

**FALL 2004 RAPTOR MIGRATION STUDY
AT SMITH POINT, TEXAS**



**HawkWatch International
Salt Lake City, Utah**

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



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Report prepared by:

Jeff P. Smith

Counts conducted by:

**Samantha Burrell, Carl Bullock, Bill Saulmon, Dick Benoit,
Winnie Burkett, Adele Bennett, and David Chinevere**

Project coordinated by:

**HawkWatch International, Inc.
Principal Investigator: Dr. Jeff P. Smith
1800 South West Temple, Suite 226
Salt Lake City, UT 84115
(801) 484-6808**

**Gulf Coast Bird Observatory
2004 Monitoring Coordinator: Sumita Prasad
103 West Highway 332
Lake Jackson, Texas 77566
(409) 480-0999**

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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 2004, HWI and GCBO conducted the 8th 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 about 26,000 to 115,000 migrants. This report summarizes the 2004 count results.

STUDY SITE

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

METHODS

Two primary full-time observers, assisted by several other trained volunteers, conducted daily counts of the raptor migration through the area from a single traditional observation platform. This was the second full-season of migration counting for both primary observers Carl Bullock and Samantha Burrell (see Appendix A for a history of observer participation). A dedicated and well-trained team of local volunteers, which this year included Bill Saulmon, Winnie Burkett, Dick Benoit, Adele Bennett, and David Chinevere, regularly assisted as supplemental and substitute observers, as has been the case since the project's inception.

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 2004 annual statistics against means and 95% confidence intervals (mean \pm 95% CI) for 1997–2003, I equate significance with a 2004 value falling outside of the 95% CI for the associated mean.

RESULTS AND DISCUSSION

WEATHER

Inclement weather was a relatively minor issue this season in terms of entirely precluding (0 days) or severely hampering observations (i.e., reduced to \leq 4 hours of observation; 2 days); the 1997–2003 averages for the site are 1.5 and 4.3 days, respectively (see Appendix C for daily weather records). Otherwise, generally fair skies predominated on 43% of the active observation days, transitional weather (i.e., skies changed from fair to mostly cloudy/overcast, or vice versa, during the day) on 24%, and mostly cloudy to overcast skies on 33%. The comparative averages for these variables are 44%, 29%, and 27%, respectively, indicating that mostly cloudy to overcast skies were slightly more common than usual in 2004. A more substantial difference is the fact that visibility reducing fog and especially haze occurred on 42% of the active observation days, which is considerably higher than the long-term average of 26%. Scattered rain also hampered observations a bit more than usual, occurring on 26% of the active days compared to the long-term average of 22%.

The wind-speed conditions at the site in 2004 were close to average, showing only a slight shift towards lighter winds. Light winds (\leq 12 kph) prevailed on 73% of the active days, moderate winds (12–28 kph) on 26%, and stronger winds on 1%. The comparative 1997–2003 averages are 68% light, 30% moderate, and 2% strong. In terms of wind directions, the norm at Smith Point is high variability; from 1997–2003 the most common wind direction patterns were variable N–E (on average, prevailing on 23% of the active observation days), SE–SW (15%), E–S (13%), NE–SE (13%), NW–NE (12%), and days where a distinct shift from NW–NE to SE–SW winds occurred during the day (9%). Noteworthy differences in 2004 included fewer days with prevailing N–E (15% of days) and NE-SE winds (4%), and twice the average prevalence of days where SE–SW winds prevailed (31%).

The temperature during active observation periods averaged 27.6°C (average of daily values, which in turn were averages of hourly readings), ranging from 11.7–32.7°C. The average value is roughly two degrees higher than the long-term average, but otherwise the temperature regime in 2004 was typical for the site. The barometric pressure during active observation periods averaged 29.89 in Hg (the average of daily values, which in turn were averages of hourly readings), ranging from 29.46–30.11°C; the average is the second lowest and the minimum and maximum are both the lowest values recorded to date.

In 2004, 28% of the active observation days received a median (of hourly ratings) thermal-lift rating of good to excellent, which is the lowest proportion yet recorded for the project (1997–2003 average of 44%, range 35–61%).

In summary, inclement weather curtailed observations less than usual in 2004, but overcast skies, scattered rain, and fog/haze were more prevalent than usual during periods of active observation. There was a subtle shift toward lighter winds compared to the average pattern, but to a much lesser degree than in 2003. A much more distinct shift in wind directions occurred, however, with SE–SW winds (quartering to head winds for migrants) twice as common as usual and easterly and northeasterly winds (tail winds for migrants) proportionately less common. The higher prevalence of unsettled weather and on-shore winds blowing in off Galveston and East Bays likely contributed to poorer thermal-lift conditions than usual.

OBSERVATION EFFORT

The observers logged 93 days and 796.34 hours of observation between 15 August and 15 November 2004. The numbers of observation days and hours were 1% and 4% higher than average, respectively. The daily-average number of observers was 2.2, which is a significant 16% higher than the 1997–2003 average of $1.9 \pm 95\%$ CI of 0.09 observers/hour.

MIGRATION SUMMARY

The observers tallied 39,698 migrant raptors of 20 species during the 2004 season, which is a non-significant 28% below the 1997–2003 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 proportions of buteos and vultures were significantly above average, whereas the proportions of accipiters, falcons, other miscellaneous species (Ospreys, Northern Harriers and eagles), and unidentified raptors were significantly below average (Figure 2). Species that accounted for 1% or more of the total count included Broad-winged Hawk (77%), Mississippi Kite (7%), Sharp-shinned Hawk (6%), Turkey Vulture (3%), American Kestrel (3%), and Cooper's Hawk (2%).

Interannual Count Trends and Regional Comparisons

Record high counts occurred in 2004 for Turkey Vultures, Ospreys, Swallow-tailed Kites, Red-shouldered Hawks, Swainson's Hawks, Crested Caracaras, and Peregrine Falcons (see Appendix E for annual count summaries). No record low counts occurred in 2004. The count of 26,032 Broad-winged Hawks was the third lowest total documented for this species to date. The count was 40% below the 1997–2003 average but was not a significant difference, reflecting high variability in counts of this species (Table 1). Only the count of Sharp-shinned Hawks was significantly below average in 2004, whereas counts were significantly above average for nine species.

Eight 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). 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, 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) and Sharp-shinned Hawk (Figure 4).

Elsewhere in coastal Texas, the overall count at Corpus Christi exceeded one million migrants for the first time (the first recorded million-bird raptor count in North America north of Mexico), primarily reflecting record-high counts of Broad-winged and Swainson's Hawks (Smith 2005). Tropical Storm Ivan was most likely the primary reason for the comparatively low Broad-winged Hawk count at Smith Point. This storm re-strengthened and came back on-shore from the Gulf of Mexico and parked for a few days

immediately northeast of Smith Point just as the main wave of Broad-winged Hawks moved down through coastal Texas from the northeast. This undoubtedly caused many birds that might otherwise have followed the Smith Point peninsula bottleneck to remain farther inland and pass north of the Galveston Bay complex. Both Texas sites recorded record high counts of Ospreys for the second year in a row, and both sites recorded record high counts of Swainson's Hawks in 2004. In contrast, a record high count of Red-shouldered Hawks occurred at Smith Point, while the opposite occurred at Corpus Christi. The only other species for which both sites showed the same significant change from the norm was the Black Vulture, for which the counts at both sites were significantly above average. However, for 11 other species comparisons against 1997–2003 averages revealed the same basic pattern; i.e., a decrease or increase. Other species for which the two sites recorded opposite trends in 2004 include Turkey Vulture, Swallow-tailed Kite, Cooper's Hawk, Broad-winged Hawk, Harris's Hawk, Bald Eagle, and Crested Caracara. Comparing trends in passage rates over the course of the two studies (both begun in 1997), both projects show similar increasing patterns for Turkey Vultures, Mississippi and Swallow-tailed Kites, and Swainson's Hawks. No species are currently showing distinct long-term decreasing trends at both sites, and the White-tailed Kite is the only species that is currently showing distinctly opposite trends at the two sites (increasing at Smith Pt; decreasing at Corpus Christi).

Elsewhere around the Gulf Coast, in the Florida Keys the overall southbound count was 28% below the 1999–2003 average for that site and was the lowest combined-species total yet recorded there (HWI unpublished data). Second lowest or record low counts were record for 8 of 15 species monitored at that site. A primary cause of the low total count was one of the worst hurricane seasons on record for Florida, which undoubtedly caused many migrants to avoid the Florida peninsula flyway and instead divert to the southwest around the Gulf. There were, however, several notable exceptions to the generally low Florida Keys counts in 2004. In particular, the count of 1,036 Cooper's Hawks was roughly 200 birds higher than any previous count and 2–3 times higher than in most years! The counts of Swainson's and Short-tailed Hawks also were well above average.

In Veracruz, Mexico, along the far southwestern Gulf Coast, the overall count (data from two count sites combined) was 20% 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 16% above average for Broad-winged Hawks, 25% above average for Turkey Vultures, 32% above average for Mississippi Kites, and 42% above average for Swainson's Hawks. In contrast, counts were 23–55% below average for four that comprise the second tier of common species: Osprey, Sharp-shinned and Cooper's Hawks, and American Kestrel.

Age Ratios

Five of nine species for which comparisons of immature : adult ratios were possible showed below average (48–82%) age ratios in 2004, but the difference was significant only for Northern Harriers and Sharp-shinned Hawks (Table 2). Low age ratios may be indicative of poor nesting success and juvenile recruitment during the previous breeding season. Low documented abundances of immature birds in 2004 contributed to the low 2004 age ratios for Northern Harriers, Mississippi Kites, Sharp-shinned Hawks, and Broad-winged Hawks, suggesting that this may have been the case for these species. For Swallow-tailed Kites, however, the low 2004 age ratio was not due to low documented abundance of immature birds, but rather to a proportionately greater increase in the documented abundance of adults. Low proportions of aged birds and substantial variation in the proportions of aged birds across years also preclude attaching great importance to the data for most species, especially for Mississippi Kites and Broad-winged Hawks. 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.

Seasonal Timing

The 2004 median passage date for Broad-winged Hawks of 29 September was a non-significant 4 days later than average (Table 3). Examination of the seasonal activity pattern shows reduced activity during the usual peak period in late September and higher than usual late-season activity in late October and early November (Figure 7). Among commonly encountered species, six showed significantly late median passage dates in 2004, four showed significantly early timing, and eight showed median passage dates that were within the normal range of variation for each species but in all cases were at least slightly later than average (Table 3). All commonly observed kites and falcons showed at least slightly later than average median passage dates (Table 3). Otherwise, there were no other consistent patterns within major species groups; however, examination of the combined-species seasonal activity pattern with Broad-winged Hawks excluded revealed a distinct late shift in activity, with relative flight volume significantly above average throughout most of late October and early November (Figure 8). Closer examination of species-specific seasonal patterns showed that most species were involved in this late wave of activity. Further examination of age-specific timing data for 10 species also revealed primarily later than average median passage dates (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 2004, resident Broad-winged, Red-shouldered, and Red-tailed Hawks were recorded throughout the season. One or more immature Red-shouldered and Broad-winged Hawks were noted as locals most days throughout the season, although sightings of local Broad-winged Hawks thinned out considerably by late October. No adult Broad-winged Hawks were recorded as locals this year, unlike in most previous years, whereas adult Red-shouldered Hawks were recorded as locals on five occasions. Scattered sightings of apparently local, mostly immature Red-tailed Hawks were recorded throughout the season. One light-morph adult was recorded as a local in late August; an adult Harlan's red-tail was recorded as a transient local on two days in late October; and one other sighting of a local light-morph adult was recorded in early November. All other local red-tails were immature light-morph birds, with sightings recorded from early September through the end of the season.

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 late August and late October, but unlike in previous years there was no obvious evidence of birds setting up in the local area for the winter.

Local Sharp-shinned and 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 of both species were likely to winter on the peninsula.

A few sightings of transient local American Kestrels occurred during the latter half of September, but by mid-October it appeared that several birds had taken up residence in the area, probably for the winter.

Transient local Merlins were recorded on three occasions in October. At least one adult and one immature Peregrine Falcons were seen interacting and frequenting the area in late October. Apparently local, perhaps transient, Crested Caracaras were recorded twice in late August and late October.

At least one adult male, one adult female, and two immature Northern Harriers were recorded as locals on more than a dozen occasions throughout the season. At least two distinct individual Ospreys were recorded as locals on several occasions throughout the season. 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 2004 totaled 930 individual visits, including repeat visits, which is only slightly lower than 2003's record visitation rate of more than 1,000 visits! Besides Texas, the source of most visitors, visitors originated in 13 other states, the United Kingdom, Mexico, and Canada. Although hampered somewhat by rain, this year's *Magnificent Migrations* special weekend festival in late September attracted a good crowd, who were treated to a good raptor flight, highly productive songbird-banding demonstrations, informative presentations by raptor expert Bill Clark and HWI Science Director Jeff Smith, and a variety of high-quality vendor wares.

In 2004, 828 hourly assessments by the observers of visitor disturbance resulted in the following ratings: 98% none, 2% low, <1% moderate, and 0% 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.

ACKNOWLEDGMENTS

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Table 1. Fall counts and passage rates by species for migrating raptors at Smith Point, TX: 1997–2003 versus 2004.

SPECIES	COUNTS			RAPTORS/100 HOURS		
	1997–2003 ¹	2004	% CHANGE	1997–2003 ¹	2004	% CHANGE
Black Vulture	159 ± 106.2	368	+131	21.6 ± 14.9	46.2	+114
Turkey Vulture	1,356 ± 532.7	3091	+128	177.6 ± 71.0	388.2	+119
TOTAL VULTURES	1,515 ± 598.7	3459	+128	199.1 ± 80.8	434.4	+118
Osprey	61 ± 7.4	87	+44	8.0 ± 1.2	10.9	+37
Northern Harrier	348 ± 109.5	246	-29	45.8 ± 15.1	30.9	-33
Hook-billed Kite	0 ± 0.3	0	-100	0.0 ± 0.0	0.0	-100
Swallow-tailed Kite	71 ± 30.7	151	+114	9.2 ± 3.9	19.0	+105
White-tailed Kite	8 ± 6.0	14	+72	1.1 ± 0.8	1.8	+67
Mississippi Kite	3,884 ± 1,463.7	3786	-3	506.8 ± 183.6	475.4	-6
TOTAL KITES	3,963 ± 1,491.7	3951	0	517.1 ± 187.2	496.1	-4
Sharp-shinned Hawk	3,131 ± 918.3	1923	-39	413.3 ± 120.9	241.5	-42
Cooper's Hawk	1,117 ± 133.1	1162	+4	147.4 ± 21.5	145.9	-1
Unknown accipiter	55 ± 46.7	14	-74	7.7 ± 7.0	1.8	-77
TOTAL ACCIPITERS	4,303 ± 1,029	3099	-28	568.3 ± 141.0	389.2	-32
Harris' Hawk	0 ± 0.6	0	-100	0.0 ± 0.1	0.0	-100
Red-shouldered Hawk	43 ± 9.6	88	+104	5.6 ± 1.1	11.1	+96
Broad-winged Hawk	43,060 ± 22,924	26032	-40	5,661 ± 3,087	3,269.0	-42
Swainson's Hawk	185 ± 66.0	1036	+460	24.0 ± 8.5	130.1	+443
White-tailed Hawk	8 ± 6.0	14	+72	1.1 ± 0.8	1.8	+67
Red-tailed Hawk	147 ± 89.7	159	+8	19.0 ± 11.2	20.0	+5
Ferruginous Hawk	1 ± 0.7	1	0	0.1 ± 0.1	0.1	-7
Rough-legged Hawk	1 ± 0.9	0	-100	0.1 ± 0.1	0.0	-100
Unidentified buteo	23 ± 22.3	5	-78	2.9 ± 2.6	0.6	-79
TOTAL BUTEOS	43,468 ± 22,995	27335	-37	5,714 ± 3,097	3,433	-40
Golden Eagle	1 ± 0.8	0	-100	0.1 ± 0.1	0.0	-100
Bald Eagle	3 ± 1.6	1	-61	0.3 ± 0.2	0.1	-61
Unknown eagle	0 ± 0.3	0	-100	0.0 ± 0.0	0.0	-100
TOTAL EAGLES	3 ± 1.9	1	-71	0.4 ± 0.2	0.1	-71
Crested Caracara	8 ± 3.2	26	+243	1.0 ± 0.4	3.3	+232
American Kestrel	1,398 ± 305.8	1272	-9	185.0 ± 45.3	159.7	-14
Merlin	58 ± 16.2	78	+33	7.5 ± 1.8	9.8	+30
Peregrine Falcon	83 ± 7.5	129	+56	11.0 ± 1.5	16.2	+48
Unknown falcon	9 ± 6.0	5	-45	1.2 ± 0.7	0.6	-47
TOTAL FALCONS	1,548 ± 302.8	1484	-4	204.7 ± 45.3	186.4	-9
Unidentified raptor	104 ± 132.8	12	-88	12.9 ± 15.5	1.5	-88
GRAND TOTAL	55,329 ± 24,145	39698	-28	7,273 ± 3,254	4,985	-31

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: 1997–2003 versus 2004.

	TOTAL AND AGE-CLASSIFIED COUNTS						IMMATURE : ADULT			
	1997–2003 AVERAGE			2004			% UNKNOWN AGE		RATIO	
	TOTAL	IMM.	ADULT	TOTAL	IMM.	ADULT	1997–2003 ¹	2004	1997–2003 ¹	2004
Northern Harrier	348	152	77	246	68	92	35 ± 15.4	35	2.3 ± 0.92	0.7
Swallow-tailed Kite	71	14	13	151	18	27	80 ± 23.7	70	1.6 ± 1.10	0.7
Mississippi Kite	3884	734	202	3786	422	168	64 ± 25.4	84	13.6 ± 12.24	2.5
Sharp-shinned Hawk	3131	965	91	1923	308	133	63 ± 15.9	77	11.6 ± 5.10	2.3
Cooper's Hawk	1117	368	74	1162	312	56	60 ± 18.3	68	4.9 ± 2.13	5.6
Red-shouldered Hawk	43	15	3	88	32	4	57 ± 24.8	59	10.7 ± 11.43	13.0
Broad-winged Hawk	43060	1236	171	26032	692	256	97 ± 2.5	96	5.2 ± 2.84	2.7
Red-tailed Hawk	147	43	40	159	58	42	34 ± 22.1	37	0.9 ± 0.38	1.4
Peregrine Falcon	83	7	18	129	16	24	71 ± 26.9	69	0.5 ± 0.49	0.7

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 2004, with a comparison of 2004 and 1997–2003 average median passage dates.

SPECIES	2004				1997–2003
	FIRST OBSERVED	LAST OBSERVED	BULK PASSAGE DATES ¹	MEDIAN PASSAGE DATE ²	MEDIAN PASSAGE DATE ^{2,3}
Black Vulture	10-Sep	8-Nov	23-Sep – 3-Nov	4-Oct	24-Oct ± 3.8
Turkey Vulture	12-Sep	12-Nov	15-Oct – 6-Nov	31-Oct	27-Oct ± 5.2
Osprey	1-Sep	4-Nov	11-Sep – 21-Oct	4-Oct	28-Sep ± 3.4
Northern Harrier	5-Sep	15-Nov	20-Sep – 8-Nov	22-Oct	16-Oct ± 5.3
Swallow-tailed Kite	17-Aug	25-Sep	18-Aug – 6-Sep	28-Aug	27-Aug ± 4.3
White-tailed Kite	31-Aug	5-Nov	16-Sep – 28-Oct	15-Oct	05-Oct ± 13.3
Mississippi Kite	15-Aug	22-Oct	30-Aug – 18-Sep	7-Sep	05-Sep ± 4.5
Sharp-shinned Hawk	30-Aug	11-Nov	27-Sep – 4-Nov	14-Oct	04-Oct ± 4.9
Cooper's Hawk	15-Aug	12-Nov	12-Sep – 6-Nov	30-Sep	09-Oct ± 3.7
Red-shouldered Hawk	29-Aug	9-Nov	30-Aug – 12-Oct	6-Sep	21-Sep ± 10.3
Broad-winged Hawk	15-Aug	14-Nov	10-Sep – 26-Oct	29-Sep	25-Sep ± 4.8
Swainson's Hawk	28-Aug	15-Nov	14-Oct – 6-Nov	24-Oct	18-Oct ± 4.4
White-tailed Hawk	22-Aug	8-Nov	24-Aug – 4-Nov	7-Sep	06-Oct ± 26.2
Red-tailed Hawk	15-Aug	15-Nov	30-Aug – 8-Nov	4-Nov	25-Oct ± 12.6
Ferruginous Hawk	20-Oct	20-Oct	–	–	–
Bald Eagle	5-Nov	5-Nov	–	–	08-Nov ³
Crested Caracara	15-Aug	13-Nov	28-Aug – 9-Nov	14-Oct	03-Oct ± 27.1
American Kestrel	15-Aug	12-Nov	27-Sep – 31-Oct	14-Oct	09-Oct ± 4.1
Merlin	13-Sep	12-Nov	22-Sep – 25-Oct	6-Oct	29-Sep ± 3.7
Peregrine Falcon	12-Sep	3-Nov	24-Sep – 25-Oct	4-Oct	02-Oct ± 1.9
Total	17-Aug	15-Nov	9-Sep – 31-Oct	30-Sep	25-Sep ± 4.7

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.

⁴ Based on data for only 2000.

Table 4. Median passage dates by age for selected species of migrating raptors at Smith Point, TX: 1997–2003 versus 2004.

SPECIES	ADULT		IMMATURE	
	1997–2003 ¹	2004	1997–2003 ¹	2004
Northern Harrier	29-Oct ± 5.4	3-Nov	13-Oct ± 4.1	14-Oct
Swallow-tailed Kite	17-Aug ± 4.9	27-Aug	28-Aug ± 9.1	30-Aug
Mississippi Kite	04-Sep ± 5.7	7-Sep	12-Sep ± 5.1	12-Sep
Sharp-shinned Hawk	18-Oct ± 8.4	22-Oct	30-Sep ± 6.2	14-Oct
Cooper’s Hawk	19-Oct ± 15.1	4-Nov	07-Oct ± 10.7	26-Sep
Red-shouldered Hawk	02-Oct ²	–	20-Sep ± 16.2	1-Sep
Broad-winged Hawk	19-Sep ± 5.5	23-Sep	21-Sep ± 12.6	27-Sep
White-tailed Hawk	21-Oct ± 6.9	0-Jan	17-Oct ± 1.0	5-Oct
Red-tailed Hawk	14-Oct ± 21.2	22-Oct	12-Oct ± 12.9	3-Nov
Peregrine Falcon	30-Sep ± 1.7	14-Oct	02-Oct ± 7.8	20-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 Value for 2003 only.



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

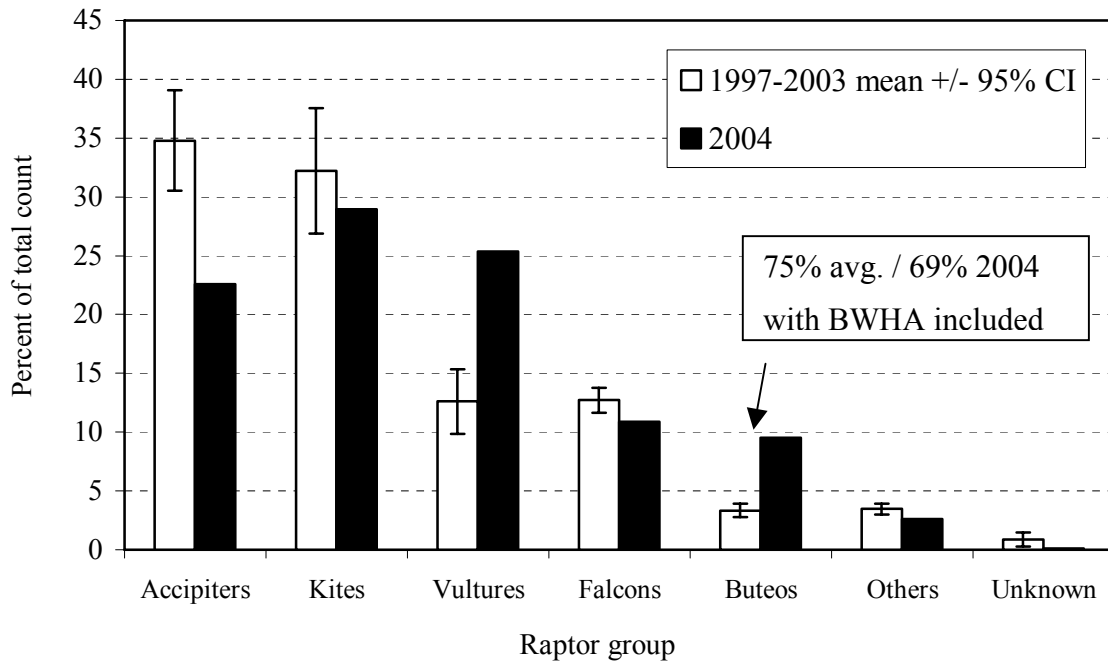


Figure 2. Composition of autumn raptor migration by major species groups at Smith Point, Texas: 1997–2003 versus 2004.

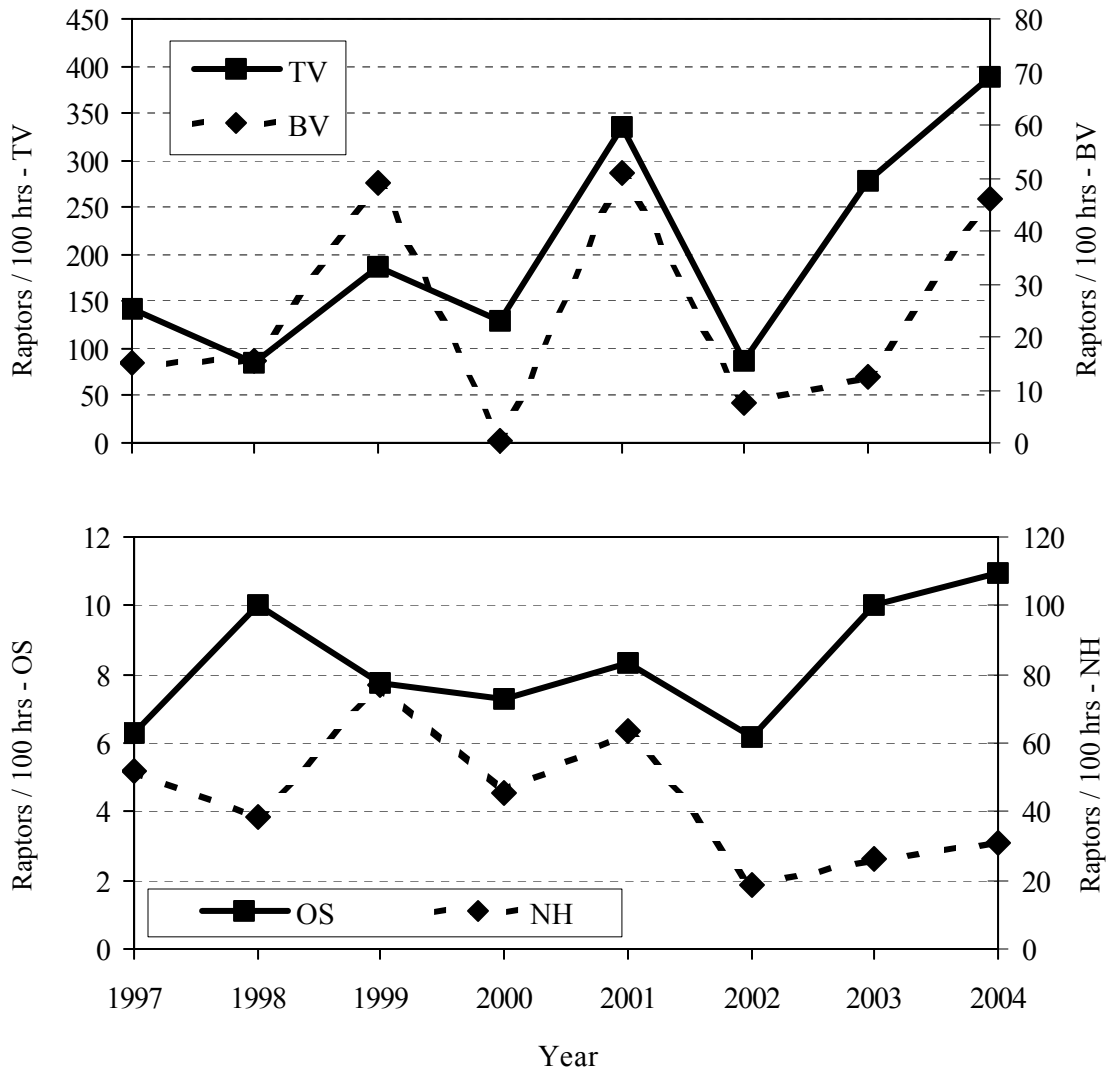


Figure 3. Annual fall-migration passage rates of Turkey and Black Vultures, Ospreys, and Northern Harriers at Smith Point, Texas: 1997–2004.

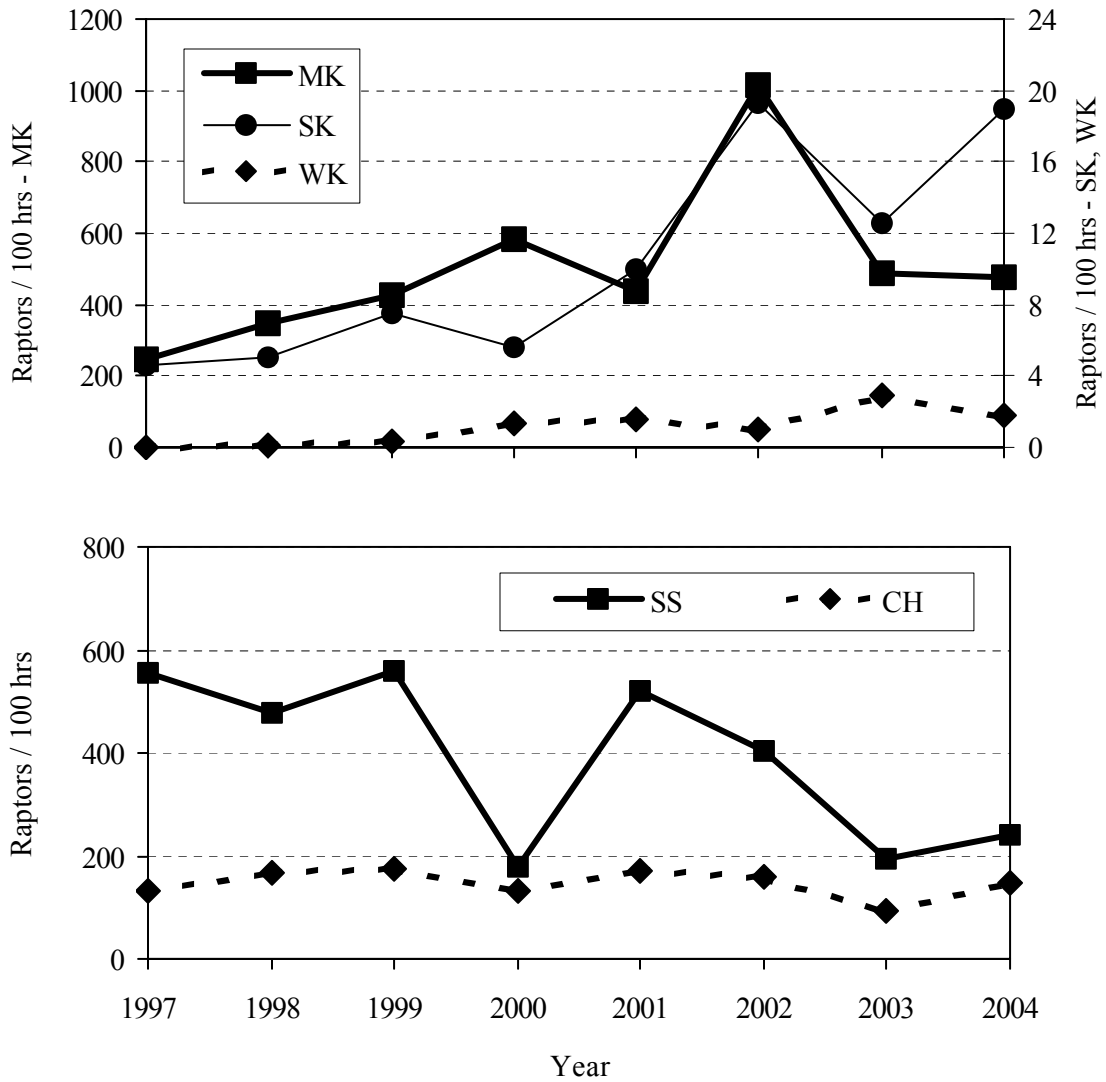


Figure 4. Annual fall-migration passage rates of Mississippi, Swallow-tailed and White-tailed Kites, and Sharp-shinned and Cooper's Hawks at Smith Point, Texas: 1997–2004.

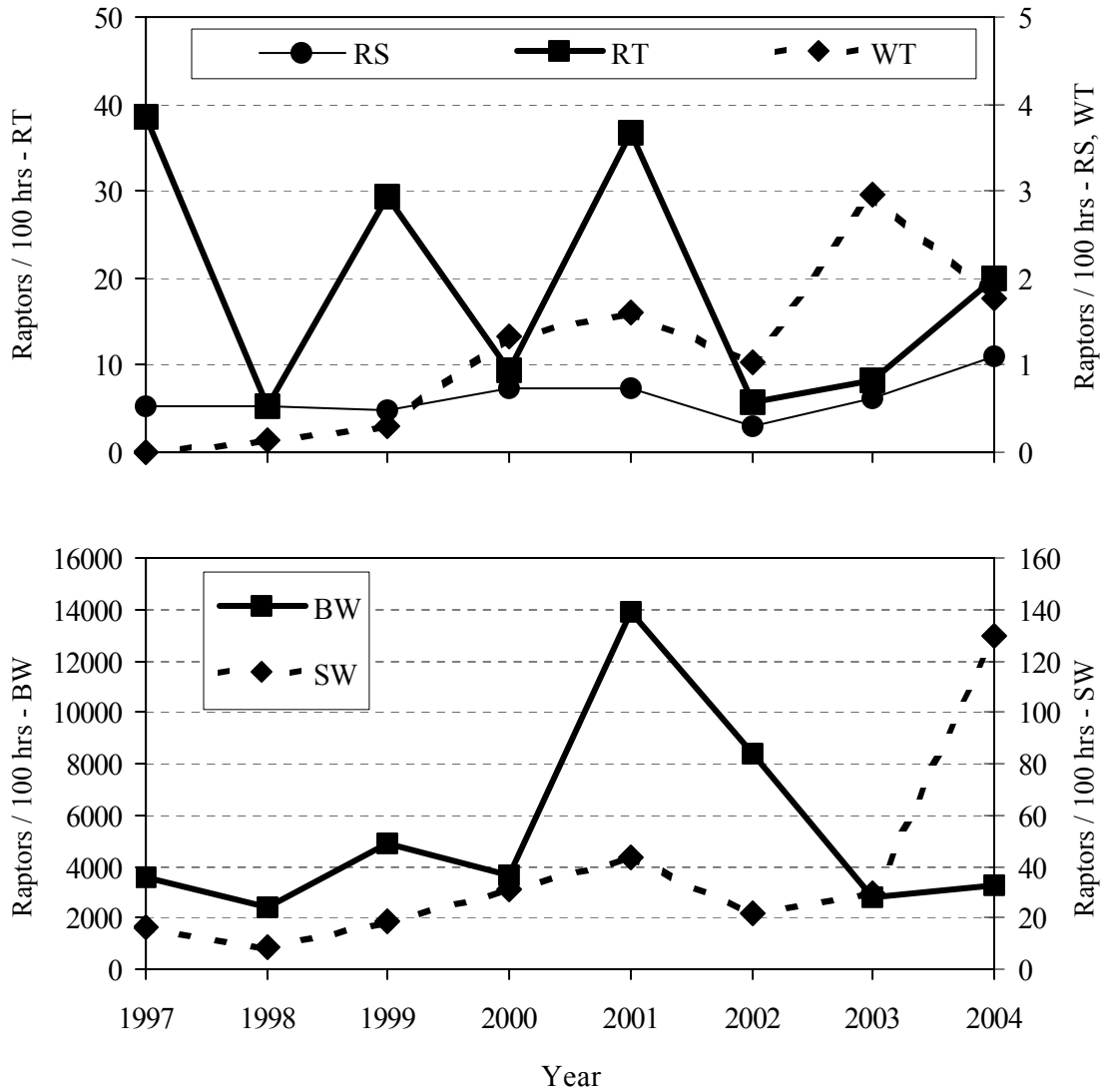


Figure 5. Annual fall-migration passage rates of Red-shouldered, Red-tailed, White-tailed, Broad-winged, and Swainson's Hawks at Smith Point, Texas: 1997–2004.

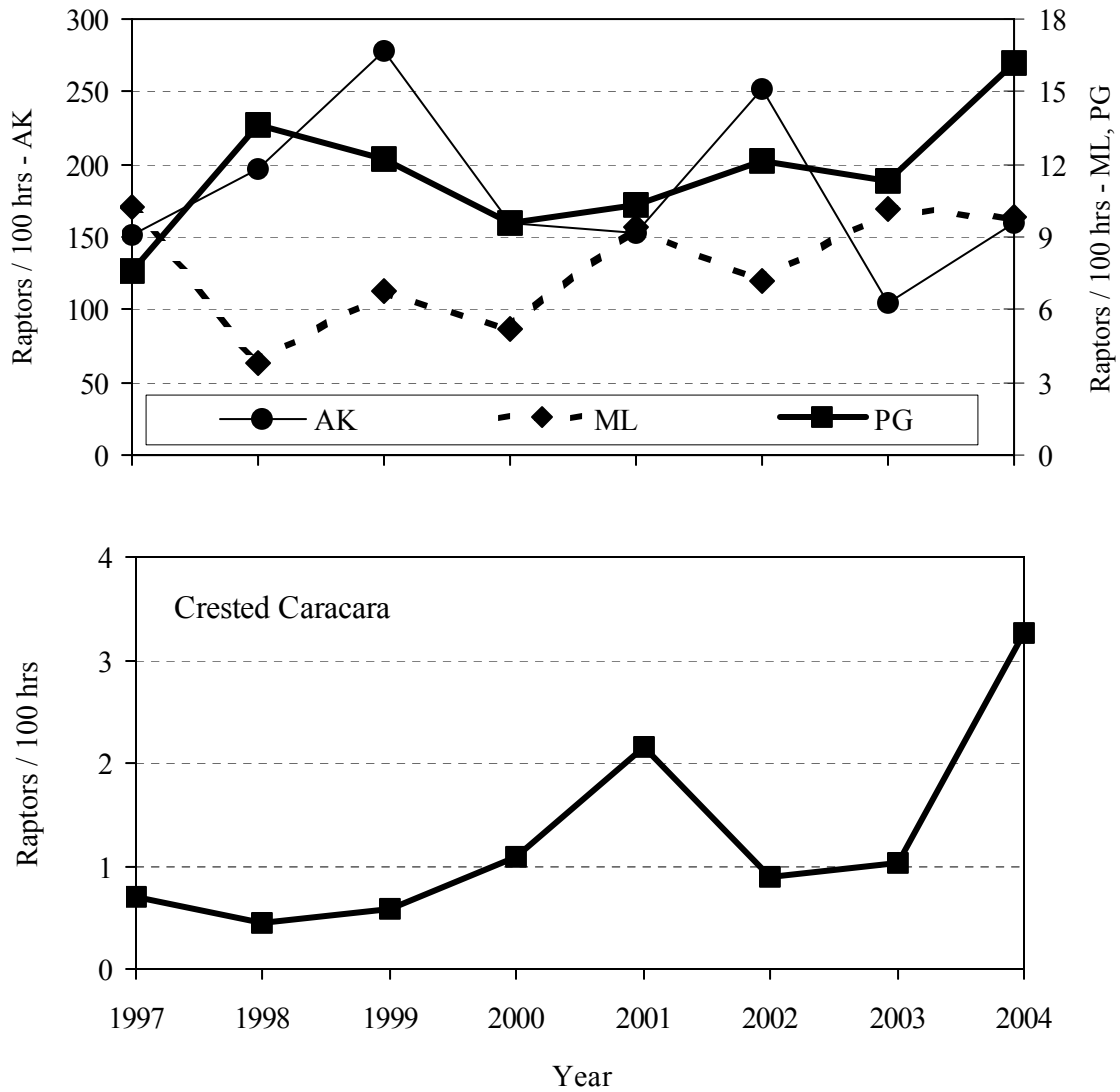


Figure 6. Annual fall-migration passage rates of American Kestrels, Merlins, Peregrine Falcons, and Crested Caracaras at Smith Point, Texas: 1997–2004.

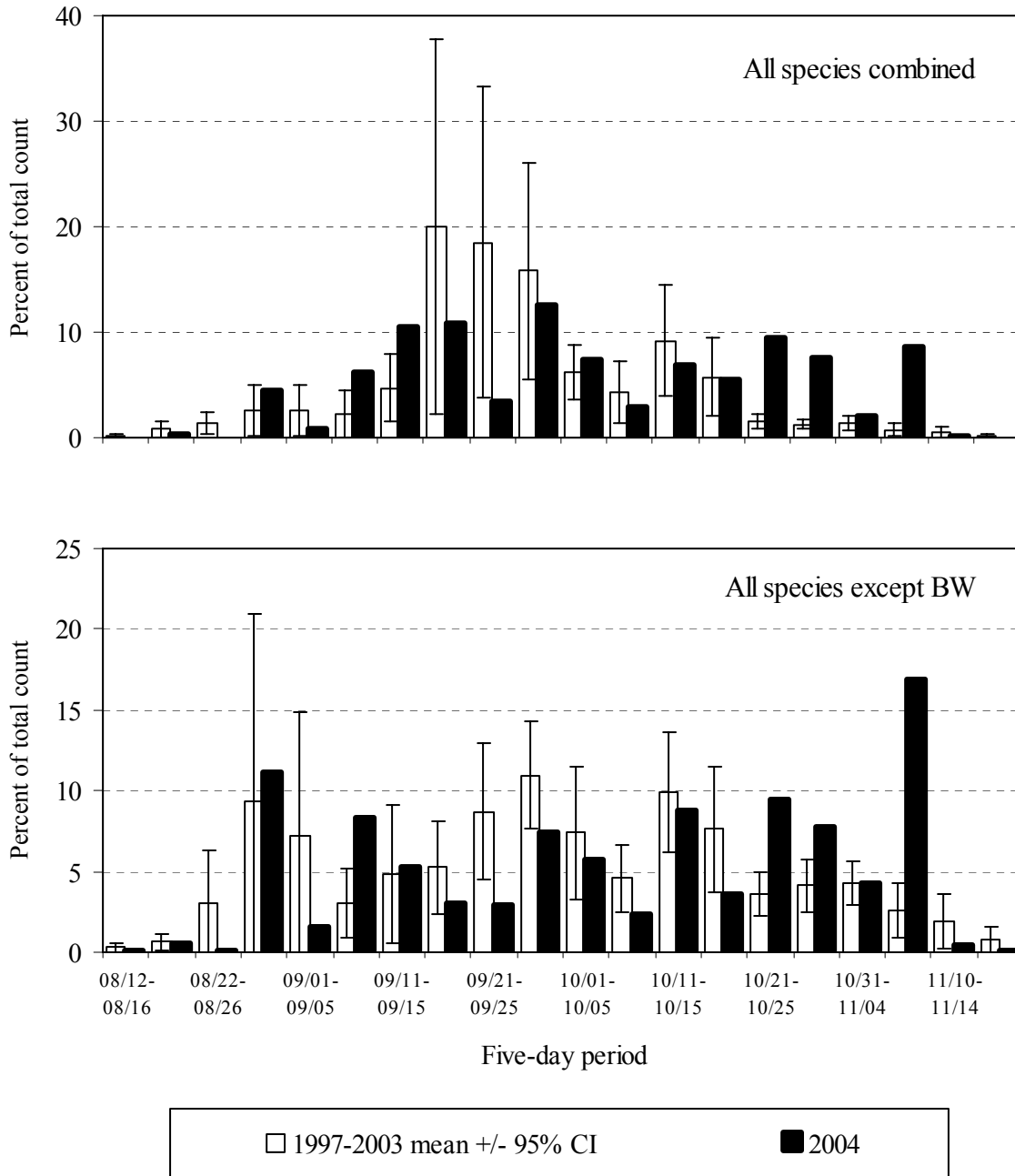


Figure 7. Combined-species flight volume by five-day periods for the autumn raptor migration at Smith Point, Texas, with and without Broad-winged Hawks: 1997–2003 versus 2004.

Appendix A. A history of official observer participation in the Smith Point Raptor Migration Project: 1997–2004.

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 Gallaway (~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 Borgman (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: Samatha Burrell (1) and Carl Bullock (1), 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		SEX ²	COLOR MORPH ³
		CODE	AGE ¹		
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' 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>Aquila or Haliaeetus spp.</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: 2004.

DATE	OBS. HOURS	OBSRVR / HOUR ¹	MEDIAN	PREDOMINANT WEATHER ³	WIND	TEMP (°C) ¹	BAROM.	MEDIAN	VISIB.	VISIB.	MEDIAN	BIRDS / HOUR	
			VISITOR DISTURB ²		SPEED (KPH) ¹		WIND DIRECTION	PRESS. (IN HG) ¹	THERMAL LIFT ⁴	EAST (KM) ¹	WEST (KM) ¹		FLIGHT DISTANCE ⁵
15-Aug	8.50	3.6	0	pc	6.8	ne-e	31.4	30.10	3	47	63	2	2.7
16-Aug	8.00	1.7	0	clr/haze	8.7	e-se	30.5	30.11	3	58	60	2	4.9
17-Aug	8.50	2.0	1	clr/haze	6.9	e-s	31.1	30.04	3	50	73	3	3.9
18-Aug	11.00	1.5	0	pc-ovc, haze	10.1	ene-s	31.2	29.94	4	38	42	2	3.3
19-Aug	6.83	1.9	0	pc-mc	19.9	se-s	31.1	29.96	4	51	54	3	0.1
20-Aug	7.00	1.9	0	mc-ovc, haze, PM rain	24.7	s-ssw	31.1	29.94	4	34	36	-	0.0
21-Aug	9.00	1.9	0	pc-ovc, haze, AM rain	8.6	ene-s	29.0	29.93	4	54	58	3	0.2
22-Aug	8.00	2.3	0	mc-ovc, PM ts	11.8	sse-s	30.7	29.90	4	46	43	1	0.6
23-Aug	8.42	2.0	0	ovc/haze, AM ts/rain	15.9	sse-s	30.5	29.87	4	35	33	-	0.0
24-Aug	8.50	1.9	0	pc-mc, haze	18.8	sse-s	31.3	29.89	4	36	42	2	0.4
25-Aug	8.58	2.0	0	pc	16.0	s	32.5	29.94	4	62	66	2	0.3
26-Aug	9.00	1.0	0	pc	20.5	s	31.2	29.92	4	50	50	1	0.2
27-Aug	9.00	1.9	0	pc-mc, PM haze	8.2	se-ssw	32.7	29.94	3	82	82	3	5.8
28-Aug	8.33	1.7	0	pc-ovc, AM rain, PM ts	3.3	se-sw/var	30.8	29.90	3	28	33	3	1.0
29-Aug	9.00	2.8	0	pc-ovc, haze	3.4	var	32.2	29.88	2	48	51	2	17.4
30-Aug	9.00	2.5	0	clr-mc, haze, PM ts	5.6	var	31.8	29.92	3	22	27	2	170.4
31-Aug	9.00	1.9	0	mc-ovc, haze	4.5	ene, se-ssw	30.9	30.02	3	45	60	2	9.4
01-Sep	9.00	2.0	0	pc/haze	6.3	ne, w-nw	30.4	30.01	2	45	45	3	17.9
02-Sep	8.00	2.0	0	mc-ovc, AM haze, PM rain	7.2	ne-ene, sse-s	30.7	29.93	3	27	25	2	5.1
03-Sep	4.50	2.0	0	ovc, fog/rain	6.5	se	24.3	29.93	4	20	20	-	0.0
04-Sep	8.50	2.0	1	pc	5.1	nne-ne, se-sse	29.5	29.95	1	20	20	2	5.2
05-Sep	8.50	2.8	0	pc, AM fog	5.8	ene-sse	32.1	29.88	3	49	62	3	9.9
06-Sep	9.00	3.3	0	pc/haze	4.1	wnw-nw/var, sse	32.5	29.80	2	47	47	2	33.9
07-Sep	9.50	4.3	0	ovc/haze	9.3	nne-ne/var	29.7	29.84	4	34	35	2	76.7
08-Sep	9.00	2.4	0	pc-ovc, haze	8.3	nne-ne, nnw-n	29.7	29.90	4	50	55	2	35.7
09-Sep	9.25	1.8	0	clr-pc	3.7	nne, nw, sw	30.4	29.94	2	84	89	3	107.6
10-Sep	9.50	2.1	0	clr-pc, haze	3.1	nne-ene, w, s	30.3	30.00	1	68	68	3	254.5
11-Sep	9.00	2.1	0	pc-mc, haze	4.5	nne-ne, s-sw	31.1	29.99	1	40	40	2	126.9
12-Sep	9.50	3.0	0	clr-mc, haze	5.8	ne/var, se-sse	30.7	29.92	2	36	41	2	52.8
13-Sep	8.50	2.0	0	pc/haze	7.8	ne-e, se	29.7	29.87	3	33	37	2	11.9
14-Sep	8.50	2.0	0	mc/haze	8.7	e, se	31.0	29.82	4	30	38	2	4.2
15-Sep	9.00	2.1	0	clr-pc, haze	6.5	n-ene	31.2	29.77	3	44	46	3	34.9
16-Sep	9.00	1.9	0	clr/haze	4.5	n, var	31.6	29.80	1	39	45	3	187.7
17-Sep	9.00	1.8	0	clr	4.7	nw, sw, sse	32.2	29.90	2	74	76	2	69.1
18-Sep	9.50	2.8	0	clr-pc, haze	4.3	ene-se	32.4	29.95	2	51	58	3	104.1
19-Sep	9.00	3.0	0	mc-clr	6.1	ene-sse	30.7	29.97	2	49	50	2	74.6
20-Sep	8.75	2.0	0	clr-pc	7.5	ne-se	29.5	29.95	3	65	66	3	37.5
21-Sep	9.25	2.4	0	clr-pc	13.3	ene-e	28.8	29.99	3	59	60	2	36.4
22-Sep	8.75	2.0	0	pc	12.7	ne-e	28.4	29.99	4	37	49	2	20.9
23-Sep	9.00	3.1	0	clr-ovc, AM haze	9.5	ne, wnw-nnw	29.7	29.94	3	53	56	2	50.3
24-Sep	8.75	1.9	0	pc-ovc	5.5	sw-w	29.4	29.93	2	39	48	3	6.1
25-Sep	6.50	5.1	0	mc-ovc, ts/rain, PM fog	4.6	ne-e/var	28.3	29.96	4	45	46	2	8.0
26-Sep	9.25	4.9	0	clr-pc, haze	6.3	ne, wnw-nw, sse	28.7	29.94	3	33	31	3	114.8
27-Sep	9.00	2.3	0	clr-pc	7.0	nne, wsw-wnw	27.7	29.91	2	46	50	2	205.4
28-Sep	9.00	2.9	0	pc-mc, haze, AM rain	3.0	nne, sw-nw	28.0	29.96	2	52	55	3	77.2
29-Sep	9.00	2.4	0	clr, AM haze	2.9	nw-ne/var	28.4	29.95	2	56	56	3	150.7
30-Sep	8.75	2.0	0	clr	3.5	ne-e, se	28.0	29.94	2	71	74	2	73.4
01-Oct	9.50	2.2	0	clr	9.6	se-ssw	29.9	29.94	3	50	50	2	47.2
02-Oct	9.50	1.8	0	ovc	9.7	nne-ne	28.2	30.10	4	58	56	2	10.8
03-Oct	9.50	2.5	0	mc-pc	3.8	nne-ne/var	30.1	30.11	2	61	65	3	54.4
04-Oct	9.00	1.7	0	mc-pc, AM fog, haze	3.8	ene-e, var	29.7	30.06	2	38	41	2	133.3
05-Oct	9.00	2.8	0	ovc	7.5	n-ne	24.6	30.07	3	60	59	2	107.2
06-Oct	7.75	2.0	0	ovc, fog/haze/rain	8.4	n-nne/var	27.7	30.05	4	19	21	2	5.8
07-Oct	5.33	2.0	0	ovc, fog, PM rain	16.7	ne, se-ssw	25.3	30.03	4	16	17	1	6.9
08-Oct	7.00	2.0	0	ovc, ts/rain	12.6	n-ne	27.3	29.84	4	43	51	2	11.0
09-Oct	9.00	2.0	0	ovc, AM fog	10.7	nnw-n	24.2	29.78	4	59	64	1	7.0
10-Oct	8.75	2.0	0	ovc, AM rain	19.0	wnw-nnw	25.0	29.69	4	30	36	2	2.9

Appendix C. continued

DATE	OBS. HOURS	OBSRVR / HOUR ¹	MEDIAN	PREDOMINANT WEATHER ³	WIND	TEMP (°C) ¹	BAROM. PRESS.	MEDIAN THERMAL	VISIB. EAST	VISIB. WEST	MEDIAN FLIGHT	BIRDS / HOUR	
			VISITOR DISTURB ²		SPEED (KPH) ¹		DIRECTION	(IN HG) ¹	LIFT ⁴	(KM) ¹	(KM) ¹		DISTANCE ⁵
11-Oct	9.25	2.2	0	clr	8.4	w-wnw	25.1	29.83	2	95	98	2	26.7
12-Oct	9.00	2.0	0	clr	10.0	wnw-nnw	24.7	29.87	3	96	98	2	88.2
13-Oct	7.50	2.0	0	mc-ovc, scat rain	4.3	sse-ssw	25.7	29.78	4	60	59	2	16.7
14-Oct	8.75	2.7	0	ovc-clr, AM rain	15.9	nnw-n	22.2	29.76	4	66	78	1	179.8
15-Oct	10.25	2.0	0	clr	9.3	sw-w	23.3	29.77	3	93	95	2	143.3
16-Oct	9.60	3.0	0	clr	7.4	sse-ssw	25.9	29.79	4	94	94	2	69.7
17-Oct	8.00	2.1	0	mc-ovc, PM rain	14.6	sse-ssw	26.4	29.58	4	48	53	1	2.0
18-Oct	9.00	3.0	0	mc-ovc	20.0	sse-s	28.1	29.69	4	65	69	1	0.4
19-Oct	9.00	2.0	0	mc-ovc, rain	16.5	s-ssw	28.6	29.76	4	28	29	1	1.1
20-Oct	9.00	2.0	0	mc-ovc, haze	6.2	sse-ssw	29.2	29.84	3	46	51	2	28.7
21-Oct	9.00	1.7	0	mc, AM fog	6.9	se-ssw	30.1	29.87	2	30	30	1	69.1
22-Oct	8.75	2.0	0	pc	13.0	ssw	28.5	29.80	3	89	95	1	209.5
23-Oct	6.25	2.0	0	mc, ts/rain	9.8	se-s, nw-n	29.7	29.88	3	53	37	1	96.0
24-Oct	9.00	1.9	0	mc-pc	9.5	se-s	28.5	29.73	4	71	90	2	51.6
25-Oct	8.50	2.0	0	pc	16.6	s-ssw	28.5	29.87	3	70	70	2	92.7
26-Oct	9.00	2.0	0	pc	13.9	sse-s	29.6	29.87	3	100	100	1	49.0
27-Oct	9.50	2.0	0	pc-mc	10.5	se-s	29.1	29.97	3	79	79	1	128.5
28-Oct	9.50	1.9	0	clr	10.5	sse-s	29.1	30.00	3	100	100	1	53.6
29-Oct	9.00	1.0	0	pc-mc	19.5	s	28.3	29.89	4	88	88	2	6.1
30-Oct	9.00	1.9	0	pc	11.7	sse-s	28.5	29.80	4	59	59	2	33.1
31-Oct	9.00	2.0	0	clr-pc	16.7	sse-s	28.5	29.60	4	100	100	2	19.9
01-Nov	3.00	2.0	0	ovc, rain	34.0	s	25.8	29.46	4	20	16	-	0.0
02-Nov	3.75	2.0	0	ovc, rain	15.4	ne	19.6	29.61	4	30	32	-	0.0
03-Nov	9.00	2.0	0	mc-ovc	13.5	nw-nnw	17.2	29.78	4	60	60	1	40.7
04-Nov	9.00	2.0	0	clr	7.9	wnw-nnw	18.5	29.91	4	100	100	2	98.0
05-Nov	10.00	2.0	0	clr	3.7	nw-n	19.7	29.98	2	100	100	3	75.1
06-Nov	9.00	2.0	0	clr, AM fog	0.5	sse-s/calm	22.1	29.95	2	46	46	2	93.2
07-Nov	9.50	1.9	0	clr	4.3	sw-wsw	20.5	29.84	2	100	100	2	46.3
08-Nov	9.50	2.0	0	clr-pc, AM fog	4.1	wnw-n	23.1	29.94	2	100	100	1	53.5
09-Nov	9.00	1.9	0	pc	8.5	nne-e	19.3	29.96	4	100	100	1	2.4
10-Nov	8.00	2.0	0	ovc, rain	6.2	se-s	24.5	29.80	4	38	34	1	0.6
11-Nov	8.00	2.0	0	pc-ovc	9.2	wnw-nnw	20.9	29.73	4	70	55	1	2.9
12-Nov	7.50	1.8	0	ovc, rain	8.1	n	11.7	29.87	4	43	40	1	4.4
13-Nov	8.00	2.0	0	ovc	8.4	nnw-nne	15.1	29.94	4	12	11	1	0.1
14-Nov	9.00	1.8	0	ovc	14.9	n-ne	15.4	30.03	4	11	10	2	1.4
15-Nov	6.50	2.0	0	ovc, PM rain	11.4	n-ne	16.3	29.90	4	40	39	1	0.5

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: 2004.

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	PG	UF	UU
15-Aug	8.50	0	0	0	0	0	0	0	11	0	1	0	0	0	6	0	0	1	0	0	0	0	0	0	1	3	0	0	0	0	23	8.50
16-Aug	8.00	0	0	0	0	0	0	0	29	0	1	0	0	0	8	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	39	8.00
17-Aug	8.50	0	0	0	0	0	4	0	17	0	0	0	0	0	11	0	0	0	0	0	0	0	0	0	1	0	0	0	0	33	8.50	
18-Aug	11.00	0	0	0	0	0	17	0	8	0	1	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	36	11.00	
19-Aug	6.83	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	1	6.83		
20-Aug	7.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7.00	
21-Aug	9.00	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	9.00	
22-Aug	8.00	0	0	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	3	5	8.00	
23-Aug	8.42	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	8.42	
24-Aug	8.50	0	0	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	3	8.50	
25-Aug	8.58	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	8.58	
26-Aug	9.00	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	9.00	
27-Aug	9.00	0	0	0	0	0	48	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	52	9.00	
28-Aug	8.33	0	0	0	0	0	5	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	8	8.33		
29-Aug	9.00	0	0	0	0	0	26	0	78	0	6	0	4	30	4	1	7	0	0	1	0	0	0	0	0	0	0	0	157	9.00		
30-Aug	9.00	0	0	0	0	0	23	0	1273	3	13	0	17	192	3	2	8	0	0	0	0	0	0	0	0	0	0	0	1534	9.00		
31-Aug	9.00	0	0	0	0	0	1	1	45	0	0	0	3	33	0	0	0	0	0	0	0	0	0	0	0	0	0	2	85	9.00		
1-Sep	9.00	0	0	1	0	0	0	0	96	0	3	0	4	55	0	0	0	0	0	0	0	0	0	0	2	0	0	0	161	9.00		
2-Sep	8.00	0	0	0	0	0	4	0	30	1	0	0	0	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	41	8.00		
3-Sep	4.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4.50		
4-Sep	8.50	0	0	1	0	0	1	0	16	0	5	1	0	19	0	0	1	0	0	0	0	0	0	0	0	0	0	0	44	8.50		
5-Sep	8.50	0	0	1	1	0	1	0	55	1	5	2	1	15	0	0	2	0	0	0	0	0	0	0	0	0	0	0	84	8.50		
6-Sep	9.00	0	0	1	2	0	4	0	178	2	14	0	19	75	4	0	2	0	0	0	0	0	0	0	2	0	0	0	305	9.00		
7-Sep	9.50	0	0	1	0	0	0	0	572	3	10	0	0	135	3	1	2	0	0	0	0	0	0	0	2	0	0	0	729	9.50		
8-Sep	9.00	0	0	0	2	0	0	0	78	0	2	0	1	234	1	0	1	0	0	0	0	0	0	2	0	0	0	0	321	9.00		
9-Sep	9.25	0	0	2	0	0	0	0	139	0	6	0	0	840	0	0	1	0	0	0	0	0	0	0	7	0	0	0	995	9.25		
10-Sep	9.50	6	0	1	2	0	4	0	307	2	9	0	2	2080	1	0	0	0	0	0	0	0	0	0	4	0	0	0	2418	9.50		
11-Sep	9.00	0	0	2	2	0	1	0	116	0	33	1	1	979	5	1	0	0	0	0	0	0	0	1	0	0	0	0	1142	9.00		
12-Sep	9.50	9	2	1	8	0	2	0	77	0	26	0	3	365	1	0	2	0	0	0	0	0	0	5	0	1	0	0	502	9.50		
13-Sep	8.50	0	0	1	0	0	2	0	40	5	3	0	0	47	0	0	1	0	0	0	0	0	0	1	1	0	0	0	101	8.50		
14-Sep	8.50	0	0	0	1	0	1	0	25	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	1	0	0	2	36	8.50		
15-Sep	9.00	0	0	1	3	0	1	0	50	4	10	0	0	238	2	0	1	0	0	0	0	0	0	4	0	0	0	0	314	9.00		
16-Sep	9.00	7	0	0	1	0	1	1	60	1	31	0	0	1582	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1689	9.00		

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	PG	UF	UU
17-Sep	9.00	0	3	0	0	0	1	0	45	8	16	0	0	2	539	0	0	2	0	0	0	0	0	0	0	5	0	1	0	0	622	9.00
18-Sep	9.50	0	0	1	1	0	0	0	70	2	10	2	0	1	896	1	0	1	0	0	1	0	0	0	1	1	1	0	0	989	9.50	
19-Sep	9.00	0	0	3	1	0	0	0	29	1	16	0	0	0	613	1	0	1	0	0	0	0	0	1	4	0	1	0	0	671	9.00	
20-Sep	8.75	0	0	1	5	0	0	0	64	6	16	0	0	2	221	2	0	3	0	0	0	0	0	0	4	3	1	0	0	328	8.75	
21-Sep	9.25	0	0	1	3	0	0	0	25	20	17	0	0	0	249	0	0	2	0	0	0	0	0	1	16	0	3	0	0	337	9.25	
22-Sep	8.75	1	0	1	2	0	0	0	27	16	10	0	0	0	115	0	0	1	0	0	0	0	0	0	5	4	1	0	0	183	8.75	
23-Sep	9.00	16	12	2	1	0	0	0	19	24	30	0	0	2	337	0	0	2	0	0	0	0	0	0	4	2	2	0	0	453	9.00	
24-Sep	8.75	16	0	1	0	0	0	0	0	1	4	0	0	0	28	1	0	1	0	0	0	0	0	0	0	0	1	0	0	53	8.75	
25-Sep	6.50	0	0	1	0	0	1	0	14	6	7	0	0	0	16	0	0	0	0	0	0	0	0	0	1	1	5	0	0	52	6.50	
26-Sep	9.25	42	10	3	2	0	0	0	25	29	44	2	0	3	860	4	0	3	0	0	0	0	0	0	23	4	7	0	1	1062	9.25	
27-Sep	9.00	21	1	2	2	0	0	0	71	89	78	0	0	0	1524	1	0	1	0	0	0	0	0	0	53	1	5	0	0	1849	9.00	
28-Sep	9.00	13	11	2	3	0	0	0	14	54	67	0	0	2	480	3	0	1	0	0	1	0	0	0	40	1	3	0	0	695	9.00	
29-Sep	9.00	13	2	7	6	0	0	0	7	69	62	0	0	3	1119	4	0	4	0	0	0	0	0	0	46	4	8	2	0	1356	9.00	
30-Sep	8.75	5	0	1	3	0	0	0	8	42	32	0	0	0	531	1	0	1	0	0	0	0	0	0	14	1	3	0	0	642	8.75	
1-Oct	9.50	5	27	0	2	0	0	0	7	18	7	1	0	1	344	0	0	2	0	0	0	0	0	2	28	1	3	0	0	448	9.50	
2-Oct	9.50	0	0	1	0	0	0	1	11	16	14	0	0	0	46	0	0	1	0	0	0	0	0	0	8	1	4	0	0	103	9.50	
3-Oct	9.50	6	29	3	3	0	0	0	23	40	58	0	0	3	275	3	0	0	0	0	0	0	0	0	57	4	12	1	0	517	9.50	
4-Oct	9.00	30	27	5	4	0	0	1	12	51	45	0	0	0	929	9	0	2	0	0	0	0	0	0	76	3	6	0	0	1200	9.00	
5-Oct	9.00	0	3	4	3	0	0	0	0	39	32	0	0	1	836	4	1	2	0	0	0	0	0	0	35	2	3	0	0	965	9.00	
6-Oct	7.75	1	0	1	1	0	0	0	0	19	3	0	0	0	0	0	0	0	0	0	0	0	0	0	12	4	4	0	0	45	7.75	
7-Oct	5.33	0	0	1	0	0	0	0	0	26	0	0	0	0	1	0	0	0	0	0	0	0	0	1	3	3	2	0	0	37	5.33	
8-Oct	7.00	0	0	2	1	0	0	0	0	25	4	0	0	0	21	1	1	0	0	0	0	0	0	0	17	2	3	0	0	77	7.00	
9-Oct	9.00	0	0	1	0	0	0	0	0	19	2	0	0	0	9	4	0	0	0	0	0	0	0	0	26	2	0	0	0	63	9.00	
10-Oct	8.75	0	0	2	0	0	0	0	0	11	2	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	2	0	0	25	8.75	
11-Oct	9.25	31	32	5	4	0	0	1	1	45	4	1	0	1	111	0	0	0	0	0	0	0	0	0	9	1	1	0	0	247	9.25	
12-Oct	9.00	16	54	3	8	0	0	0	1	134	10	0	0	1	519	8	0	0	0	0	0	0	0	2	32	1	5	0	0	794	9.00	
13-Oct	7.50	0	8	2	2	0	0	0	1	67	3	0	0	0	18	0	0	0	0	0	0	0	0	0	20	2	2	0	0	125	7.50	
14-Oct	8.75	5	51	7	15	0	0	0	0	303	79	1	0	2	923	49	1	4	0	0	0	0	0	1	128	2	2	0	0	1573	8.75	
15-Oct	10.25	0	145	0	10	0	0	1	4	25	5	0	0	0	1183	30	0	1	0	0	0	0	0	0	63	1	0	1	0	1469	10.25	
16-Oct	9.60	0	117	0	4	0	0	0	0	13	5	0	0	0	487	30	0	2	0	0	0	0	0	0	9	2	0	0	0	669	9.60	
17-Oct	8.00	0	0	0	2	0	0	0	0	7	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	3	0	0	16	8.00	
18-Oct	9.00	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	4	9.00	
19-Oct	9.00	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	8	0	0	0	0	10	9.00	

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
20-Oct	9.00	6	62	0	6	0	0	0	0	21	2	0	0	0	124	11	0	1	1	0	0	0	0	0	0	20	1	3	0	0	258	9.00
21-Oct	9.00	9	92	3	5	0	0	0	3	19	8	0	0	1	408	42	0	2	0	0	0	0	0	0	0	20	3	6	0	1	622	9.00
22-Oct	8.75	0	215	0	9	0	0	2	2	56	7	0	0	0	1235	259	0	1	0	0	0	0	0	0	40	3	4	0	0	1833	8.75	
23-Oct	6.25	15	89	1	0	0	0	1	0	42	5	0	0	0	415	9	1	0	0	0	0	0	0	0	1	18	1	2	0	0	600	6.25
24-Oct	9.00	0	21	2	2	0	0	0	0	22	10	0	0	1	303	58	0	1	0	0	0	0	0	0	0	42	0	1	1	0	464	9.00
25-Oct	8.50	10	88	1	3	0	0	0	0	23	5	0	0	0	564	36	0	1	0	0	0	0	0	0	0	48	6	3	0	0	788	8.50
26-Oct	9.00	3	78	1	4	0	0	1	0	25	4	0	0	0	230	60	0	0	0	0	0	0	0	0	0	31	1	3	0	0	441	9.00
27-Oct	9.50	11	106	0	11	0	0	0	0	47	2	0	0	0	884	122	0	0	0	0	0	0	0	0	1	35	1	1	0	0	1221	9.50
28-Oct	9.50	9	130	1	9	0	0	1	0	62	3	0	0	0	260	3	0	2	0	0	0	0	0	0	2	25	0	2	0	0	509	9.50
29-Oct	9.00	0	0	0	3	0	0	0	0	15	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	28	0	0	0	0	55	9.00
30-Oct	9.00	18	117	0	1	0	0	0	0	32	4	0	0	0	85	5	0	0	0	0	0	0	0	0	0	34	1	1	0	0	298	9.00
31-Oct	9.00	5	38	1	5	0	0	0	0	26	5	0	0	0	52	0	0	0	0	0	0	0	0	0	0	43	1	3	0	0	179	9.00
1-Nov	3.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.00
2-Nov	3.75	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	3.75
3-Nov	9.00	12	168	0	8	0	0	0	0	23	6	1	0	0	122	9	0	1	0	0	0	0	0	0	3	10	1	2	0	0	366	9.00
4-Nov	9.00	11	445	1	17	0	0	0	0	114	35	0	0	0	183	36	1	8	0	0	0	0	0	0	1	29	1	0	0	0	882	9.00
5-Nov	10.00	7	292	0	16	0	0	1	0	49	70	0	0	0	203	59	0	33	0	0	0	0	0	1	0	0	0	0	1	751	10.00	
6-Nov	9.00	0	368	0	2	0	0	0	0	20	31	0	0	1	330	71	0	4	0	0	0	0	0	0	0	12	0	0	0	0	839	9.00
7-Nov	9.50	5	135	0	9	0	0	0	0	28	43	1	0	1	170	22	0	9	0	0	1	0	0	0	1	15	0	0	0	0	440	9.50
8-Nov	9.50	4	101	0	14	0	0	0	0	40	53	1	0	1	228	38	1	20	0	0	0	0	0	0	0	7	0	0	0	0	508	9.50
9-Nov	9.00	0	0	0	4	0	0	0	0	5	1	0	0	1	5	2	0	0	0	0	0	0	0	0	2	2	0	0	0	0	22	9.00
10-Nov	8.00	0	0	0	2	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	5	8.00
11-Nov	8.00	0	0	0	3	0	0	0	0	6	1	0	0	0	7	1	0	3	0	0	0	0	0	0	0	2	0	0	0	0	23	8.00
12-Nov	7.50	0	12	0	1	0	0	0	0	0	3	0	0	0	9	4	0	2	0	0	0	0	0	0	0	1	1	0	0	0	33	7.50
13-Nov	8.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	8.00	
14-Nov	9.00	0	0	0	0	0	0	0	0	0	0	0	0	0	8	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	13	9.00
15-Nov	6.50	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	3	6.50
Total	796.34	368	3091	87	246	0	151	12	3786	1923	1162	14	0	88	26032	1036	14	159	1	0	5	0	1	0	26	1272	78	129	5	12	39698	796.34

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: 1997–2004.

	1997	1998	1999	2000	2001	2002	2003	2004	MEAN
Start date	17-Aug	15-Aug	15-Aug	12-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
Observation days	94	91	89	94	93	91	92	93	92
Observation hours	860.11	677.25	696.68	823.08	743.33	775.66	777.75	796.34	768.78
SPECIES	RAPTOR COUNTS								
Black Vulture	130	105	341	4	379	59	96	368	185
Turkey Vulture	1,225	581	1,295	1,059	2,488	678	2,163	3,091	1,573
TOTAL VULTURES	1,355	686	1,636	1,063	2,867	737	2,259	3,459	1,758
Osprey	54	68	54	60	62	48	78	87	64
Northern Harrier	445	262	537	372	472	144	203	246	335
Hook-billed Kite	0	0	0	0	0	0	1	0	0
Swallow-tailed Kite	40	34	52	46	74	150	98	151	81
White-tailed Kite	0	1	2	11	12	8	23	14	9
Mississippi Kite	2,124	2,362	2,975	4,788	3,253	7,879	3,809	3,786	3,872
TOTAL KITES	2,164	2,397	3,029	4,845	3,339	8,037	3,930	3,951	3,962
Sharp-shinned Hawk	4,780	3,231	3,896	1,484	3,878	3,142	1,508	1,923	2,980
Cooper's Hawk	1,137	1,136	1,207	1,088	1,281	1,233	738	1,162	1,123
Unknown accipiter	49	170	113	14	15	18	4	14	56
TOTAL ACCIPITERS	5,966	4,537	5,216	2,586	5,174	4,393	2,250	3,099	4,153
Harris' Hawk	0	0	0	0	2	0	0	0	0
Red-shouldered Hawk	45	36	34	61	54	23	49	88	49
Broad-winged Hawk	30,417	16,137	34,243	29,956	103,612	65,255	21,799	26,032	40,931
Swainson's Hawk	137	56	129	255	321	168	228	1,036	291
White-tailed Hawk	0	1	2	11	12	8	23	14	9
Red-tailed Hawk	331	35	204	77	273	44	64	159	148
Ferruginous Hawk	0	0	2	0	2	1	2	1	1
Rough-legged Hawk	0	0	2	0	3	0	0	0	<1
Unidentified buteo	86	26	31	3	4	5	6	5	21
TOTAL BUTEOS	31,016	16,291	34,647	30,363	104,283	65,504	22,171	27,335	41,451
Golden Eagle	3	0	1	1	0	0	0	0	<1
Bald Eagle	2	0	2	7	2	3	2	1	2
Unknown eagle	0	0	0	0	0	0	1	0	<1
TOTAL EAGLES	5	0	3	8	2	3	3	1	3
Crested Caracara	6	3	4	9	16	7	8	26	10
American Kestrel	1,297	1,334	1,938	1,311	1,140	1,949	816	1,272	1,382
Merlin	88	26	47	43	70	56	79	78	61
Peregrine Falcon	65	92	85	79	77	94	88	129	89
Unknown falcon	25	13	9	5	1	8	3	5	10
TOTAL FALCONS	1,475	1,465	2,079	1,438	1,288	2,107	986	1,484	1,540
Unidentified raptor	496	91	116	16	0	5	1	12	92
GRAND TOTAL	42,993	25,824	47,337	40,766	117,517	80,984	31,885	39,698	53,376