

**FALL 2003 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 2003, HWI and GCBO conducted the 7<sup>th</sup> consecutive standardized, full-season migration count at this site on Galveston Bay. Since 1997, 23 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 2003 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 official or designated observers, assisted by several trained volunteers, conducted daily counts of the raptor migration through the area from a single traditional observation platform. This was the first full season of migration counting for both full-time observers Dane Ferrell and Dan Russell (see Appendix A for a history of observer participation). A dedicated and well-trained team of local volunteers, which this year included Bill Saulmon, Wayne Nicholas, Winnie Burkett, and Dick and Adelle Bennett, regularly assisted as supplemental and substitute observers, as has been the case since the project's inception. Observations usually began between 0600 and 0800 hrs and ended between 1400 and 1600 hrs Central Standard Time (CST). 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.

Otherwise, data gathering and recording followed standardized protocols used at all HWI migration sites (Hoffman and Smith 2003). Common and scientific names, species codes, and regularly applied age, sex, and color-morph distinctions for each species recorded to date at Smith Point are listed in Appendix B.

## RESULTS AND DISCUSSION

### WEATHER

Inclement weather (i.e., heavy rain or thunderstorms) entirely precluded only 1 day of observation in 2003, but severely hampered observations (<4 hours) on another 6 days (see Appendix C for daily weather records). The 1997–2002 averages for these variables are 1.5 and 4.0 days, respectively. Otherwise, generally fair skies predominated on 37% of the active observation days, transitional weather (i.e., skies changed from fair to mostly cloudy/overcast, or vice versa, during the day) on 36% (average 29%), and mostly cloudy to overcast skies on 27%. The comparative averages for these variables are 46%, 27%, and 27%, respectively, indicating that predominantly fair skies were less common than usual in 2003, while transitional weather was more common. However, days where fog, haze, and/or rain further hampered visibility were much less common in 2003 compared to the 1997–2002 average (26% versus 52% of the active observation days).

The wind patterns at the site in 2003 also were unusual compared to most years; light winds prevailed on 91% of the active days and moderate winds on the remainder, compared to the 1997–2002 averages of 64% light, 33% moderate, and 3% strong. Thus far, only 2001 had a similar high prevalence of light winds. In terms of wind directions, the norm at Smith Point is high variability; from 1997–2002 the four most common wind direction patterns were variable N to E (average 22% of active observation days), variable NE to SE (11%), variable E to S (21%), and calm/variable (19%). The only notable difference in pattern in 2003 was that days with predominantly variable NE to SE winds were slightly more common than usual (18%), while days with predominantly variable E to S winds were slightly less common than usual (13%).

The temperature during active observation periods averaged 29.0°C (the average of daily values, which in turn were averages of hourly readings), ranging from 16.3–37.1°C. The average and minimum temperatures are the warmest yet recorded at the site, with the maximum the second highest. The barometric pressure during active observation periods averaged 29.95 in Hg (the average of daily values, which in turn were averages of hourly readings), ranging from 29.70–30.34°C. These values are well within the normal ranges for the site.

In 2003, 40% of the active observation days received a median (of hourly ratings) thermal-lift rating of good to excellent, compared to the 1997–2002 average of 45% (range 35–61%).

Daily-average visibility estimates averaged 23 km to the east and 24 km to the west, compared to the 1997–2002 averages of 17 km in both directions.

In summary, the weather at Smith Point during the 2003 season was warmer than average. Primarily heavy thunderstorms shut down observations a bit more often than usual and cloud cover conditions changed more frequently on a daily basis. Otherwise, however, fog, haze, and rain were less common than usual during active observation periods, which translated to higher average visibility. It was also less windy than usual and there was a subtle shift towards more east/northeasterly winds (tail winds for migrants) as opposed to southeast/southerly winds (quartering to head winds).

### OBSERVATION EFFORT

The observers logged 92 days and 777.75 hours of observation between 15 August and 15 November 2003. The numbers of observation days and hours were both within 2% of average. The daily-average number of observers was 2.3, which is a significant 24% above the 1997–2002 average of  $1.9 \pm 95\%$  CI of 0.07 observers/hour.

## **MIGRATION SUMMARY**

The observers counted 31,885 migrant raptors of 21 species during the 2003 season (Table 1, and see Appendix D for daily count records). As is typical, buteos, accipiters, and kites were the predominant species groups; however, with Broad-winged Hawks excluded, the relative proportions of kites and especially vultures were 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 (68%), Mississippi Kite (12%), Turkey Vulture (7%), Sharp-shinned Hawk (5%), American Kestrel (3%), and Cooper's Hawk (2%).

### **Interannual Count Trends and Regional Comparisons**

The count of 21,799 Broad-winged Hawks was the second lowest total documented for this species since 1997 (53% below average; Table 1, and see Appendix E for annual project summaries), which is the opposite of the 2002 pattern (second highest count, 52% above average). Significantly above-average, record-high counts (since 1997) were established for Osprey, White-tailed Kite, and White-tailed Hawk (Appendix E). In addition, the crew documented the first-ever sighting of a Hook-billed Kite in the area, and the tally of two Ferruginous Hawks tied the high count for this species. Counts were also significantly above average for Turkey Vultures. In contrast, counts fell to record lows for Cooper's Hawks and American Kestrels, and were significantly below average for Northern Harriers and Sharp-shinned Hawks. The same basic patterns of interannual change were evident in comparing passage rates (Table 1).

Seven years is too short of a period to warrant detailed attention to long-term trends. Nevertheless, a cursory examination of apparent patterns in annual passage rates is instructive. Species showing distinct increasing patterns over the period of record include Swallow-tailed, White-tailed and Mississippi Kites, Swainson's and White-tailed Hawks, and possibly Turkey Vultures and Crested Caracaras (Figures 3–6). Species showing distinct decreasing patterns include Northern Harriers and Sharp-shinned Hawks.

Elsewhere in coastal Texas, the overall count at Corpus Christi also was below average in 2003 (Smith 2004); however, the Smith Point count was more than 40% below average whereas the Corpus Christi count was only 6% below average (passage rate actually above average). These overall patterns primarily reflect trends in counts of Broad-winged Hawks, the dominant species at both sites. The highlight of both seasons was sightings of the first Hook-billed Kites ever recorded near either site. In both cases, multiple observers obtained good views of the birds, with two sightings at Corpus Christi over a two-day period (undoubtedly the same bird). Corpus Christi is only ~240 km from a known breeding area, but the Smith Point sighting was a great surprise to all! Both Texas sites recorded record high counts of Ospreys and generally high counts for all falcons, except that Corpus Christi posted a record high count for American Kestrels (extending a fairly steady increasing trend), whereas Smith Point posted a record low count for kestrels (no distinct longer term trend). Reasons for such discrepancies are unclear at this time, but likely reflect a combination of effects related to weather and wind patterns, and differences in source populations (Smith et al. 2001). Future multivariate modeling of the count and auxiliary data from both projects that accounts for confounding variables such as weather and variation in observation effort, as well as careful comparisons of trends from the different sites likely will be necessary to produce robust assessments of underlying regional population trends.

Elsewhere around the Gulf Coast, in the Florida Keys the overall southbound count was 5% below the 1999–2002 average for that site; however, record high counts were recorded for Swallow-tailed Kites, Broad-winged Hawks, and Peregrine Falcons (HWI unpublished data). In Veracruz, Mexico, along the far southwestern Gulf Coast, the overall count (data from two count sites combined) was the third highest since the project began in 1993 (HWI, Hawk Mountain Sanctuary, and Pronatura Veracruz unpublished data). Among the four most common species, counts were slightly below average for Broad-winged

Hawks, well above average for Turkey Vultures and Mississippi Kites, and rose to a new record high of ~1.2 million Swainson's Hawks! Among the second tier of common species, counts were average for Ospreys but well below average for Sharp-shinned Hawks, Cooper's Hawks, and American Kestrels.

### **Age Ratios**

Six of nine species for which comparisons of immature : adult ratios were possible showed below average age ratios in 2003, with the differences significant for Swallow-tailed Kites, Sharp-shinned Hawks, and Broad-winged Hawks (Table 2). Low age ratios may be indicative of poor nesting success and juvenile recruitment during the previous breeding season. However, low age ratios in 2003 for Swallow-tailed Kites and Peregrine Falcons were not due to low documented abundance of immature birds. Moreover, very low proportions of aged birds precludes attaching much importance to the data for Mississippi Kites and Broad-winged Hawks, and significant variation in proportions of aged birds among years confounds comparisons for most species. 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 2003 median passage date for Broad-winged Hawks of 7 October was a significant 14 days later than average (Table 3), as is clearly illustrated by a plot of seasonal activity (Figure 7). Among commonly encountered species, five showed later than average timing, five showed earlier than average timing, and 11 showed average timing (Table 3). Thus, there was little overall consistency in pattern across species and a plot of combined-species seasonal activity excluding Broad-winged Hawks also showed no distinct pattern of variation from the norm (Figure 8). However, all of the falcons and accipiters were at least slightly late, while both vulture species were significantly earlier than average. Moreover, examination of age-specific timing data for 10 species revealed at least slightly late timing for immatures of all 10 species, whereas adults were at least slightly earlier than average for 6 of 10 species (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 2003, 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. Adults of both species were less commonly recorded as locals, but adult Broad-winged Hawks were more common than adult Red-shouldered Hawks, undoubtedly reflecting higher abundance of stopover transients. By the end of the season, it appeared that at least two immature and one adult Broad-winged Hawks, and one immature Red-shouldered Hawk intended to winter on the peninsula. Local Red-tailed Hawks were relatively easy to distinguish because of distinct plumage patterns. Two immature Red-tailed Hawks were recorded as local birds from the start, probably representing locally produced birds, and it appeared that at least 1 or 2 young red-tails also intended to winter in the area. However, most red-tails recorded as locals appeared to be transient residents for a few



days, and most of these birds were immature. A few transient Swainson's Hawks were recorded as locals late in the season.

Transient Mississippi Kites that remained in the area for up to several days were common throughout the species' early-season migration period, but not thereafter. Transient White-tailed Kites were regularly recorded for up to a few days at a time throughout the season, and by the end of the season it appeared that at least 2–3 birds intended to winter in the area.

Local Sharp-shinned and Cooper's Hawks were commonly recorded beginning early in the season. Most were stopover transients that remained for a few days, but some birds remained in the area for longer periods and that at least a few individuals of both species likely wintered on the peninsula.

American Kestrels were common residents, especially by mid-season, and by season's end at least 6–7 individuals appeared to be wintering around the count site. Both Merlins and Peregrine Falcons were occasionally recorded as transient residents for up to a few days.

During October and November, up to 3–4 Northern Harriers, mostly immature birds, could frequently be seen hunting in the area at any given time, with perhaps as many as 15 birds residing in the area typically for at least a week or more sometime during the season. At least one local Osprey was seen regularly throughout the season, often carrying a fish or perched atop a telephone pole consuming its catch.

Local Black and Turkey Vultures were present throughout the season. The permanent resident population near the tip of the peninsula likely included at least 30 Turkey Vultures and 3–4 Black Vultures. Local vulture activity swelled during the peak passage period for migrants of each species as transients came and went, then settled back to similar pre-migration levels after that.

## **VISITOR PARTICIPATION AND PUBLIC OUTREACH**

Documented visitation in 2003 totaled 1,076 individual visits, including repeat visits, which is roughly a 25% increase compared to 2002 and the highest visitation rate for the project to date! Besides Texas, the source of most visitors, visitors originated in 10 other states, the United Kingdom, and Japan. Two special educational workshops coordinated by GCBO at the site in late September and early October were particularly strong attractors for visitors and achieved some very positive public outreach for the project.

In 2003, 794 hourly assessments by the observers of visitor disturbance resulted in the following ratings: 91% none, 5% low, 4% moderate, and <1% high. This low level of disturbance testifies to the advantages of having GCBO staff and several additional knowledgeable and dedicated local volunteers available at most times to facilitate visitor interactions and ensure enjoyable and informative visits for all guests without unnecessarily distracting the official observers from documenting the migration.

## **ACKNOWLEDGMENTS**

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**Table 1. Fall counts and passage rates by species for migrating raptors at Smith Point, TX: 1997–2002 versus 2003.**

SPECIES	COUNTS			RAPTORS/100 HOURS		
	1997–2002 <sup>1</sup>	2003	% Change	1997–2002 <sup>1</sup>	2003	% Change
Black Vulture	170 ± 123	96	-43	23.1 ± 17.2	12.3	-47
Turkey Vulture	1,221 ± 548	2,163	+77	160.8 ± 74.4	278.1	+73
TOTAL VULTURES	1,391 ± 647	2,259	+62	183.9 ± 88.9	290.5	+58
Osprey	58 ± 5.7	78	+35	7.6 ± 1.2	10.0	+31
Northern Harrier	372 ± 117	203	-45	49.1 ± 16.2	26.1	-47
Hook-billed Kite	0 ± 0.0	1	–	0.0 ± 0.0	0.1	–
Swallow-tailed Kite	66 ± 34.7	98	+48	8.7 ± 4.5	12.6	+45
White-tailed Kite	6 ± 4.3	23	+306	0.7 ± 0.5	3.0	+302
Mississippi Kite	3,897 ± 1,732	3,809	-2	509.6 ± 217.2	489.7	-4
TOTAL KITES	3,969 ± 1,765	3,930	-1	519.0 ± 221.5	505.3	-3
Sharp-shinned Hawk	3,402 ± 887	1,508	-56	449.9 ± 115.3	193.9	-57
Cooper’s Hawk	1,180 ± 57.7	738	-37	156.1 ± 15.4	94.9	-39
Unknown accipiter	63 ± 51.7	4	-94	9.5 ± 7.3	0.5	-95
TOTAL ACCIPITERS	4,645 ± 924	2,250	-52	614.8 ± 127.3	289.3	-53
Harris’ Hawk	0 ± 0.7	0	-100	0.0 ± 0.1	0.0	-100
Red-shouldered Hawk	42 ± 11.2	49	+16	5.5 ± 1.3	6.3	+14
Broad-winged Hawk	46,603 ± 25,849	21,799	-53	6,138 ± 3,481	2,803	-54
Swainson’s Hawk	178 ± 76.3	228	+28	23.1 ± 9.9	29.3	+27
White-tailed Hawk	6 ± 4.3	23	+306	0.7 ± 0.5	3.0	+302
Red-tailed Hawk	161 ± 101	64	-60	20.8 ± 12.6	8.2	-60
Ferruginous Hawk	1 ± 0.8	2	+140	0.1 ± 0.1	0.3	+125
Rough-legged Hawk	1 ± 1.1	0	-100	0.1 ± 0.1	0.0	-100
Unidentified buteo	26 ± 25.5	6	-77	3.3 ± 3.0	0.8	-77
TOTAL BUTEOS	47,017 ± 25,933	22,171	-53	6,191 ± 3,493	2,851	-54
Golden Eagle	1 ± 0.9	0	-100	0.1 ± 0.1	0.0	-100
Bald Eagle	3 ± 1.9	2	-25	0.3 ± 0.2	0.3	-24
Unknown eagle	0 ± 0.0	1	–	0.0 ± 0.0	0.1	–
TOTAL EAGLES	4 ± 2.2	3	-14	0.4 ± 0.3	0.4	-12
Crested Caracara	8 ± 3.7	8	+7	1.0 ± 0.5	1.0	+5
American Kestrel	1,495 ± 283	816	-45	198.3 ± 43.8	104.9	-47
Merlin	55 ± 17.4	79	+44	7.1 ± 1.9	10.2	+43
Peregrine Falcon	82 ± 8.6	88	+7	10.9 ± 1.7	11.3	+4
Unknown falcon	10 ± 6.6	3	-70	1.4 ± 0.8	0.5	-64
TOTAL FALCONS	1,642 ± 285	986	-40	217.6 ± 44.4	126.8	-42
Unidentified raptor	121 ± 152	1	-99	15.1 ± 17.6	0.1	-99
GRAND TOTAL	59,237 ± 27,094	31,885	-46	7,802 ± 3,649	4,100	-47

<sup>1</sup> 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: 1997–2002 versus 2003.**

	TOTAL AND AGE-CLASSIFIED COUNTS						IMMATURE : ADULT			
	1997–2002 AVERAGE			2003			% UNKNOWN AGE		RATIO	
	TOTAL	IMM	ADULT	TOTAL	IMM	ADULT	1997–2002 <sup>1</sup>	2003	1997–2002 <sup>1</sup>	2003
Northern Harrier	372	165	84	203	76	36	33 ± 17.9	45	2.4 ± 1.09	2.1
Swallow-tailed Kite	66	13	11	98	20	46	87 ± 21.3	33	2.0 ± 1.13	0.4
Mississippi Kite	3897	786	208	3809	414	55	60 ± 28.6	88	14.6 ± 14.29	7.5
Sharp-shinned Hawk	3402	993	84	1508	794	138	67 ± 16.2	38	12.6 ± 5.60	5.8
Cooper's Hawk	1180	365	75	738	387	71	63 ± 19.9	38	4.8 ± 2.51	5.5
Red-shouldered Hawk	42	14	2	49	25	11	62 ± 26.8	27	12.1 ± 13.12	13.0
Broad-winged Hawk	46603	1416	184	21799	157	93	97 ± 2.9	99	6.0 ± 3.04	1.7
Red-tailed Hawk	161	45	43	64	30	23	37 ± 25.4	17	0.9 ± 0.42	1.3
Peregrine Falcon	82	5	13	88	22	48	80 ± 25.1	20	0.5 ± 0.85	0.5

<sup>1</sup> 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 2003, with a comparison of 2003 and 1997–2002 average median passage dates.**

SPECIES	2003				1997–2002	
	FIRST OBSERVED	LAST OBSERVED	BULK PASSAGE DATES <sup>1</sup>	MEDIAN PASSAGE DATE <sup>2</sup>	MEDIAN PASSAGE DATE <sup>2,3</sup>	
Black Vulture	8-Oct	9-Nov	13-Oct – 8-Nov	18-Oct	25-Oct	± 3.6
Turkey Vulture	7-Oct	8-Nov	13-Oct – 3-Nov	20-Oct	28-Oct	± 5.4
Osprey	15-Aug	9-Nov	5-Sep – 1-Nov	4-Oct	27-Sep	± 3.5
Northern Harrier	20-Aug	15-Nov	26-Sep – 6-Nov	18-Oct	16-Oct	± 6.3
Hook-billed Kite	18-Oct	18-Oct	–	–	–	–
Swallow-tailed Kite	15-Aug	23-Sep	15-Aug 17-Sep	23-Aug	27-Aug	± 4.8
White-tailed Kite	7-Sep	13-Nov	15-Sep 31-Oct	18-Oct	03-Oct	± 15.0
Mississippi Kite	15-Aug	1-Nov	24-Aug 23-Sep	5-Sep	05-Sep	± 5.3
Sharp-shinned Hawk	28-Aug	15-Nov	26-Sep – 31-Oct	12-Oct	03-Oct	± 5.1
Cooper's Hawk	15-Aug	10-Nov	24-Sep – 27-Oct	11-Oct	09-Oct	± 4.3
Red-shouldered Hawk	15-Aug	10-Nov	22-Aug 23-Oct	3-Oct	19-Sep	± 11.3
Broad-winged Hawk	15-Aug	13-Nov	7-Sep – 18-Oct	7-Oct	23-Sep	± 3.5
Swainson's Hawk	15-Aug	15-Nov	4-Sep – 1-Nov	18-Oct	18-Oct	± 5.2
White-tailed Hawk	16-Aug	9-Nov	6-Sep 3-Nov	18-Oct	03-Oct	± 35.6
Red-tailed Hawk	16-Aug	13-Nov	28-Sep – 8-Nov	18-Oct	26-Oct	± 14.6
Ferruginous Hawk	5-Oct	18-Oct	–	–	–	–
Bald Eagle	28-Sep	1-Nov	–	–	–	–
Crested Caracara	27-Aug	5-Nov	27-Aug 5-Nov	16-Sep	08-Oct	± 33.1
American Kestrel	15-Aug	9-Nov	26-Sep – 29-Oct	14-Oct	09-Oct	± 4.6
Merlin	14-Sep	13-Nov	20-Sep – 27-Oct	30-Sep	29-Sep	± 4.4
Peregrine Falcon	16-Aug	6-Nov	16-Sep – 27-Oct	3-Oct	02-Oct	± 2.2
Total	17-Aug	15-Nov	6-Sep – 19-Oct	7-Oct	23-Sep	± 3.3

<sup>1</sup> Dates between which the central 80% of the flight passed the lookout.

<sup>2</sup> Date by which 50% of the flight had passed the lookout.

<sup>3</sup> 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.

**Table 4. Median passage dates by age for selected species of migrating raptors at Smith Point, TX: 1997–2002 versus 2003.**

SPECIES	ADULT		IMMATURE	
	1997–2002 <sup>1</sup>	2003	1997–2002 <sup>1</sup>	2003
Northern Harrier	30-Oct ± 6.4	29-Oct	12-Oct ± 4.5	18-Oct
Swallow-tailed Kite	20-Aug <sup>2</sup>	15-Aug	24-Aug ± 7.8	5-Sep
Mississippi Kite	06-Sep ± 4.8	23-Aug	10-Sep ± 4.0	24-Sep
Sharp-shinned Hawk	18-Oct ± 9.9	15-Oct	28-Sep ± 5.9	12-Oct
Cooper’s Hawk	19-Oct ± 17.9	17-Oct	06-Oct ± 12.6	11-Oct
Red-shouldered Hawk	–	2-Oct	15-Sep ± 15.9	12-Oct
Broad-winged Hawk	17-Sep ± 5.6	27-Sep	15-Sep ± 5.8	21-Oct
Red-tailed Hawk	14-Oct ± 25.0	14-Oct	11-Oct ± 15.5	19-Oct
Peregrine Falcon	30-Sep ± 2.9	1-Oct	30-Sep ± 11.8	6-Oct

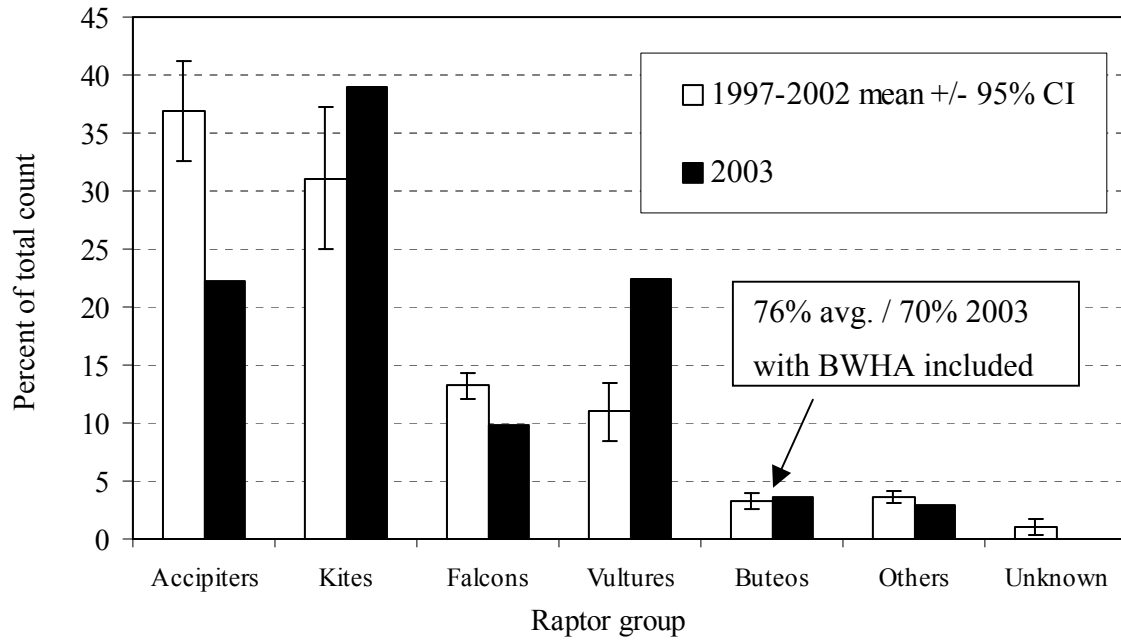
Note: Median passage dates are dates by which 50% of species/age-specific flights had passed; values are based only on annual counts ≥5 birds.

<sup>1</sup> Mean ± 95% confidence interval in days; values are given only for species with annual counts ≥5 birds for ≥ 3 years.

<sup>2</sup> Value for 2002 only.

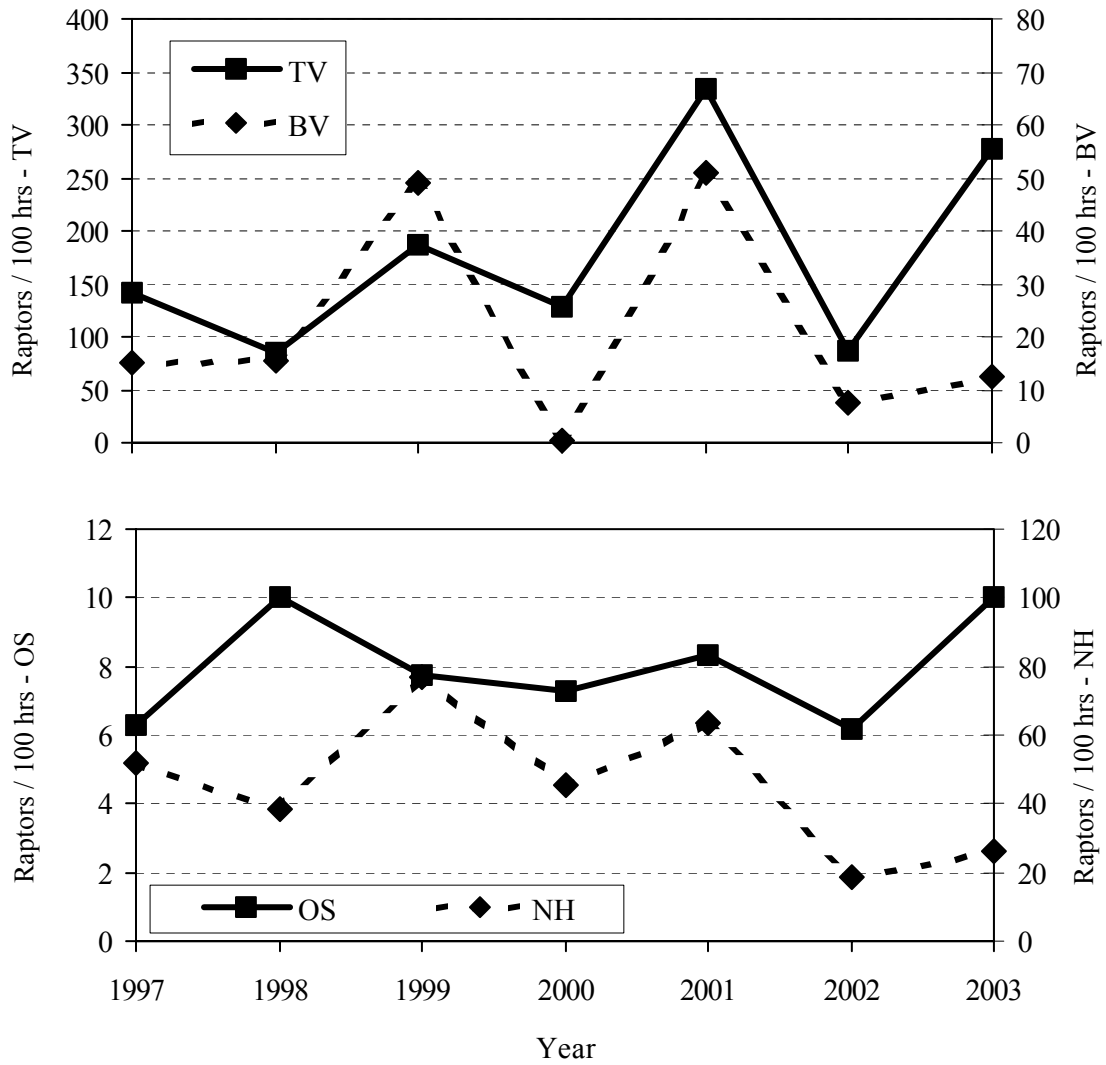


Figure 1. Location of the Smith Point Raptor Migration Project study site in southeast Texas.

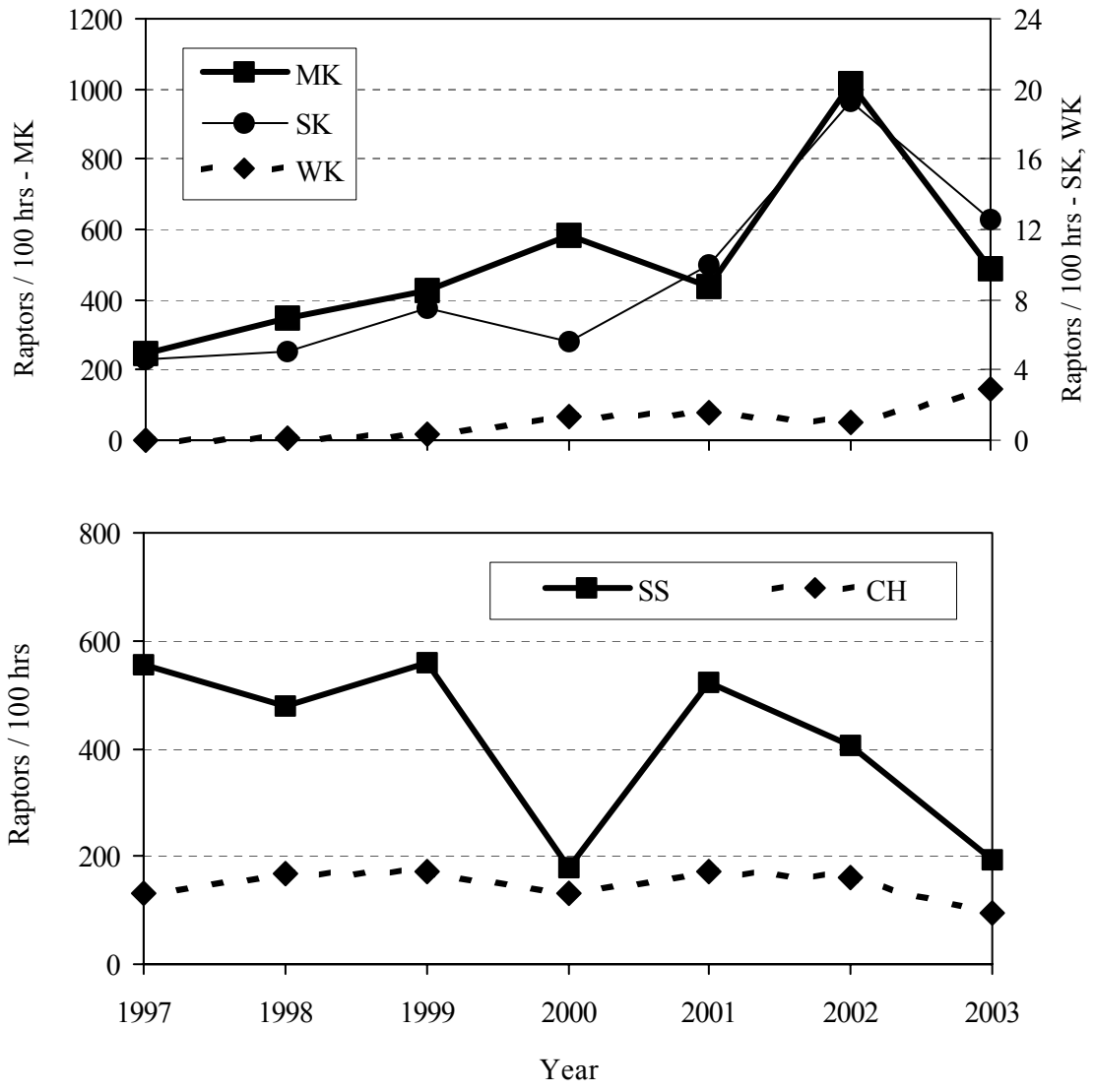


**Figure 2. Composition of autumn raptor migration by major species groups at Smith Point, Texas: 1997–2002 versus 2003.**

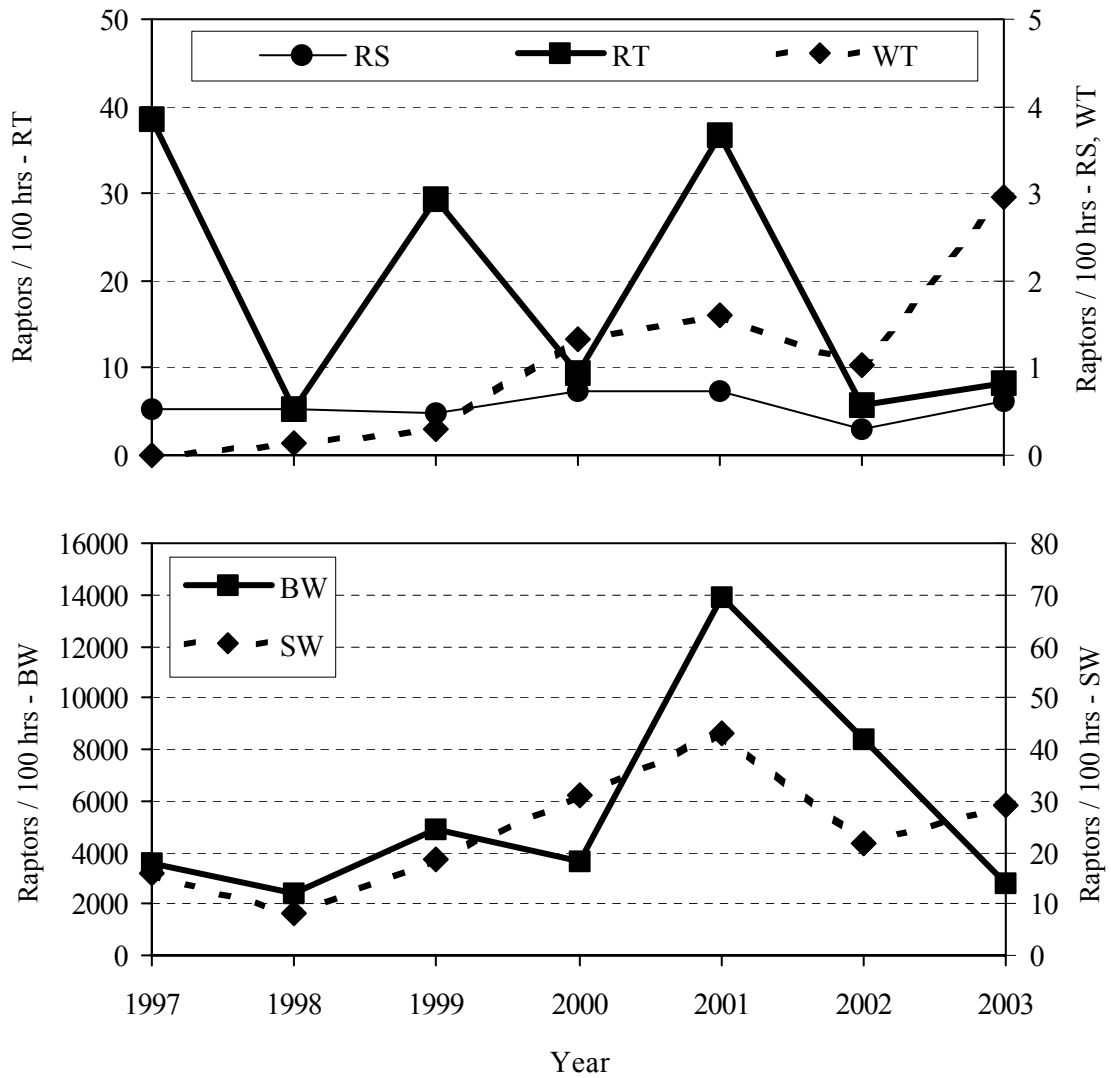




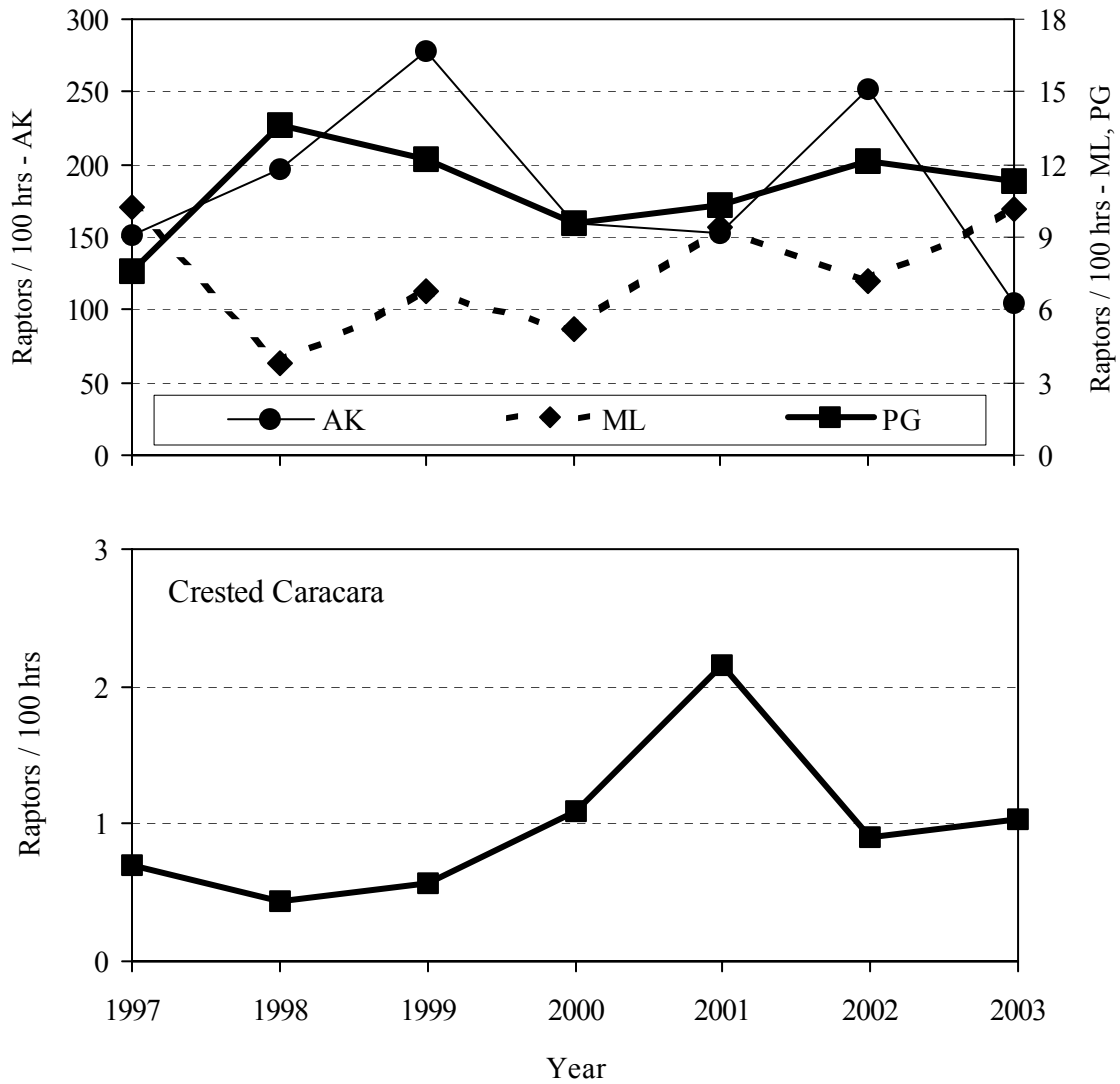
**Figure 3. Annual fall-migration passage rates of Turkey and Black Vultures, Ospreys, and Northern Harriers at Smith Point, Texas: 1997–2003.**



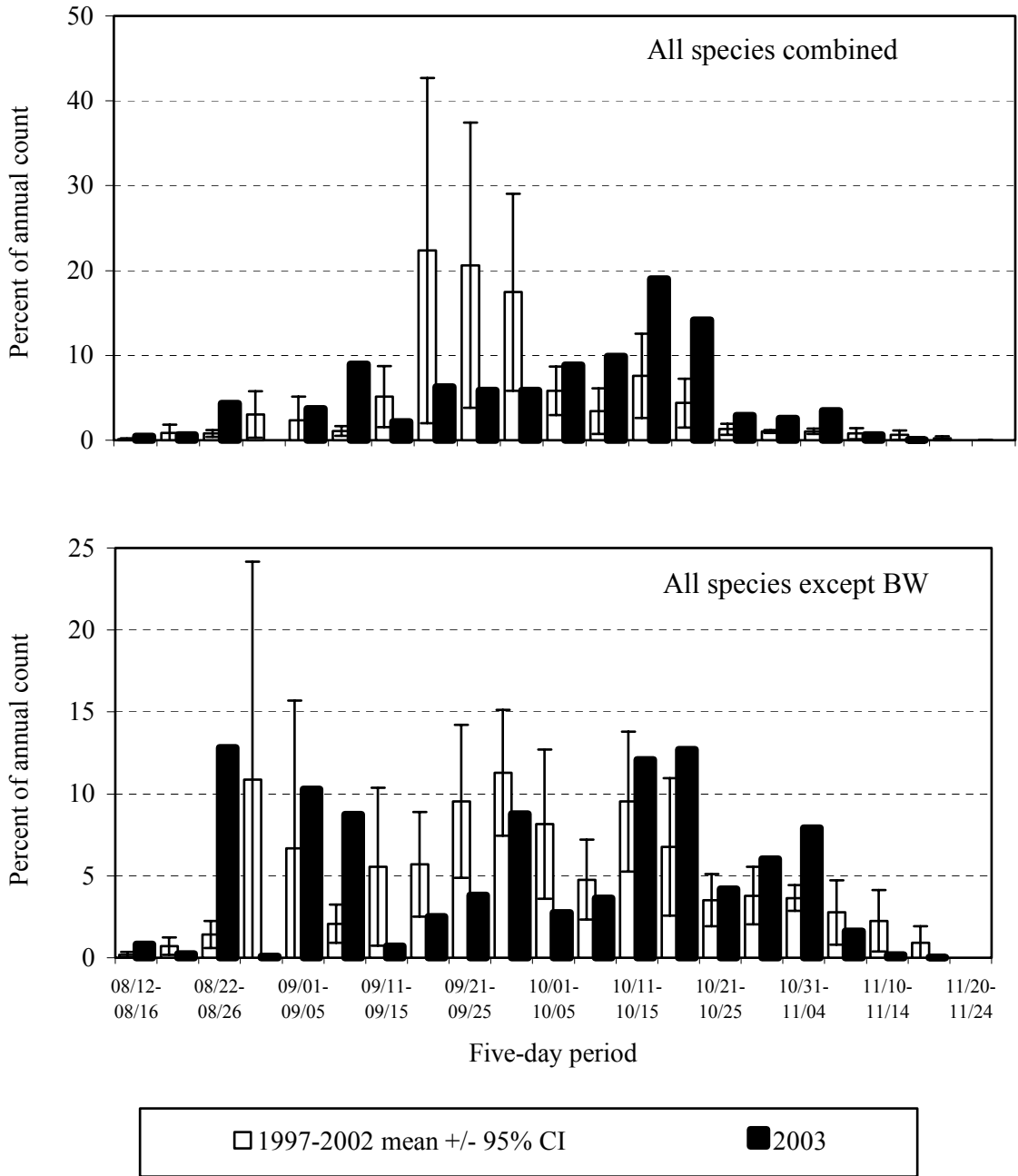
**Figure 4. Annual fall-migration passage rates of Mississippi, Swallow-tailed and White-tailed Kites, and Sharp-shinned and Cooper's Hawks at Smith Point, Texas: 1997–2003.**



**Figure 5. Annual fall-migration passage rates of Red-shouldered, Red-tailed, White-tailed, Broad-winged, and Swainson's Hawks at Smith Point, Texas: 1997–2003.**



**Figure 6. Annual fall-migration passage rates of American Kestrels, Merlins, Peregrine Falcons, and Crested Caracaras at Smith Point, Texas: 1997–2003.**



**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: 1997–2002 versus 2003.**

## **Appendix A. A history of official observer participation in the Smith Point Raptor Migration Project: 1997–2003.**

**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.

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<sup>1</sup> 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 <sup>2</sup>	COLOR MORPH <sup>3</sup>
		CODE	AGE <sup>1</sup>		
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 <sup>4</sup>	U	NA
Bald Eagle	<i>Haliaeetus leucocephalus</i>	BE	A S2 S1 I NA U <sup>5</sup>	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	Falconiformes	UU	U	U	NA

<sup>1</sup> A = adult, I = immature (HY), Br = brown (adult female or immature), U = unknown age.

<sup>2</sup> M = male, F = female, U = unknown.

<sup>3</sup> D = dark or rufous, L = light, U – unknown, NA = not applicable.

<sup>4</sup> 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.

<sup>5</sup> 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: 2003.**

DATE	OBS. HOURS	OBSRVR / HOUR <sup>1</sup>	MEDIAN	PREDOMINANT WEATHER <sup>3</sup>	WIND	TEMP (°C) <sup>1</sup>	BAROM. PRESS. (IN HG) <sup>1</sup>	MEDIAN	VISIB. EAST (KM) <sup>1</sup>	VISIB. WEST (KM) <sup>1</sup>	MEDIAN	BIRDS / HOUR	
			VISITOR DISTURB <sup>2</sup>		SPEED (KPH) <sup>1</sup>			WIND DIRECTION			THERMAL LIFT <sup>4</sup>		FLIGHT DISTANCE <sup>5</sup>
15-Aug	9.00	5.6	0	ovc	14	nne-ne	33.1	30.06	3	22	22	2	11.3
16-Aug	10.50	3.5	0	pc-ovc	5	ne, sw	32.9	29.98	3	24	24	3	4.9
17-Aug	9.00	2.3	0	clr, PM ovc	9	nnw	34.8	29.87	2	21	22	2	12.4
18-Aug	9.50	2.0	0	pc-mc	8	se-sw	34.6	29.93	2	26	26	3	2.6
19-Aug	9.00	2.0	0	pc-mc	7	sw-wnw, se	34.3	29.98	2	27	25	3	4.4
20-Aug	9.00	2.0	0	pc	7	sw, se-s	36.7	29.95	2	27	26	2	1.6
21-Aug	9.50	3.4	0	pc-mc	5	sw, se-s	35.9	29.93	2	28	26	2	0.7
22-Aug	9.00	2.3	0	ovc-clr	4	nne, se-s	32.7	29.90	3	21	22	2	2.1
23-Aug	9.25	3.8	0	clr-mc	5	wsww-nw, se	34.3	29.90	2	26	24	2	13.2
24-Aug	9.25	2.3	0	clr-mc	5	sw-nw, se	37.1	29.94	2	24	25	2	85.0
25-Aug	9.00	2.0	0	pc-mc	7	nw-n, ssw-w, se	35.5	29.92	3	25	26	2	49.6
26-Aug	5.50	2.5	0	ovc, ts/rain	3	ne-e	31.3	29.92	4	25	25	1	1.1
27-Aug	6.50	1.9	0	ovc	8	ne-se	31.9	29.88	4	22	24	2	0.8
28-Aug	9.00	2.0	0	mc	8	e-se	34.8	29.89	3	27	26	1	0.3
29-Aug	9.25	3.3	0	mc-ovc	8	ene-se	33.2	29.87	4	25	26	-	0.0
30-Aug	6.75	2.9	0	mc-ovc, PM ts/rain	11	ne-e	29.8	29.87	4	22	23	-	0.0
31-Aug	5.00	1.0	0	ovc, AM ts/rain	24	se-ssw	29.0	29.77	4	21	21	-	0.0
01-Sep	3.75	3.0	0	ovc	6	ese-se	30.5	29.87	4	25	25	-	0.0
02-Sep	7.50	2.0	0	mc-ovc, scat ts/rain	5	se, wnw-nw	32.5	29.90	3	25	25	-	0.0
03-Sep	9.00	2.0	0	pc-mc	6	e-se/var	31.9	29.82	2	25	25	3	0.4
04-Sep	7.50	4.0	0	pc-mc	8	nw-n	34.2	29.88	2	20	24	2	76.3
05-Sep	9.00	2.0	0	ovc-pc	10	nnw-ne	31.0	29.88	3	21	25	2	68.2
06-Sep	9.50	3.6	3	clr	8	nw-nne	30.7	29.89	2	24	26	2	139.5
07-Sep	9.00	2.8	1	clr	6	n-ne, sw-w	30.2	29.88	2	24	25	3	149.6
08-Sep	8.00	2.0	0	pc-mc	3	calm/nw, se	31.6	29.86	3	22	22	2	10.4
09-Sep	9.00	2.0	0	clr-pc	9	ne-se	32.4	29.89	3	19	23	2	12.2
10-Sep	2.25	2.0	0	mc-ovc, ts/rain	3	n-ese	29.8	29.89	4	26	23	1	0.4
11-Sep	3.75	2.0	0	mc-ovc, ts/rain	13	se-s	30.2	29.88	3	25	27	-	0.0
12-Sep	0.00			rain									
13-Sep	9.50	4.3	0	clr	5	sw-w, sse-s	30.7	29.83	2	26	27	2	32.0
14-Sep	8.25	2.6	0	clr-mc	8	ne-ene	31.1	29.96	3	24	26	2	35.5
15-Sep	9.00	1.6	0	clr-mc	9	ne-ese	30.8	30.00	3	24	26	2	11.2
16-Sep	9.00	2.7	0	clr	10	ne-ene	31.2	29.94	3	24	27	2	53.9
17-Sep	9.00	3.0	0	clr-pc	10	ne-se	31.7	29.88	3	24	26	2	19.9
18-Sep	7.00	2.0	0	ovc	7	ne-se	29.9	29.87	4	16	23	2	7.7
19-Sep	9.00	2.0	0	clr-mc	8	nne-ese	32.0	29.93	2	20	25	3	133.4
20-Sep	6.50	3.4	2	ovc	9	ne-ene	27.9	29.92	4	18	22	2	14.0
21-Sep	2.50	2.0	1	ovc	4	w	27.5	29.74	4	25	27	1	7.2
22-Sep	9.00	2.2	0	mc-ovc	6	nnw-ne	27.5	29.91	3	25	27	2	35.1
23-Sep	9.00	3.5	0	clr-mc	6	nne-se	28.9	29.96	2	22	24	2	37.0
24-Sep	9.00	2.0	0	pc-ovc	5	ene-se	29.6	29.88	2	21	23	2	46.7
25-Sep	9.00	2.0	0	clr-pc	6	n-ne, sse-s	31.1	29.87	2	20	25	2	86.6
26-Sep	8.50	2.3	0	ovc-pc, scat rain	5	nnw-n	27.6	29.75	4	20	25	1	37.5
27-Sep	9.00	3.9	2	clr	6	nw-nne	30.2	29.78	2	24	25	2	132.2
28-Sep	9.00	3.6	1	clr	12	ne	28.5	29.85	3	24	26	2	27.0
29-Sep	9.00	2.0	0	clr	10	ne-e	26.2	30.06	2	27	29	1	9.2
30-Sep	8.00	2.0	0	clr	9	ne/var	24.5	30.17	3	26	28	2	6.0
01-Oct	9.00	2.0	0	clr	12	ne	26.9	30.05	3	27	29	2	42.8
02-Oct	9.00	2.0	0	clr	11	ne-ene	23.0	30.04	3	26	27	2	30.2
03-Oct	9.00	2.0	0	clr	8	ne-ese	25.1	29.93	3	25	27	2	12.7
04-Oct	9.50	2.8	0	clr	6	ene-e	27.5	29.95	3	24	27	2	51.3
05-Oct	9.00	1.9	0	clr-pc	2	e-se	31.9	29.89	2	21	21	2	173.1
06-Oct	7.25	2.0	0	pc-mc, AM fog, PM ts/rain	4	ne-se/var	29.8	29.87	3	17	16	3	51.9
07-Oct	9.50	1.9	0	pc-mc, AM haze	4	ne-se	29.3	29.87	2	16	19	2	172.7



Appendix C. continued

DATE	OBS. HOURS	OBSRVR / HOUR <sup>1</sup>	MEDIAN	PREDOMINANT WEATHER <sup>3</sup>	WIND	TEMP (°C) <sup>1</sup>	BAROM.	MEDIAN	VISIB.	VISIB.	MEDIAN	BIRDS / HOUR	
			VISITOR DISTURB <sup>2</sup>		SPEED (KPH) <sup>1</sup>		WIND DIRECTION	PRESS. (IN HG) <sup>1</sup>	THERMAL LIFT <sup>4</sup>	EAST (KM) <sup>1</sup>	WEST (KM) <sup>1</sup>		FLIGHT DISTANCE <sup>5</sup>
08-Oct	9.50	1.9	0	pc-mc	6	ene-ese	30.0	29.88	2	15	17	2	103.8
09-Oct	4.00	2.5	0	ovc, rain	11	ne-se	26.3	29.80	4	14	17	1	9.0
10-Oct	9.00	2.0	0	ovc, AM fog/rain	5	n-ne/var	25.4	29.70	4	23	25	2	12.7
11-Oct	9.00	1.0	1	clr-ovc	4	ne-e, var	29.5	29.80	2	23	26	2	172.8
12-Oct	9.00	1.3	1	pc-ovc	4	ne-e, se	29.1	29.93	3	23	26	3	137.7
13-Oct	9.50	1.8	0	ovc	1	calm/var	28.5	29.86	3	22	24	2	121.4
14-Oct	9.00	1.8	0	clr-ovc	11	wnw-n	29.0	29.84	3	25	26	2	193.4
15-Oct	9.00	1.9	0	clr	8	ne-e	24.8	30.03	2	27	29	2	40.6
16-Oct	9.00	2.0	0	pc-ovc	7	nne-ese	27.6	29.99	4	25	26	2	10.0
17-Oct	9.00	1.6	0	pc-mc, PM haze	3	w-n	30.5	29.98	2	21	25	2	146.2
18-Oct	9.50	2.8	0	clr	8	n-ne	24.6	30.06	3	23	27	2	306.2
19-Oct	9.50	1.8	0	clr	5	ne, s-sw	26.1	30.03	3	25	27	2	14.6
20-Oct	9.00	2.0	0	clr, haze	5	ne-se	29.1	30.08	2	23	26	1	6.7
21-Oct	8.00	2.0	0	clr, haze	6	w-n	30.5	30.07	2	21	19	2	34.8
22-Oct	9.50	1.1	0	clr, PM haze	6	ws-wnw, sse-s	29.6	29.85	2	21	25	3	22.7
23-Oct	9.50	1.9	0	clr	4	ws-wnw, sse-s	28.4	29.83	3	23	26	2	31.4
24-Oct	9.00	3.3	0	clr-ovc	12	se-sw	27.9	29.86	3	25	26	2	13.7
25-Oct	4.00	1.3	2	mc-ovc, ts/rain	10	se	25.6	29.93	4	21	24	2	2.8
26-Oct	9.00	3.1	0	ovc	15	n-nne	17.8	30.00	4	18	20	2	15.7
27-Oct	9.50	2.0	0	mc-ovc	8	n-w-nne	16.3	30.02	4	27	27	2	11.1
28-Oct	9.00	2.5	0	clr	8	sse-sw	25.0	29.75	2	26	27	2	25.1
29-Oct	9.00	2.0	0	clr-pc	5	sse-ssw	26.1	29.89	2	27	27	2	35.0
30-Oct	9.00	2.0	0	clr	11	sse-s	27.5	29.93	3	24	27	2	4.3
31-Oct	9.00	1.0	0	pc-mc	7	se	27.8	30.12	3	19	26	2	16.2
01-Nov	9.00	1.7	1	clr-pc, AM fog	8	ne-ene	27.5	30.16	2	18	23	2	22.2
02-Nov	9.00	1.8	0	clr-ovc, AM haze	6	ene-se	28.9	30.14	3	20	26	1	12.4
03-Nov	9.00	2.0	0	clr-pc, AM fog	5	e-se	27.9	30.03	2	23	27	2	50.2
04-Nov	9.00	2.0	0	clr-pc	5	se-ssw	28.4	29.91	2	26	26	2	22.6
05-Nov	9.00	2.0	0	clr-pc	5	se-sse	29.3	30.00	2	26	25	2	1.6
06-Nov	9.00	2.0	0	clr-ovc	7	n-w-n/calm/var	28.3	30.13	3	23	24	2	7.6
07-Nov	9.00	1.9	0	ovc, fog	4	n-ne	19.8	30.18	4	12	12	2	2.0
08-Nov	9.50	2.0	0	ovc, AM fog	7	n-ne/calm/var	19.7	30.26	4	12	15	2	3.8
09-Nov	9.00	2.9	0	clr-pc	7	n-ne/var	22.9	30.33	2	18	23	2	8.1
10-Nov	9.00	2.0	0	pc-ovc, PM fog	7	ne-e	23.0	30.26	4	17	20	1	0.4
11-Nov	9.00	2.0	0	pc-mc	10	se-sse	28.8	30.15	3	19	24	1	0.1
12-Nov	9.00	1.6	0	clr-pc	6	e-sse	29.8	30.11	2	24	27	1	0.2
13-Nov	9.00	2.0	0	ovc	14	ne	23.9	30.34	4	26	26	2	1.7
14-Nov	9.00	1.5	0	clr	13	ne-ene	21.3	30.28	4	26	28	-	0.0
15-Nov	9.00	3.4	0	mc-ovc	6	ese-se	25.7	30.01	3	23	26	2	0.3

<sup>1</sup> Average of hourly records.

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

<sup>3</sup> 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.

<sup>4</sup> 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.

<sup>5</sup> 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: 2003.

DATE	HOURS	SPECIES <sup>1</sup>																								BIRDS				
		BV	TV	OS	NH	SK	WK	MK	SS	CH	UA	HH	RS	BW	SW	WT	RT	FH	RL	UB	GE	BE	CC	AK	ML	PG	UF	UU	TOTAL	/HR
15-Aug	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
16-Aug	8.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
17-Aug	9.25	0	0	0	0	11	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	13	1.4	
18-Aug	9.25	0	0	0	0	24	0	1	0	2	1	0	0	7	0	0	2	0	0	0	0	0	0	0	0	0	0	37	4.0	
19-Aug	9.00	0	0	0	0	20	0	2	0	1	0	0	0	0	0	0	0	0	1	0	0	3	0	0	0	0	1	28	3.1	
20-Aug	9.00	0	0	0	0	27	0	0	1	0	0	0	0	0	2	0	0	0	0	0	0	1	1	0	0	0	0	32	3.6	
21-Aug	9.00	0	0	0	0	0	0	0	2	2	0	0	1	48	7	0	5	0	0	1	0	0	0	0	0	0	0	66	7.3	
22-Aug	8.50	0	0	0	0	14	0	2	0	2	0	0	0	128	2	0	0	0	0	0	0	0	0	0	0	0	0	148	17.4	
23-Aug	9.25	0	0	0	0	4	0	0	1	0	0	0	0	208	4	0	0	0	0	0	0	0	0	0	0	0	0	217	23.5	
24-Aug	9.00	0	0	0	0	0	0	0	0	0	0	0	0	51	0	0	1	0	0	0	0	0	0	0	0	0	1	53	5.9	
25-Aug	9.00	0	0	0	0	8	0	6	0	2	2	0	1	158	9	1	1	0	0	1	0	0	0	0	0	0	0	189	21.0	
26-Aug	9.00	0	0	1	0	6	0	210	0	3	0	0	3	63	1	0	0	0	0	0	0	0	0	0	0	0	0	287	31.9	
27-Aug	8.50	0	0	0	0	5	0	113	1	3	0	0	2	65	5	2	4	0	0	0	0	0	0	0	0	0	0	200	23.5	
28-Aug	10.00	0	0	0	0	9	0	2828	0	1	0	0	2	115	3	1	3	0	0	0	0	0	1	0	0	0	0	2963	296.3	
29-Aug	9.00	0	0	0	1	4	0	3790	0	3	2	0	2	228	6	0	0	0	0	0	0	0	1	0	0	0	0	4037	448.6	
30-Aug	9.00	0	0	2	0	0	0	4	0	1	0	0	0	42	0	0	0	0	0	0	0	0	1	0	0	0	0	50	5.6	
31-Aug	10.00	0	0	0	0	1	0	13	0	3	0	0	2	34	0	0	0	0	0	0	0	0	1	0	0	0	0	54	5.4	
1-Sep	9.00	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	3	0	0	0	1	24	2.7	
2-Sep	9.00	0	0	1	1	0	0	9	2	0	0	0	1	34	0	0	1	0	0	1	0	0	4	0	0	0	1	55	6.1	
3-Sep	9.00	0	0	0	0	0	0	11	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	14	1.6	
4-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	0	0	0	0	0.0	
5-Sep	9.00	0	0	0	0	3	0	59	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	65	7.2	
6-Sep	0.00																													
7-Sep	8.75	0	0	0	0	0	0	2	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0.5	
8-Sep	8.75	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0.3	
9-Sep	8.00	0	0	0	0	4	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	6	0.8	
10-Sep	9.00	0	0	1	0	0	0	112	0	0	0	0	0	103	0	0	0	0	0	0	0	0	2	0	0	0	0	218	24.2	
11-Sep	9.00	0	0	0	1	0	0	0	0	1	0	0	0	98	0	0	0	0	0	0	0	0	1	0	0	0	0	101	11.2	
12-Sep	9.00	0	0	1	0	1	0	49	0	1	0	0	0	70	0	0	0	0	0	0	0	0	3	0	0	0	0	125	13.9	
13-Sep	9.50	0	0	2	0	0	0	57	0	2	0	0	1	2065	0	0	0	0	0	0	0	0	1	0	0	0	0	2128	224.0	
14-Sep	10.00	0	0	1	0	0	0	97	0	1	0	0	0	5243	0	0	0	0	0	0	0	0	4	1	0	0	0	5347	534.7	
15-Sep	4.75	0	0	0	0	0	0	91	0	0	0	0	0	769	0	0	0	0	0	0	0	0	1	1	0	0	0	862	181.5	
16-Sep	0.00																													
17-Sep	8.56	0	0	0	0	0	0	16	0	0	0	0	0	84	0	0	1	0	0	0	0	0	0	1	0	0	0	102	11.9	
18-Sep	9.00	0	0	0	1	0	0	28	0	0	0	0	0	29	0	0	0	0	0	0	0	0	0	1	0	1	0	60	6.7	

## Appendix D. continued

DATE	HOURS	SPECIES <sup>1</sup>																								BIRDS				
		BV	TV	OS	NH	SK	WK	MK	SS	CH	UA	HH	RS	BW	SW	WT	RT	FH	RL	UB	GE	BE	CC	AK	ML	PG	UF	UU	TOTAL	/HR
19-Sep	7.16	0	0	0	0	0	0	2	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	7	1.0
20-Sep	9.75	0	0	1	2	1	0	70	0	10	0	1	2970	1	0	2	0	0	0	0	0	0	0	1	1	19	2	0	3081	316.0
21-Sep	10.17	0	0	2	5	3	0	23	0	17	0	0	1927	0	0	1	0	0	0	0	0	0	8	1	1	0	0	1988	195.5	
22-Sep	9.50	0	0	2	1	2	0	91	70	16	0	0	1248	0	0	1	0	0	0	0	0	0	36	2	2	1	0	1472	154.9	
23-Sep	9.50	0	0	1	1	0	0	77	59	24	0	0	0	0	0	0	0	0	0	0	0	0	32	2	2	0	0	198	20.8	
24-Sep	10.25	0	0	1	5	1	0	43	128	32	1	0	17114	4	0	0	0	0	0	0	0	0	69	3	1	0	0	17402	1697.8	
25-Sep	9.50	0	0	2	2	0	1	0	70	25	1	0	4140	0	0	0	0	0	0	0	0	0	20	1	3	0	0	4265	448.9	
26-Sep	9.56	0	0	1	1	0	0	0	108	13	0	0	1107	0	0	0	0	0	0	0	0	0	15	2	5	0	0	1252	131.0	
27-Sep	10.00	0	0	2	1	0	0	6	57	14	0	0	2741	0	0	6	0	0	0	0	0	0	23	0	5	0	0	2855	285.5	
28-Sep	9.94	0	0	2	4	0	2	8	45	43	3	0	7544	3	1	1	0	0	0	0	0	0	33	3	8	0	0	7702	774.8	
29-Sep	9.75	0	0	3	1	0	0	15	108	31	0	0	1349	0	0	0	0	0	0	0	0	0	35	3	3	1	0	1549	158.9	
30-Sep	9.75	0	0	1	1	0	0	4	71	16	5	0	370	0	0	0	0	0	0	0	0	0	53	1	2	0	0	525	53.8	
1-Oct	9.44	0	0	0	0	0	0	2	44	5	0	0	176	0	0	0	0	0	0	0	0	0	4	2	2	0	0	235	24.9	
2-Oct	9.50	0	0	0	0	0	0	4	44	3	0	0	153	0	0	0	0	0	0	0	0	0	11	2	3	0	0	220	23.2	
3-Oct	8.75	0	0	1	0	0	0	0	104	1	0	0	0	1	0	0	0	0	0	0	0	0	65	1	1	0	0	174	19.9	
4-Oct	9.16	0	0	0	1	0	0	0	14	0	0	0	254	0	0	0	0	0	0	0	0	0	2	0	2	0	0	273	29.8	
5-Oct	8.75	0	11	0	0	0	0	0	39	9	0	0	297	2	1	0	0	0	0	0	0	0	19	0	0	0	0	378	43.2	
6-Oct	9.50	0	5	3	0	0	0	0	101	11	0	0	220	0	0	0	0	0	0	0	0	0	18	1	14	0	0	373	39.3	
7-Oct	6.56	0	33	1	0	0	0	0	32	6	0	0	0	0	0	0	0	0	0	0	0	0	15	0	3	0	0	90	13.7	
8-Oct	8.42	7	0	2	1	0	0	7	28	7	0	0	541	0	0	0	0	0	0	0	0	1	19	2	0	0	0	615	73.0	
9-Oct	0.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
10-Oct	9.44	0	0	0	4	0	0	8	83	16	0	0	229	5	0	0	0	0	0	0	0	0	88	1	2	0	0	436	46.2	
11-Oct	9.67	7	14	4	4	0	0	6	108	15	0	0	1480	7	0	0	0	0	0	0	0	0	106	2	2	0	0	1755	181.5	
12-Oct	10.25	0	12	4	6	0	0	4	105	17	0	0	1910	9	0	2	0	0	0	0	0	0	50	3	5	1	0	2128	207.6	
13-Oct	10.25	0	0	1	9	0	0	0	372	78	0	0	350	12	1	1	0	0	0	0	0	0	429	1	0	0	0	1254	122.3	
14-Oct	9.33	2	21	0	6	0	1	1	176	117	0	0	2030	11	0	0	0	0	0	0	0	0	191	0	2	0	0	2558	274.2	
15-Oct	9.56	4	35	0	8	0	0	0	616	159	1	0	4549	12	0	1	1	0	0	0	0	0	203	1	0	1	0	5592	584.9	
16-Oct	9.50	3	42	2	4	0	0	1	55	43	0	0	1637	13	0	1	0	0	0	0	0	0	44	1	0	0	0	1847	194.4	
17-Oct	9.25	5	60	1	6	0	1	1	40	31	0	0	517	9	0	1	0	0	0	0	0	0	22	1	0	0	0	696	75.2	
18-Oct	9.00	0	0	0	3	0	0	0	21	10	0	0	14	0	0	0	0	0	0	0	0	0	49	3	1	0	0	101	11.2	
19-Oct	8.83	0	0	0	0	0	0	0	13	3	0	0	0	0	0	0	0	0	0	0	0	0	8	0	3	1	0	28	3.2	
20-Oct	9.56	0	11	0	2	0	0	0	96	92	0	0	122	2	0	0	0	0	0	0	0	0	79	1	1	0	0	406	42.5	
21-Oct	6.33	0	0	0	0	0	0	0	8	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	11	1.7	
22-Oct	4.08	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0.5	
23-Oct	4.83	0	0	1	0	0	1	0	3	5	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	11	2.3	

Appendix D. continued

DATE	HOURS	SPECIES <sup>1</sup>																									BIRDS			
		BV	TV	OS	NH	SK	WK	MK	SS	CH	UA	HH	RS	BW	SW	WT	RT	FH	RL	UB	GE	BE	CC	AK	ML	PG	UF	UU	TOTAL	/Hr
24-Oct	6.67	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0.3	
25-Oct	4.16	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	1.9	
26-Oct	2.75	0	0	0	0	0	0	7	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	2.9	
27-Oct	9.00	0	0	0	0	0	0	21	5	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	33	3.7	
28-Oct	3.16	0	0	0	1	0	0	2	10	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	15	4.7	
29-Oct	9.00	0	31	0	7	0	0	0	107	77	1	0	1	173	15	0	0	0	0	0	0	0	47	4	1	0	0	464	51.6	
30-Oct	9.50	0	81	0	10	0	0	0	35	51	0	0	0	56	8	1	0	0	0	0	0	0	26	1	0	0	0	269	28.3	
31-Oct	9.00	3	73	1	1	0	0	0	51	50	0	0	0	205	0	0	1	0	0	0	0	1	0	37	1	0	0	424	47.1	
1-Nov	9.00	0	11	0	1	0	0	0	9	26	1	0	0	42	2	0	1	0	0	0	0	1	0	10	0	0	0	105	11.7	
2-Nov	8.25	0	0	0	1	0	0	0	9	11	0	0	0	0	0	0	0	0	0	1	0	0	0	11	0	0	0	33	4.0	
3-Nov	8.67	0	0	0	0	0	0	1	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0.8	
4-Nov	8.00	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	0.3	
5-Nov	9.00	0	28	0	2	0	0	0	2	10	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	48	5.3	
6-Nov	9.17	3	72	0	11	0	0	0	10	26	0	0	0	86	2	0	0	0	0	0	0	0	4	1	0	0	0	215	23.4	
7-Nov	9.00	0	0	0	5	0	0	0	3	4	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	14	1.6	
8-Nov	9.08	0	0	0	4	0	0	0	5	5	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	17	1.9	
9-Nov	9.08	0	0	0	0	0	0	0	4	3	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	9	1.0	
10-Nov	9.00	0	0	0	2	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	6	0.7	
11-Nov	9.00	7	46	0	5	0	1	0	6	13	0	0	0	11	3	0	3	0	0	0	0	0	3	0	0	0	0	98	10.9	
12-Nov	9.08	0	32	0	4	0	0	0	18	30	0	0	0	12	2	0	0	0	0	0	0	1	0	11	0	0	0	110	12.1	
13-Nov	9.08	18	33	0	3	0	0	0	1	5	0	0	0	4	0	0	3	0	0	0	0	1	0	1	0	0	0	69	7.6	
14-Nov	9.08	0	0	0	1	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	4	0.4	
15-Nov	8.33	0	27	0	4	0	0	0	4	10	0	0	0	5	2	0	0	0	0	0	0	0	5	0	0	0	0	57	6.8	
Total	775.66	59	678	48	144	150	7	7879	3142	1233	18	0	23	65255	168	8	44	1	0	5	0	3	7	1949	56	94	8	5	80984	104.4

<sup>1</sup> 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: 1997–2003.**

	1997	1998	1999	2000	2001	2002	2003	MEAN
Start date	17-Aug	15-Aug	15-Aug	12-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
Observation days	94	91	89	94	93	91	92	92
Observation hours	860.11	677.25	696.68	823.08	743.33	775.66	777.75	764.84
SPECIES	RAPTOR COUNTS							
Black Vulture	130	105	341	4	379	59	96	159
Turkey Vulture	1,225	581	1,295	1,059	2,488	678	2,163	1,356
TOTAL VULTURES	1,355	686	1,636	1,063	2,867	737	2,259	1,515
Osprey	54	68	54	60	62	48	78	61
Northern Harrier	445	262	537	372	472	144	203	348
Hook-billed Kite	0	0	0	0	0	0	1	0
Swallow-tailed Kite	40	34	52	46	74	150	98	71
White-tailed Kite	0	1	2	11	12	8	23	8
Mississippi Kite	2,124	2,362	2,975	4,788	3,253	7,879	3,809	3,884
TOTAL KITES	2,164	2,397	3,029	4,845	3,339	8,037	3,930	3,963
Sharp-shinned Hawk	4,780	3,231	3,896	1,484	3,878	3,142	1,508	3,131
Cooper's Hawk	1,137	1,136	1,207	1,088	1,281	1,233	738	1,117
Unknown accipiter	49	170	113	14	15	18	4	61
TOTAL ACCIPITERS	5,966	4,537	5,216	2,586	5,174	4,393	2,250	4,303
Harris' Hawk	0	0	0	0	2	0	0	0
Red-shouldered Hawk	45	36	34	61	54	23	49	43
Broad-winged Hawk	30,417	16,137	34,243	29,956	103,612	65,255	21,799	43,060
Swainson's Hawk	137	56	129	255	321	168	228	185
White-tailed Hawk	0	1	2	11	12	8	23	8
Red-tailed Hawk	331	35	204	77	273	44	64	147
Ferruginous Hawk	0	0	2	0	2	1	2	1
Rough-legged Hawk	0	0	2	0	3	0	0	0.7
Unidentified buteo	86	26	31	3	4	5	6	23
TOTAL BUTEOS	31,016	16,291	34,647	30,363	104,283	65,504	22,171	43,468
Golden Eagle	3	0	1	1	0	0	0	0.7
Bald Eagle	2	0	2	7	2	3	2	3
Unknown eagle	0	0	0	0	0	0	1	0.1
TOTAL EAGLES	5	0	3	8	2	3	3	3
Crested Caracara	6	3	4	9	16	7	8	8
American Kestrel	1,297	1,334	1,938	1,311	1,140	1,949	816	1,398
Merlin	88	26	47	43	70	56	79	58
Peregrine Falcon	65	92	85	79	77	94	88	83
Unknown falcon	25	13	9	5	1	8	3	10
TOTAL FALCONS	1,475	1,465	2,079	1,438	1,288	2,107	986	1,548
Unidentified raptor	496	91	116	16	0	5	1	104
GRAND TOTAL	42,993	25,824	47,337	40,766	117,517	80,984	31,885	55,329