Sep	± 4.0
Sharp-shinned Hawk	27-Aug	14-Nov	29-Sep – 14-Oct	2-Oct	06-Oct	± 4.9
Cooper's Hawk	15-Aug	14-Nov	19-Sep – 23-Oct	4-Oct	08-Oct	± 3.8
Red-shouldered Hawk	21-Aug	10-Nov	21-Aug – 27-Oct	29-Sep	19-Sep	± 9.5
Broad-winged Hawk	16-Aug	14-Nov	14-Sep – 21-Oct	20-Sep	26-Sep	± 4.3
Swainson's Hawk	15-Aug	14-Nov	21-Aug – 3-Nov	22-Oct	19-Oct	± 4.2
White-tailed Hawk	17-Aug	10-Nov	24-Aug – 21-Oct	29-Sep	01-Oct	± 23.2
Red-tailed Hawk	3-Sep	14-Nov	20-Oct – 10-Nov	25-Oct	26-Oct	± 11.2
Bald Eagle	19-Sep	25-Oct	19-Sep – 25-Oct	16-Oct	08-Nov	⁴
Crested Caracara	18-Aug	2-Nov	29-Aug – 21-Oct	11-Sep	05-Oct	± 22.4
American Kestrel	28-Aug	14-Nov	30-Sep – 22-Oct	7-Oct	10-Oct	± 3.8
Merlin	11-Sep	10-Nov	18-Sep – 12-Oct	29-Sep	30-Sep	± 3.7
Peregrine Falcon	25-Aug	9-Nov	20-Sep – 16-Oct	1-Oct	02-Oct	± 1.8
Total	17-Aug	14-Nov	28-Aug – 12-Oct	20-Sep	26-Sep	± 4.3

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 \pm 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.

⁴ Value for 2000 only.

Table 4. Median passage dates by age for selected species of migrating raptors at Smith Point, TX: 1997–2004 versus 2005.

SPECIES	ADULT		IMMATURE	
	1997–2004 ¹	2005	1997–2004 ¹	2005
Northern Harrier	30-Oct ± 4.9	24-Oct	13-Oct ± 3.6	20-Oct
Swallow-tailed Kite	21-Aug ± 7.4	28-Aug	28-Aug ± 6.6	–
Mississippi Kite	04-Sep ± 5.0	27-Aug	12-Sep ± 4.4	9-Sep
Sharp-shinned Hawk	18-Oct ± 7.4	23-Oct	02-Oct ± 6.5	3-Oct
Cooper’s Hawk	21-Oct ± 13.7	22-Oct	05-Oct ± 9.6	1-Oct
Red-shouldered Hawk	02-Oct ²	–	17-Sep ± 14.6	20-Sep
Broad-winged Hawk	19-Sep ± 4.8	20-Sep	22-Sep ± 10.8	30-Sep
White-tailed Hawk	21-Oct ± 6.9	–	13-Oct ± 7.5	20-Sep
Red-tailed Hawk	15-Oct ± 18.5	1-Nov	15-Oct ± 12.5	25-Oct
Peregrine Falcon	04-Oct ± 7.1	29-Sep	06-Oct ± 10.8	20-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 2003 only.



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

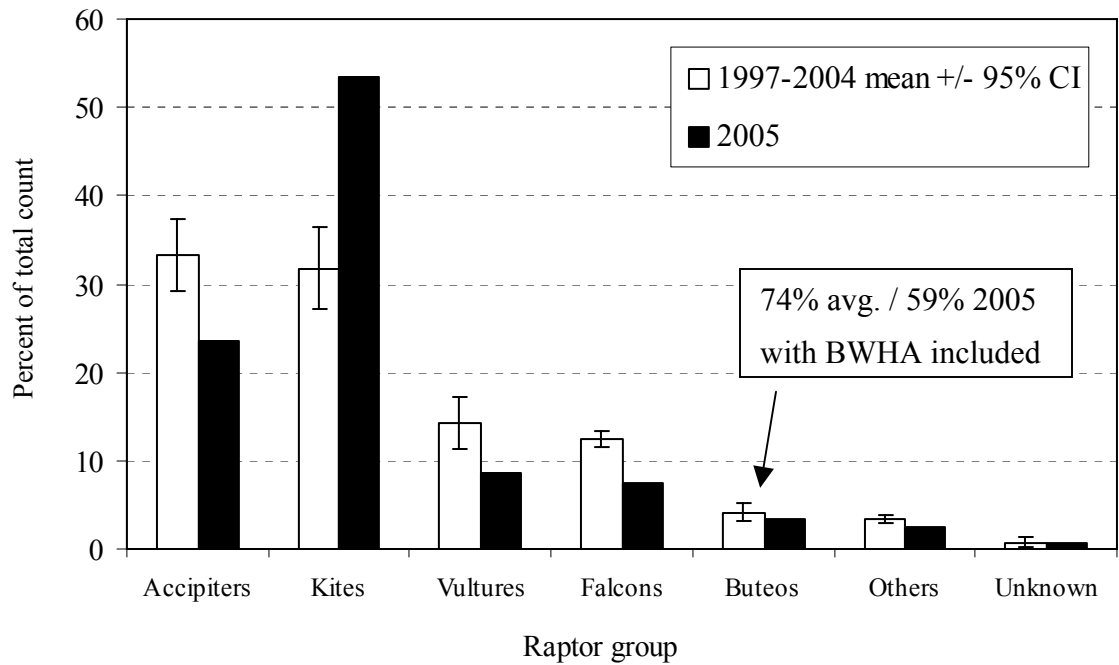


Figure 2. Composition of autumn raptor migration by major species groups at Smith Point, Texas: 1997–2004 versus 2005.

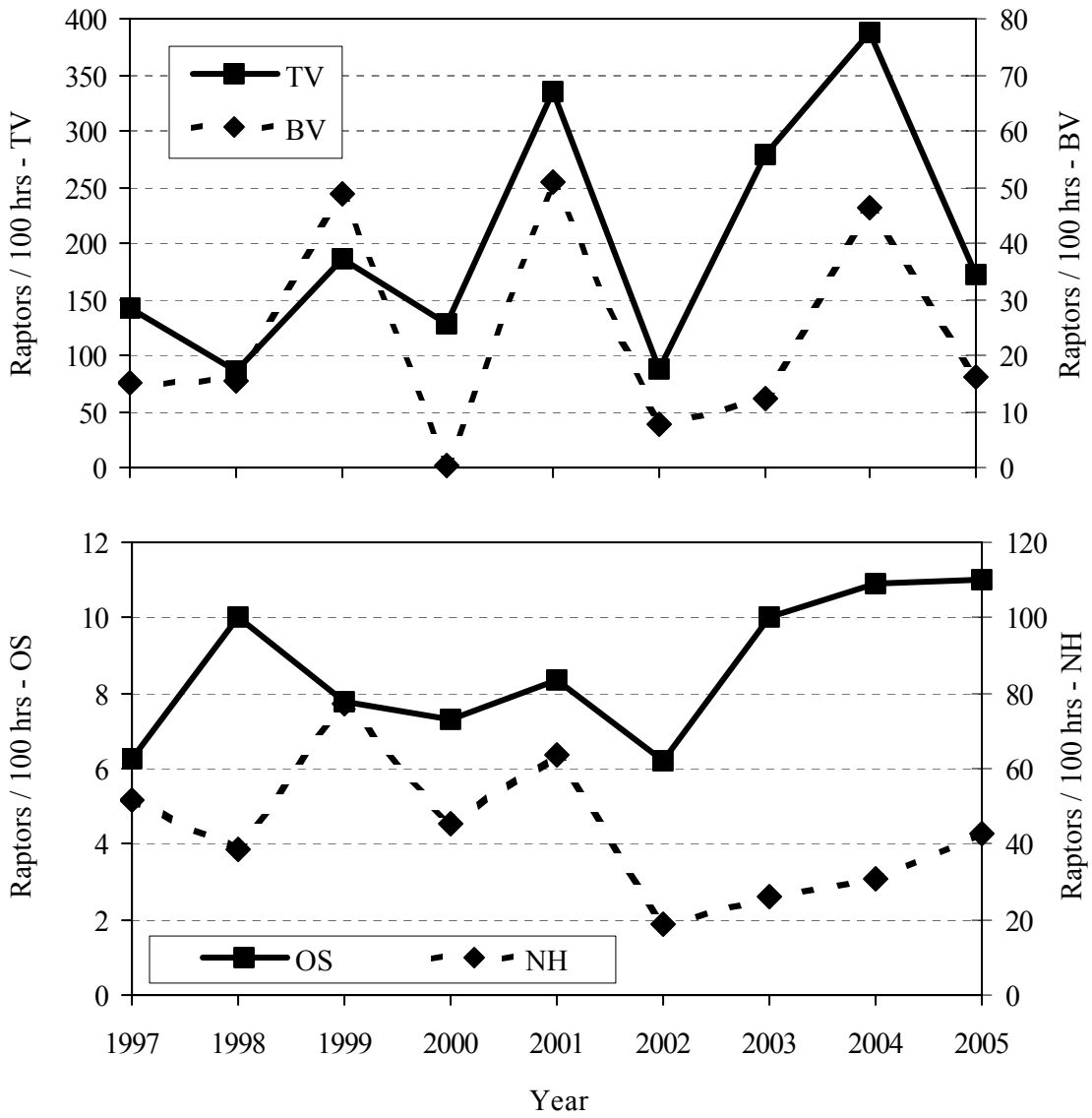


Figure 3. Annual fall-migration passage rates of Turkey and Black Vultures, Ospreys, and Northern Harriers at Smith Point, Texas: 1997–2005.

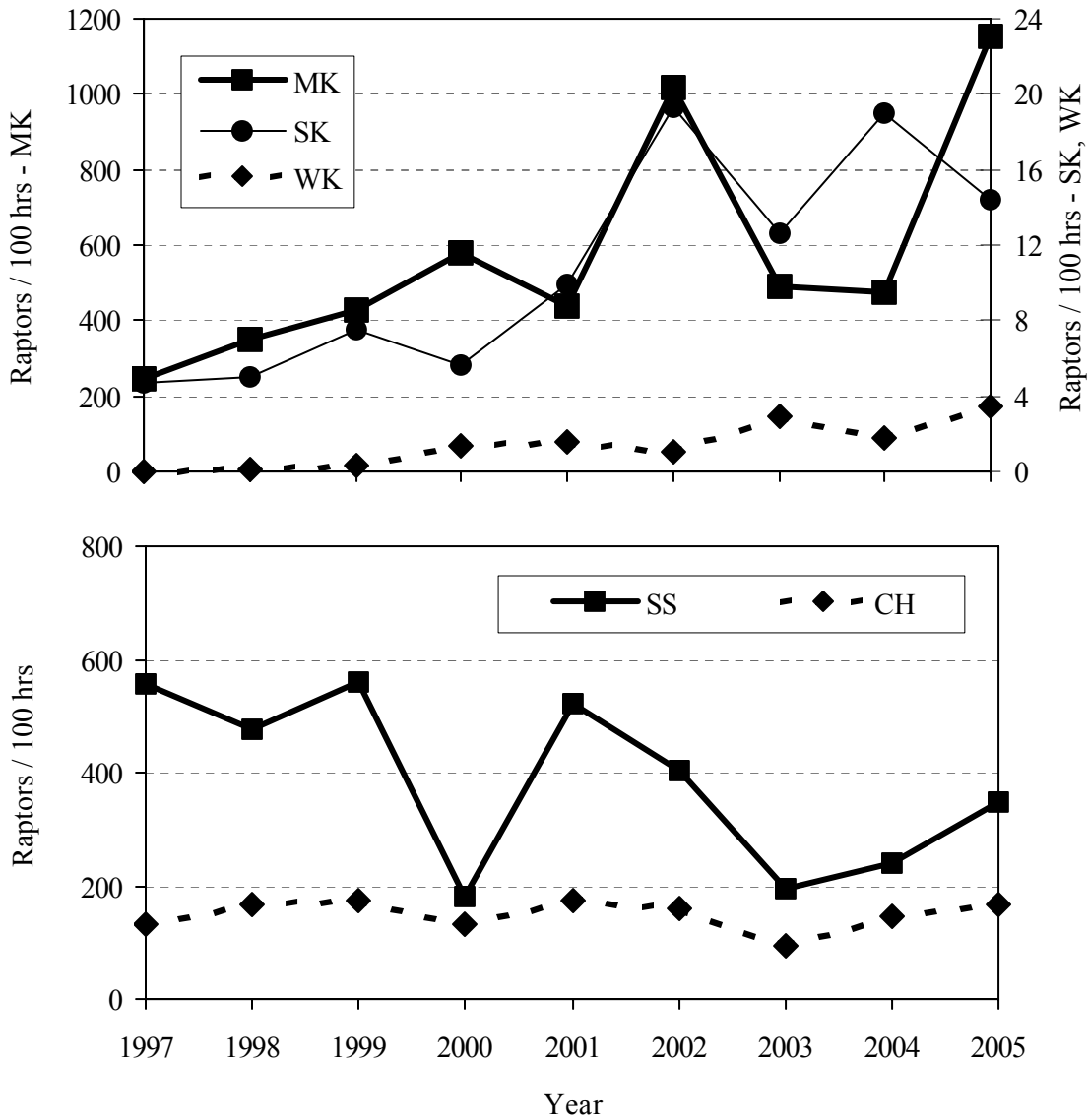


Figure 4. Annual fall-migration passage rates of Mississippi, Swallow-tailed and White-tailed Kites, and Sharp-shinned and Cooper's Hawks at Smith Point, Texas: 1997–2005.

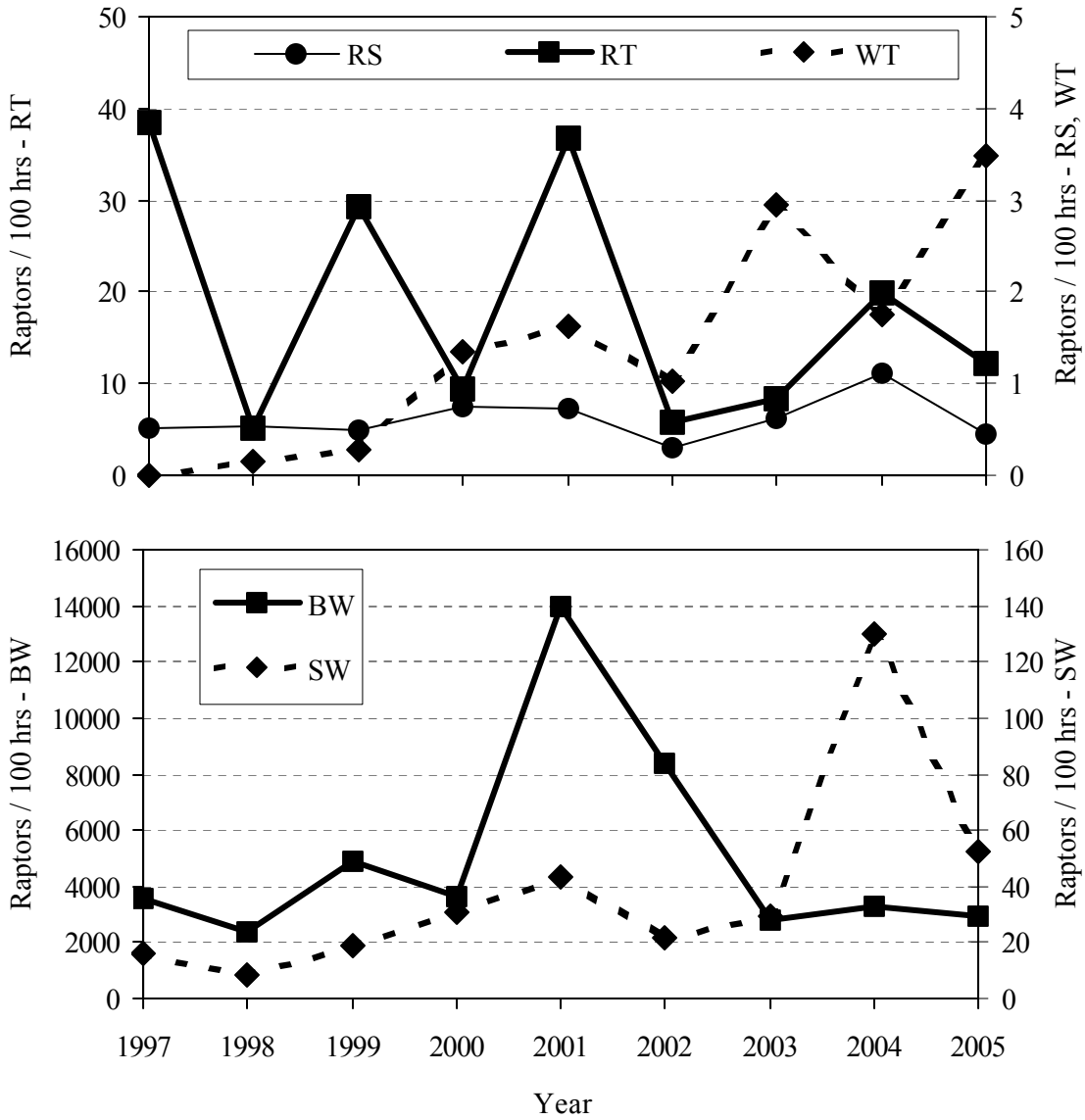


Figure 5. Annual fall-migration passage rates of Red-shouldered, Red-tailed, White-tailed, Broad-winged, and Swainson's Hawks at Smith Point, Texas: 1997–2005.

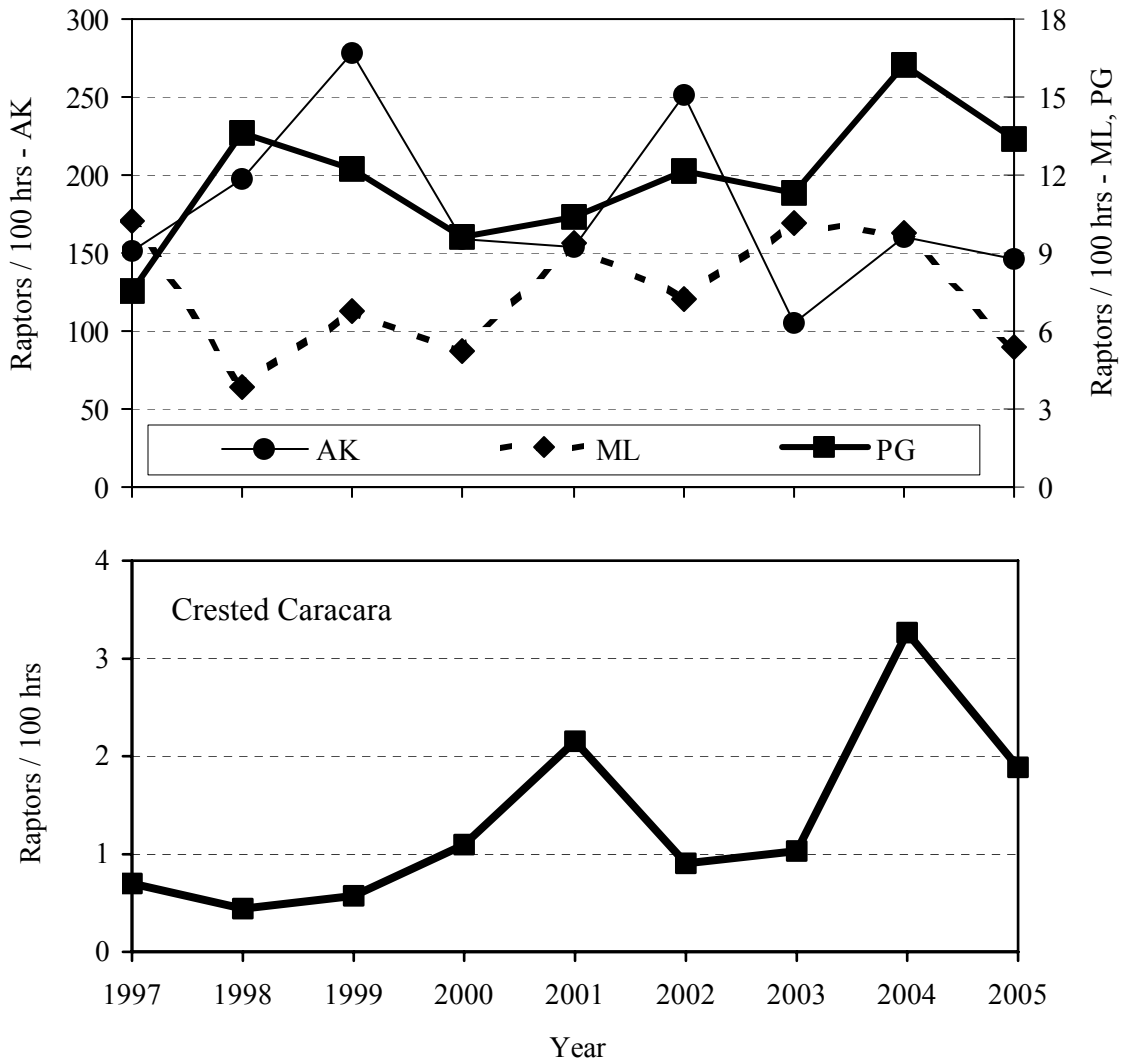


Figure 6. Annual fall-migration passage rates of American Kestrels, Merlins, Peregrine Falcons, and Crested Caracaras at Smith Point, Texas: 1997–2005.

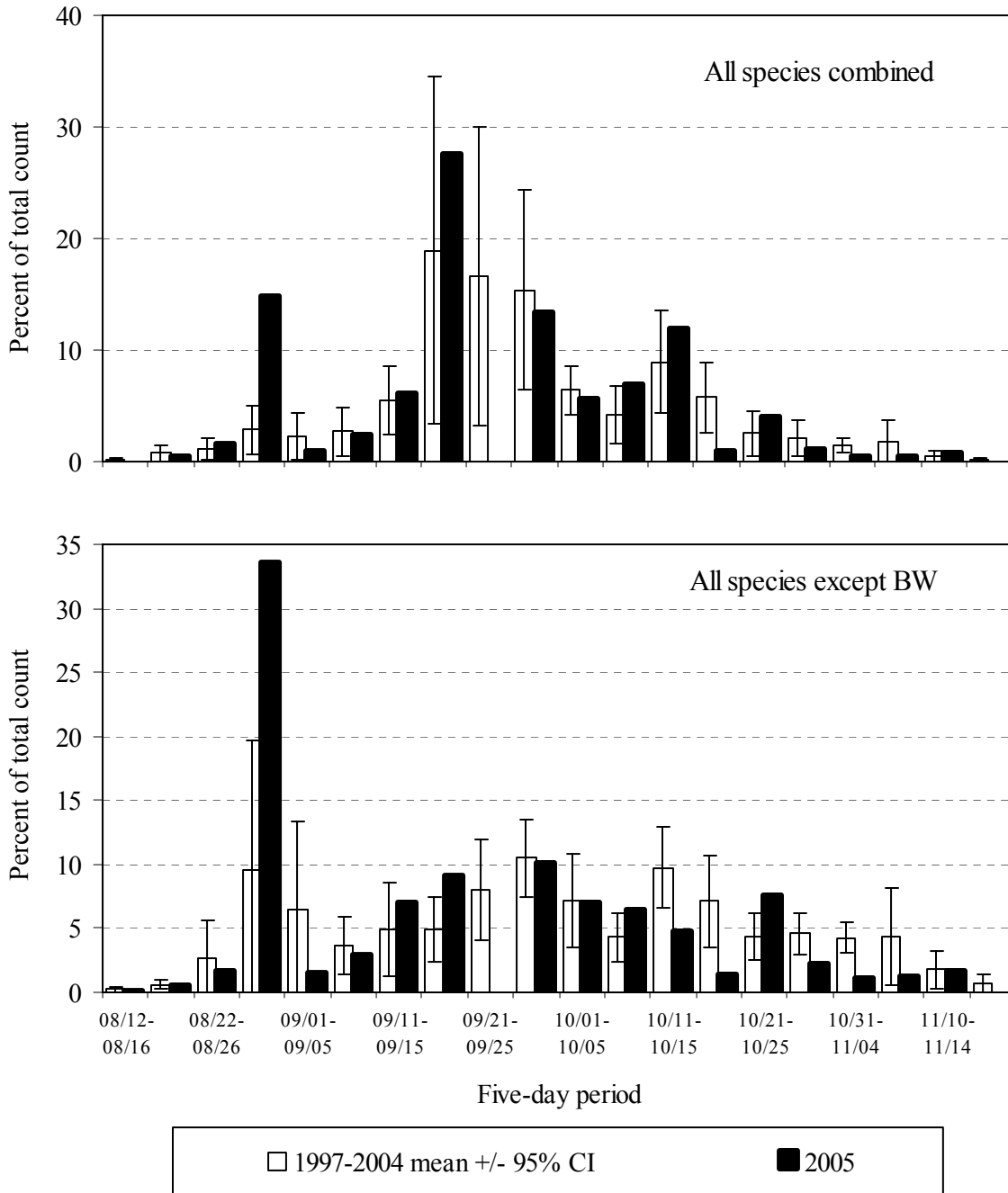


Figure 7. Combined-species flight volume by five-day periods for the autumn raptor migration at Smith Point, Texas, with and without Broad-winged Hawks: 1997–2004 versus 2005.

Appendix A. A history of official observer participation in the Smith Point Raptor Migration Project: 1997–2005.

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.

2004: 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.

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	<i>Coragyps atratus</i>	BV	U	U	NA
Turkey Vulture	<i>Cathartes aura</i>	TV	U	U	NA
Osprey	<i>Pandion haliaetus</i>	OS	U	U	NA
Northern Harrier	<i>Circus cyaneus</i>	NH	A I Br U	M F U	NA
Hook-billed Kite	<i>Chondrohierax uncinatus</i>	HK	A I U	AM AF U	D L U
Swallow-tailed Kite	<i>Elanoides forficatus</i>	SK	U	U	NA
White-tailed Kite	<i>Elanus leucurus</i>	WK	U	U	NA
Mississippi Kite	<i>Ictinia mississippiensis</i>	MK	A I U	U	NA
Unknown kite	<i>see above</i>	UK	U	U	NA
Sharp-shinned Hawk	<i>Accipiter striatus</i>	SS	A I U	U	NA
Cooper's Hawk	<i>Accipiter cooperii</i>	CH	A I U	U	NA
Unknown accipiter	<i>Accipiter spp.</i>	UA	U	U	NA
Harris's Hawk	<i>Parabuteo unicinctus</i>	HH	A I U	U	NA
Red-shouldered Hawk	<i>Buteo lineatus</i>	RS	A I U	U	NA
Broad-winged Hawk	<i>Buteo platypterus</i>	BW	A I U	U	D L U
Swainson's Hawk	<i>Buteo swainsoni</i>	SW	U	U	D L U
White-tailed Hawk	<i>Buteo albicaudatus</i>	WT	A I U	U	NA
Red-tailed Hawk	<i>Buteo jamaicensis</i>	RT	A I U	U	D L U
Ferruginous Hawk	<i>Buteo regalis</i>	FH	A I U	U	D L U
Rough-legged Hawk	<i>Buteo lagopus</i>	RL	U	U	D L U
Unknown buteo	<i>Buteo spp.</i>	UB	U	U	D L U
Golden Eagle	<i>Aquila chrysaetos</i>	GE	A S I NA U ⁴	U	NA
Bald Eagle	<i>Haliaeetus leucocephalus</i>	BE	A S2 S1 I NA U ⁵	U	NA
Unknown eagle	<i>see above</i>	UE	U	U	NA
Crested Caracara	<i>Caracara cheriway</i>	CC	U	U	NA
American Kestrel	<i>Falco sparverius</i>	AK	U	M F U	NA
Merlin	<i>Falco columbarius</i>	ML	AM Br	M U	NA
Peregrine Falcon	<i>Falco peregrinus</i>	PG	A I U	U	NA
Unknown falcon	<i>Falco spp.</i>	UF	U	U	NA
Unknown raptor	<i>Falconiformes</i>	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: 2005.

DATE	OBS. HOURS	OBSRVR / HOUR ¹	MEDIAN		WIND		TEMP (°C) ¹	BAROM. PRESS. (IN HG) ¹	MEDIAN THERMAL LIFT ⁴	VISIB. EAST (KM) ¹	VISIB. WEST (KM) ¹	MEDIAN	
			VISITOR DISTURB ²	PREDOMINANT WEATHER ³	SPEED (KPH) ¹	DIRECTION						FLIGHT DISTANCE ⁵	BIRDS / HOUR
15-Aug	5.25	2.5	0	mc-ovc, PM ts	4.7	ne, se	33.0	30.01	4	22	25	3	0.8
16-Aug	9.00	1.0	0	pc-ovc, scat rain/ts	5.0	calm, se-s	32.7	29.99	4	19	19	2	1.8
17-Aug	9.00	1.0	0	pc	4.7	nne, se-s	32.5	29.93	2	41	41	3	1.9
18-Aug	9.00	1.3	0	pc	8.2	sse-sw	32.9	29.91	3	47	47	2	3.3
19-Aug	9.00	1.3	0	pc	12.4	s	33.0	29.94	3	0	0	-	3.2
20-Aug	9.25	1.3	0	mc-clr	8.2	sse-sw	32.6	30.03	2	28	26	3	4.1
21-Aug	8.75	1.7	0	clr, PM haze	3.5	calm, s-sw	32.3	30.00	1	30	30	3	7.9
22-Aug	7.75	1.0	0	clr-ovc/haze, PM scat rain	5.8	w, se	33.1	29.89	2	20	22	2	34.8
23-Aug	8.50	1.0	0	clr-pc, haze	6.2	w, s-se	32.6	29.84	2	31	28	3	3.4
24-Aug	9.00	1.0	0	pc-mc, scat rain	5.5	calm, w, s	32.8	29.87	3	37	37	3	9.4
25-Aug	9.00	1.0	0	pc-ovc, scat rain/ts/haze	3.0	calm/var	32.8	29.95	3	17	12	2	6.8
26-Aug	7.00	1.0	0	mc-ovc, scat ts/rain/haze	4.4	calm/var	31.9	29.87	2	16	11	2	15.1
27-Aug	9.00	2.6	0	pc	3.2	n, s	34.3	29.73	1	8	8	3	34.9
28-Aug	8.25	1.9	0	mc-clr, PM haze	5.6	nw-n	32.4	29.66	2	9	9	2	529.5
29-Aug	8.00	1.4	0	clr-pc, haze	15.1	w-nw	32.0	29.53	4	13	10	2	50.9
30-Aug	9.50	1.0	0	clr/haze	4.9	sw-w, nw-n	31.4	29.71	1	28	25	2	16.6
31-Aug	8.00	1.0	0	clr-pc/haze, scat ts	5.8	var	32.7	29.80	2	17	11	2	2.8
1-Sep	8.08	1.0	0	ovc-pc, scat rain/ts/haze	7.4	var	31.6	29.90	3	27	18	3	2.5
2-Sep	8.50	1.0	0	ovc, AM haze, PM scat rain/ts	6.0	e	31.2	30.00	4	10	6	1	0.2
3-Sep	7.00	2.3	0	mc-ovc, AM rain	6.0	var	28.9	30.02	4	7	4	2	3.0
4-Sep	8.50	2.9	0	clr/haze	6.3	ne, s-ssw	32.0	29.99	1	18	16	3	21.3
5-Sep	8.75	3.0	0	clr-pc	4.6	ne, s-ssw	33.8	29.97	1	13	13	3	16.3
6-Sep	8.00	3.0	0	clr/haze	10.0	ne-e	31.8	29.99	3	9	9	1	16.4
7-Sep	8.25	3.0	0	clr-pc	9.1	ne-se	30.8	30.01	2	20	20	2	12.8
8-Sep	9.00	2.8	0	clr-ovc, PM dust	7.0	ne-sse	32.1	29.96	2	22	22	2	31.4
9-Sep	8.00	2.1	0	clr-pc	6.0	ne-ese	32.0	29.96	2	18	19	2	37.1
10-Sep	7.00	1.8	0	ovc, scat rain/ts	9.3	se	30.2	29.94	4	14	17	1	9.1
11-Sep	9.50	2.2	0	clr-pc/haze	9.7	e-ese	32.7	29.99	3	13	13	2	44.9
12-Sep	2.25	1.0	0	ovc, scat rain	14.9	se-s	29.1	29.98	4	13	10	-	0.0
13-Sep	9.50	2.9	0	pc-ovc	10.4	sse-sw	32.2	29.93	3	44	39	2	78.2
14-Sep	9.25	2.4	0	clr-pc	10.9	sse	31.3	29.91	2	47	47	3	63.7
15-Sep	9.50	2.5	0	clr-pc, PM haze	17.8	s-ssw	31.9	29.91	4	32	28	3	45.8
16-Sep	7.50	1.9	0	clr-ovc, scat haze/rain	13.3	s-ssw	32.0	30.00	4	17	17	3	34.9
17-Sep	8.00	3.0	0	clr-pc, PM haze	5.7	s-wsw	31.4	29.95	2	27	33	3	266.8
18-Sep	9.00	2.3	0	clr-pc	6.5	sse	32.7	29.93	2	44	44	3	89.2
19-Sep	9.08	2.4	0	clr/haze	5.6	se-sse	32.2	30.05	1	8	8	3	242.3
20-Sep	10.00	1.0	0	clr/haze	5.9	n-ne, nw	32.0	30.06	2	9	9	2	443.8
21-Sep	0.00			hurricane evacuation									
22-Sep	0.00			hurricane evacuation									
23-Sep	0.00			hurricane evacuation									
24-Sep	0.00			hurricane evacuation									
25-Sep	0.00			hurricane evacuation									
26-Sep	0.00			hurricane evacuation									
27-Sep	4.50	1.0	0	ovc-clr/haze	11.3	s-wsw	30.3	29.93	3	13	12	3	8.7
28-Sep	8.50	1.0	0	ovc-clr/haze	11.0	s	31.5	29.83	3	38	38	2	35.8
29-Sep	9.00	1.0	0	mc-clr/haze	8.3	calm, w, n	31.6	29.93	3	18	18	2	344.7
30-Sep	8.50	1.9	0	clr-mc/haze	5.6	nnw-nne	29.1	29.93	2	29	29	3	158.1
1-Oct	9.50	2.4	0	clr-pc	7.9	e-ese	31.0	29.91	2	34	33	3	32.8
2-Oct	8.83	1.2	0	clr-ovc	10.0	e-ese	31.2	29.95	2	34	33	1	63.4
3-Oct	8.17	1.0	0	ovc-clr/haze	11.9	ne-e	29.4	29.96	4	11	10	2	52.7
4-Oct	8.75	1.0	0	clr-pc, haze	13.4	ne-ene	29.2	29.92	4	12	12	2	54.4
5-Oct	9.17	2.0	0	clr-pc	6.0	ne	32.2	29.85	2	15	15	2	24.1
6-Oct	8.67	2.0	0	clr	7.9	nnw-ne	29.3	29.83	2	30	30	2	21.5
7-Oct	9.83	2.4	0	clr-pc	8.3	nnw	26.1	29.86	2	15	15	1	50.1

Appendix C. continued

DATE	OBS. HOURS	OBSRVR / HOUR ¹	MEDIAN	PREDOMINANT WEATHER ³	WIND			BAROM.	MEDIAN	VISIB.	VISIB.	MEDIAN	BIRDS
			VISITOR DISTURB ²		SPEED (KPH) ¹	WIND DIRECTION	TEMP (°C) ¹	PRESS. (IN HG) ¹	THERMAL LIFT ⁴	EAST (KM) ¹	WEST (KM) ¹	FLIGHT DISTANCE ⁵ / HOUR	
8-Oct	9.00	2.1	0	mc-pc	8.3	n	23.2	29.85	3	23	23	1	64.0
9-Oct	9.00	2.0	0	clr	5.6	sw-nnw	24.2	29.83	2	27	27	3	133.1
10-Oct	0.75	2.0	0	ovc, rain	10.3	ne	21.7	29.79	4	10	5	-	0.0
11-Oct	9.00	2.0	0	ovc-pc/haze	6.2	ne-e	26.5	29.89	3	8	7	3	163.0
12-Oct	9.00	2.0	0	clr/haze	5.7	ne-se, wsw	26.8	29.92	1	14	12	3	231.2
13-Oct	8.25	2.0	0	clr-pc/haze	8.4	nw-ene	26.3	29.97	2	12	10	3	42.1
14-Oct	9.00	1.0	0	mc-pc	5.4	nnw-ne	28.2	30.02	2	11	11	1	23.8
15-Oct	9.00	1.0	0	clr-pc/haze	5.5	var	26.2	30.02	2	14	12	3	12.9
16-Oct	9.25	1.8	0	clr	3.8	var	25.6	30.01	1	41	41	3	10.1
17-Oct	8.25	1.9	0	clr	6.3	calm, sw-w	26.3	30.00	2	32	32	2	11.4
18-Oct	9.00	2.0	0	clr/haze	4.2	s-wsw	27.3	29.96	1	25	24	3	10.2
19-Oct	6.50	1.0	0	clr	3.0	calm, se	28.0	29.95	1	36	36	3	3.1
20-Oct	8.75	1.0	0	clr	5.6	sse-ssw	28.7	29.85	2	48	48	3	3.1
21-Oct	7.00	2.9	0	clr	6.4	nw-n	25.3	29.88	2	10	3	1	30.1
22-Oct	9.33	1.1	0	clr	9.0	nw-n	21.4	29.91	3	35	35	2	38.1
23-Oct	8.00	2.0	0	clr, PM haze	8.0	nw-ne	23.6	29.88	2	20	20	2	24.6
24-Oct	8.75	1.0	0	clr	11.4	n	17.0	30.16	4	50	50	2	37.8
25-Oct	5.50	1.0	0	clr	3.9	nw-nnw	19.6	30.11	1	44	44	2	64.9
26-Oct	8.00	1.0	0	clr	5.7	ne-se	20.6	30.05	1	50	50	3	24.9
27-Oct	7.50	1.0	0	clr-pc	11.6	ne	21.7	30.09	4	46	46	3	19.6
28-Oct	0.00			weather day									
29-Oct	8.00	1.0	0	clr/haze	9.1	ne-e	19.6	30.25	3	14	14	2	1.6
30-Oct	7.25	1.9	0	clr-pc, haze	7.9	ne-e	24.3	30.21	3	8	7	2	2.3
31-Oct	7.00	1.0	0	clr-pc, AM haze	10.8	e	25.6	30.07	3	26	26	2	1.1
1-Nov	8.50	1.0	0	clr	14.1	e-s	19.3	30.18	4	50	50	1	6.8
2-Nov	8.00	1.0	0	clr	5.1	nw-n	21.0	30.25	2	50	50	3	11.1
3-Nov	7.67	1.0	0	clr	5.7	n-ene, se-s	23.1	30.16	2	50	50	3	3.0
4-Nov	8.00	1.0	0	ovc	9.9	se-s	25.5	29.95	4	43	43	1	0.4
5-Nov	6.00	1.0	0	pc-mc, scat rain	10.0	s	26.3	29.83	2	1	11	-	0.8
6-Nov	8.00	1.0	0	pc, fog/haze	7.6	sse-s	27.1	30.01	3	12	11	2	17.6
7-Nov	7.00	1.0	0	ovc/fog/haze	9.1	se-s	26.5	30.11	4	4	4	1	0.1
8-Nov	7.50	1.0	0	clr-pc	9.4	e	27.0	30.08	3	22	22	2	0.9
9-Nov	7.00	1.0	0	mc-clr/haze	10.6	ese-sse	27.3	30.07	3	23	23	3	4.4
10-Nov	7.50	1.0	0	pc-mc/haze	6.0	sse	28.0	30.09	2	11	11	3	29.1
11-Nov	7.00	1.0	0	ovc-pc	7.6	s-w	22.7	30.08	4	9	9	1	1.3
12-Nov	6.33	1.0	0	mc-pc/haze, scat rain	17.1	ne-ese	26.1	29.92	4	11	10	1	0.5
13-Nov	8.00	1.0	0	clr-pc/haze	9.1	sse	27.2	30.04	3	29	29	2	2.9
14-Nov	7.25	1.0	0	pc-mc/haze	8.3	sse	27.2	29.97	3	16	15	3	3.9
15-Nov	2.75	1.0	0	ovc, scat rain	22.0	se	27.8	29.89	4	11	7	-	0.0

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: 2005.

DATE	HOURS	SPECIES ¹																									BIRDS								
		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	5.25	0	0	0	0	0	0	0	0	0	1	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0.8
16-Aug	9.00	0	0	1	0	0	8	0	0	0	0	0	0	0	3	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	1.8	
17-Aug	9.00	0	0	1	0	0	9	0	0	0	0	0	0	0	6	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	1.9		
18-Aug	9.00	0	0	0	0	0	0	0	1	0	1	0	0	0	12	15	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	30	3.3		
19-Aug	9.00	0	0	0	0	0	0	0	0	0	1	0	0	0	26	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	29	3.2		
20-Aug	9.25	0	0	0	0	0	17	0	3	0	0	0	0	0	17	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	38	4.1		
21-Aug	8.75	0	0	1	0	0	2	1	0	0	3	0	0	2	46	13	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	69	7.9		
22-Aug	7.75	0	0	0	0	0	4	1	142	0	5	1	0	0	113	1	0	0	0	0	0	0	0	0	0	0	0	0	0	3	270	34.8			
23-Aug	8.50	0	0	0	0	0	2	0	6	0	1	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	3.4			
24-Aug	9.00	0	0	1	0	0	11	0	7	0	3	0	0	1	56	0	4	0	0	0	1	0	0	0	0	0	0	0	1	85	9.4				
25-Aug	9.00	0	0	0	0	0	9	0	3	0	0	0	0	0	48	0	0	0	0	0	0	0	0	0	0	0	0	1	0	61	6.8				
26-Aug	7.00	0	0	0	0	0	3	0	46	0	0	0	0	0	54	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	106	15.1			
27-Aug	9.00	0	0	0	0	0	5	0	249	1	7	0	0	0	46	2	0	0	0	0	3	0	0	0	0	0	0	1	0	314	34.9				
28-Aug	8.25	0	0	1	0	0	21	0	4282	1	5	0	0	0	47	10	0	0	0	0	0	0	0	0	0	1	0	0	0	0	4368	529.5			
29-Aug	8.00	0	0	0	0	0	0	0	377	0	1	0	0	0	26	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	407	50.9			
30-Aug	9.50	0	0	1	1	0	0	0	93	4	10	3	0	1	40	2	0	0	0	0	0	0	0	0	0	3	0	0	0	0	158	16.6			
31-Aug	8.00	0	0	0	2	0	0	1	9	1	1	2	0	0	5	0	1	0	0	0	0	0	0	0	0	0	0	0	0	22	2.8				
1-Sep	8.08	0	0	1	1	0	0	1	4	0	3	0	0	0	7	1	1	0	0	0	0	0	0	0	1	0	0	0	0	20	2.5				
2-Sep	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	2	0	0	0	0	2	0.2				
3-Sep	7.00	0	0	3	0	0	2	0	9	0	0	0	0	0	5	0	0	1	0	0	0	0	0	0	0	0	0	1	0	21	3.0				
4-Sep	8.50	0	0	1	1	0	0	0	78	1	13	1	0	0	84	0	1	0	0	0	0	0	0	0	1	0	0	0	0	181	21.3				
5-Sep	8.75	0	0	0	1	0	1	0	86	0	5	1	0	1	45	0	0	0	0	0	1	0	0	0	1	0	0	0	1	143	16.3				
6-Sep	8.00	0	0	3	1	0	0	0	113	0	0	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	131	16.4			
7-Sep	8.25	0	0	2	1	0	1	0	65	0	3	0	0	0	32	0	0	0	0	0	0	0	0	0	1	0	1	0	0	106	12.8				
8-Sep	9.00	0	0	1	2	0	0	0	88	0	7	0	0	0	166	0	0	0	0	0	0	0	0	0	0	0	1	0	18	283	31.4				
9-Sep	8.00	0	0	0	1	0	0	0	55	0	9	0	0	0	227	0	0	0	0	0	0	0	0	0	0	0	0	0	5	297	37.1				
10-Sep	7.00	0	0	0	0	0	0	0	61	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	64	9.1				
11-Sep	9.50	0	0	1	1	0	3	0	367	0	0	0	0	0	53	0	0	0	0	0	0	0	0	0	1	0	1	0	0	427	44.9				
12-Sep	2.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0			
13-Sep	9.50	0	0	1	0	0	0	0	231	1	2	0	0	0	459	1	0	0	0	0	0	0	0	0	0	0	0	0	48	743	78.2				
14-Sep	9.25	0	0	2	0	0	0	0	180	0	0	0	0	0	407	0	0	0	0	0	0	0	0	0	0	0	0	0	0	589	63.7				
15-Sep	9.50	0	0	1	0	0	0	0	221	0	0	0	0	0	212	0	0	0	0	0	0	0	0	0	0	0	1	0	0	435	45.8				
16-Sep	7.50	0	0	0	0	0	0	0	74	0	0	0	0	0	186	1	0	0	0	0	0	0	0	0	0	1	0	0	0	262	34.9				

Appendix D. continued

DATE	HOURS	SPECIES ¹																								BIRDS						
		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
17-Sep	8.00	0	0	7	0	0	0	0	211	0	3	0	0	0	1907	1	1	1	0	0	2	0	0	0	0	1	0	0	0	0	2134	266.8
18-Sep	9.00	0	0	4	17	0	1	1	83	1	11	7	1	1	662	1	0	0	0	0	0	0	0	0	9	1	3	0	0	803	89.2	
19-Sep	9.08	0	0	4	22	0	0	1	241	3	31	7	0	3	1874	1	0	0	0	0	0	0	1	0	0	9	3	1	0	0	2201	242.3
20-Sep	10.00	0	0	2	14	0	0	0	467	18	77	7	0	5	3824	3	1	0	0	0	0	0	0	0	5	7	8	0	0	4438	443.8	
21-Sep	0.00																															
22-Sep	0.00																															
23-Sep	0.00																															
24-Sep	0.00																															
25-Sep	0.00																															
26-Sep	0.00																															
27-Sep	4.50	0	0	0	1	0	0	0	1	2	3	0	0	0	27	0	0	0	0	0	0	0	0	1	1	0	3	0	0	39	8.7	
28-Sep	8.50	0	0	4	3	0	0	0	12	173	12	0	0	0	90	0	0	0	0	0	0	0	0	0	7	1	2	0	0	304	35.8	
29-Sep	9.00	0	0	3	14	0	0	0	34	584	116	0	0	2	2280	2	2	2	0	0	0	0	0	1	44	8	10	0	0	3102	344.7	
30-Sep	8.50	13	0	6	13	0	0	1	17	240	116	0	0	0	859	1	0	1	0	0	0	0	0	0	60	0	13	0	4	1344	158.1	
1-Oct	9.50	0	0	6	6	0	0	0	9	130	53	0	0	0	34	0	1	0	0	0	0	0	0	0	47	3	12	1	6	312	32.8	
2-Oct	8.83	0	0	2	4	0	0	2	3	114	39	0	0	1	353	1	1	0	0	0	0	0	0	0	27	1	8	0	1	560	63.4	
3-Oct	8.17	0	0	1	1	0	0	1	1	176	20	0	0	0	185	1	0	0	0	0	0	0	0	0	38	0	1	0	5	430	52.7	
4-Oct	8.75	0	1	1	4	0	0	0	18	116	21	2	0	0	273	0	0	0	0	0	0	0	0	0	39	0	0	0	1	476	54.4	
5-Oct	9.17	0	0	3	3	0	0	0	0	65	21	0	0	0	90	0	0	0	0	0	0	0	0	0	39	0	0	0	0	221	24.1	
6-Oct	8.67	9	6	1	3	0	0	0	2	37	32	0	0	0	71	0	0	0	0	0	0	0	0	0	21	0	2	0	2	186	21.5	
7-Oct	9.83	0	0	0	8	0	0	0	0	189	36	0	0	0	60	2	0	0	0	0	0	0	0	0	192	5	1	0	0	493	50.1	
8-Oct	9.00	0	21	2	7	0	0	0	0	87	57	0	0	0	294	1	0	0	0	0	0	0	0	0	98	0	6	0	3	576	64.0	
9-Oct	9.00	0	25	0	5	0	0	0	1	22	24	20	0	0	1056	4	1	1	0	0	5	0	0	0	27	1	4	0	2	1198	133.1	
10-Oct	0.75	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-Oct	9.00	3	11	3	5	0	0	1	0	54	25	3	0	0	1318	4	0	0	0	0	0	0	0	0	38	0	2	0	0	1467	163.0	
12-Oct	9.00	6	15	0	7	0	0	0	0	61	21	4	1	1	1895	30	0	1	0	0	0	0	1	0	35	2	1	0	0	2081	231.2	
13-Oct	8.25	0	11	0	2	0	0	0	0	39	37	7	0	0	224	5	1	0	0	0	0	0	0	0	21	0	0	0	0	347	42.1	
14-Oct	9.00	0	3	0	4	0	0	0	2	63	58	10	0	1	37	2	0	0	0	0	0	0	0	1	33	0	0	0	0	214	23.8	
15-Oct	9.00	0	25	1	5	0	0	0	0	17	19	5	0	0	18	3	0	1	0	0	1	0	0	0	21	0	0	0	0	116	12.9	
16-Oct	9.25	0	2	1	3	0	0	2	0	8	26	2	0	0	29	3	2	0	0	0	0	0	1	0	12	0	2	0	0	93	10.1	
17-Oct	8.25	10	12	0	1	0	0	0	0	8	16	0	0	1	26	0	2	0	0	0	0	0	0	1	16	0	1	0	0	94	11.4	
18-Oct	9.00	0	7	0	4	0	0	3	0	8	10	0	0	1	41	3	0	0	0	0	0	0	0	13	0	2	0	0	92	10.2		

Appendix D. continued

DATE	HOURS	SPECIES ¹																									BIRDS					
		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
19-Oct	6.50	0	0	0	1	0	0	0	0	2	5	0	0	0	8	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	20	3.1
20-Oct	8.75	0	0	0	1	0	0	0	0	3	4	1	0	0	10	0	0	1	0	0	0	0	0	0	7	0	0	0	0	27	3.1	
21-Oct	7.00	0	14	1	3	0	0	0	0	26	18	0	1	1	86	22	3	11	0	0	1	0	1	0	17	1	3	1	0	211	30.1	
22-Oct	9.33	7	50	0	20	0	0	0	0	15	33	1	0	2	79	125	0	2	0	0	0	0	0	0	22	0	0	0	0	356	38.1	
23-Oct	8.00	0	58	0	20	0	0	0	0	29	27	3	0	0	19	4	0	2	0	0	0	0	0	0	35	0	0	0	0	197	24.6	
24-Oct	8.75	0	146	0	8	0	0	0	0	34	28	2	0	0	89	10	0	1	0	0	0	0	0	0	13	0	0	0	0	331	37.8	
25-Oct	5.50	2	228	0	11	0	0	0	0	12	27	7	0	1	33	15	0	18	0	0	0	0	1	0	0	0	1	0	1	357	64.9	
26-Oct	8.00	0	170	0	6	0	0	0	0	7	3	3	0	0	0	3	0	2	0	0	0	0	0	0	5	0	0	0	0	199	24.9	
27-Oct	7.50	4	67	0	5	0	0	0	0	5	8	3	0	3	33	8	0	4	0	0	2	0	0	0	5	0	0	0	0	147	19.6	
28-Oct	0.00																															
29-Oct	8.00	0	0	0	3	0	0	0	0	6	2	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	13	1.6	
30-Oct	7.25	0	0	0	2	0	0	0	0	5	5	0	0	0	2	0	0	0	0	0	0	0	0	0	3	0	0	0	0	17	2.3	
31-Oct	7.00	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	5	0	0	0	0	8	1.1	
1-Nov	8.50	1	8	0	2	0	0	0	0	8	6	0	0	0	4	7	0	5	0	0	0	0	0	0	17	0	0	0	0	58	6.8	
2-Nov	8.00	10	54	1	5	0	0	0	0	3	5	0	0	1	5	2	0	2	0	0	0	0	0	1	0	0	0	0	0	89	11.1	
3-Nov	7.67	0	14	0	1	0	0	0	0	3	1	0	0	0	2	1	0	0	0	0	0	0	0	0	1	0	0	0	0	23	3.0	
4-Nov	8.00	0	0	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0.4	
5-Nov	6.00	0	0	0	2	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0.8	
6-Nov	8.00	40	91	0	5	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	141	17.6	
7-Nov	7.00	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.1	
8-Nov	7.50	0	0	0	1	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	7	0.9	
9-Nov	7.00	0	18	0	1	0	0	0	0	1	2	0	0	0	0	5	0	0	0	0	0	0	0	0	3	0	1	0	0	31	4.4	
10-Nov	7.50	7	128	0	8	0	0	0	0	10	4	0	0	2	14	21	1	19	0	0	2	0	0	0	1	1	0	0	0	218	29.1	
11-Nov	7.00	0	0	0	4	0	0	0	0	2	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	9	1.3	
12-Nov	6.33	0	0	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0.5	
13-Nov	8.00	0	0	0	10	0	0	0	0	3	1	0	0	0	0	3	0	1	0	0	0	0	0	0	5	0	0	0	0	23	2.9	
14-Nov	7.25	0	0	1	4	0	0	0	0	5	1	0	0	0	3	7	0	5	0	0	0	0	0	0	2	0	0	0	0	28	3.9	
15-Nov	2.75	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	
Total	688.92	112	1185	76	296	0	99	18	7952	2407	1150	104	3	31	20380	360	24	84	0	0	21	0	5	0	13	1011	37	92	2	101	35570	51.6

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: 1997–2005.

	1997	1998	1999	2000	2001	2002	2003	2004	2005	MEAN
Start date	17-Aug	15-Aug	15-Aug	12-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	15-Nov
Observation days	94	91	89	94	93	91	92	93	86	91
Observation hours	860.11	677.25	696.68	823.08	743.33	775.66	777.75	796.34	688.92	759.90
SPECIES	RAPTOR COUNTS									
Black Vulture	130	105	341	4	379	59	96	368	112	177
Turkey Vulture	1,225	581	1,295	1,059	2,488	678	2,163	3,091	1,185	1,529
TOTAL VULTURES	1,355	686	1,636	1,063	2,867	737	2,259	3,459	1,297	1,707
Osprey	54	68	54	60	62	48	78	87	76	65
Northern Harrier	445	262	537	372	472	144	203	246	296	331
Hook-billed Kite	0	0	0	0	0	0	1	0	0	0
Swallow-tailed Kite	40	34	52	46	74	150	98	151	99	83
White-tailed Kite	0	1	2	11	12	8	23	14	24	11
Mississippi Kite	2,124	2,362	2,975	4,788	3,253	7,879	3,809	3,786	7,952	4,325
TOTAL KITES	2,164	2,397	3,029	4,845	3,339	8,037	3,930	3,951	8,075	4,419
Sharp-shinned Hawk	4,780	3,231	3,896	1,484	3,878	3,142	1,508	1,923	2,407	2,917
Cooper's Hawk	1,137	1,136	1,207	1,088	1,281	1,233	738	1,162	1,150	1,126
Unknown accipiter	49	170	113	14	15	18	4	14	104	51
TOTAL ACCIPITERS	5,966	4,537	5,216	2,586	5,174	4,393	2,250	3,099	3,668	4,099
Harris' Hawk	0	0	0	0	2	0	0	0	3	1
Red-shouldered Hawk	45	36	34	61	54	23	49	88	31	47
Broad-winged Hawk	30,417	16,137	34,243	29,956	103,612	65,255	21,799	26,032	20,380	38,648
Swainson's Hawk	137	56	129	255	321	168	228	1,036	360	299
White-tailed Hawk	0	1	2	11	12	8	23	14	24	11
Red-tailed Hawk	331	35	204	77	273	44	64	159	84	141
Ferruginous Hawk	0	0	2	0	2	1	2	1	0	1
Rough-legged Hawk	0	0	2	0	3	0	0	0	0	0.6
Unidentified buteo	86	26	31	3	4	5	6	5	21	21
TOTAL BUTEOS	31,016	16,291	34,647	30,363	104,283	65,504	22,171	27,335	20,903	39,168
Golden Eagle	3	0	1	1	0	0	0	0	0	0.6
Bald Eagle	2	0	2	7	2	3	2	1	5	3
Unknown eagle	0	0	0	0	0	0	1	0	0	0.1
TOTAL EAGLES	5	0	3	8	2	3	3	1	5	3
Crested Caracara	6	3	4	9	16	7	8	26	13	10
American Kestrel	1,297	1,334	1,938	1,311	1,140	1,949	816	1,272	1,011	1,341
Merlin	88	26	47	43	70	56	79	78	37	58
Peregrine Falcon	65	92	85	79	77	94	88	129	92	89
Unknown falcon	25	13	9	5	1	8	3	5	2	7
TOTAL FALCONS	1,475	1,465	2,079	1,438	1,288	2,107	986	1,484	1,142	1,496
Unidentified raptor	496	91	116	16	0	5	1	12	101	93
GRAND TOTAL	42,993	25,824	47,337	40,766	117,517	80,984	31,885	39,698	35,570	51,397